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WASTE DISPOSAL IN THE COASTAL WATERS OF NEW YORK HARBOR

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HEARING

BEFORE THE

COMMITTEE ON RIVERS AND HARBORS

OF THE

COMMITTEE ON PUBLIC WORKS

HOUSE OF REPRESENTATIVES

NINETY-FIRST CONGRESS

SECOND SESSION

ON

H.R. 15915

TO AMEND THE ACT OF JUNE 29, 1888, RELATING TO THE
PREVENTION OF OBSTRUCTIVE AND INJURIOUS DEPOSITS
IN THE HARBOR OF NEW YORK, TO PROVIDE FOR THE
TERMINATION OF CERTAIN LICENSES AND PERMITS

FEBRUARY 23, 1970

AT SANDY HOOK, N.J.

Printed for the use of the Committee on Public Works



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CONTENTS

H.R. 15915: To amend the act of June 29, 1888, relating to the prevention of obstructive and injurious deposits in the harbor of New York, to provide for the termination of certain licenses and permits.....	Page v
--	-----------

TESTIMONY

Barnett, Col. James W., District Engineer, U.S. Army Engineer District, New York, accompanied by Joseph Caldwell, Technical Director, U.S. Army Coastal Engineering Research Center.....	5
Blaisdell, Mrs. Jane, Monmouth County Citizens Against Water Pollution; accompanied by Brinton M. Miller, Section Head, Department of Parasitology, Merck Institute for Therapeutic Research, Rahway, N.J.	94
Eheret, Joseph, Monmouth County Sewerage Advisory Committee; accompanied by Peter Homack, Consulting Engineer.....	97
Meacham, Hon. Charles H., Commissioner of the Fish & Wildlife Service and Deputy Assistant Secretary for Fish and Wildlife, Parks, and Marine Resources; accompanied by Mr. John Clark, Acting Director, Sandy Hook Marine Laboratory; and Dr. Jack Pearce, author of interim report.....	20
Rippere, Mrs. R. O., Water Chairman, Monmouth County League of Women Voters.....	90
Sullivan, Richard J., Director, New Jersey State Division of Clean Air and Water; accompanied by Ernest Segesser, Chief, New Jersey State Water Pollution Control Program.....	81

MATERIAL RECEIVED FOR THE RECORD

Cahill, Hon. William T., Governor of the State of New Jersey, statement on sludge barging to sea.....	82
Citizens Against Water Pollution, policy statement on sewage treatment plant sludge disposal.....	94
Current permits for disposal of waste, Atlantic Ocean.....	19
Department of the Army, New York District, Corps of Engineers, letter dated January 6, 1970, to Monmouth County Sewerage Advisory Committee.....	100
Glenn, Thomas R., Jr., director and chief engineer of the Interstate Sanitation Commission of New York, New Jersey and Connecticut, letters to Mr. Carl Klein, Assistant Secretary, Water Quality and Research, U.S. Department of Interior.....	105
Humble Oil & Refining Co., Linden, N.J., letter of May 26, 1965, to superintendent of New York Harbor, requesting permission to dump refinery spent caustic soda at sea.....	9
Interim Progress Report on the Study of the Effects of Waste Disposal in New York Bight Area, by the Sandy Hook Marine Laboratory of the Department of Interior to the U.S. Army Engineer Coastal Engineering Research Center, January 1970.....	53
Introduction.....	54
Report on chemical analyses.....	55
Water analyses.....	55
Phosphorous.....	55
Nitrogen.....	55
Iron.....	55
Heavy metals.....	56
Primary productivity.....	56
Sediment analyses.....	56
Heavy metals.....	56
Hydrophobic materials.....	56
Pesticides.....	57

IV

Interim Progress Report—Continued

Research Center, January 1970—Continued

Report on chemical analyses—Continued

	Page
Tissue analyses.....	57
Heavy metals.....	57
Pesticides.....	57
Discussion.....	57
Benthic studies.....	58
Dissolved oxygen content of bottom waters over the sewage sludge disposal area.....	58
Sediment analysis—Grain size distribution and total organic content.....	58
Benthic macrofauna—Introduction.....	59
Sewage sludge disposal area.....	60
Dredge spoil disposal area.....	62
Amphipoda.....	63
Benthic meiofauna.....	63
Benthic microbiology.....	64
Pathology—Possible waste induced disease in benthic organisms.....	64
Behavior of benthic organisms confronted with polluted sediments.....	66
Pelagic studies.....	67
Zooplankton communities.....	67
Laboratory studies on zooplankton.....	68
Effects of sewage sludge contaminated waters on phytoplankton growth and photosynthesis.....	68
Finfish investigations.....	69
Laboratory studies on finfish.....	70
Hydrographic studies.....	70
Materials and methods.....	70
Temperature.....	71
Bucket temperatures.....	71
Electrical resistance thermistor.....	71
Temperature recorders.....	71
Currents.....	71
Surface drifters.....	71
Seabed drifters.....	71
Current meters.....	71
Salinity.....	72
Dissolved oxygen.....	72
Temperature characteristics of study area.....	72
Surface temperature patterns.....	73
Bottom temperature patterns.....	73
Salinity characteristics of study area.....	74
Surface salinity patterns.....	74
Bottom salinity patterns.....	75
Surface drifter returns.....	75
Seabed drifter returns.....	76
Current meter results.....	77
Dissolved oxygen (bottom).....	77
Discussion.....	77
Future work.....	78
Discussion.....	79
Bibliography.....	80
New Jersey Chapter Natural Food Associates, Inc., Farmingdale, N.J., letter.....	111
New Jersey Society of Professional Engineers, Engineers-in-Industry Practice Session, Trenton, N.J., statement.....	108
Materials dumped at the chemical waste dumping ground in fiscal year 1968.....	9
Monmouth County Sewerage Advisory Committee, statement.....	98
Scientists' Committee for Public Information, Inc. (New York), letter and statement.....	109

91ST CONGRESS
2^D SESSION

H. R. 15915

IN THE HOUSE OF REPRESENTATIVES

FEBRUARY 16, 1970

Mr. HOWARD introduced the following bill; which was referred to the Committee on Public Works

A BILL

To amend the Act of June 29, 1888, relating to the prevention of obstructive and injurious deposits in the harbor of New York, to provide for the termination of certain licenses and permits.

- 1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 That section 3 of the Act entitled "An Act to prevent ob-
4 structive and injurious deposits within the harbor and adja-
5 cent waters of New York, by dumping or otherwise, and to
6 punish and prevent such offenses", approved June 29, 1888
7 (33 U.S.C. 443-448), is amended by inserting "(a)" im-
8 mediately after "SEC. 3." and by adding at the end thereof
9 the following new subsections:

I

1 “(b) Notwithstanding any other provision of law, the
2 Secretary of the Army acting through the Chief of Engi-
3 neers shall, within thirty days following the date of enact-
4 ment of this subsection, revoke or otherwise terminate any
5 license or permit which he has issued authorizing the dis-
6 charge (including, but not limited to, any spilling, leaking,
7 pumping, pouring, emitting, emptying, or dumping) of any
8 sewage, sludge, spoil, or other waste into the waters of the
9 New York Bight or into any other waters within a twenty-
10 five mile radius of the Ambrose Lighthouse.

11 “(c) The Secretary of the Army acting through the
12 Chief of Engineers shall make a complete investigation and
13 study of the methods by which, and the cost of, restoring
14 the waters of the New York Bight and any other waters re-
15 ferred to in subsection (b) of this section, to their condition
16 prior to the discharges terminated under subsection (b) of
17 this section. Such Secretary shall report to Congress the
18 results of such investigation and study, together with his
19 recommendations, no later than one year after the date of
20 enactment of this subsection.”

WASTE DISPOSAL IN THE COASTAL WATERS OF NEW YORK HARBOR

MONDAY, FEBRUARY 23, 1970

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RIVERS AND HARBORS
OF THE COMMITTEE ON PUBLIC WORKS,
Sandy Hook, N.J.

The Subcommittee met at 2:35 o'clock, p.m., Conference Room, Marine Research Laboratory, the Honorable James J. Howard, Acting Chairman, presiding.

Present: Messrs. Howard, McCarthy, Olsen, and Hammerschmidt.

Staff present: Richard J. Sullivan, Chief Counsel; and Lester Edelman, Counsel.

Mr. HOWARD. The Subcommittee on Rivers and Harbors, Public Works Committee, of the House of Representatives will please come to order.

We are very happy that we are able to hold these hearings here in New Jersey this afternoon. We are very gratified, the entire Public Works Committee, of the tremendous interest that has been shown in the environment concerning pollution and other matters recently.

Of course, to my colleagues, I would say those of us here in Monmouth County have been quite aware of citizen participation concerning our lovely beaches and our water for quite some time.

We are hoping that as we go into the 1970's, we are going to see that we are able to reverse the trend that the nation has taken over the years, having advanced so far in so many things, and yet been regressive as far as our own environment is concerned.

Before we begin taking testimony, I am aware that the room is overflowing, and that many people have come to Sandy Hook today who wish to say something to the Public Works Committee and to the Congress, and certainly we wish to hear all of them. We do have a time limitation, however; in fact, I have been informed by the logistical team that my colleagues and the staff members and the people from the Corps and the people who came from Washington will have to be prepared to leave Sandy Hook at an early hour because of darkness at Lakehurst; so we will have a time limit, not extending much past five o'clock, at which time the hearings will have to end.

We are not going to be able to hear personally from many people today, but many people have indicated to me that they do wish to have some testimony or information placed before the committee, during consideration of the legislation we have before us.

So, in the beginning, I will ask of my colleagues unanimous consent that any information that may come to me, directed to me at the

House of Representatives in Washington, D.C., may be made a part of the committee file during the consideration of this legislation.

Without objection, it is so ordered.

We meet today to hear testimony relating to the dumping of sewage sludge and dredge spoils into the ocean and to discuss how this problem can best be handled in the future.

I am James J. Howard, acting chairman of the House Subcommittee on Rivers and Harbors and author of H.R. 15915, the proposed legislation which will be discussed at this hearing.

First, I want to express my extreme gratitude to Representative George H. Fallon, of Maryland, the distinguished chairman of the House Committee on Public Works who scheduled a hearing on this legislation only one week to the day after it had been introduced. This is just one indication of the strong commitment Chairman Fallon has toward cleaning up the polluted waters of this Nation.

Second, I wish to extend my deep appreciation to the other members of the House Committee on Public Works, Democrats and Republicans alike, who gave up their holiday today to participate in this important hearing. I am equally appreciative to the staff of the committee who spent much time setting up this hearing and who also gave up a holiday to attend.

This hearing is a direct result of an interim report authored by Dr. Jack Pearce of the Sandy Hook Marine Laboratory. It was because of the interim findings in this report that I introduced by legislation. Obviously no definite final conclusions can be made until the entire report is finished and reevaluated. However, the basic warnings in the report are ominous enough to galvanize us into action.

The practice of dumping sewage sludge into the ocean must be ended eventually because we cannot allow the ocean to become an open sewer which could endanger our beaches, kill our marine life and cause health dangers.

In planning for the eventual end to dumping into the ocean we have to approach the matter in a calm, practical, and reasonable manner. An immediate halt to present dumping procedures apparently is neither practical nor reasonable.

The answer to this problem presents no scientific challenge, but it does require a much stronger commitment on the part of many persons to join in the fight against water pollution.

The obvious long-term solution is the construction of adequate treatment plants and the modernization of present ones so that the sewage can be treated at the source rather than be dumped into the ocean.

To those who say we cannot afford to make a realistic fight against water pollution, I say we can ill afford not to make such a fight. A serious pollution problem which might force us to close our beaches could cause serious financial damage to our great resort industry, not to mention the adverse effect it already has had on marine life.

The legislation which I have introduced and which is under consideration today would require that barges dump their refuse at least 25 miles from shore. This, of course, from my view is negotiable. There are a lot of people who know a lot more about the scientific aspect of this than I do, and I hope we will be able to get some constructive and practical advice on this.

While this may be desirable for a period of time, it obviously is not the final solution. To do this for the next 40 years would merely result in the formation of another "dead sea" area similar to the one that already exists.

While we must look to the past to review what has occurred, we must look to the future to find the solutions. Therefore, I am hopeful that we can emphasize the future, rather than searching for someone to blame for the past.

I wish now to acknowledge the presence, with my personal gratitude, of my colleagues in the House of Representatives who have given up a day that they should have off, to travel with us to New Jersey, to get up early to travel by plane and helicopter, to be briefed and rebriefed, and then to hear testimony all afternoon, on a day they could have spent at home with their families.

It is interesting that none of them have districts bordering on the ocean, although one has a Great Lake that he is concerned with.

I wish to introduce my colleagues in the House and ask them if they have a statement that they would care to make before we begin hearing the testimony.

First I would like to introduce a great friend, an excellent Member of the House of Representatives, who, as I said, has very little ocean sewage problems in his district, coming from the State of Montana, the gentleman from Montana, Congressman Arnold Olsen. Mr. Olsen.

Mr. OLSEN. Thank you very much, Mr. Howard.

I simply want to say that I am grateful to you for the opportunity to come to your area and witness another problem of sewage firsthand. We are going to cope with these problems; and certainly you, Mr. Howard, have become a real leader in this field. I am again happy that I had the opportunity to come here, because it is another lesson that I can report to the people in Montana of the evils of the situation; and of course alert them that with the ecology of Montana, we have to be on guard, and not get into the circumstance that you have here.

I pledge you, Mr. Howard, my support of your legislation, and I am hopeful that, as you develop the facts, I can continue to be there when you develop them.

Thank you, again.

Mr. HOWARD. Thank you very much, Mr. Olsen.

Also with us from the State of New York is an active conservationist, who sits beside me on the Public Works Committee, who has been working with us, and has been a great support for me when I was concerned about oil pollution, and I was very happy to be able to work with him as he led the way in the great concern of our Nation over pollution by poison gas.

He, incidentally, as a plug, has written a book about it, that has recently been released; so I imagine he is a very wealthy man at this time—from the Buffalo area of New York State, Congressman Richard McCarthy.

Mr. McCARTHY. Thank you, Mr. Chairman.

My initial information about this problem occurred when the Army was planning to dump some 27,000 tons of nerve gas, and other lethal agents, in the ocean out at the farther point on the map that we saw.

Fortunately, we were able to stop this.

The material is now being detoxified out in Colorado. But this problem obviously is, in many respects, even greater than that one.

When you look at the figures, which I just accumulated here, that over a billion and a half tons of untreated municipal and industrial waste are dumped into the Hudson daily in the New York City area, you see the dimensions of the problem.

My staff also advised me that while the New York State Health Department sets standards that determine whether beaches are safe, from a health standpoint, for swimming; if the bacteria count rises above a certain level, swimming is not permitted.

In 1968 and 1967 it was revealed that the bacteria count at Coney Island and at some of the beaches on Staten Island had risen above the safe level; but the beaches were not closed by the Health Department.

I think that this points up the very serious nature of this problem. If it continues, then many millions of people are going to be denied the use of the beaches here in the Greater New York Metropolitan Area.

I feel, and this is not derogation of the Corps, but that the responsibility for these matters, at least the civil functions of the Corps, should be shifted to the Department of the Interior; and I am reviewing legislation designed to accomplish this.

Mr. HOWARD. Thank you, Mr. McCarthy.

Now, our other Member, who gives this committee a bipartisan flavor, one of the most respected and active Members of the House Committee on Public Works, from the State of Arkansas, our good friend, Congressman John Paul Hammerschmidt.

Mr. HAMMERSCHMIDT. Thank you, Mr. Chairman.

I will not take valuable time away from our valuable witnesses; and I notice many people have come to talk about this problem. They are concerned.

I will say that our visit here today has been constructive and enlightening.

Dr. Pearce's briefing was excellent, and it gives us a chance to relate on to other members of our committee what we have seen and heard here today. There is nothing like experiencing it first-hand.

We have many hours to discuss this before our own committee; so, there is no need for us to take the time to do it here. There is a serious problem here, and this committee will look for a reasonable, effective, solution to it, weighing all things: the good of the communities as well as the environmental good; as it affects your recreation area here, and the health of the Nation.

I congratulate you for having an outstanding Congressman in this area. It is my real pleasure to be with him, and I know that just your presence here shows your high respect for Jim Howard.

Jim, it is good to be in your district.

Mr. HOWARD. Thank you very much, John.

I have been informed that there are some visitors who do have prepared testimony that they would like the committee to consider. I would ask that at the close of the hearings, if those of you can see either the gentleman on my right or the one on my left, Mr. Richard Sullivan, Chief Counsel of the Public Works Committee, or Mr. Lester Edelman, counsel for the Public Works Committee, or members of my staff; if you would hand the testimony to them, you can be sure that it will become an official part of these hearings.

I wish also to acknowledge with gratitude the many persons who did come from Washington: people from the Federal agencies, from the Interior Department, from the Corps of Engineers; and I will ask unanimous consent that a listing of the names of all these people be printed in the record at this time, with the gratitude of the Public Works Committee.

Without objection, it is so ordered.

(List of names follow:)

(Major General Francis P. Koisch, Director of Civil Works, Office, Chief of Engineers; Major General Charles M. Duke, Division Engineer, U.S. Army Engineer Division, North Atlantic, New York, New York; Colonel Leonard Edelman, Assistant Director of Civil Works for Atlantic Divisions Office, Chief of Engineers; Joseph Caldwell, Technical Director, U.S. Army Coastal Engineering Research Center; Kenneth Osborn, U.S. Army Coastal Engineering Research Center; Charles H. Meacham (Deputy Assistant Secretary of Interior) Commissioner, U.S. Fish and Wildlife Service, Department of Interior; Captain Claude R. Frazier, USN Ret., U.S. Navy Escort Officer; Captain Thomas Wentworth, USN, U.S. Navy Escort Officer; Captain John Bruce, U.S. Coast Guard, Office of the Commandant and Fred Mutz, Legislative Assistant to Congressman James J. Howard (N.J.).)

Mr. HOWARD. To hear testimony at this time, we are very happy to have with us the representative of the Corps of Engineers, Colonel James W. Barnett, who is the District Engineer of the United States Army Engineer District of New York.

Colonel, we are very happy to have you with us. If you have anyone with you, when you begin your testimony, please announce the name and position of those people.

Of course, as you know, we are not only considering H.R. 15915, but also the report that I have before me known as the Interim Progress Report on the Study of the Effects of Waste Disposal in the New York Bight Area.

Colonel, we thank you for giving up a holiday to appear before the committee.

If you have any testimony to be placed in the record, you may do so; then you may proceed as you will.

**STATEMENT OF COL. JAMES W. BARNETT, DISTRICT ENGINEER,
U.S. ARMY ENGINEER DISTRICT, NEW YORK; ACCOMPANIED BY
JOSEPH CALDWELL, TECHNICAL DIRECTOR, U.S. ARMY COASTAL
ENGINEERING RESEARCH CENTER**

Colonel BARNETT. Thank you very much, Mr. Howard.

I have enjoyed the day so far, and I hope the information that I have for you is meaningful to your inquiry.

Sitting with me at the table now is Mr. Joseph Caldwell of the Coastal Engineering Research Center, and I believe you intend to have him appear formally in a few minutes. If you would let me say at the outset that the Corps of Engineers is certainly pleased to have this subcommittee here today, and we hope we can assist you in deciding this issue, which is so obvious in the public interest.

I think all of us feel a determination to try to solve this particular problem satisfactorily. The important thing, it seems to me, is to solve it not for just today but for the long term.

Any number of us perhaps could, off the top of our head, suggest an immediate solution that would really be no solution at all in the long run. I know that as you ponder the problem before you, as to what tremendous amounts of waste that are certainly increasing every year, that you will have to seek the advice of many others; and, hopefully, that advice will provide you the clarity of vision and the soundness of fact on which to base the proper decision.

I assure you that we in the Corps of Engineers want to do anything we can to make that decision the best one that is possible for the country.

You very properly identified me as the District Engineer, New York District, Corps of Engineers. I am also the supervisor of the harbor of New York, and it is under that latter authority that I am empowered by law to enforce the provisions of the United States Code which prohibits the deposit of refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge, acid, or any other matter of any kind into the harbor of New York, its adjacent or tributary waters, or in those of Long Island Sound.

Section 443 of title 33 of the United States Code designates the supervisors of the harbor as the source of permits to dump these same materials within precise limits, and makes it a misdemeanor to move any vessel with those materials aboard until a permit has been obtained.

The office of the Supervisor of New York Harbor was established under an act of Congress approved on June 29, 1888, to, and I quote:

* * * prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses.

The circumstances that led to the creation of this office were generally as follows:

The contractors who were engaged in dredging the vessel slips, building the piers, and improving the channels, as well as those who were disposing of materials excavated from tunnels, subways, cellars and foundations of buildings, and those who were disposing of other wastes, particularly from Manhattan, were not always as conscientious, and public spirited, as they might have been.

As a result, the waste materials were not always taken out to sea where there were adequate depths. In order to make a quick turnaround, scows were dumped at the entrances to the harbor, or even inside the harbor, decreasing the available depth and endangering navigation. In addition, vessels coming from other ports in ballast followed the common practice of throwing the ballast overboard at the harbor entrance, frequently in the navigation channel.

Since the continuation of these harmful practices would imperil shipping and nullify the benefits of improvements being made to the Port of New York, the Act of 1888 was passed, creating the Supervisor of the Harbor of New York.

Initially, dumping grounds for dredgings and waste materials were designated just a short distance outside the entrance to the harbor. One of these old dumping grounds is now one of the fishing spots frequented by party fishing boats operating out of New York.

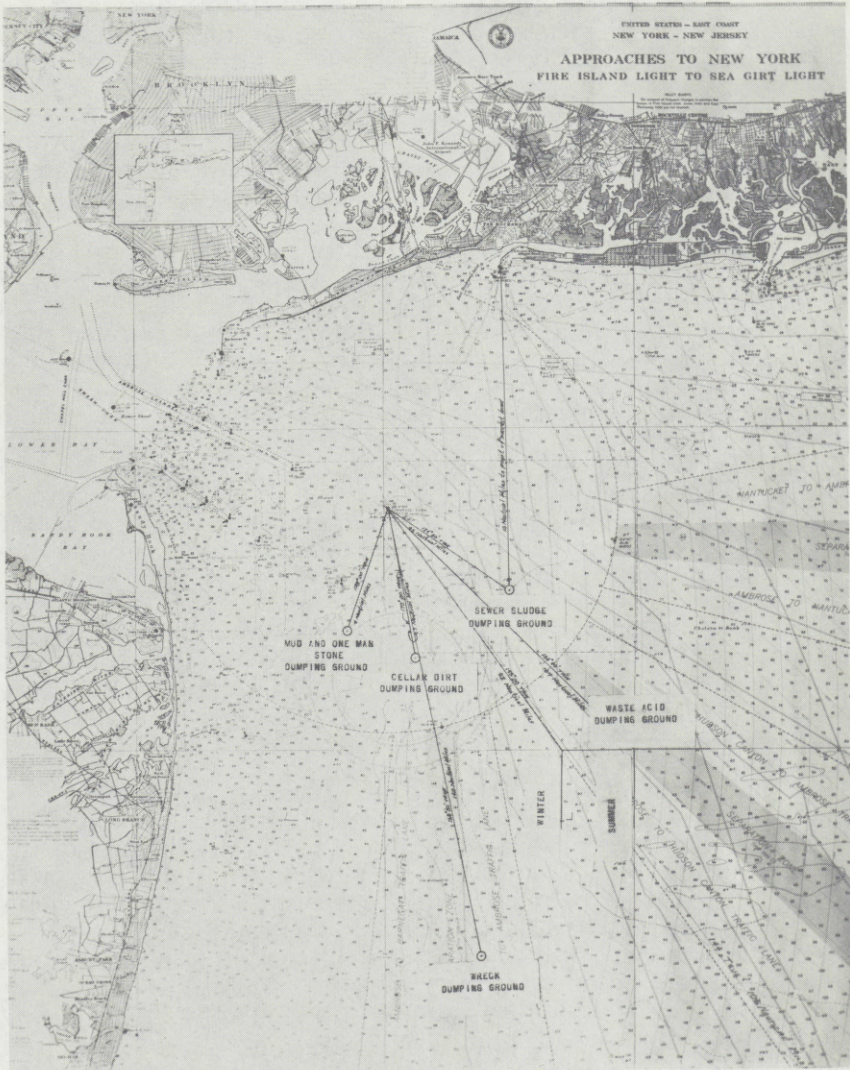
As the depths in the earlier designated areas noticeably decreased, other dumping grounds, further out to sea, were designated.

Today there are six separate dumping grounds designated in the Atlantic Ocean off the entrance to New York Harbor.

If you will refer to the photograph I hand you, you will see them designated thereon.

Mr. HOWARD. Excuse me, Colonel. By unanimous consent, and without objection, this will be made a part of the record at this point.

(Photograph referred to follows:)



Colonel BARNETT. It may be meaningful to you to know what goes into each of those.

Into the Mud Dumping Ground, go materials dredged from vessel berths, anchorage grounds and channels, clean earth and steam ashes.

Into the Cellar Dirt Dumping Ground, materials excavated from cellars, foundations, broken concrete, blasted rock, and rubble may be dumped.

Into Sewer Sludge Dumping Ground go, well, just as the name implies.

A Wreck Dumping Ground is for the deposit of salvaged vessels removed from other navigable waters. I might add that was deliberately selected with a depth not less than 200 feet, for obvious reasons.

Into the Waste Acid Dumping Ground, just as its name implies; and into the Waste Chemical Dumping Ground, other things perhaps more noxious than the normal dilute sulphuric acids deposited in the former.

The disposal of garbage and other floatable and offensive refuse was halted in 1933, following issuance of an injunction in 1931 by the Supreme Court of the United States. It was obtained by the State of New Jersey against the City of New York because the garbage and refuse floated up onto the beaches.

Since then, these wastes have either been incinerated or placed as sanitary land fill in low-lying areas such as the Fresh Kills area of Staten Island or the Hackensack Meadowlands.

In recent years, State and local health authorities have taken steps to bar the disposal of toxic solid wastes in land fills where their components could ultimately reach potable water; and, further, to bar the disposal of toxic liquid wastes into streams and other bodies of fresh water.

Mr. OLSEN. Could you identify what you are talking about when you say "toxic materials"?

Colonel BARNETT. Generally speaking, sir, these are products of various industrial processes, where certain materials poisonous to humans are the waste product from that process.

Mr. OLSEN. Could you be more specific?

Colonel BARNETT. There are a number of them in which heavy metals mix with the solvents in the waste material, leads, coppers, chromium, even—and these things which you do not want to appear in the potable water source were what were excluded—

Mr. OLSEN. Were there any particular named organizations that dumped it?

Colonel BARNETT. No, sir; because I am talking now about not only this immediate area, but other parts of the country as well as New York and New Jersey. This has been a general edict by most of the States, I know, and, I suspect, by many of the counties as well.

Mr. OLSEN. Could you refer us to some record where we could obtain the specific names of the products dumped, and from whom?

Colonel BARNETT. I will have to research that and provide you that information; but I would be happy to do so.

Mr. OLSEN. I would appreciate having that for the record at this point, Mr. Chairman.

Mr. HOWARD. Without objection, so ordered.

(The following was received for the record:)

(The following letter application from the Humble Oil & Refining Company typifies the toxic wastes resulting from industrial processes that are deposited in the Waste Chemical Dumping Grounds.)

HUMBLE OIL & REFINING Co.,
Linden, N.J., May 26, 1965.

DUMPING OF REFINERY SPENT CAUSTIC SODA AT SEA

SUPERINTENDENT OF NEW YORK HARBOR,
New York, N.Y.

DEAR SIR: We are requesting permission to dump, either at ten, thirteen, or hundred mile limit, spent caustic soda in 8,000 to 10,000 barrel barge lots on a 5-to-7 day basis.

A typical analysis of Refinery spent caustic consists of the following components:

Component:	Percent
Sodium Carbonate-----	5
Sodium Hydroxide-----	58
Sodium Sulphide-----	20
Sodium Naphthanate-----	2
Sodium Phenolate-----	3
Sodium Sulphate-Sulfite-----	2
Sodium Mercaptide-----	10
	100

PH 12-14

Concentration: 5°-20° Baumé

By Weight: % Water—97-86

% Sodium Salts—3-14

Color: Pale yellow to light green—clear

The dumping of Refinery spent caustic soda at sea will continue for an indefinite period of time. However, alternate methods of disposal are in the process of being developed, but these are of a long range nature.

If any other information is required for this type of operation, please do not hesitate to contact us.

Very truly yours,

T. J. INNER.

MATERIALS DUMPED AT THE CHEMICAL WASTE DUMPING GROUND IN FISCAL YEAR 1968

Name of permittee	Type of material	Work performed for	Total amount (cubic yards)
Spentonbush Transport Service-----	Spent caustic-----	Humble Oil Co.-----	21,664
Do-----	do-----	Chevron Oil Co.-----	3,000
Do-----	Nepera waste-----	Tappan Tanker Terminal-----	9,388

Mr. HOWARD. Continue.

Colonel BARNETT. This has resulted in increased activity and interest in disposing of these wastes at sea. With this increased activity and the rising concern of the Nation over water quality and pollution, the Corps of Engineers decided that it should determine accurately the environmental impact of the dumping operations.

Accordingly, the Chief of Engineers directed that a study be made of various dumping grounds, to do three things:

First, determine the effects of such dumping;

Second, make changes in areas or procedures to eliminate any harmful effects or to enhance any beneficial effects; and

Third, determine the particular effects to be expected from specific types of waste materials.

The coastal area off New York Harbor, which has been referred to as the New York Bight, was selected for the study because it is such a rich habitat for fish and shellfish, because there is such a concentration of population and industry, and because the established dumping grounds have been used for many years under conditions that were controlled, monitored, and documented.

Responsibility for supervision and administration of the study was assigned to the Coastal Engineering Research Center of the Corps of Engineers, and Mr. Caldwell, and perhaps other representatives of that activity, here prepared to testify further about the study at your request.

May I answer any of your questions?

Mr. HOWARD. Thank you very much, Colonel.

We are very grateful for your report. I have just a couple of brief questions here.

I believe you reported a total of about 11 million cubic yards of sludge and dredge spoil being dumped; that is, annually?

Colonel BARNETT. That is about the right figure.

Mr. HOWARD. Is this the quantity of solids, or does this quantity include the water content of these wastes?

Colonel BARNETT. That includes the water content, sir, and there are two principal elements of that that have large amounts of water in them; particularly the sewage sludge, which runs better than 90, close to 95 percent water, and the waste acid, which is about the same, 90 percent water.

Mr. HOWARD. What is the quantity of tidal water moving through the New York Bight, which would dilute the waste material?

Colonel BARNETT. I believe Mr. Caldwell might know that.

Mr. HOWARD. Mr. Caldwell.

Mr. CALDWELL. I could respond to that if you would like me to.

Mr. HOWARD. Please do.

Mr. CALDWELL. According to the best computation that we could make, based on observations of the Coast and Geodetic Survey, there are about two billion cubic yards of water moving into and out of New York each day by tidal action.

Mr. HOWARD. In this sufficient water to insure neutralization of the waste material before any might reach the shore?

Mr. CALDWELL. According to my understanding, sir, it is completely sufficient to neutralize the bacteria in this material.

Mr. HOWARD. Is this rate of decay sufficient to insure that the bacteria in the sludge waste would not contaminate the shores of New Jersey and Long Island?

Mr. CALDWELL. The rate of decay, sir, is sufficient according to authorities, and the particular authority that I quote is Dr. Pearson, who is Professor of Sanitary Engineering and Chairman of the Division of Hydraulics and Sanitary Engineering at the University of California. Dr. Pearson gives a rate of reduction in sea water of 90 percent each four hours; this means that every four hours the residual is reduced another 90 percent, so that at the end of the day there would be a reduction in the bacteria to about 1 in a million.

The reduction would continue at that rate, and each day there is another million parts reduction in the bacteria.

Mr. HOWARD. How long has this been taking place, the dumping of sludge in the—

Colonel BARNETT. In this particular area, sir, about forty years. There has been dumping prior to this, but in a different area.

Mr. HOWARD. We have an indication that an overwhelming amount of this 11 million cubic yards of sludge, water, and only a very small amount of it sludge; but there is a fantastic quantity of tidal water moving through the New York Bight that would dilute this waste material. We also have the statement by the Corps that this is sufficient to insure neutralization of the waste material before any might reach the shore.

Well, if, as these answers indicate, there is really no problem here, I wonder why we have had the Department of the Army Coastal Engineering Research Center go through all of the work to provide this report for us? And I wonder why my colleagues and I saw so much that appalled us this morning from the people at the Marine Lab, who have been studying this problem and who went out to that general area just last Thursday and brought back slides of an area that is devoid of life, an area which the report itself called a "dead sea"?

I wonder then, why the Corps is not the least bit concerned about the sludge dumping in the New York Bight Area, or not the least bit concerned about even bothering to look at this interim report?

Mr. CALDWELL. Sir, I think I can respond to that by saying that it was not any lack of concern, in fact it was our concern that lead us to make this study. The response made a few minutes ago to the question was whether or not this pollution had resulted in contamination of the bathing beaches. It was not a response to whether or not the bottom out near the dumping grounds and for a considerable distance around it had been contaminated. What the response to the question was developing is whether or not the bathing beaches were at this present time endangered from this off-shore dumping.

I think that the corps has recognized for some time that there was a considerable but unevaluated effect from this dumping on the bottom itself in the vicinity of the dumping area. Therefore, we were making the study to find out to what extent this bottom activity was taking place, or in what sense it was being polluted and over what area.

There are additional measurements to be made in connection with this study, and additional conclusions, and I suppose additional recommendations will come out of this study as it is presently being made by the Sandy Hook Marine Laboratory.

That report would be expected to be furnished to us the latter part of this year.

Mr. HOWARD. I see. You would be willing to consider the possibility that a decision to dump further out into the sea might be a good thing for the environment; you would consider it?

Colonel BARNETT. Sir, that is certainly true. I might pass onto you some of the charges that were given to the Advisory Panel of the Smithsonian Institution when they were asked to further evaluate the findings of the Marine Laboratory; and that we wanted recommendations as to how best to live with what society is now foisting off on itself, we are generating this waste, all of us. We have managed to live with it thus far; whether we are to continue to live with it, and

under what arrangements, is what must be decided. And certainly better direction to the Corps of Engineers, as they are managers only of the disposal of the waste, is what is hoped for in terms of the scientific advice resulting from this study.

Mr. HOWARD. I am very, very happy to hear that, that you would be willing to consider all possibilities, including maybe moving it out farther to sea.

I am happy to hear that, because I was very concerned to read in the paper the other day where the corps officials portrayed New York and New Jersey officials as living in ivory towers. We have a New York official here on my far right, and I am only one of the many New Jersey officials here, who were accused of living in ivory towers "with little comprehension of the enormous cost and logistical impossibility of dumping the waste farther out to sea."

May I take it that this is not the official Corps position, even though it was stated by Corps officials?

Colonel BARNETT. That is correct, sir. That is not the official Corps position.

Mr. HOWARD. Also, it had been stated by some people that this dumping of the toxic waste within 12 miles of New York and New Jersey coasts has created a veritable cesspool, a polluted doldrum devoid of any marine life.

I believe the report calls it a "dead sea."

We certainly have seen graphic proof of that in the slide presentation by the Marine Lab here, and yet I have here an article quoting Mr. Locke Mouton, Deputy Chief of Public Affairs for the Engineers in Washington, who poked fun at this contention; which might mean, I thought, that maybe the Corps was just throwing out this report, saying: "I imagine lots of fish that haven't read such newspapers as The New York Times"—a newspaper which, incidentally, has been kicked around quite a bit lately from the very top of the Government—"have swum through the pollution site; and I understand they are getting along just fine."

I do not believe that that is so, and I would like to get it for the record, from the Corps, your contention that this is a personal statement and not the statement of the Corps; very possibly the spokesman did not know any of the fish who have been swimming through there, or maybe had not read the New York Times.

Colonel BARNETT. I am sure your interpretation is correct, because I do not know that that information has not been provided in anything like that form, and your interpretation is 100 percent correct.

Mr. HOWARD. Thank you very much.

I am very happy that we could get that for the record. But it is statements like this that make it difficult for the Corps of Engineers to even travel through the Monmouth County area. So, I am very happy to have this cleared up.

I know, having dealt with the Corps through my time with the Public Works Committee, that we are going to get concerned and competent cooperation from the Corps as we go through this hearing.

I have no further questions. We are looking forward to getting information from the Corps as we continue with the interim report, and also as we get information and possible solutions, we are sure that

we can depend on your continued cooperation to work in the interest of the ocean areas, and toward the improvement of our environment. Congressman Olsen.

Mr. OLSEN. Thank you very much.

Colonel Barnett, do I understand it correctly that it was the Corps of Engineers' concern that caused the Sandy Hook Marine Lab to be created?

Colonel BARNETT. No, sir; that is not correct. The Laboratory existed long before. We took advantage of the capability of the Laboratory to undertake a study which the Chief of Engineers felt was important in order to be able to manage his responsibilities for control of waste disposal.

Mr. OLSEN. What I was really getting to was whether or not it was your concern, sufficient to obtain appropriations for this purpose, and that it was your concern or the Corps of Engineers' concern, that delegated a sum of money and a function to the Sandy Hook Marine Laboratory?

Colonel BARNETT. That is absolutely correct.

Mr. OLSEN. How much money is that?

Mr. CALDWELL. \$280,000, sir.

Mr. OLSEN. In a single year?

Mr. CALDWELL. No, sir; that is spread over 3 years.

Mr. OLSEN. And is that going to continue?

Mr. CALDWELL. Yes, sir; that is the amount that is earmarked for this study.

Mr. OLSEN. How long is this period going to continue?

Mr. CALDWELL. The study is scheduled for completion about the first of next year. There was an appropriation in fiscal year 1969, and an appropriation in 1970, final appropriation will be in 1971. The 1971 one will be the smallest; that will be for the writing of the final report. There will be practically no fieldwork, as I understand it, involved in the final year.

Mr. OLSEN. So that the Corps of Engineers' principal obligation here is to protect navigation and that, as an offshoot of that, you will become concerned enough about the health problem; is that it?

Colonel BARNETT. We also have some responsibilities under the Refuse Act, sir. It is the execution of those responsibilities—

Mr. OLSEN. What is that Refuse Act?

Colonel BARNETT. That is the act of 1888—1899, excuse me, created to supervise—1899 was the Refuse Act.

Mr. OLSEN. Under the Refuse Act you have had this obligation all the time?

Colonel BARNETT. To control the deposit of refuse in certain designated areas only.

Mr. OLSEN. Thank you.

Mr. HOWARD. Mr. McCarthy.

Mr. MCCARTHY. Colonel, I would like to cite some information first, and then ask you a question.

The Federal Water Pollution Control Administration reports that the waters of New York Harbor are grossly contaminated, millions of gallons of raw sewage from New York City and Metropolitan New Jersey pour into the harbor and Raritan Bay. The FWPCA

said the level of contamination within the harbor is high enough to impose a danger to those who use small boats on its waters. It could endanger, for example, someone standing on the bow of one of the Staten Island ferries getting spray on his face, according to the Federal Water Pollution Control Administration.

Now, my question is this: When you grant these permits, do you take information like this into consideration? When you are granting a permit to permit dumping of pollutants, what guidelines do you look to? Do you take information like this and take it into consideration in granting that permit?

Colonel BARNETT. Sir, that is absolutely correct. I would go a little further to say that we not only consider that information ourselves, but we ask the advice and counsel of the other Federal agencies, such as FWPCA, Department of the Interior, in reviewing these requests for permits.

Mr. McCARTHY. You mean that they have to approve them, too?

Colonel BARNETT. In practice, they send us comments and recommendations. The ultimate approval is with us.

Mr. McCARTHY. Have they objected to any recently?

Colonel BARNETT. Yes, sir; they have.

Mr. McCARTHY. Which ones?

Colonel BARNETT. There are not any that I can quote to you right now that affect the dumping grounds that we witnessed this morning.

Mr. McCARTHY. But they have objected to some other dumpings?

Colonel BARNETT. Primarily to some other work along waterfronts, sir. They are routinely contacted in regards to permit requests wherever there is an apparent effect on the environment; and I will quote you a fictional example right now.

If you asked for a permit to, let us say, dredge a slip for your private boat, if you owned one, at your private beachfront home, if you owned one, that permit would come to us and we would routinely contact the other authorities that have interest in that. They would comment, for example, on whether or not the presence of your boat and the oil it might spill, or the products of the marine head would have any effect on the bay that your house is upon.

They would comment upon whether the draining caused by your slip had an adverse effect, let us say, on breeding grounds; and these are routinely considered before we grant or deny a permit.

Mr. McCARTHY. Now, when you grant a permit for dumping out here, do you take into consideration the ecological consequences of that dumping?

Colonel BARNETT. We do, sir. At this point we have not changed any of the ground rules on the public dumping grounds that I enumerated to you at the outset, because of any ecological effect. If we are asked to consider dumping at an entirely different dumping ground, it is entirely a new ballgame, and we do in fact completely review that along with our other sister agencies of the Federal Government that have an interest in this.

Mr. McCARTHY. But you do not conduct such a review for an existing authorized site?

Colonel BARNETT. That is correct.

Mr. McCARTHY. Now, you permitted the dumping for some 38 years, and then about 2 years ago you decided to do a study of the effects of this. Is that correct?

Colonel BARNETT. That is correct.

Mr. McCARTHY. But you were not mandated to do that by law?

Colonel BARNETT. That is absolutely correct.

Mr. HOWARD. Congressman Hammerschmidt.

Mr. HAMMERSCHMIDT. Colonel, you mentioned 11 million cubic yards. How is that divided between those two dumping grounds?

Colonel BARNETT. Sewer sludge takes about 4.8 million. The dredge materials, about 8 or 8.5 million.

Mr. HAMMERSCHMIDT. That adds up to around 13.

What I am getting at is, in the dredging dumping ground, the Corps of Engineers themselves do a certain amount of dredging, do they not?

Colonel BARNETT. About 2.7 million in fiscal 1968, to give you an example.

Mr. HAMMERSCHMIDT. Little less than of the total?

Colonel BARNETT. A little less than half.

Mr. HAMMERSCHMIDT. Should the Sandy Hook Marine Laboratory experiment and the Smithsonian Evaluation Panel, prove an unacceptable ecological situation, has the Corps studied, or are you studying alternatives?

Colonel BARNETT. We are studying that now. But we do not have an acceptable alternative that suits us at this point.

Mr. HAMMERSCHMIDT. You logically probably could not go inland; it probably would be to the sea?

Colonel BARNETT. The same thing that makes the dredged material noxious in its present location makes it perhaps even more so inland.

Mr. HAMMERSCHMIDT. Well, in these waste disposals we deal with the private sector as well as the Government sector. In your study I imagine that any extra cost would accrue to the taxpayers?

Colonel BARNETT. Yes, sir.

Mr. HAMMERSCHMIDT. I do not suppose it would be quite in your bailiwick to figure out what part of the other cost would accrue to the consumer as an end product somewhere, but that would logically be part of the picture?

Colonel BARNETT. I am sure that is where it would accrue, but I do not have any good judgment on what the numbers might be.

Mr. HAMMERSCHMIDT. That is all I have, sir.

Mr. SULLIVAN. Colonel, could you explain for the benefit of the committee the difference between the dredging permit, and this dumping permit that we are talking about—that the committee is concerned with?

Colonel BARNETT. Yes, Mr. Sullivan.

When you desire to make an alteration that affects waterway within the purview of the Corps of Engineers, you must obtain a permit prior to beginning the work. That permit, as a rule, is requested on the basis of what the nature of the improvement is to be. It includes a review by the Corps of Engineers of your general design, and it includes consideration of where you expect to put any of the residual materials.

Now, if you are building a wharf, you probably do not have residual materials of any consequence, other than scrap lumber and so on. On the other hand, if you are dredging a channel, building a jetty, you are generating some materials that must fall within the purview of the dumping, so your request for permit must also say where you intend

to dispose of those materials. And that permit request, with the public hearing, if it is necessary, that accompanies this, and the review by the other Federal agencies, gets considered, then, in the light of not only what will be generated but where it is to be put.

Now, another step is, if you are county or sewage authority, then you do not obtain a permit to generate sewage, you just generate it; but you must obtain a permit to discharge it in these dumping grounds.

In that case you come to us for a permit to dump only.

Does that help?

MR. SULLIVAN. Do you consult, in the second case, when you are talking about the sewage, with other Federal agencies before the permit is issued?

Colonel BARNETT. Sir, our practice is, if there is what I would call a new customer, we would. If there is to be a change in the dumping ground, we obviously would consult with other agencies. If it is a periodic renewal of an old customer, using the originally designated dumping grounds, we do not routinely go back to the other agencies.

MR. SULLIVAN. In the question of dredging, when you are removing dredge spoil, do you not have an agreement with the FWPCA to consult with them before you issue that permit?

Colonel BARNETT. We do.

MR. SULLIVAN. Is that honored and practiced in the New York District?

Colonel BARNETT. It is.

MR. SULLIVAN. Thank you.

MR. OLSEN. Right up to now you have never had, as your concern in the Corps of Engineers, as a principal concern, the health problems?

Has not always your principal concern here, and in the Great Lakes and wherever you operate, been with navigation?

Colonel BARNETT. I do not know how to answer that, Mr. Olsen. We are chartered by law—certainly as regards navigation.

MR. OLSEN. What I am saying is, even in the Great Lakes, all you do is move sludge from one place to another. You do not do anything about eliminating the sludge as a health hazard?

Colonel BARNETT. I understand now. Yes, sir; that is correct.

MR. OLSEN. And that is the situation here?

Colonel BARNETT. That is correct.

MR. OLSEN. And this is, then, the first effort that has been made to determine the health hazard, this specific one here?

Colonel BARNETT. It is certainly the first effort that affects coastal waters, sir. I do not know about inland waters. I could not answer that accurately.

MR. OLSEN. I am concerned that out of this administration, or any other, I am talking about the corps now, that there has never been any suggestion in the Congress that we do something about the health problem, from you people.

Colonel BARNETT. Not that I am aware of, sir.

MR. MCCARTHY. On these dumping areas that are farther out, where you do not give permits for the toxic waste and the acid waste; now, those are in international waters, are they not?

Colonel BARNETT. Yes, sir; they are.

MR. MCCARTHY. What is the authority under which you would grant a permit to dump in international waters?

Colonel BARNETT. I do not know of any authority, sir.

Mr. McCARTHY. Well, there are treaties, you know, that prohibit international pollution; and I just wonder if you really are on sound ground in granting a permit to go that far out.

Colonel BARNETT. I understand your point, sir.

Mr. McCARTHY. Has this given you any concern?

Colonel BARNETT. To this degree, it has, if we were called upon to, let's say, enforce this against a reluctant applicant, I am not sure what authority we would lean upon. To my knowledge, we have not had reluctant applicants in the context in which I used the term. Those that have applied have been willing to go along with the ruling was.

Now, in practice, the law says that the master of any vessel who takes aboard these materials that I described earlier in my testimony, including the materials you stated, expecting to take them to a dumping ground, and failing to obtain a permit therefor, before he moves the vessel, is guilty of a misdemeanor.

That really is the authority on which we can hang our hat.

Mr. McCARTHY. But you do not know of any authority to go into international waters?

Colonel BARNETT. None that I know of, sir.

Mr. McCARTHY. Do you notify the Department of State when you grant a permit beyond the 12-mile limit?

Colonel BARNETT. They are notified.

Mr. McCARTHY. They are?

Colonel BARNETT. And other Federal agencies as well.

I might add, at the request of other Federal agencies, we have denied requests to deposit these noxious wastes at sea several times.

Mr. McCARTHY. What makes me concerned is that your sister and brother agency, the Chemical Corps insisted that the safest method to dispose of these nerve gases and other things was at sea. Then a panel of the National Academy of Sciences conducted a review and they found that it would destroy 600 cubic miles of marine life in the Atlantic Ocean.

This is when I began to wonder if the Army was really considering the ecological consequences of what it was doing in these dumpings.

Colonel BARNETT. I understand your concern, sir.

Mr. SULLIVAN. Mr. Chairman, I might ask the Colonel this question:

Assume the Congress enacts legislation which would do away with authority, without issuing permits at all—

Colonel BARNETT. If there is no source of permits, there would still be waste generated. My expectation of what would happen is that those people who now generate or contract to haul off waste would simply dump it at the closest possible place, probably within New York Harbor or—

Mr. SULLIVAN. There would be no control and no violation of any laws; is that right?

Colonel BARNETT. That is right, Mr. Sullivan.

Mr. HOWARD. Thank you, Colonel.

Would you agree that this interim report raises serious questions concerning health, as a result of the dumping of the sludge?

Colonel BARNETT. Sir, that is correct; and I think the remaining work to be done and, certainly, the analysis of the data that has been obtained must consider that concern very carefully.

Mr. HOWARD. I do not know whether the Corps of Engineers had any part in it, but I had been informed of this report and of the serious statements made in the report as far back as last December 3.

Being a member of the Public Works Committee and Subcommittee on Rivers and Harbors, which deals with the water pollution, I requested from the Corps a copy of the report and was informed that it was not ready, it was still being evaluated and put together.

About 3 weeks later I phoned again and asked for one, and was told it was not available at that time; and so I requested that I be given a copy of the report as soon as it is made public. That started on December 3, and then on February 9 it was reported publicly, the entire report.

I still had not received a copy, been told or anything of it.

Do you know how that came about, by any chance?

Colonel BARNETT. I am sorry, but I do not know how that came about.

Mr. HOWARD. Was the report under the jurisdiction of the Corps of Engineers at the time it was made public, or had it been with the Smithsonian, or with another agency?

Colonel BARTLETT. I do not know—just a minute, please, sir.

Mr. CALDWELL. I think I can give you a little information, sir, on what that was all about.

The report, I believe, carries the date of 1 January 1970. However, we received a looseleaf copy of it back around the first part of December. Now, this was a progress report and was not considered by us, or by the Sandy Hook Marine Laboratory, to be a conclusive report.

We had requested this committee of the Smithsonian to evaluate this report, and we thought that anybody who was concerned with these findings, would be in a position to read the report and the Smithsonian findings at the same time. We really hoped that they would wait until the full report was out a year hence; but when the interest in this interim report continued to build up, it became evident that what was wanted was the release of this report right away.

We never, in the sense, released it in the sense of printing many copies and sending it around; but whoever asked for a copy, we began to give them copies at that time.

Mr. HOWARD. I had asked for them since December 3.

Thank you, Colonel.

I would ask for you to supply for the subcommittee and for the record, and without objection it will become a part of the record: one, a list of all the permits in the four disposal areas; two, a list of the permittees; and, three, a list explaining for whom the permittees are dumping.

Could you provide that for the committee?

Colonel BARNETT. I would be happy to provide that for the committee.

(Information follows:)

CURRENT PERMITS FOR DISPOSAL OF WASTE, ATLANTIC OCEAN

Name of disposal area, description (sludge, acid, etc.) and U.S.C. & G. S. Chart No.	Name of permittee	Length of term	For whom dumped
Sewer sludge dumping ground; Chart No. 1215.	McAllister Bros., Inc.	3 months	South Kearny Sewerage Authority.
Do.	do.	do.	Westchester County.
Do.	do.	do.	Linden-Roselle Sewerage Authority.
Do.	do.	do.	Passaic Valley Sewerage Authority.
Do.	do.	do.	City of Glen Cove
Do.	do.	do.	Bergen County Sewerage Authority.
Do.	do.	do.	Middlesex County Sewerage Authority.
Do.	New York City Department of Water Resources (Rockaway).	do.	Permittee.
Do.	(Wards Island)	do.	Do.
Do.	(Owls Head)	do.	Do.
Do.	(Coney Island Ave. 2)	do.	Do.
Do.	(Hunts Pt.)	do.	Do.
Do.	(Port Richmond)	do.	Do.
Do.	(Jamaica Bay 26th Ward)	do.	Do.
Do.	(Tallmans Island College Pt.)	do.	Do.
Do.	(Jamaica Water)	do.	Do.
Do.	(Newtown Cr.)	do.	Do.
Do.	(Bowery Bay Astoria)	do.	Do.
Do.	Moran Towing & Transporting.	do.	Bergen County Sewerage Authority.
Do.	do.	do.	Linden Roselle Sewerage Authority.
Do.	do.	do.	Middlesex County Sewerage Authority.
Do.	do.	do.	Passaic Valley Sewerage Commission.
Do.	do.	do.	City of Glen Cove.
Do.	do.	do.	Joint Meeting Elizabeth, N.J.
Do.	General Marine Transportation.	do.	Rockaway (Pearsalls-Hassock).
Do.	do.	do.	Bayonne.
Do.	do.	do.	City of Long Beach.
Cellar dirt dumping ground; Chart No. 1215.	Moran Towing & Transporting.	do.	Permittee.
Do.	Great Lakes Dredging & Dock Co.	do.	A. J. Pegno Co.
Do.	Dunbar & Sullivan Dredging Co.	do.	New York City Transit Authority.
Mud and 1-man stone dumping ground; Chart No. 1215.	Great Lakes Dredging & Dock Co.	do.	Seatrains Lines.
Do.	do.	do.	Do.
Do.	do.	do.	American Export.
Do.	do.	do.	International Terminal.
Do.	Weeks Dredging Contracting, Inc.	do.	Filtered Petroleum Corp.
Do.	do.	do.	Grow Construction Co.
Do.	Dunbar & Sullivan Dredging Co.	do.	New York City Transit Authority.
Do.	do.	do.	Do.
Do.	Moran Towing & Transporting Co.	do.	Transit Mix.
Do.	do.	do.	Consolidated Edison Co.
Do.	do.	do.	Do.
Waste acid (winter) dumping ground; Chart No. 1215.	do.	do.	Permittee.
Do.	do.	do.	National Lead.
Do.	do.	do.	Brooklyn Union Gas Co.
Do.	Spentonbush Transportation Service.	do.	E. I. du Pont.
Do.	McAlister Bros.	do.	Permittee.
Do.	Allied Chemical Corp.	do.	Do.
Do.	General Marine Transportation.	do.	Do.
Do.	do.	do.	Do.
Waste acid (summer) dumping grade; chart No. 1215.	No permits issued.		
Wreck dumping ground; chart No. 1215.	do.		
Chemical waste dump; chart No. 1000	Spentonbush Transportation	3 months	American Cyanamid.
Do.	do.	do.	Tappan Tanker Terminal.
Do.	do.	do.	Humble Oil Co.
Do.	do.	do.	Chevron Oil Co.
Do.	Moran Towing & Transporting.	do.	Dow Industrial Service.
Do.	General Marine Transportation.	do.	Pratt & Whitney.

Mr. HOWARD. Thank you very much. I appreciate having your testimony. I am sure the corps will be called upon in the coming months as hearings are continued on this matter and approaching the final report, which I believe is expected in late summer; and wish to thank you for your cooperation here today.

Colonel BARNETT. It has been a pleasure to appear and talk to the committee. I trust that we will have the opportunity to cooperate further in this.

Mr. HOWARD. Thank you.

Our time is running along. I did promise my colleagues that they would get out early enough to be able to get the helicopter to get back to Washington. Of course I may ramble on, because I am not going back with you.

The next witnesses are from the Department of Interior, and I wish to call to the stand Mr. Charles H. Meacham, Commissioner of Fish and Wildlife, and Deputy Assistant Secretary for Fish and Wildlife, Parks and Marine Resources of the Department of Interior; accompanying him is Dr. John Clark, the Acting Director of Sandy Hook Marine Laboratory, and Dr. Jack Pearce, the author of the Interim Report being discussed.

Gentlemen, welcome to the subcommittee. We are very happy that you are here.

We are pressed for time, and if you have any statement that you wish to make for the record, by unanimous consent it will be made a part of the record.

We hope you will be able to summarize your remarks.

STATEMENT OF HON. CHARLES H. MEACHAM, DEPUTY ASSISTANT SECRETARY FOR FISH AND WILDLIFE, PARKS, AND MARINE RESOURCES; ACCOMPANIED BY JOHN CLARK, ACTING DIRECTOR, SANDY HOOK MARINE LABORATORY; AND DR. JACK PEARCE, AUTHOR OF INTERIM REPORT

Mr. MEACHAM. Thank you, Mr. Chairman, and members of the committee.

It is our privilege to have you here today at our Sandy Hook Marine Laboratory. We are proud of what we have here, and we are more proud of our staff and their capabilities.

I have a short statement here to read into the record. Mr. Clark and Dr. Pearce are available to answer your questions.

The study of offshore waste disposal in the Atlantic is funded through an Interservice Support Agreement between the U.S. Army Corps of Engineers, Coastal Engineering Research Center (CERC) and the Bureau of Sport Fisheries and Wildlife.

The purpose of the work is to determine the effect on the biota of the surrounding waters of various kinds of wastes being dumped into the waters of the New York Bight.

About five million cubic yards of sewage sludge and six million yards of dredging spoil are dumped per annum in the study area. The practice has been going on for about forty years without any knowledge of its effect on the biotas.

The proposal, as accepted by CERC, included \$135,000 for the first year, fiscal year 1969; \$115,000 for fiscal year 1970; and an additional \$30,000 for fiscal year 1971.

The study began in August 1968 and an interim report was submitted to CERC on December 3, 1969, outlining the progress made on the study through November 1, 1969. Results indicate severe contamination of the sediments by petrochemicals and other waste.

High levels of heavy metals, chromium, 200 ppm; copper, 350 ppm; lead, 250 ppm, are found with concentrations decreasing as the distance from the dump area increased. Pesticides are present in concentrations up to 200 ppb. High biological oxygen demands are associated with sediments from both the dredge spoil and sewage sludge areas. In the summer the dissolved oxygen content of the water over these areas is often less than 0.9 to 1.5 ppm.

In the laboratory, lobsters, crabs and snails died in water containing dredge spoil and sewer sludge when the dissolved oxygen fell below 2 ppm. Crustaceans and horseshoe crabs maintained for five to six weeks in well-aerated aquaria containing dredge spoil and sewage sludge developed pathological conditions in which gills became eroded and packed with detritus and petroleum residues and necrotic tissue and open lesions developed on the legs and claws.

The meio- and microfauna in both areas is greatly reduced in comparison with a variety of nonpolluted benthic environments. Even nematodes are absent. Total coliform and fecal coliform bacteria are heavily concentrated in the sewer sludge disposal area.

Sea bed current drifters released in the disposal area and the analysis of temperature-salinity profiles indicate a general movement of bottom water onto Long Island beaches north and northeast of the sewage sludge dumping site and nearshore water movements are north and northwest onto New Jersey beaches at Sandy Hook.

Our research to date does not suggest a specific alternative area or method of disposal. Cessation of dumping in the present area, however, would certainly allow for the improvement of the benthic environment.

Before we could suggest an alternative we would have to experiment with other areas. A possible alternative would be the evaluation of dumping at the twenty-fathom contour.

This, or a zone close to it, appears to be at the edge of the rich coastal water and the colder offshore water. The twenty-fathom contour ranges 30-40 miles offshore and is well inside the nationally and internationally important 100-fathom fisheries area.

That concludes my statement. The gentlemen would be prepared to answer your questions.

Mr. HOWARD. Thank you very much, Mr. Meacham.

We certainly appreciate your statement.

Dr. Pearce, throughout the past year or more you have conducted a survey of conditions being created by the dumping of sludge. This was presented to the members of the committee who are here, through the use of slides and your commentary this morning.

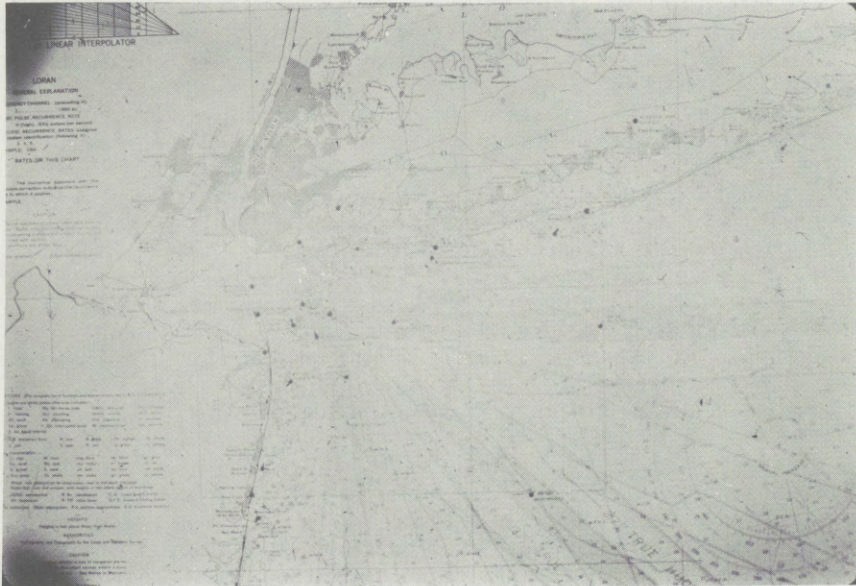
I would ask you, if you will, to present for the committee, and without objection it will become a part of the committee record, a copy of these slides with commentary similar to that of this morning, which will accompany it, for the committee.

Dr. PEARCE. I will be glad to do that.

Mr. HOWARD. Without objection, it will become a part of the record at this point.

(Information follows:)

The following commentary accompanied the showing of a series of slides which were presented as part of the Congressional Hearing held at Sandy Hook Marine Laboratory, Highlands, New Jersey, on February 23, 1970. These slides depict the methodology and results of a study of the effects of offshore waste disposal practices on the ecology of the New York Bight.



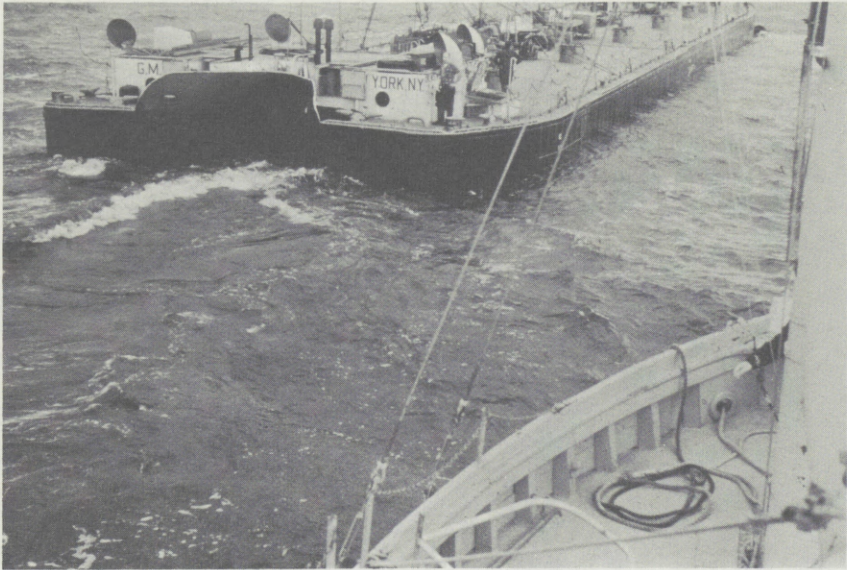
SLIDE No. 1

A standard CGS chart which indicates the location of Ambrose Light in relation to Long Island, New York Harbor, and Sandy Hook, N.J. The approximate location of the specified acid waste, dredge spoils, and sewage sludge disposal areas were pointed out on this chart.



SLIDE No. 2

Shows the acid waste barge dumping; the coloration of the water was noted. It was also mentioned that these discolored waters often extend 20 miles in a north-south direction, particularly during summer months when longer periods of calm weather prevail.



SLIDE No. 3

A sewage sludge barge dumping wastes ; this is a smaller barge which is towed by a tug. Larger barges are self-propelled. Five million cubic yards of sewage sludge are dumped annually. Slicks a mile in diameter occur following individual dumping. Oxygen values are markedly depressed in the surface waters of these slicks.

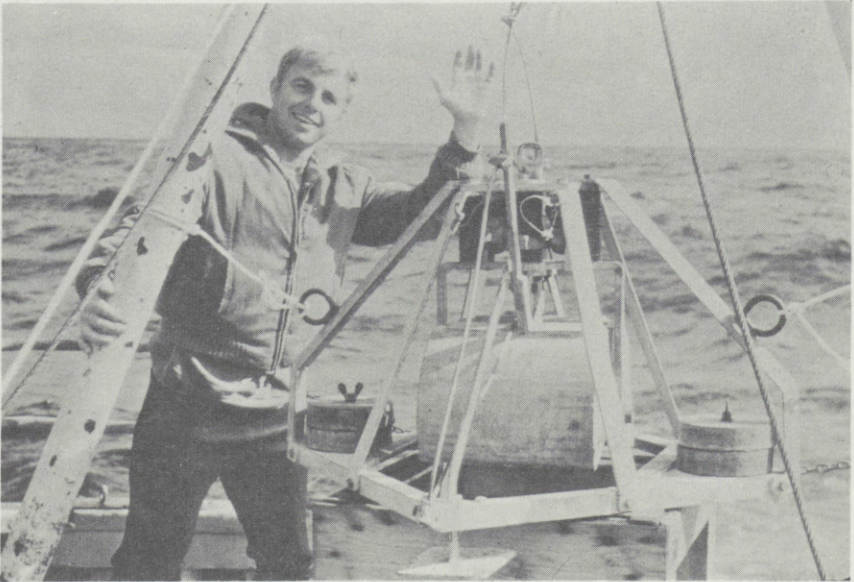
The odor of these dumps can be smelled several miles away. Plankton tows are difficult to obtain because the plankton nets are quickly fouled with fiber, probably from the toilet paper contents of sludge.

Similar fibers are reported as forming a high percentage of the debris which accounts for the turbidity of the New York Bight.



SLIDE No. 4

Indicates the location of the principal sampling stations in the area under investigation. Stations labelled with a numeral are original survey stations selected in order to determine bottom sediments and associated flora and fauna. Once the general boundaries of the areas affected by sludge and spoils were determined, a grid of sampling stations was established in order to more closely delineate the boundaries of the impoverished areas.



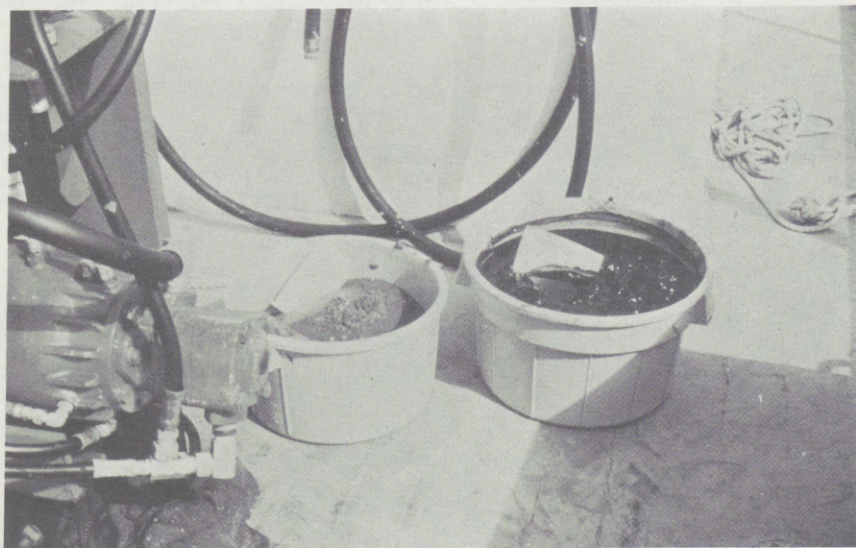
SLIDE No. 5

The Smith-McIntyre bottom grab used to obtain quantitative samples for investigation of animal community structure and for sediment analyses.



SLIDE No. 6

The Sanders anchor dredge used to obtain larger, semi-quantitative samples to determine the distribution of larger bottom-dwelling animals.



SLIDE No. 7

This slide illustrates the visual differences between samples taken at station 59, the impoverished center of the sewage sludge disposal area, and stations located some distance (2 miles) to the east of the sludge disposal area.

Subsamples are taken from each grab sample to investigate the distribution of smaller animals (meio- and microfauna) as well as for analysis for organic content, presence of heavy metals, and sediment type.



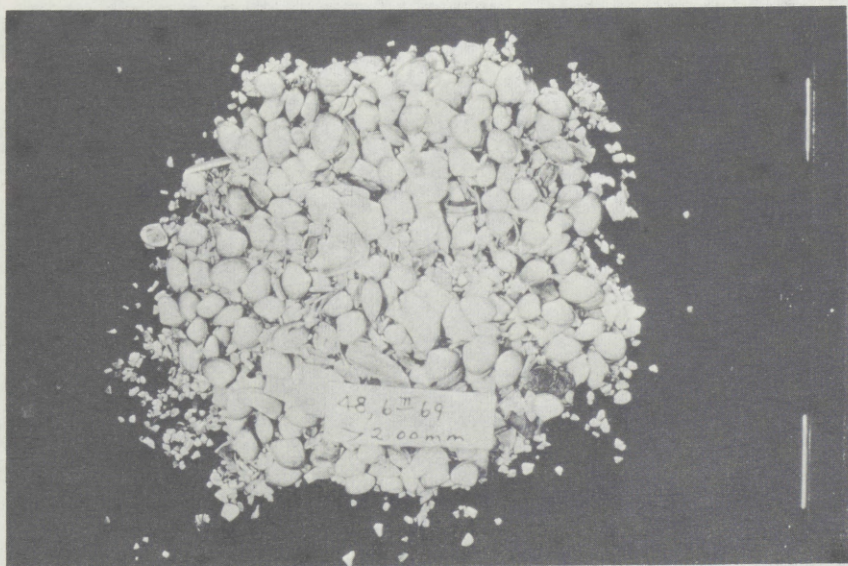
SLIDE No. 8

After the subsamples are removed the remaining samples are sieved through standard geological screens in order to separate the living materials from the sediments. The living materials are narcotized with $MgCl_2$, fixed in 5% formulin, and finally preserved in 70% ethanol.



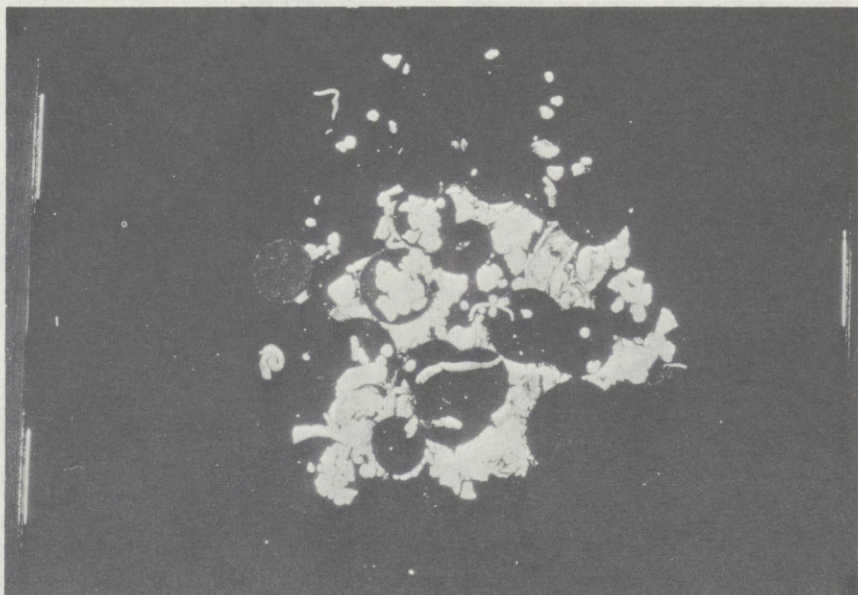
SLIDE No. 4 (repeat)

The locations of stations 48, 47, 42, 59, 82, and 4 were pointed out. The following six slides show the type of animal communities which exist at these stations. The physical environment at each station was described.



SLIDE No. 9

The fauna in a grab sample collected at station 48; a single species, the surf clam, *Spisula*, is dominant at this station. Almost 300 clams were found in a single grab which collects a sample $\frac{1}{10}$ of a meter square in surface area.

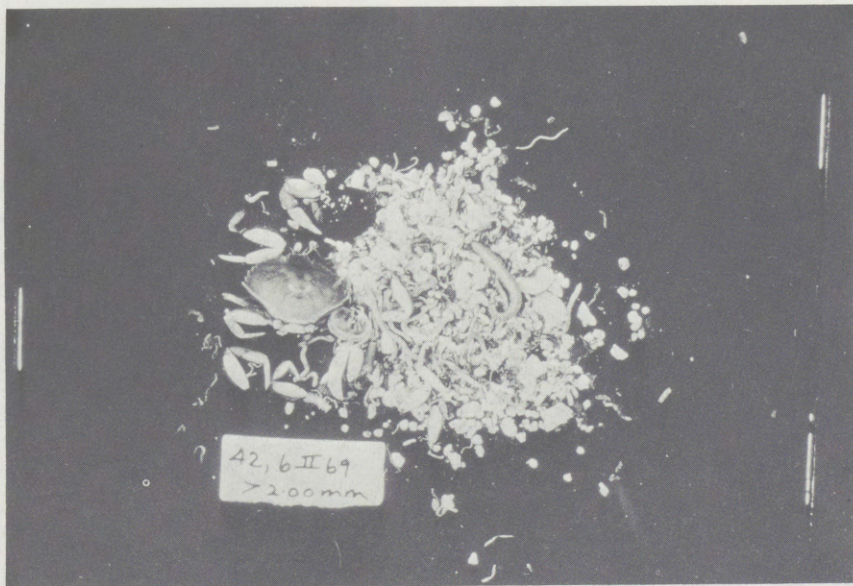


Slide No. 10

The fauna in a grab sample collected at station 47; the sand dollar is the dominant species.

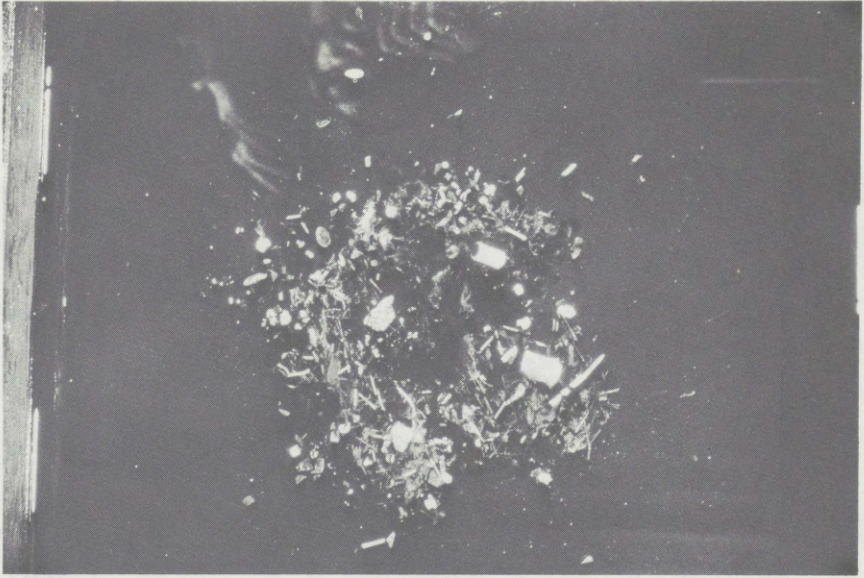
The communities at stations 48 and 47 are said to have low diversity, only a few species, and high dominance, one species is overwhelmingly abundant or conspicuous. Low diversity and high dominance are characteristic of environments under ecological stress. In this case, the stress is severe wave action at depths of 30-35 feet. Very few forms can accommodate to this stress.

The clam and sand dollar beds are not directly impinged upon by the sewage sludge and other wastes but may receive marginal pollution from the fine materials which remain in suspension following dumping.



Slide No. 11

Indicates the contents of a grab sample from station 42 which is in a physically non-stress environment. The water is 85-90 feet deep and consequently little wave action is obtained. The numerous species present (several clams and snails, 30-35 species of worms, and many crustaceans) indicate a fairly high diversity and low dominance. Analyses, including sediment type, suggest that this type of community may have existed throughout the sewage sludge disposal area prior to mass dumping.



Slide No. 12

The contents of a grab sample from station 59 (sewage sludge); no living macrofauna was present, only cigarette filters, band aids, various seeds, foil wrappers and other indicators of human contamination. Similar samples were collected from station 59 and other stations located throughout a 10 square mile area around the sewage dump area over an 18-month period.



Slide No. 13

A sample collected at station 82 in the area affected by dredge spoil dumping. No living macrofauna was present, only remnants of marsh grasses which probably had their origins in the harbor areas of metropolitan New York. We find petrochemicals (over 1%) and pesticides (over 2 p.p.m.) present in these samples. Station 82 is two nautical miles north of the area designated for dumping!



Slide No. 14

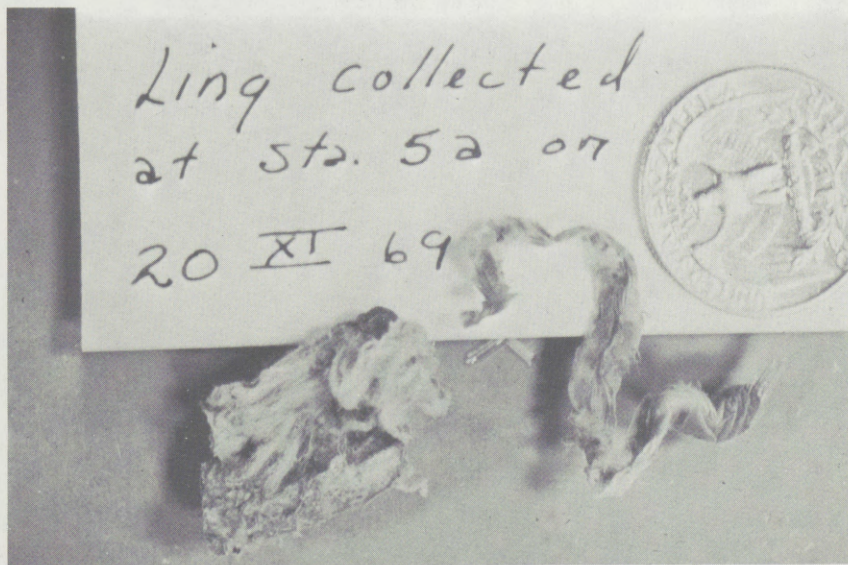
A sample collected from station 4; this station is 2 miles west of 59 in the sewage sludge disposal area. Again, no living materials were recovered, only cinders, organic debris, etc.

Stations 59, 82, and 4 all lack diversity; the stress is undoubtedly the various factors associated with pollution i.e., low oxygen, presence of toxic materials, and direct inundation of life by solid wastes.



Slide No. 15

Shows the contents of a trawl made through the sewage sludge disposal area. These include tampax and other debris of human origin. Only a single animal was present a small shrimp which is free-swimming and is not attached to the bottom sediments.



Slide No. 16

Gut contents of a bottom-feeding fish, a ling, collected at the northern periphery of the dumping grounds. They include a cellulose filter and a worm (family: Flabelligeridae) which is characteristic of marginally polluted bottom environments.



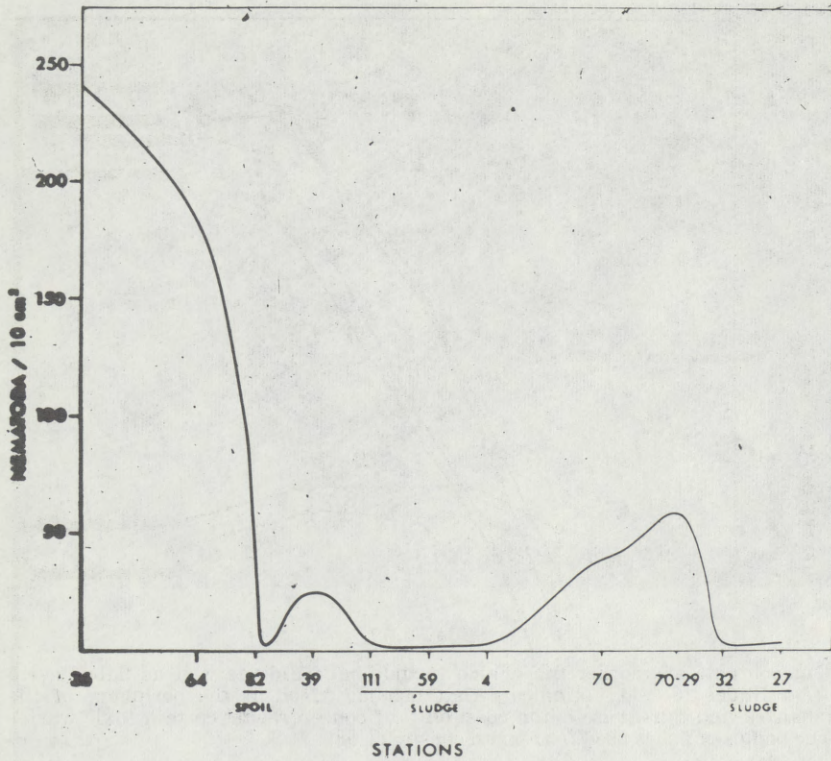
Slide No. 17

Gut contents of another ling which include band aids as well as flabelligerid worms. Slides 16 and 17 indicate that fish may feed at the periphery of the dump area and thus there is the possibility of concentrating certain toxic wastes in the bodies of fishes used for human consumption.



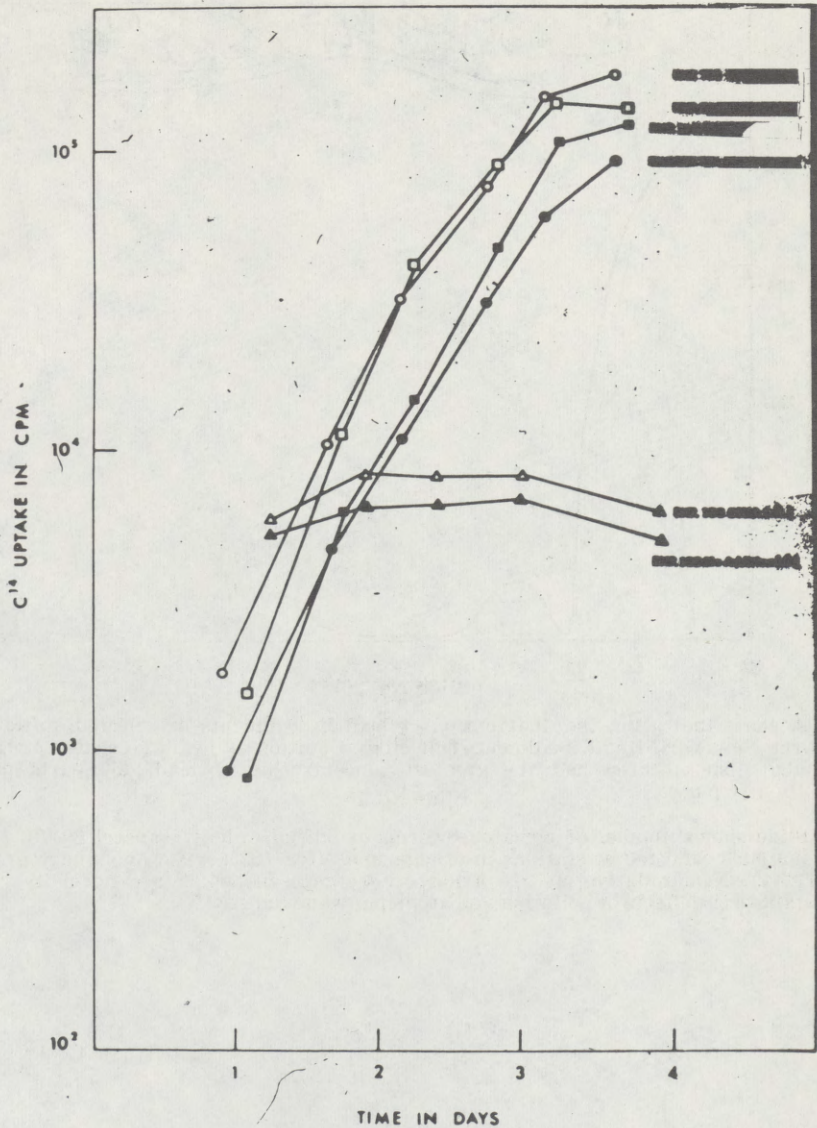
Slide No. 4 (repeat)

Chart with location of sampling stations. An east-west transect including stations 36, 64, 82, 39, 111, 59, 4, and 70 was pointed out to introduce following slides (No. 18 and 26).



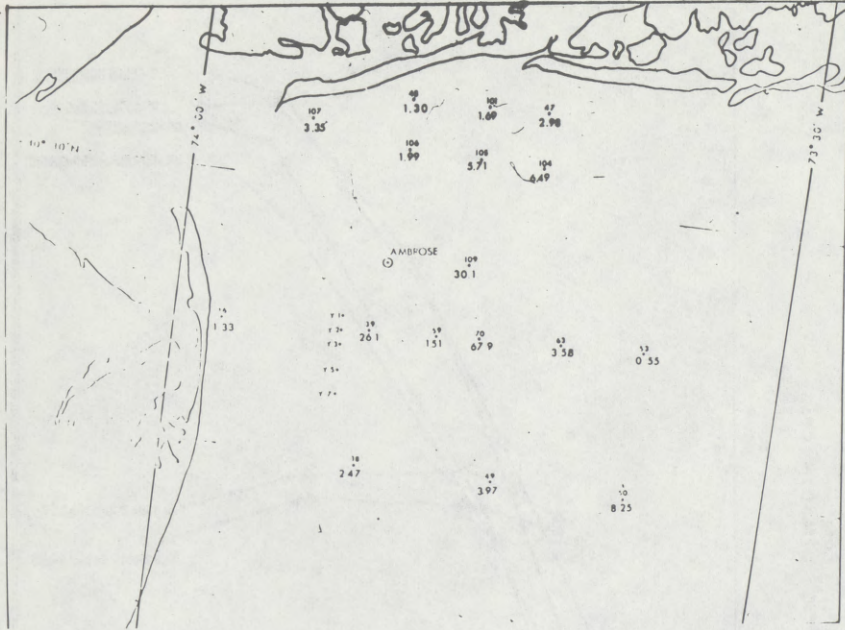
Slide No. 18

Slide shows number of nematode worms at stations along transect 36-70. No nematodes collected at stations in dredge spoil area (82) or sewage sludge area (111-4). Nematode worms are among the organisms which are normally resistant to the effects of pollution and accompany anoxia, etc.



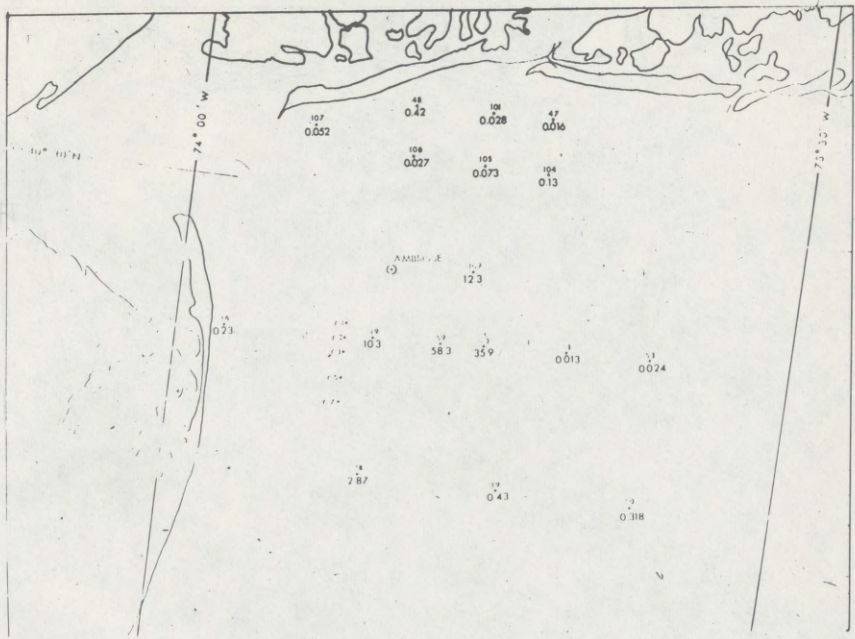
Slide No. 19

A graph depicting the effects of sludge contaminated waters on cell division of phytoplankton organisms. Lower curves indicate no growth of diatoms cultured in filtered water from sludge disposal area. Upper curve shows continued cell division in diatoms cultured in water from Raritan Bay and Verrazano Narrows, both highly polluted. Because phytoplankton populations form the base of marine food chains these findings have a great deal of significance.



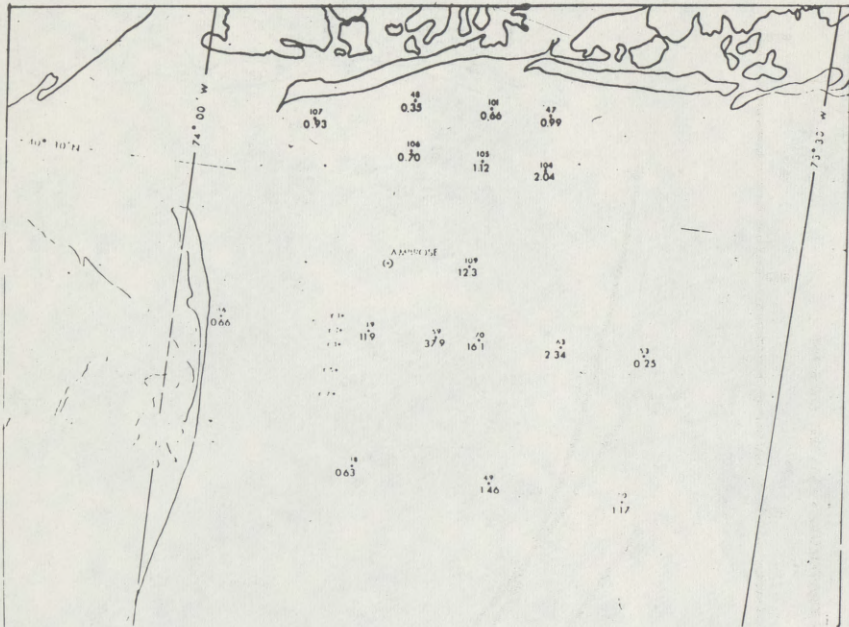
Slide No. 20

A chart indicating the distribution of lead in sediments at selected stations in the New York Bight. Sediments collected at station 59 near the center of the sludge disposal area had the greatest concentration of lead, 150 parts per million (p.p.m.).



Slide No. 21

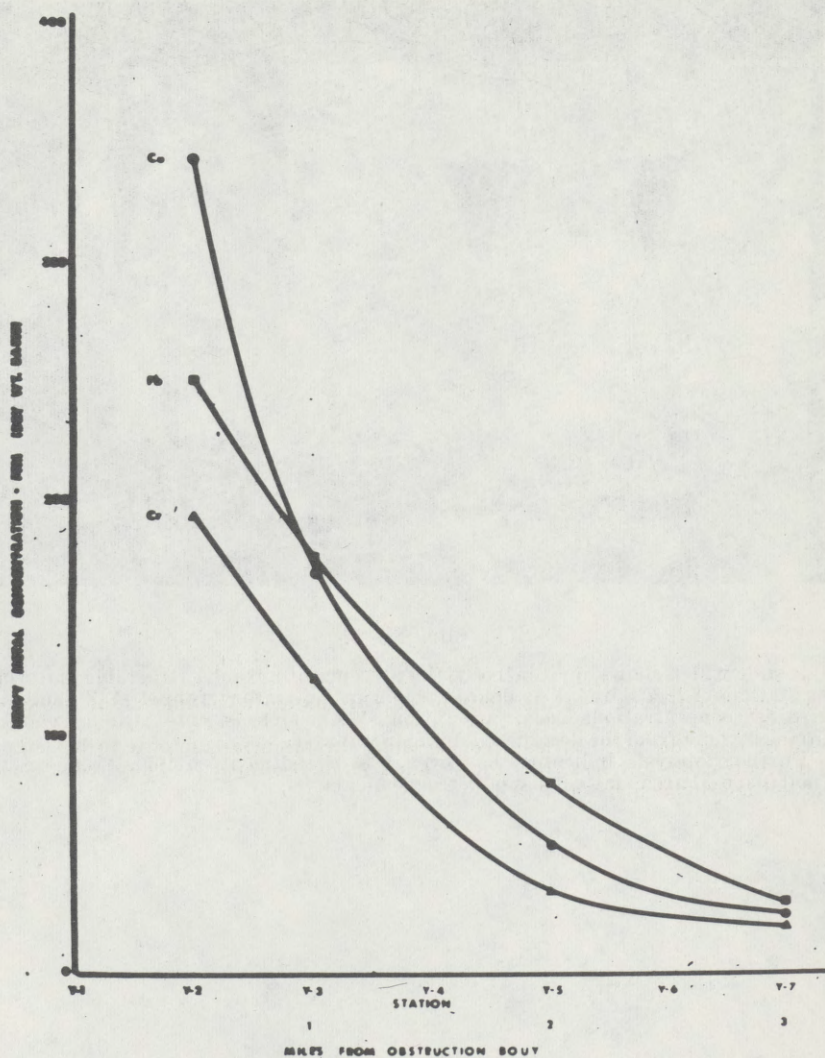
A chart indicating the distribution of copper in sediments at selected stations.



Slide No. 22

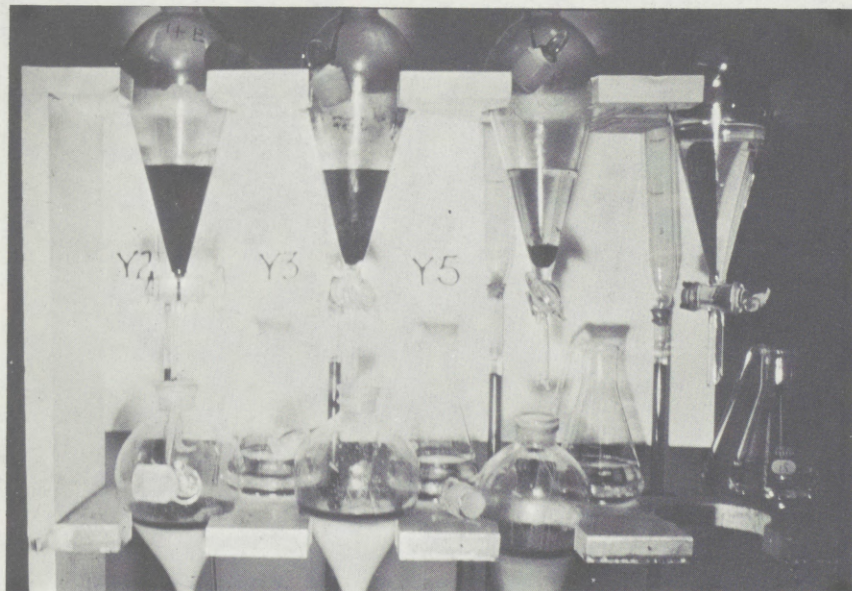
A chart indicating the distribution of chromium in sediments at selected stations.

All of these metals, i.e., lead, copper, and chromium are known to be lethal at concentrations far less than those found in the sediment at the dredge spoil and sewage sludge disposal areas.



Slide No. 23

A graph showing the distribution of heavy metals along north-south transect Y which passes through a portion of the dredge spoil disposal area.



Slide No. 24

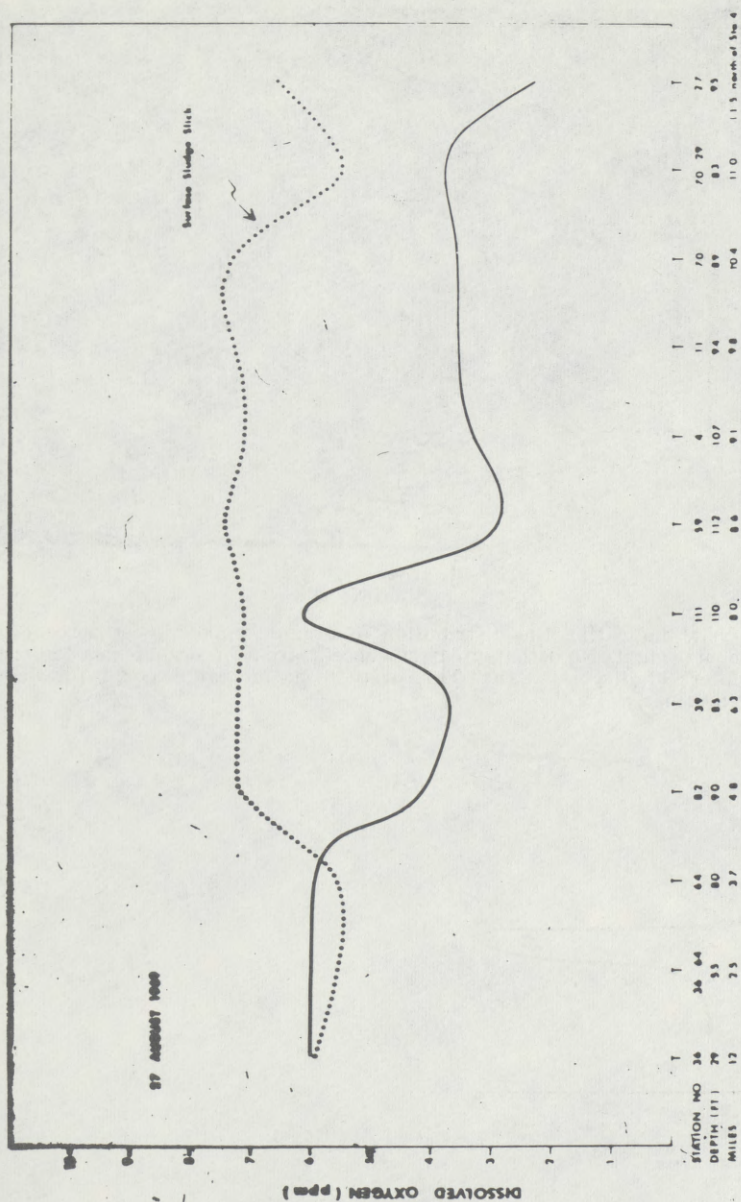
A slide which shows, qualitatively, the presence of hexane-extractable materials at stations Y2, Y3, and Y5; densest color in separatory funnel -Y-Z indicates greatest concentrations occur at station -Y-Z which is, interestingly enough, farthest north from the designated dredge spoil area.

Further analysis indicates that over 1% of sediment samples from dredge spoil disposal area may consist of petrochemicals.



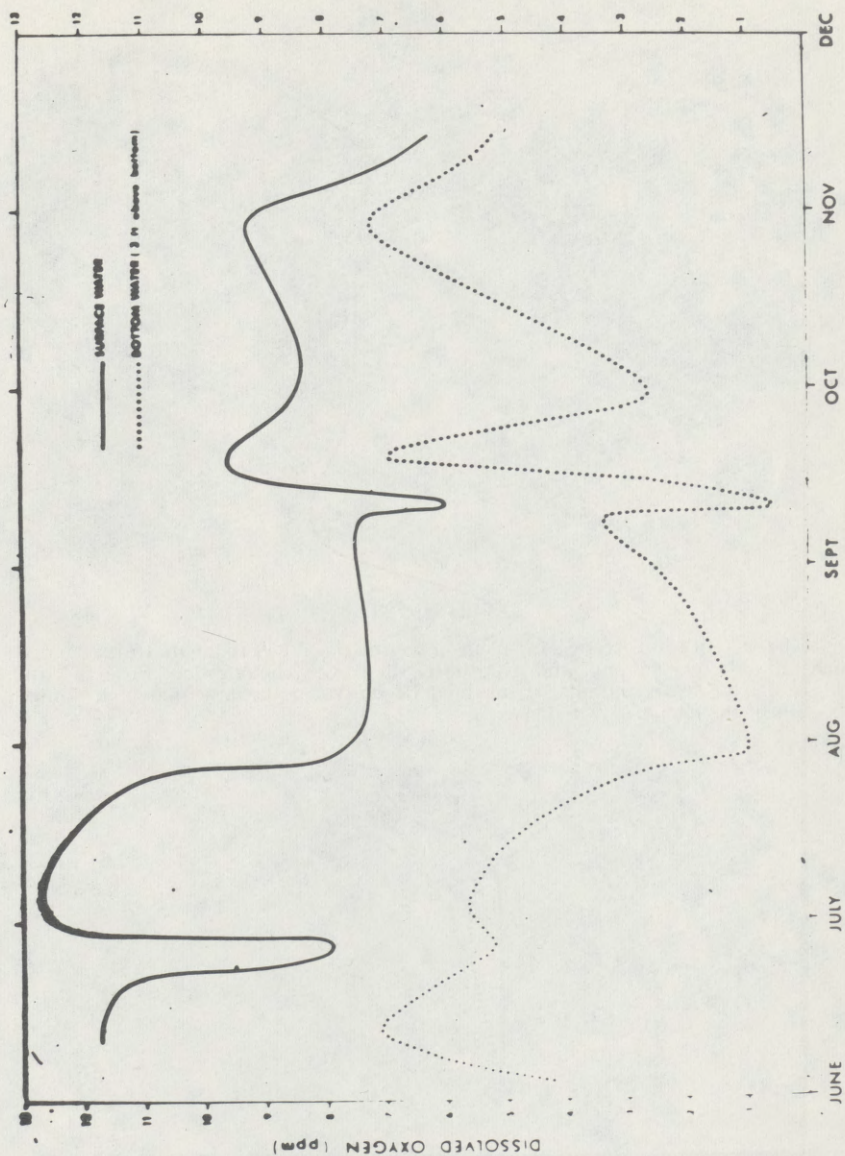
Slide No. 25

A chart indicating the distribution of organic matter as a percent of dry sediment weight. Note that greatest concentration of organic matter occurred at centers of disposal areas. This organic matter can account for depressed oxygen values.



Slide No. 26

Amounts of dissolved oxygen (in p.p.m.) in surface and bottom waters along transect 36-70 on 27 August 1969. Note that stations in the spoil and sludge disposal areas have far less bottom oxygen.



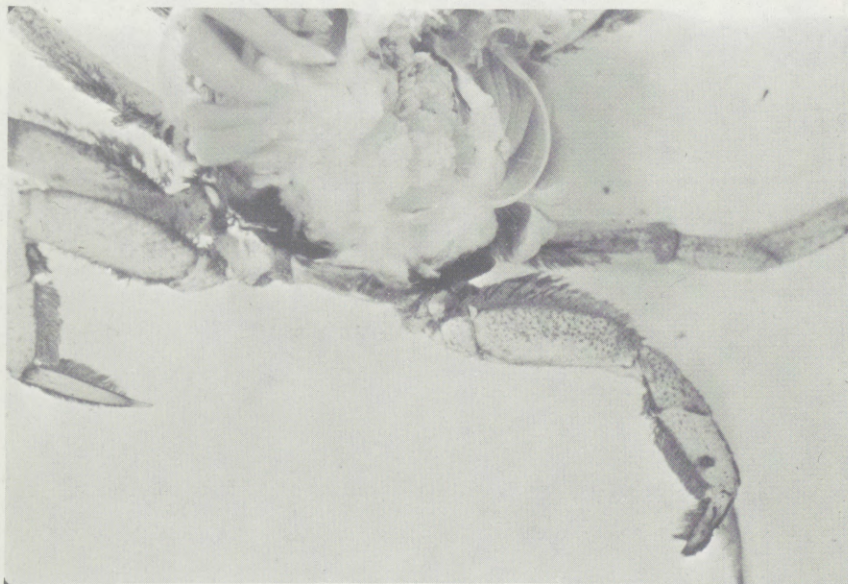
Slide No. 27

Amounts of dissolved oxygen at station 59 during 1969. Note that during the summer months the dissolved oxygen levels frequently fall below 1 p.p.m. This is far less than the amount necessary to sustain normal bottom-dwelling (benthic) life.



Slide No. 28

A lobster held for a five-week period in well-aerated aquaria containing sludge. Such animals become sick and eventually died even though they were fed and maintained as were animals maintained in control aquaria which lack sludge. The gills of the lobsters were diseased.



Slide No. 29

A crab maintained under conditions similar to the lobster shown in slide No. 28. Crabs also became diseased and died after periods of 4-5 weeks on sludge in laboratory aquaria. Horseshoe crabs followed similar patterns.



Slide No. 4 (repeat)

Indicate location of offshore reefs and wrecks where mass mortality occurred in August, 1968.



Slide No. 30

Shows dead fish and crabs observed in August, 1968. Many other reef-dwelling species died including mussels, clams, snails, and hydroids. This suggests that a serious deterioration of the environment or severe toxicity had occurred. Measurements made at this time indicated very low levels of dissolved oxygen in bottom waters over the wrecks and reefs. It is possible that waters impoverished of dissolved oxygen over the waste disposal areas impinged upon these reef and wreck environments. Recently dredge spoils, dredged from Dutch harbor areas contaminated with industrial wastes, were shown to have lethal effects over 100 miles away from where they were dumped off the coast of Holland.



Slide No. 31

This slide shows dead lobsters on same reef as was shown in figure 30.

Mr. HOWARD. I have a few brief questions for either Dr. Pearce, Mr. Clark or anyone who is at the table.

Do you believe that the dumping in the present area is harmful to the ecology of the coastal sea?

Dr. PEARCE. Yes, I do. Do you want me to comment on that?

Mr. HOWARD. Yes, it would be helpful if you would.

Dr. PEARCE. Indications are that the environment is adversely affected. We do not know how rapidly the area would recover if dumping was ceased.

However, as the gentleman from the Corps of Engineers mentioned, there were areas in the New York Harbor and New Jersey area where dumping previously occurred and was terminated. I understand that there were areas for dumping in the war, when submarines constituted threats in the area.

I think we should locate those areas and see if they, themselves, have improved in the years following the dumping practices.

Mr. HOWARD. Very good. One of them is right near George Washington Bridge, I understand. But the problem, I was told, was that when they checked to see how deep this area was, it was not deep at all and the debris was moving right out. I think it might be a little difficult to find an area where it stayed. Probably a good deal of it may be in the Sandy Hook Bay at the present time.

Am I correct, to get this clear on the record, when the municipalities and the companies have tertiary treatment, which is about the finest we can have, there will be no more sludge?

Dr. PEARCE. There will be sludge. The sludge has to be disposed of in an ecologically appropriate manner, that is, instead of dumping at sea.

With tertiary treatment, you actually give more sludge in some cases, because you are removing more solids and material from the water. These effluent that is being discharged is much cleaner. It can be potable.

Mr. HOWARD. That means drinkable?

Dr. PEARCE. Drinkable. The sludge must be treated in an ecologically appropriate manner. It can be dehydrated. It can be put through a process of vacuum filtration, and then disposed of on land-fills or as fertilizers, or you can even treat it nowadays to use it as cattle food.

Mr. HOWARD. If you did have sludge even after this tertiary treatment, you would have something of a problem in dumping in the ocean, then?

Dr. PEARCE. You would still have a problem with dumping it into the ocean, that is true. We have to find alternative ways.

Mr. HOWARD. We are very far, for practical reasons, from having tertiary treatment in all of the New York Bight Area. We recognize that. I think this should be a goal for our country. I believe it will be, beginning in the 1970's; but we do have a problem in the meantime.

In your estimation, can the material be dumped in some other place, where the damage to the ocean would be lessened? In other words, it is not going to be good; it is apparently very bad where it is going now, and it is bad for the area. Is it a hopeless cause, or is there some other place than it could be dumped that might lessen the problem if we have agreed we cannot eliminate it immediately?

Dr. PEARCE. The present dumping site is one of the more productive areas in the New York Bight, in that it is a unique situation formed by the Hudson River. I think Mr. Clark might have something to say about the appropriate areas in which dumping could continue in the future.

Mr. HOWARD. Mr. Clark, there is, in your estimation, another area which might be better?

Mr. CLARK. Mr. Chairman, if I could step to the map behind you, I think I could save you some time.

Mr. HOWARD. All right. Please do.

We do wish to move along, and if it will speed up things, please proceed.

Mr. CLARK. This is a map of the New York Bight Area. These organic fields shown on the map are the present areas that appear to be under the influence of deposition of waste matter.

This area is used in what we think of as the rich productive coastal zone, and it varies in various places around the country; but here in our area this is best defined by this 20-fathom depth line.

That is the distance offshore at which the bottom lies 120 feet or 20 fathoms below the surface.

Mr. HOWARD. Excuse me.

In other words, what you are saying is that in an area less than 20 fathoms deep, which is what you call rich coastal area, is productive area in the ocean that should be preserved?

Mr. CLARK. Yes, sir. We believe that very strongly.

The area lying inside here is warmer water. The current flow is different. This is the place where there is the concentration of surf clams on the bottom, rich benthic life, and it is the place where all summer long our coastal fisheries congregate that move in from deep water in the winter. This is an area we would like to consider as a no-tolerance pollution area; and we would be quite willing to talk about tolerances of amounts of pollution outside of that area.

Mr. HOWARD. About how many miles is that from the shore?

Mr. CLARK. This would be about 22 miles down from Ambrose Light, about 30 miles from the harbor entrance.

Mr. HOWARD. Thank you, Mr. Clark.

So you feel the area inside this 20-fathom line is what you would call a no-tolerance zone? We should not do anything to upset the marine ecology in that area, and that is about 30 miles from shore?

Mr. CLARK. Yes, sir.

Mr. HOWARD. So you would feel there would be much less danger to marine life if sludge and such dumping as must be done in the immediate future were to be put out beyond that line?

Mr. CLARK. We cannot help but think that, Mr. Chairman, because I think all my colleagues would agree that that is our most precious marine resource, the rich productive fragile coastal environment that extends in a narrow band along the shore.

Mr. HOWARD. Then if they were to go out beyond this 20 fathom line, you feel it would be useful for your purposes of trying to find ways to preserve marine life along the shore area?

Mr. CLARK. Yes, if we can consider that no-tolerance zone along the shore for pollution.

Mr. HOWARD. Do you feel that merely extending the mileage out beyond that no-tolerance zone would be sufficient, or would it be better if there were some pre-experimentation held as to methods, means and specific locations out beyond the no-tolerance zone?

Mr. CLARK. Yes, I think you can say that we believe that in the Department of Interior, that before we could suggest that any point out there is better in any way than the present area, we would need to experiment out there with the actual materials and large quantities.

In other words, we do not have the experimental possibility, as it now exists, because they continue to dump in the same place. All we can try to do is to describe what is going on; and to come up with a real scientific accomplishment on this will require an experimental period.

Mr. HAMMERSCHMIDT. Mr. Chairman, would you yield?

Mr. HOWARD. Certainly. But one further thing, I wanted to ask the Corps if they could give a semi-official reaction to what they feel would be a problem if the dumping limit were moved out to this line approximately 30 miles from shore area?

I am not talking now of the 100-mile area. We have heard and read some things on this. I do not want to call you back to the stand, but if you could submit to the committee at least an interim reaction to the 30-mile figure, it would be appreciated.

Thank you. And without objection, that will be made part of the record when it is received by the committee.

(Information received is as follows:)

It is estimated that the disposal of sewage sludge 25 miles from Ambrose Light would cost those communities involved about \$2,000,000 per year in transportation costs alone. It is estimated that the cost to dispose of dredged material farther at sea would increase the present cost of disposal by 50 to 100 percent. Any change in location of ocean dumping might create another area duplicating the present effect without attendant benefits. In fact the over-all results might be adverse.

In view of the inconclusive status of the studies that are being carried on at the present together with the consideration that it is anticipated that the studies will be completed in a relatively short time, it appears that the Federal Government and local communities as well as private industries that are now dependent upon the use of the areas should not be saddled with greatly increased operating cost until a proper solution to the disposal problem, based on facts and the best of scientific advice, can be found. It is believed that this approach is consistent with the time being allowed for implementation of other aspects of the pollution abatement program, such as the time table established for industries and communities to reduce the deposition of pollutants in our waterways. This position is further supported by the evidence that damage to the ecology is now limited to an area where it is controlled. This in no way detracts from the need for early resolution of the problems.

Mr. HOWARD. Mr. Hammerschmidt.

Mr. HAMMERSCHMIDT. I wondered, Mr. Clark, if this represents an official position of the Commission on Fish and Wildlife, or is this just an interim observation you are making here?

I would like to ask Mr. Meacham.

Mr. CLARK. I will turn the microphone over to Mr. Meacham.

Mr. MEACHAM. This is an interim observation, made with what data is available. The Department of Interior's concern—our basic philosophy is, we are against all dumping. We have to take a practical approach and accept what is a reasonable thing; but, from our basic principle, we are against all dumping in the ocean.

Mr. HAMMERSCHMIDT. Mr. Clark is making what looks like may be a reasonable alternative to the problem.

Mr. CLARK. We would like the opportunity to experiment with the actual materials in a new place, where we can really get a scientific answer to this problem.

Mr. HAMMERSCHMIDT. Thank you, Mr. Chairman.

Mr. HOWARD. Mr. McCarthy of New York.

Mr. MCCARTHY. Thank you, Mr. Chairman.

I have some figures here, which I think are relevant. I do not want to dispel the illusion of Utopia, when we all have tertiary treatment, but just to give you an idea of what we face here: the 137th street waste treatment plant, which will serve several million people on the upper West Side of Manhattan, along with feeder lines, is going to cost about \$100 million.

Now, even though the Congress this year appropriated four times what the Nixon administration had asked for, and that comes to a total of \$800 million, New York State will only get \$69.9 million, about \$70 million. So, in other words, for the whole State of New York we are only going to get \$70 million.

Only a fraction of that amount will be available to pay for one plant on the upper West Side of Manhattan which is going to cost \$100 million.

I think that the point is that it is going to take a long time, at the rate we are going now with appropriations, before we reach that point that you have discussed, about when we have a virtually relatively innocuous sludge.

Now, I know that you gentlemen have been pressing for more appropriations, but at the present level we are not even scratching the surface.

Mr. HAMMERSCHMIDT. Would the gentleman from New York yield for just a moment?

Mr. MCCARTHY. Surely.

Mr. HAMMERSCHMIDT. I would like to at least have in the record that the new administration has bills pending that ask for billion-dollar-per-year authorizations with full funding of those bills for the next 4 years.

I just wanted to be sure that that was part of the record.

Mr. HOWARD. I would like to note in the record, with all deference to the present administration, even though the administration has asked for authorization bills for \$1 billion beginning this year, that the Congress has already authorized \$1.25 billion; so I hope we can go for full funding for that amount which is 25 percent closer toward cleanup of pollution.

Mr. OLSEN?

Mr. OLSEN. The fact has been well pointed out by our chairman, Mr. Howard, several times, and this is over a course of more than a year now, that dumping is not the answer. It is not ever going to be the answer.

The real answer is the treatment of our waste so that they are not noxious or toxious, but that they are materially beneficial.

The best thing that has happened out of these discussions, and what I observe as a happy thing here, is that people are becoming concerned about ecology. They are becoming concerned about whether or not they

are destroying the environment; and, hopefully, the American public will be aroused enough so that every administration will agree that we must fund fully, and that the American people have got to be willing to pay, by one way or another, they have got to be willing to pay for the remedial treatment of our waste materials in all of them. And I want to say that for the benefit of your constituents, Jim Howard—he will not say it himself, but I am going to say it for him—that he has been an advocate of that kind of Utopia, if some people want to call it that, but I do not. I think that is the practical answer.

We are still doing it out in Montana, and there is not any reason why they cannot do it every place else.

Mr. HOWARD. Thank you very much, Mr. Olsen.

Mr. Meacham, Dr. Pearce, and Mr. Clark; we certainly wish to thank you, not only for the testimony you have given us just now but for the tremendous in-depth Interim Progress Report which the committee has, and which, incidentally, I would like to ask unanimous consent that it be made a part of the hearing record. Without objection, so ordered.

(Interim Progress Report follows:)

DEPARTMENT OF THE ARMY,
COASTAL ENGINEERING RESEARCH CENTER,
Washington, D.C., February 4, 1970.

INTERIM PROGRESS REPORT ON THE STUDY OF THE EFFECTS OF WASTE
DISPOSAL IN NEW YORK BIGHT AREA

This report, dated 1 January 1970, is a progress report by the Sandy Hook Marine Laboratory of the Department of Interior to the U.S. Army Engineer Coastal Engineering Research Center. The Laboratory undertook the work described in this report at the request of the Center and with funds provided by the Corps of Engineers from its Civil Works program.

Before commissioning the Marine Laboratory to undertake the study, the Center requested the Smithsonian Institution to recommend a program of study of the disposal operations. The Smithsonian Institution assembled a small committee of competent disinterested scientists who drew up a recommended program; the study being carried out by the Marine Laboratory in major part follows the plan of study recommended by the Smithsonian committee.

The study was begun in the fall of 1968 and schedules 1½ years of field observations plus about six months for preparation of a final report. The present report is a progress report on the first year of field work and office analysis. The Marine Laboratory and the Corps of Engineers considers the analyses and funding in this report to be tentative and incomplete and subject to change as the study progresses.

At the request of the Center, the Smithsonian Institution has again convened a small committee to review this interim report, to comment on the tentative findings, and to recommend any changes thought to be needed in the field study program still underway.

The Center feels that any assessment of the results of this interim progress report can best be made after the Smithsonian committee has completed its review. The Center further believes that definitive statements concerning the waste disposal operations can best be made after the Marine Laboratory completes its field work and supplies its final report early in 1971.

EDWARD M. WILLIS,
Lieutenant Colonel, CE Director.

THE EFFECTS OF WASTE DISPOSAL IN THE NEW YORK BIGHT—
INTERIM REPORT FOR JANUARY 1, 1970

A Report to: The Coastal Engineering Research Center, U.S. Army Corps of Engineers, Washington, D.C.

Prepared by: The Sandy Hook Marine Laboratory, U.S. Bureau of Sport Fisheries and Wildlife, Sandy Hook, Highlands, N.J., December 3, 1969

Approved:

L. A. WALFORD,
Laboratory Director.

INTRODUCTION

In March, 1968, a working committee comprised of invited scientists, staff members of the Corps of Engineers, and representatives of the Smithsonian Institution met to delineate the problem areas and to design studies which would elucidate the effects of waste disposal practices in the New York Bight.

The committee suggested that a two-year program of study could be developed which would answer at least some of the questions posed (Gross and Wallen, 1968, p. 4); it was also recognized that many questions could not be answered except through a much longer period of study, perhaps up to five years. An interim report was to be made available on or before 1 November 1969 with a final report due 1 November 1970.

The areas deemed to require investigation included: 1) biological characteristics of the New York Bight, 2) physical and chemical properties of bottom sediments and water-borne particles, 3) physical and chemical properties of the marine environment, New York Bight, and 4) sources, dispersal, and movement of waste materials (Gross and Wallen, 1968, pp. 6-17). Each subject area was further broken down into subheadings including appropriate literature surveys, field activities, and laboratory studies. Those items of research which were considered essential for the basic (two-year) study were indicated.

In response to a request from the Coastal Engineering Research Center (CERC), Sandy Hook Marine Laboratory prepared and submitted to CERC a proposal, "The effects of waste disposal in the coastal waters of New York Harbor." Based on this proposal the Laboratory was awarded a contract by CERC to conduct a study within the guidelines set by the Smithsonian Institution's recommendations and our proposal. Following the recommendations (Gross and Wallen, 1968; p. 6, par. 3), we initially concentrated our biological studies on the benthic communities of the New York Bight. We then concentrated our efforts on the investigation of the sewage sludge and acid waste disposal areas. Our preliminary work soon indicated, however, that to understand the effects of the various wastes, we would have to study the pelagic and planktonic populations as well as the benthos.

We also found it necessary to initiate some work in the dredge spoil dumping area to learn how the spoil dumping might be affecting our other results. Preliminary data from this survey indicated that dredge spoil has an adverse effect on benthic communities equal to or greater than that resulting from the sewage sludges. These wastes are being dumped much closer to the shore line of Sandy Hook than are the sewage sludges and industrial wastes.

Finally, we initiated a preliminary hydrographic program designed to give us information on the movements of water masses. The results of these studies are consistent with the distribution of organic matter, heavy metals, and coliform bacteria. Our original proposal stated that Dr. T. Ichiye of the Lamont Geological Observatory would subcontract with us to conduct certain aspects of our hydrographic studies. Before we commenced the study, Dr. Ichiye permanently left Lamont. We therefore commenced a program of hydrographic data collections using laboratory personnel. These collections were taken much more frequently than the original two-seasonal studies proposed by the Lamont personnel. The final analyses of field data will be completed in conjunction with recognized authorities in the field of physical oceanography.

The following report is arranged according to activities rather than research sites or individual disposal areas. Where data from one activity or method of analysis complement, substantiate, or contradict other lines of evidence, a cross reference is made.

Where the understanding of a methodology is essential to the interpretation of data, the methods of collection and/or analyses are presented to interpret accurately the results. The sum of our total data is, however, too great to be given in this interim report, so species lists, tabular data, etc., will be deferred until our final published report.

The following colleagues were responsible for major segments of the work; Charles Gibson, pelagic planktonic studies; Robert Wicklund, hydrography; Andrew Draxler, chemistry.

JACK B. PEARCE.

REPORT ON CHEMICAL ANALYSES

We have chemically analyzed the water, sediment, and tissues of animals collected in disposal areas. In each section of the chemical report we present the reason for studying the particular chemical, the methodology, and the results.

Our goals are to:

1. establish the presence or absence of noxious or toxic chemical species,
2. follow the dispersal and distribution toxins as they are related to entrained wastes or effluents, and
3. determine nutrient levels and primary productivity to aid our biological interpretations.

WATER ANALYSIS

We collected samples monthly at 15 stations. Stations on the transects through the disposal areas were sampled bimonthly. Water samples were taken at surface, mid-depth, and bottom. A 250 ml water sample was filtered and the filter retained for chlorophyll-a determinations; a 200 ml water sample, to which 1 ml of HCl was added, was taken for iron analysis. A 350 ml sample was taken for nutrient analysis and 750 ml taken for heavy metals determination. All samples were immediately frozen.

Analyses were performed to establish the presence and amounts of several forms of phosphorous, nitrate nitrogen, iron, and heavy metals. Heavy metal determinations were run on a Perkins-Elmer 303 atomic absorption spectrometer. All others were done by colometric determinations on a Beckman Model DU photospectrometer.

Phosphorous

Phosphorous may exist in a variety of forms depending on definition and separation. Most workers have categorized phosphorous as organic or inorganic, soluble or particulate, and total. Another form, polyphosphorous, is most important as a pollution index and tracer (Solórizano and Strickland, 1968). In this study we have determined the concentration of the following components: orthophosphate, polyphosphate, organic phosphorous, and total phosphorous.

All analytical methods for determination of phosphates in sea water rely on the formation of phosphomolybdate complex and its subsequent reduction to a highly colored blue compound (Strickland and Parsons, 1966).

Orthophosphorous reacts readily with molybdate. Ultraviolet light irradiation destroys all organic phosphate bonds but does not affect polyphosphate linkages (Armstrong, Williams and Strickland, 1966) and all forms are hydrolyzable by autoclaving with persulphate.

Nitrogen

Nitrate in sea water is reduced to nitrite when run through a column containing 7% Fe_2SO_4 , iron was used as a tracer to follow the movements of the entrained nitrite and coupled with N-(1-naphthyl-ethylenediamine) to form a colored azo dye. This procedure is being followed rather than the Brucine sulphate-sulphonilic acid procedure of Kahn's which has given erratic results.

Iron

Because the acid waste (from National Lead Company) contains an average of 7% Fe_2SO_4 , iron was used as a tracer to follow the movements of the entrained pollutants.

Biologically reactive iron is measured after a preliminary treatment with hydrochloric acid. This treatment liberates ferric iron from all substances likely to be available to marine phytoplankton and hence allows a more conservative estimate of the available and biologically active iron than does the treatment in

which total iron is obtained by a process of high temperature wet digestion. The treated iron is reacted with $\alpha\alpha'$ -dipyridyl in an acetate buffer, in the presence of a hydroxylamine-reducing agent to give an orange ferrous complex. High levels of iron were found at Stations 76-77, and 72 which are in the acid waste disposal area.

Heavy metals

We have studied the presence of heavy metals in water through the extraction of their organic complexes into solvents using the APDC-MIBK method (Brooks, Presley and Kaplan, 1967). Determinations of metal concentrations in the water column are not complete. Our plans include, however, a comprehensive study of the distribution of copper, lead, and zinc.

Primary productivity

We are routinely taking chlorophyll-a samples for analysis according to Strickland (1966) to measure the primary productivity in polluted and nonpolluted areas of the New York Bight. The analyses are now being conducted and the results will be included in the final report.

SEDIMENT ANALYSIS

Sediment samples were collected at stations regularly sampled for benthic population and sediment analyses. A plastic corer liner was used to obtain subsamples from the Smith-McIntyre grab. We have also used a sediment corer but these samples have not yet been analyzed.

We have investigated hydrophobic materials (grease and oil), pesticides, and heavy metals associated with sediments.

Heavy metals

Sediments have been analyzed for heavy metals including lead, chromium, and copper. Because ashing facilities were not available at the initiation of our experiment, the values reported herein represent partially extracted or readily available heavy metals.

The data indicate that the amounts of extractable metals vary with changing concentrations of acid. We used 0.2 percent, 2.0 percent and 50 percent dilutions of concentrated HNO_3 . To remove total heavy metal contents, we will in the future extract sediments with 50 percent HNO_3 after all organics have been destroyed by ashing. This will volatilize copper but leave lead and chromium unaffected.

Metals from the dredge spoil are held in place by an oil-water emulsion and the metals are apparently exchanged or mechanically transported as are those in the sewage sludge area.

Hydrophobic materials

Recent work (Hartung, 1969) has shown that when petroleum covers the surface of an aqueous environment, pesticides, which are only slightly soluble in water, are selectively extracted and are therefore concentrated in the organic (petroleum) phase. When particles of dust or detritus come in contact with the oil, they become coated, aggregated, and sink, carrying the pesticides with them to the benthos.

Our investigations using hexane and acetone extraction techniques followed by gravimetric determinations (Kahn, 1969), show a large percent of hydrophobic materials to be present in the dredge spoil disposal area. Because of the high dissolved organic content of the water, and since metals are readily chelated by organic matter, metals probably do not exist in the New York Bight except in complexes. We believe these organo-metallic complexes are extracted into the petroleum phase in the same way as pesticides.

The great number of refineries and the tremendous amount of water traffic, both commercial and private, dump large amounts of crude and refined petroleum into the harbors and canals. These oils coat foreign particles and sink. The harbors in the New York metropolitan area are continually dredged and the spoils removed to the dredge spoil dumping grounds.

Nelson-Smith (1967), interpreting Chipman and Galtsoff (1940) and North et al. (1965) said, "Fresh oil has serious effects on marine plants and the animals at between 0.01 percent and 0.1 percent and kills them at 0.5-5.0 percent." Of the three stations that were sampled from the dredge spoil area, two tested in the lethal category and the third in the serious effects range for hexane extractable materials alone. We have pointed out the stationary characteristic of the dredge spoil sediment on the basis of heavy metal distribution. This is also true of the

distribution of organic material (see section on grain size distribution and total organic content). The water-oil emulsion results in a sediment which has the consistency of mayonnaise, while beyond the periphery of the dredge spoil area the sediment can be characterized as sandy. It should be noted that the FWPCA manual on water quality criteria states that "no oil or petroleum products should be discharged into estuarine or coastal waters in quantities that form an oil sludge deposit on the shores or bottom of the receiving body of water (or) become effective toxicants. . . ."

Pesticides

We are cooperating with personnel of the U.S. Bureau of Sport Fisheries and Wildlife Laboratory, Columbus, Missouri, in a study of pesticide contamination of marine sediments. Because of the contamination of these samples with petrochemicals, the extraction of pure pesticides residues has been extremely difficult. It is therefore quite probable that the levels of chlorinated hydrocarbons we have found (187 P.P.B.) are much lower than their actual value.

TISSUE ANALYSIS

Organisms used for analysis have been taken from Smith-McIntyre grab samples, zooplankton net hauls, and otter trawl hauls.

Heavy metals

Preliminary heavy metal analyses were conducted on a worm, *Neanthes* sp., and a clam, *Arctica icelandica*, from station B-6 at the edge of a heavily polluted area. Because of inadequate ashing facilities and the fact that metals are tightly bound by organic molecules these results must be considered only approximate. The level obtained is, however, higher for both chromium and lead than reported as significant in the FWPCA Water Quality Criteria manual.

We also analyzed two samples of *Neanthes* sp. After drying the organisms, we added known amounts of chromium copper to one; these additions indicated that approximately 1/7th of the metals was recovered. This suggests that our estimates are conservative.

A mixed group of zooplankton from the sewage sludge grounds was completely ashed over an open flame. Analysis of the ash extract clearly showed the presence of chromium. Using our newly acquired ashing furnace the above animals as well as the lobster, *Homarus americanus*; winter flounder, *Pseudopleuronectes americanus*, and other demersal species will be analyzed for their tissue content of lead and chromium.

Pesticides

Because of the problem mentioned regarding hydrophobic materials in sediments and the possibility of involvement of pesticides in the food chain we have initiated studies of pesticide content of organisms found in the waste disposal areas. This work is done in conjunction with the U.S. Food and Drug Administration and Mr. Jack Foehrenbach, Sanitary Chemist.

DISCUSSION

A search of the literature revealed no direct reference to the toxicity of heavy metals in sediments. However, experiments by Wilder (1952) in wooden tanks floored with various metals showed copper, zinc, and lead killed lobsters in 1, 9, and 20 days, respectively. We are investigating whether these metals are readily available to organisms living in the sediments from the waste disposal grounds. We have found copper, chromium and lead in sediments in amounts of 338, 197 and 249 ppm, respectively. Since the centers of the waste disposal areas, where the concentrations are very high, are effectively devoid of benthic life, there is little danger of passage of these metals into the food chain. However, at the peripheries where limited life is established, uptake could be significant; the results with *Neanthes* sp. and *Arctica icelandica* indicate that this definitely is true. Further studies of lobsters, flatfishes, etc., will show the extent of the problem and its relation to the food chain.

The introduction of heavy metals into the water column could be significant. Once heavy metals are in the water column, they can be assimilated by phytoplankton and zooplankton and passed through the food chain to man. Our preliminary studies with zooplankton suggest that this may be taking place.

As the organic molecules in the sewage sludge are degraded, phosphorous is hydrolyzed to orthophosphate. The organic phosphorous and polyphosphorous levels in combination with the distribution of metals as an indicator of dilution may serve as an index of sludge degradation. Analyses of sediment show that

large amounts of heavy metals are present in the dredge spoil disposal area. Because of the amounts of hydrophobic materials with its minimal exchange of heavy metals with the water and minimal mechanical transport, heavy metals from the dredge spoils should not interfere with the dilution patterns of the sewage sludge.

Data from the initial U.V. irradiation studies of water showed that the organophosphorous content of the water overlying the sludge dump fluctuates considerably. However, a single water extraction of the sediment from station 109 indicated the feasibility of studying phosphate content of sediments; the extract, when reacted with molybdate and tested colorimetrically, developed a color so dense that it was unreadable without extreme dilution.

Considering these facts, it seems probable that distribution, disintegration, and exchange of the sewage sludge with the water column can be monitored.

BENTHIC STUDIES

Dissolved oxygen content of bottom waters over the sewage sludge disposal area

We collected water samples for the analysis of dissolved oxygen at frequent intervals (usually weekly) throughout late spring, summer, and autumn of the past year. Dissolved oxygen was usually measured at the surface and the bottom at most sites. We found a wide variation in oxygen levels throughout the summer, with a continuous strong correlation between the surface and bottom levels at all stations in spite of a well-developed thermocline. Generally there was a 2-13 ppm difference between the surface and bottom levels; these differences diminished rapidly with the breakdown of the thermocline in October and November. Although on any given sampling date, the dissolved oxygen content of offshore surface waters was quite uniform for all stations, the bottom water samples showed considerable variability. Bottom waters collected in the dredge spoil and sewage sludge disposal areas frequently contained 2-3 ppm less dissolved oxygen than did bottom waters at stations of the same depths but some distance removed from the disposal areas. We collected samples 3-4 feet above the substrata and would almost certainly have found even lower values if our sampling devices had enabled us to collect water (uncontaminated with sediments) at the water-substratum interface.

When we examined the data concerning the amounts of dissolved oxygen present in the bottom waters over the sewage sludge disposal area it was immediately apparent that from late July to mid-September oxygen levels were frequently below 2 ppm. Our laboratory experimentation indicates that such quantities of dissolved oxygen are insufficient to sustain life in the bioassay organisms which we used. Our data also show that reduced dissolved oxygen values for bottom waters extend over a distance of several miles.

Sediment analysis—Grain size distribution and total organic content

It is known that the distribution of the benthic infauna is well correlated with the nature of the bottom sediments (Sanders, 1958). A substantial part of the New York Bight is polluted to a point where no macrofauna can exist in the affected areas; therefore, we must know the nature of the sediments in which existing communities have established themselves in order for us to assess the effects of solid waste pollution on benthic communities. The analyses of the organic and inorganic components of sediments help in: 1) determining the degree of pollution (our data to date indicate that those stations which are marginally and severely contaminated are characterized by large amounts of organic materials and very fine inorganic particles), 2) establishing the distribution patterns and spread of sewage sludges and dredge spoils, and 3) relating species composition (diversity) and benthic community structure to the distribution of sediment types.

Comparison of sediment types indicates that the coastal waters (to a depth of 60 feet) along the Jersey shore are characterized by moderately coarse sands containing, in some cases, gravel (stations 36, 41, and 64). Stations 55 and 56, under the direct influence of a sewage outfall at Long Branch, N.J., are characterized by sands with finer particles and a higher organic matter content.

Coarse coastal sands grade into medium sands in waters 60-90 feet in depth (stations 60 and 2007). Fine sands generally characterize the sediments found in waters approximately 90 feet and deeper. Some silts and clays are usually associated with these fine sands. Sands in 30 feet of water along the south shore of Long Island are similar to the 60-foot stations off the Jersey shore. The coarser sediments in the shallow water along the Jersey shore probably reflect a greater scour-

ing effect by long shore currents. Sediments at the 30-foot stations off the Long Island shore have from two to six times as much organic material as comparable stations along the Jersey shore.

Sediments collected from the dredge spoil disposal area are high in organic matter content (up to 11.6% of dry weight). Limited data indicate, however, that once the dumped dredge spoil materials become associated with the sediments they apparently become relatively confined to the disposal area or are generally moving towards the east and the Hudson Gorge. The similar patterns of heavy metal distribution substantiate these findings.

Sediments in the dredge spoil area are characterized by a wide distribution of inorganic particle sizes. This is the result of the almost continuous addition of dredge materials of a wide range of particle sizes from gravels and construction rubble to clays.

Conversely, the organic materials associated with the sewage sludge disposal area appear to be carried or moved to the east and northeast where they are deposited on beds of rather coarse sands. The pattern of distribution of heavy metals also substantiates this movement; the heavy metals probably become bonded to organic moieties and are carried in a general northeasterly direction.

We suspect that much of the lighter components in individual sewage sludge dumps do not immediately sink in the designated dump areas, but rather are moved to the northeast towards the Long Island shoreline. Subjective observations of sewage sludge dump slicks indicate this to be true. Many slicks originating with dumps made in the vicinity of stations 11 and 70 can be followed to stations 29 and 58 before they begin to be obscured. Water samples collected in these slicks for dissolved oxygen analysis frequently contained significantly reduced levels of dissolved oxygen. Recent investigations in Gt. Britain on the movement of sewage sludges paralleled our observations (Ministry of Technology, Water Pollution Research Laboratory, 1968).

Benthic macrofauna—Introduction

Examination of our original collections suggested that a significant portion of the sewage sludge disposal area was impoverished of benthic macrofauna. We initially established several transects and a broad grid system with 86 stations separated by 2.5 mile intervals. After the general periphery of the sludge disposal ground was located a grid of stations was established over the grounds, the intersections of the grid lines designated as sampling sites, and appropriate Loran navigational coordinates assigned to each station. These stations were 0.5 nautical miles apart and were designated by the letters and numerical figures assigned to intersecting lines, i.e., A1 or Z5. Once we had collected samples from the dredge spoils disposal area and determined that a normal benthic fauna was also missing there, we established a 0.5 mile interval grid system over this area. Again, the collecting stations were designated by the intersections of lettered North-South vertical chart lines and East-West numbered horizontal grid lines. We have systematically sampled the benthic communities at a total of 221 different stations.

We collected quantitative samples using a 0.1 m² Smith-McIntyre bottom grab and a 10 cm² coring device. Larger, semi-quantitative samples were taken with a modified anchor dredge and a clam dredge. Subsamples of 10 cm² x 5 cm are removed from the grab samples for chemical and geological analyses (for sediments and total organics) as well as for quantitative analyses of the meio- and micro-fauna, i.e., those forms smaller than 1.0 mm in their smallest dimension. The remaining portion of the grab sample was washed through a series of screens with apertures of 4.0, 2.0 and 1.0 mm. The biological contents of the screens were narcotized in MgCl₂, fixed in 5% formalin, and preserved in 70% ethanol containing 5% glycerol.

In almost all cases, we have been able to sort the samples to the one millimeter fraction. Fractions of the biological materials smaller than 1 mm require a longer period to sort to individual species.

Once sorted, the materials in each sample are grouped according to species, if possible. In most cases we have had our identifications confirmed by competent taxonomists. Dr. E. L. Bousfield (chairman, Zoology Section, Canadian National Museum, Ottawa) has confirmed some 40 species of gammarid Amphipoda from our New York Bight collections. These small crustaceans are extremely important in benthic communities and, because of their diversity, can serve as indices to biotic changes resulting from increases in environmental pollution.

Katherine Hobson (Systematics-Ecology Program, Marine Biological Laboratory, Woods Hole, Massachusetts) has checked our polychaete worm collections and verified our tentative identifications. Dr. Kenneth Boss (Museum of Comparative Zoology, Cambridge, Massachusetts) has identified several small bivalve mollusks and Cand. Mag. Kurt Ockelmann (Marine Laboratorium, Helsingør, Denmark) identified several small planktonic bivalve larvae.

Sewage sludge disposal area

To date we have found that the areas liberally covered with sewage sludge are devoid of any normal benthic populations. These areas include the portions of the sewage sludge and dredge spoil disposal grounds in which dried sediments contain more than 10% organic matter. As noted in a previous report dated November 18, 1968, sediment samples collected from the sewage sludge area are black, have the characteristic odors of sewage sludges, hydrogen sulfide, and, occasionally, petrochemicals. These samples invariably contain large amounts of debris and artifacts identifiable as having a human origin. When subjected to physical and chemical analyses we found the samples to be heavily contaminated with heavy metals. During summer months the waters overlying the sediments of the dredge spoil and sewage disposal areas are depleted of dissolved oxygen.

All of these factors indicate a highly reduced environment inimical to normal benthic faunas. At the periphery of the sewage sludge dump area we have found a community frequently dominated by large numbers of the burrowing sea anemone, *Cerianthus*. This animal constructs a substantial tube which probably confers protection from the effects of a marginally polluted environment. Associated with the *Cerianthus* we have found worms belonging to the phylum Rhynchocoela as well as representatives of several families of polychaete worms. Also, characteristic of the marginally polluted areas are two protobranch bivalves, *Yoldia limatula* and *Nucula proxima*. Both bivalves are generally found in organic, muddy sediments and would be expected to be found in the highly organic types of sediments surrounding the sludge dumping grounds.

Considering Stations 21, 66, and A5 representative of sites to the west and northwest of the impoverished sewage sludge disposal area, their fauna conforms to that described above. The sediments at these stations are similar in grain size distribution and all contain comparable amounts of organic materials (approximately 10% organic matter on a dry weight basis).

At stations located to the southwest of the disposal area the grain size distribution of sediments is comparable to that of stations in the west and northwest sectors. However, the organic matter content is less, ranging from 1.5 to 5%. The fauna also shows some variation. Worms belonging to the polychaete families Cossuridae and Paraonidae are either not present or sparsely represented in samples taken from the northwest sector. They are very abundant at the more distant southwest stations and somewhat less abundant at southwest station 25, close to the biologically impoverished disposal area. Conversely, large worms belonging to the family Flabelligeridae are found in far greater abundance at the northwest stations than at southwest stations. Also worms of the family Nephthydidae are well represented in the west and northwest stations, whereas in the southwest sectors they are found in reduced numbers; at the southwest station 25, they are more abundant than at the other stations in the southwest sector. Again, this station is closer to the disposal area and the sediments contain a greater percentage of organic matter. Stations in the west and northwest sectors contain large numbers of the protobranch bivalve, *Nucula proxima*, whereas this species is completely absent from stations to the southwest. Again, however, *Nucula* is well represented at southwest station 25 which is close to the periphery of the affected disposal area.

Stations 13 and 31 are located approximately one nautical mile northeast of the periphery of the sludge disposal area. The sediments from this area are quite similar to those of the stations northwest of the disposal area. A few stations in this general area do, however, have sediments somewhat coarser than the stations in the northwest sectors. Although the fauna at the northeast stations is similar to fauna at stations located to the northwest, there are, with one or two exceptions, far fewer numbers representing each species. In terms of biomass the fauna in the northeast sector is dominated by the burrowing sea anemone, *Cerianthus*. Numerically, the most abundant organism is the spionid polychaete worm, *Prionospio malmgreni*. While it was by no means rare in collections from stations to the northwest, west, and southwest of the disposal area, we have found it to be extremely abundant at the stations located to the

northeast of the sewage sludge disposal area. This may reflect a specific preference for the slightly coarser sediments which occur in conjunction with the relatively high levels of organic matter that are characteristic of those areas to the northeast of the disposal area or simply represent an intensive localized setting of *Prionospio* larvae in this area. Future study will enable us to determine the cause of such extensive populations.

Stations 63 and 65 are representative of those stations located 3-4 miles east of the disposal area. The sediments at these stations are characterized by medium grained sands and lower levels of organic matter (2-3% of dry sediments). While many species found at these stations are also common to stations in the northwest, southwest, and northeast, they are present in far fewer numbers. The sea anemone, *Cerianthus*, is completely absent from samples east of the sludge disposal area. Other taxa which were dominant in the finer organic sediments previously considered are also lacking. These include polychaete worms belonging to the families Ampharetidae, Cossuridae, Flabelligeridae, Maldanidae, and Nereidae. We have found instead several species of bivalve mollusca including large numbers of *Tellina agilis*, a species generally found in clean sands.

Stations located up to 9-10 miles northeast, east, and southeast of the periphery of the disposal area are characterized by very coarse sands which contain over 5% organic matter. There is here some suggestion that water currents moving to the northeast from the sewage sludge disposal area may carry entrained fine sewage sludge organic matter to this area where it is deposited. Our observations do not indicate that this added organic matter has enriched or significantly increased the fauna at these stations. In fact, there are fewer individuals representing each species than at some stations where there is less than half the amount of organic matter associated with the sediments.

Stations located to the southeast of the sewage sludge disposal area are similar in their fauna to the eastward stations. Again, however, stations closest to the sludge disposal area have elements (e.g. *Cerianthus*) in common with stations located northwest and southwest of the disposal area.

In conclusion, we have found a large area to be almost devoid of normal benthic macrofauna. Surrounding this impoverished area we have found a band which may be sporadically impoverished or contain elements of the *Cerianthus* community previously described. The *Cerianthus* community extends outward from the periphery of the sludge disposal area; this is particularly true in the sectors to the northwest, north, and southwest. This area includes much of the upper reaches of the submerged Hudson Gorge; the *Cerianthus* community represents the fauna probably indigenous to the entire canyon area prior to the commencement of solid waste disposal activities in this area.

Stations to the south and southeast of the disposal area are characterized by sediments with medium to coarse grained sands. The fauna associated with these areas is reduced in both diversity and number of individuals per species present. Preliminary evaluations suggest the biomass at the eastern and southeastern stations is less than that in the areas characterized by the *Cerianthus* communities. Bottom communities to the east of the sewage sludge disposal area are less productive than *Cerianthus* communities located to the north, west, and southwest of the sludge disposal area.

Analysis of inorganic components of the sediments indicates sewage sludge is being disposed of in a productive portion of the New York Bight. Our comparison of the distribution of organic matter and sediment types with standing crops of organisms does not suggest that increased amounts of organic matter over normal background levels has any fertilizing effect on benthic communities. Moreover, the recent work of Barber noted in another section of this report indicates that organic matter of a sewage sludge origin may inhibit productivity, at least of phytoplankton. As suggested by M. Bloom (Woods Hole Oceanographic Institution), oil and other pollutants may interfere with behavioral and biological responses of many marine animals. In a related project, we are presently investigating the settling activities, colonization, growth, and survival of epibenthic animals in polluted and relatively unpolluted oceanic and bay waters in order to determine the effects of pollutants on these activities (Pearce, 1968).

We have attempted to sample those areas of the New York Bight known to contain commercially exploitable beds of the surf clam, *Spisula solidissima*. These clams are generally abundant in waters 20-60 feet deep off both the Long Island and New Jersey shore lines. We found particularly heavy sets of these clams at stations located two miles off Long Island. Data relating to standing crops and growth rates of juvenile surf clams and preserved specimens are being furnished to Mr. John Ropes, Bureau of Commercial Fisheries Shellfish Laboratory,

Oxford, Maryland, who is interested in determining the age at which this species becomes sexually mature. We are interested in determining if sewage sludge or other pollutants affect gametogenesis in the surf clam. Clams from polluted and unpolluted environments have been collected and preserved for histological examination. Clams taken from stations located between the sewage sludge dump area and Long Island are heavily contaminated with coliform bacteria.

We are not interested solely in the areal or horizontal distribution of sewage sludge. Our investigation indicates that over most of the sewage disposal area sludges have accumulated to a vertical depth greater than the 15 cm depth which our Smith-McIntyre grab can sample. Alpine Geophysical Associates, Inc. (AGA) has furnished us with a series of deep cores (5-7 m) taken in or near the sludge disposal area. Core 90 (AGA designation) was taken at the northern boundary of the sludge disposal area and contained a limited amount of sludge debris (<0.5 cm). Core 91 (AGA) was taken near the northern sludge boundary and again contained a limited amount of organic matter identifiable as sludge material. Core 94 was taken at a position between our stations 11 and 70 at the eastern edge of the sludge dumping area. This is an area which is marginally polluted and we have noted that the substratum changes in response to water movements accompanying severe storms. In other words, we have collected sands on one sampling date and sludge at the same station on a subsequent date following an intense storm. Occasionally we have found the contents of our grab samples from the area to be layered with clean sand alternating with sediments contaminated by sludge. Nevertheless, the upper 3 feet of core 94 were contaminated with sludge. Below this we found the remainder of the core to consist of a very compacted sand having a peculiar green color, much like some clays. We have taken subsamples from several depths of each core; these were frozen and we are analyzing them as time allows.

In addition to our analyses of the deep cores we have taken Phleger core subsamples from each Smith-McIntyre grab sample. These are separated vertically into 1 cm lengths which are examined for the meiofauna which occur at different levels in our samples. We are interested in the distribution of interstitial organisms in thoroughly and marginally polluted samples. Cores processed indicate that samples from the centers of the sewage sludge and dredge spoil disposal areas are relatively devoid of meiofauna at all depths of sediment. Our meiofaunal analyses consider copepods (harpacticoids), nematodes, larval forms, and foraminiferans.

Dredge spoil disposal area

We have found the dredge spoil disposal area to be as seriously affected biologically as the sewage sludge disposal area. For our study of the effects of dredge spoil, we have begun to collect, process, and analyze samples in the same manner as for the sewage sludge area.

To date most benthic samples from the dredge spoil area have been processed to the 1 mm level. The central portion of the dredge spoil disposal area contains no living macrofauna. Stations outside this area are frequently barren; however, there are intervening stations containing some life.

The bottom sediments in the dredge spoil area were quite different from those of the sewage sludge disposal area. The cumulative curves are very irregular, and reflect the dumping of spoils of various sizes, from clays to gravels. When the dredge spoil sediments were washed through our screen stacks, we found fewer human artifacts (cellulose cigarette filters, band aids, and aluminum foil wrappers) than in the sewage sludge sediments.

We have, however, found levels of heavy metal contamination as high as those at the sewage sludge disposal area, or higher. We have also found significant levels of pesticides belonging to the chlorinated hydrocarbon groups. The sediments from the dredge spoil disposal area always have a noticeable odor of petrochemicals, even when we find living benthic macrofauna in a particular sample. These sediments are always oily in appearance; when they are washed through screens they confer an oily surface to the decks, washing hoses, and apparatus. Preliminary analysis of these sediments for hexane-extractable materials have revealed, qualitatively and quantitatively a large amount of hexane-extractables at the center of the dumping area. These levels diminish in samples taken at progressively increasing distances from the center of dumping activity. The apparent center of dumping activities is some distance north of the designated dumping area.

The benthic communities surrounding the dredge spoil disposal area reflect the diversity of bottom types which surround it. Dredge spoils are being dumped in an area between the shallow waters off Sandy Hook and the deeper waters of the Hudson Gorge. At stations west of the dredge spoil area in 30 feet of water the fauna is very limited and characterized by a few dominant bivalves including the surf clam, *Spisula solidissima*, and *Tellina*. The polychaete fauna is dominated by *Prionospio* and *Spiophanes*, both of the family Spionidae. Sand dollars, *Euchinarachnius parma*, are also very common in the collections and form the majority of the biomass in many samples. All of these forms are characteristically found in medium to coarse sands in high energy, wave swept, coastal environments.

Stations south and east of the dredge spoil disposal area have an irregular sediment grain size distribution curve indicating an influence from limited waste disposal activities, but the animal community is diverse and similar to faunas of the upper Hudson Gorge which are not substantially influenced by solid waste disposal activities. We found slightly over 6% organic matter in sediments collected at these stations.

We have some evidence (from materials such as cigarette filters and petrochemical odors) which suggests a tendency for the movement of contaminated sediments into the Gorge itself. Similarly, we have found some indication that contaminated sediments may have been moved westward from the sewage sludge disposal area into the Hudson Gorge. Our next major effort will be to determine if this has occurred. The Hudson Gorge is an extremely important ecological entity and if wastes from the two disposal areas are coalescing and covering the sediments in the Gorge, serious ecological consequences may result.

Amphipoda

Gammarid amphipods are an extremely important element in benthic communities. Many species form tubes which act to stabilize the bottom sediments; these and other species are extremely important in the diet of reef- and bottom-dwelling finfishes. Because of their ecological importance we have carefully analyzed their distribution in the study area.

As with other macrofaunal taxa, the Amphipoda are almost completely absent from the spoil and sludge disposal areas. We have found only one species, *Unciola irrorata*, which occurs in the impoverished portions of the dumping grounds; occasionally a single *Unciola* will be found in a sample. It is probable that these isolates are carried to the area by water movements.

What is even more interesting is that even those areas which are only marginally polluted are relatively impoverished of an Amphipoda fauna. This suggests that these small peracaridan crustaceans may be more sensitive to the effects of pollution than is the sea anemone, *Cerianthus*, many species of polychaete worms, and certain bivalve molluscs. Fincham (1969) discusses the importance of pollution in the distribution of the Amphipoda. We have identified 23 species of amphipods associated with soft sediments in the study area. There are another 25 species which are associated with epibenthic communities in the New York Bight area.

We plan to use several of these species as laboratory bioassay organisms and are particularly interested in the effects of fine sewage sludge and dredge spoil debris on the tube-building activities of the tubicolous species.

Benthic meiofauna

We have found a considerable portion of the sewage sludge and dredge spoil deposit areas devoid of living macrofauna. Recognizing that certain meiofauna (unicellular forms and metazoans less than 1.00 mm in their greatest dimension) are tolerant of polluted conditions, we have initiated a study of the distribution of these organisms in relation to the waste disposal sediments.

Preliminary analysis of cores and core aliquots of Smith-McIntyre grab samples indicates that nematode worms are limited in their distribution by the presence of sewage sludge and dredge spoils. Nematodes are completely absent from samples taken in the dredge spoil area. Very few nematodes are present at stations in the center of the sewage sludge disposal area. In addition, few nematodes were found at stations located at the northern periphery of the sludge grounds. Since many free-living nematode species are resistant to the anoxic conditions which are lethal to other taxa of marine organisms, it seems to us that the concentrations of heavy metals or other toxins may effect nematode distribution. We plan to conduct further laboratory studies to determine the responses of nematodes to different solid waste materials, concentrations of heavy metals, and anaerobic conditions.

When we considered the individuals representing all the meiofauna and the number of species found in each meiofauna collection, we noted that stations outside the sludge dump area contained more individuals and more species diversification than did the stations inside the sludge grounds. The type of distribution for all elements of the meiofauna is the same as for the nematodes alone. On 3 April 1969, one station five miles north of the center of sludge dumping activities, contained over 270 individuals per cm^2 representing 13 taxa, whereas a station located at the center of dumping activities contained only 20 individuals which represented 8 taxa.

Benthic microbiology

In cooperation with the U. S. Public Health Service, Food and Drug Administration (F.D.A.) (Davisville, R. I.) and the clam depuration laboratory of Rutgers University (Monmouth Beach, N. J.), we have begun an investigation of coliform bacterial contamination in the sewage sludge disposal area. The F.D.A. analyzed sediments and waters collected in and around the sewage sludge area during the period 23 June to 3 July 1969. Their figures are given as most probable numbers (MPN) of total and fecal coliform bacteria. In both cases these numbers exceed the levels recommended by the FWPCA (1968: p. 92) for estuarine waters used for shellfish cultivation and harvesting. The criteria of the National Shellfish Sanitation Program Manual of Operation and quoted by the FWPCA suggests that "the coliform median MPN of the water not exceed 70/100 ml, and not more than 10 per cent of the samples ordinarily exceed an MPN of 230/100 ml for a 5-tube decimal dilution test (or 330/100 ml where the 3-tube decimal dilution test is used)."

It can be readily noted that the interstitial waters of sediments up to six miles distance from the sewage sludge disposal area exceed these levels (station 70 at the sewage sludge dump site had a count of 160,000/100 ml). This is significant since the sea quahog, *Cyprina islandica*, occurs in the moderately polluted bottoms peripheral to the sludge disposal area. Also, substantial numbers of the surf clam, *Spisula solidissima*, occur in these same areas. Both these clams are used as chowder clams and during the past year large spatfalls of *Spisula* occurred in waters immediately adjacent to the sludge disposal area. As juveniles and young adults, these clams use interstitial water and water from the water-sediment interface and can thus be readily contaminated with coliform and pathogenic bacteria. Mr. James Verber, Director, Food and Drug Administration, Northeast Technical Services Administration, Davisville, Rhode Island, has recommended to the F.D.A., on the basis of the present investigation of water and sediment contamination, that all waters within a radius of six miles from the center of sewage sludge disposal activities be closed to shellfish harvesting activities. His unit will cooperate with us in future studies designed to sample the waters and sediments of the sludge disposal area for *Salmonella* and other pathogenic micro-organisms. He also plans to study more intensively the level of heavy metals in surf clams and other shellfish found adjacent to the disposal areas. Because much of the center of the disposal area is completely devoid of living macrofauna, it is obviously difficult to find suitable bioassay organisms in the areas that are intensively polluted.

On a few occasions we have been able to collect from marginal areas clams which we furnished to the Rutgers University Clam Depuration Laboratory for analyses of the levels of clam meat contamination. The method of analysis was such that the *E. coli* figures are reported as counts/ml. A conversion factor was used to obtain the approximate MPN levels. Of six clams examined from an 8 September 1969 sample, five exceeded the acceptable coliform levels for market clams.

Addendum

We have recently (March, 1970) collected surf clams and sea quahogs north of the sewage sludge disposal area which are severely contaminated with coliform bacteria; marketable surf clams taken 2 miles off Atlantic Beach, Long Island, had plate counts of 59,100/100 ml. Quahogs collected in deeper waters, between the sludge disposal area and the Long Island shore, had MPN's of 79,000/100 ml.

Pathology—Possible waste induced disease in benthic organisms

Because we have observed a paucity or complete absence of normal bottom-dwelling macrofauna over much of the spoil and sludge grounds, we have brought samples of these bottom sediments into the laboratory in order to observe their effects on bioassay organisms. Sludge and dredge spoil sediments were placed to a 2-inch depth over the bottoms of 30-gallon aquaria. Sea water was then

added and aerated so as to maintain a dissolved oxygen level of 7-8 ppm. The temperature of the individual aquaria was maintained at 17-18°C (ambient temperature of our constant environment room). Six aquaria were set up containing sewage sludge, two aquaria contained dredge spoil sediments, and one each containing clean sand and no sediment were established as controls. In the first experiment two aquaria containing sludge were aerated constantly; in two aquaria containing sludge aeration was terminated; in one aquarium containing dredge spoils aeration was continuous, and in a second aquarium containing dredge spoil aeration was ceased. The experiment was replicated four times.

The experimental animal selected for the initial experiment was the lobster, *Homarus americanus*, a commercially important species common to the New York Bight and taken by fishermen in close proximity to the sludge and spoil grounds. All lobsters used were approximately 25 cm in length (rostrum to tip of telson) and of the same weight. One lobster was added to each aquarium prior to the termination of aeration. In the unaerated aquaria containing sludge and dredge spoils all the lobsters became quiescent within 30 hours and were dead at the end of 96 hours. In aerated aquaria the lobsters remained alive for extended periods; they did, however, develop pathological conditions which will be reported later in this section.

In the unaerated control aquarium containing clean sand the lobsters survived an average of 216 hours. The more precipitous fall in dissolved oxygen in the aquaria containing sludges and spoils is a reflection of the biological oxygen demand (BOD) of the highly organic sludge and spoil sediments. Also at the end of any given period there was less oxygen available to the experimental animals in the unaerated aquaria which contained sludge. In the unaerated control aquarium without sediments, or that containing clean sand, the dissolved oxygen content of the water leveled off at a point above the threshold which was immediately lethal to the experimental animals. The oxygen demand of the experimental animal and the BOD of the central aquaria system could be met by gaseous exchange across the water-air interface.

We repeated this series of experiments using the crabs, *Cancer irroratus*. The responses of the crabs were almost identical to that of the lobsters, with death occurring within 48 hours if the dissolved oxygen level was allowed to fall below 2 ppm.

Lobsters, crabs, and horseshoe crabs (*Limulus*) which we maintained for 6 weeks (21 Aug. to 9 Oct. 1969) in well aerated (7-8 ppm) aquaria containing sewage sludge were found to develop several pathological anomalies. Where the exoskeleton of these arthropods is formed into prolongations or spines, severe erosions developed. These necrotic areas were enlarged with continued exposure to sewage sludge. Chela (claws) and pereopods (walking legs) of the lobsters, crabs, and horseshoe crabs were eroded, with the most significant damage at the tips. In the case of horseshoe crab, infection involved the eyes with necrotic tissue penetrating under the ocular capsules and involving the membranous pleural regions which separate the dorsal and ventral exoskeleton. These infections, particularly at the tips of the chela and pereopods would obviously interfere with feeding activities, mobility, and protective posture. Animals held in control aquaria did not develop pathological anomalies.

We have preserved affected tissues from crabs, horseshoe crabs, and lobsters and these are being prepared, i.e., embedded and sectioned, for histological examination. We plan to repeat these experiments under different temperature regimes in order to follow the incubation periods and development of infections in crustaceans and merostomes at various ambient temperatures.

ADDENDUM

We are currently (March, 1970) repeating this series of experiments using crabs, *Cancer irroratus*, as bioassay organisms.

A second pathological condition which we observed in crustaceans maintained in aerated aquaria containing sewage sludge was the fouling of the branchial chambers and gills by silt, organic debris, and oil. All animals maintained in sewage sludge for prolonged periods developed this condition. In the early stages, silt and detritus could be found at the bases of the gill attachment and in the many pockets and depressions characteristic of the branchial chambers of crabs and lobsters. We observed that lobsters placed on sewage sludge and dredge spoil sediments for only a few hours and then moved to clean water voided fine silts and detritus from the anterior openings of the gill chambers.

Finally, we found that the gills of lobsters held for 6 weeks were covered with spots of oil and debris and the fine integument covering the gills of each lobster was penetrated by small necrotic openings.

The general surface areas of the experimental animals were covered by a fine layer or orange pigmented material. This could be wiped off but was not easily removed by gentle washing which suggests that it might be a physically stable complex which would allow the incubation of microorganisms on the surfaces of the exoskeleton, thus preparing the way for the penetrations of the exoskeleton.

These experiments and observations are significant in that both lobsters and crabs are migratory, moving from deeper to shallow waters at certain times of the year. In some cases such migrations would result in the crabs and lobsters moving across or near the periphery of the waste disposal areas.

Behavior of benthic organisms confronted with polluted sediments

Our field and laboratory observations of benthic communities definitely indicate that sewage sludge and dredge spoil deposits are incompatible with most normal biological phenomena; animals are generally not present in the field collections from disposal areas and they are killed when exposed to laboratory conditions which approximate those found in the field. The lack of macrofauna in much of the sludge area can be accounted for by three factors: 1) the adults are incapacitated or killed by anoxia, toxins (heavy metals), or inundation by solid wastes; 2) the physical environment provided in the sludge and dredge spoil areas is inimical to the normal development of eggs and larvae and the metamorphosis of juvenile to adult stages; and 3) adult and larval organisms actively avoid areas contaminated with dredge spoil and sewage sludge. The latter point will be considered in the following paragraphs.

Recognizing that many marine larvae and adults are highly selective in establishing themselves in the environment (Wilson, 1953) and that they are attracted or repelled by various metabolites or exocrine factors (Crisp and Meadows, 1962) we conducted an extensive series of experiments to determine if selected organisms would avoid contact with sewage sludge. The bioassay organism we selected for the first series of experiments was the small mud snail, *Nassarius obsoletus* (Say). This snail can tolerate a wide fluctuation in temperature and salinity and is common in environments where the sediments are highly organic and reducing in nature. It is, in fact, an organism which regularly occurs in polluted waters; therefore any avoidance of particular conditions could be construed as significant.

Pyrex baking dishes 15 cm wide, 25 cm long, and 5 cm deep were divided in the center forming two chambers 15 by 12.5 cm. Sterile beach sand was added to one chamber and sewage sludge sediment to the other; both chambers were filled with sediment to a depth of 3 cm. After the sediments were in place salt water from the sea water system was carefully added, without mixing the two sediment types, to fill the trays to their upper lip. This was sufficient to completely cover the experimental organisms. The experimental trays were covered with glass sheets and held under constant light conditions which were uniform over the entire length of the trays. We introduced a single experimental animal into each experiment by placing it at the interface between the clean sand and sludge. The position of the animal in the tray was then recorded at five minute intervals during the first half hour, at fifteen minute intervals during the second half hour, and at one hour intervals thereafter for a 24-hour period. A total of 402 observations were made. The snails were recorded as being present on the surface of the sand or sludge or on the tray walls or glass cover over the water covering the sand and sludge.

We observed the snails on or over the sand and sludge in approximately equal numbers of cases; 208 on the sand side and 194 on the sludge side. The interesting point, however, is that in 53 percent of the sand observations the snails were actually in direct contact with the sediment whereas only 31 percent of the snails on the sludge side were in direct contact with the sediment. In those cases in which snails were actually on sediment, almost twice as many were on the sand (110 on sand, 61 on sludge).

The snails did not show any definite initial preference during the first half hour and no choices or change occurred after the first 5½ hours in the experimental trays. Seeking and choosing activity thus was restricted to a five-hour interval early in the experimental period.

Ninety-one percent of the snails found on sediments at the end of the 24-hour period were on sand; only 8 percent were recovered from the sludge.

In control aquaria snails were found on the sediments in 71 percent of the observations; in the remainder of the cases they were found on the sides of the trays and on the glass covers. As mentioned before, in the experimental trays snails were found on the sandy sediments in 53 percent of the total sand-side observations and on the sludge in only 31 percent of the cases. The reduced numbers of observations of snails on sand in the experimental aquaria, when contrasted to the controls, may reflect a reduction in available dissolved oxygen resulting from reducing bacteria present in the sludge sediment. Reduced oxygen tension is a known stimulus for upward movement away from substrata.

Light did not appear to influence the movement of the snails. In the control experiments no influence of light could be noted at any interval in the experiment; equal numbers of snails were found in the darkened and lighted halves of the trays at the end of one-half hour, 5½ hours, and at the termination of the experiments.

A second animal used in choice and avoidance experiments was the hermit crab, *Pagurus longicarpus*. The experimental methodology was identical to that used with snails except that the crabs were, by their morphology, restricted to the sediments; they were unable to climb the walls of the aquaria or position themselves on the glass covers.

A total of 90 observations were made. As with the snails, the crabs spent much less time on the sewage sludge than on sand; in 73 percent of the observations the crabs were found on the sand. Moreover, at the termination of all experiments, i.e., at the end of each 24-hour period, the crabs were always located on sand.

PELAGIC STUDIES

Zooplankton communities

The zooplankton program was initiated in January 1969. The program is designed to compare the zooplankton communities of the waste disposal with the communities of the surrounding areas. Stations were located on a series of five parallel east-west transects, each consisting of three stations. The transects were located north of the sewage sludge disposal area (66, 67, 68), through the sewage sludge grounds (69, 70, 71), between the sewage sludge and acid waste disposal areas (72, 73, 74), through the acid waste disposal area (75, 76-77, 78), and south of the acid waste disposal area (79, 80, 81). Stations 76 and 77 have been combined into one sampling site located in the center of an acid waste stain. All stations were sampled monthly. The stations located on the transects through the disposal areas have been sampled twice each month.

At each station parallel tows were made with metered 0.5-meter #8 mesh (0.203 mm. aperture) non-closing zooplankton nets at surface (0.1 m), mid-depth (12-13 m), and bottom (24-26 m) levels. The following physical and chemical factors were also measured at the three levels: conductivity, salinity, temperature, dissolved oxygen, pH, chlorophyll-a, nitrate (total), phosphate (inorganic reactive, organic, poly), and total reactive iron.

Over 700 zooplankton collections have been made to date. Each sample requires at least one man day for complete analysis. Because of time limitations the majority of the samples will not be completely analyzed until the field program, which is designed to cover one year, has been terminated.

The three stations located on the transect through the waste acid disposal area (75, 76-77, 78) had approximately 2,000 animals per cubic meter in the late winter, increasing to 7,000 animals per cubic meter in April. The peaks in February and April at station 75 were caused by bivalve larvae and *Oithona* (Copepoda, Cyclopoida), respectively. The data for station 70 are more limited but the pattern indicated is similar to that found at the other stations except that the spring increase occurred in late May.

Generally, copepods comprised at least 50 percent of the zooplankton populations. Only in the late winter, when bivalve larvae were abundant, did they form less than 50 percent of the zooplankton.

We found that the general community structure changed from dominance of *Oithona-Pseudocalanus*-bivalve larvae to *Oithona-Tortanus-Temora*. Other organisms that occasionally make up 40 percent of the population in surface waters consist predominantly of cladocerans (Branchipoda) and *Oikopleura*, (Chordata, Larvacea).

We are identifying the juvenile calanoid copepods to genera. Preliminary data show the generic composition of juveniles to be similar in relative frequency to that of the adults.

Oithona is predominantly a surface-dwelling animal. It comprises 20 to 40 percent of the surface samples at stations 75 and 78 in the late winter and then

reaches a high of 80 to 90 percent in June. In the spring we did not observe this dominance at stations 76-77 and 70 where disposal materials are being dumped daily. Surface-dwelling organisms would be subjected to the strongest concentration of disposed material and therefore would be most likely affected by the waste material. The total number of zooplankton taken at station 76-77 surface was very low for late May and June; however, the amount taken at station 70 surface during the same period was high.

Deevey's work (1952, 1960) on the zooplankton of Block Island Sound and the waters outside Delaware Bay indicate that *Centropages* should be one of the major genera in this area. Through June very few animals from this genus were taken but were a high percent in October samples. Deevey (1952) found that *Oithona* was the dominant form in Block Island Sound which is consistent with our observations through June.

Addendum.—We have found large amounts of fibrous material associated with stations in and near the sewage sludge disposal area. This material appears identical with the materials collected by Manheim *et al* (1970) and which apparently contribute to the turbidity of the waters in New York Bight. Such fibers may also interfere with the normal activities of zooplankton.

Laboratory studies on zooplankton

We are testing selected dominant members of the zooplankton community in the laboratory for their reaction to various dilutions of the disposal materials. The experiments are run at various concentrations up to lethal levels for short exposure times of 1 to 24 hours; experiments on the effects of sublethal concentrations of pollutants on growth, gametogenesis and fecundity will also be conducted.

In addition to these experiments, we have initiated work on the passage of certain heavy metals through the food chain. This has involved the testing of animals from the study area for the presence of heavy metals in their tissues. We are culturing phytoplankton, copepods, and fishes in non-lethal concentrations of the disposal materials and then analyze for heavy metal concentrations. We plan to feed experimental animals food species that either contain or have been cultured in various concentration of disposal materials in order to discover whether heavy metals are being concentrated at successively higher levels in the food chain.

Effects of sewage sludge contaminated waters on phytoplankton growth and photosynthesis

On 9 September 1969 David Barber, Woods Hole Oceanographic Institution, collected bottom and surface water samples from Raritan Bay, Verrazano Narrows, and the sewage sludge dumping grounds (station 70). Phytoplankton organisms indigenous to surface waters survived well and continued to photosynthesize and undergo cell division in filtered bottom water from Raritan Bay and the Narrows; filtered bottom water collected from the sewage sludge dump area, however, completely inhibited cell growth. Several replicate experiments were performed, all with similar results. The results suggested that heavy metals might be involved; however, EDTA, which can be used to modify the effects of heavy metals, had no effects when added in normal amounts to the sewage sludge waters. Inhibition was present for up to four days when the experiments were terminated.

On 30 October, Dr. Barber participated in a *Challenger* cruise to extend his collections and observations. Samples were taken at stations in the dredge spoil (82) and sewage sludge disposal areas (59 and 70) and uncontaminated areas (36, 63, and 67). Bottom water from station 36 had no inhibitory effect on phytoplankton cell division and growth. Bottom water collected over the sewage sludge grounds at station 59 likewise had no effects on cell growth. Bottom waters collected at stations 67, 63, and 70 did, however, have inhibitory effects. Water from station 67 showed the greatest inhibitory effect, followed by 63, 70, and 82. The latter station is located just east of the dredge spoil disposal area. Station 67 is located 3 nautical miles northeast of the center of sewage sludge dumping activities. Stations 63 and 70 are both located east of the dumping area. This suggests that the influence of the sludge effect extends to the east and northeast, in the direction of general movement of water. This is shown by our hydrographic studies and is substantiated by the distribution of organic matter and surface slicks to the east of the area of impact of the solid moieties of sewage sludge.

All levels of total organic matter in the water column (mg/l) are extremely high; values for organic matter are normally reported in g/l, not mg/l. The water collected from station 65 81.01 mg/l) almost certainly contained organic matter having its origin in a recent sludge dump. Likewise, other stations had large amounts of organic materials although the total amount of organic matter was lower at stations 35, 59, and 63. These amounts of organic matter could only be counted for by the residues remaining in the water column following the dumping of sewage sludge or other organic wastes. The important factor is that it was stations slightly to the east and northeast which were most heavily contaminated with organic matter. We have frequently observed slicks and debris patches whose origins were in the sewage sludge dumps. These slicks are usually somewhat east of those bottom areas over which the actual dumps occur. Sediment analysis and the distribution of heavy metals also suggest that there is a general movement of water to the northeast and east.

Finfish investigations

We initiated otter trawl collections in May 1969; at this time a series of collections was made to determine the feasibility of otter trawling as a sampling method in and around the disposal areas.

Trawling was proposed for stations 39, 65, 67, 70, 72, 75, 76-77, and 78. We felt that catches at these stations would be representative of the distribution of bottom fish in that area of New York Bight which is of interest and collections from these stations should reveal any variation that might be caused by the waste disposal practices. Trawling has been conducted at all of these stations except station 72. The bottom topography at station 39 was too irregular for sampling and this station was eliminated from the sampling program.

We have made several cruises in the area of the sewage sludge disposal grounds using a 40-foot otter trawl that had 2¼-inch stretch mesh, and one cruise using a 60-foot otter trawl with 2½-inch stretch mesh cod. We found the larger trawl captured a greater number of fish but not more species per station. Since larger samples provide a more statistically valid sample of the fishable population and we plan to use the larger net on future cruises.

The number of fish taken at station 70 in the sewage sludge disposal area, reached a low in July. It was at this time that the lowest dissolved oxygen value (1 ppm) for the sampling period was recorded. The number of individual fish increased again in August when slightly higher dissolved oxygen levels (2.5 ppm) were recorded. It appears that the fish will enter this area until low dissolved oxygen levels preclude their entrance or force them to move to other areas. They apparently return when oxygen levels rise to a higher level.

Several species of fish found in the sewage sludge disposal area are those which are taken by commercial and sport fishermen. Any pollutants, such as heavy metals and pesticide residues, which might be retained in the tissues of the animals, could affect not only the fish species involved but also those who eat the fish. Plans have been made to test fish from the disposal areas for heavy metal concentrations and pesticide residues.

Materials other than the living animals caught in the net were of interest. Only at station 70 did the net dredge up materials that one would associate with sewage. Included in these materials were cigarette butts, hair, sanitary napkins, band aids, metal foil, fruit rinds, and masses of cotton fibers. The small net contained about 2 gallons of this material per tow whereas the large, heavier net contained ten times as much. The entire cod end of the large net was covered with this material and had an odor usually associated with sewage plants and the sludge disposal area.

To date we have made only one cruise through the acid waste disposal area. Our data show an even distribution of fish through this area.

We have made a schedule to sample stations 75, 76-77, 78, 65, 67, 70, and 72 using the 60-foot otter trawl. We are trying to locate trawl stations in the vicinity of the dredge spoils disposal area but this area is regularly used for the dumping of building rubble and was mined during World War II; the location of safe sampling sites in this area has presented major problems.

Stomach content analysis is being conducted. The data to date, however, are too limited for any conclusions. Interesting items including cellulose cigarette filters and band aids were found in the stomachs of silver hake, *Merluccius bilinearis*, collected at station 70. The bottom of the sewage sludge disposal area is covered with these items, often over 30 per 0.1m². These items could be mistaken

as food items or eaten incidental to normal food items by the fish. This indicates that some fish do feed at least at the periphery of the dump area and there therefore exists the possibility, and a mechanism, whereby toxic materials may be introduced into the higher levels of the food-chain.

Laboratory studies on finfish

To date a series of preliminary experiments have been run using waste acid obtained from National Lead Company. We tested two species of fish, *Mugil curema* and *Menidia menidia*, for LD₅₀ concentration based on a 24-hour test period. These animals were collected locally with a beach seine and held in a 30-gallon aquarium under constant temperature (19° C) and photoperiod (18 hr day). The animals were then tested in 4-liter containers with various dilutions of the acid wastes. The test tanks were maintained at the same temperature and photoperiod as the holding tanks. Aeration was continuous in all tanks. The acid waste was placed in the test tanks which were aerated for 24 hours. The fish were then placed in the test tanks and observed until either death occurred on the 24-hour period ended. Both pH and dissolved oxygen were checked before the introduction of the fish and throughout the experiment. These two factors remained relatively constant throughout the experiment.

The white mullet, *Mugil curema*, was the more tolerant of the two species. At dilutions greater than 1:600 (acid to sea water) all fish died within 24 hours. At a dilution of 1:750 all fish survived for the 24-hour test period.

For *Menidia menidia*, the common silverside, the break point was between dilutions of 1:1000 and 1:1500. All fish held in the 1:1000 dilution died within 5 hours. The fish in the 1:1500 dilution survived for three days, well beyond the 24-hour test period.

An experiment was conducted with juvenile bluefish, *Pomatomus saltatrix*. Two fish were placed in one 30-gallon tank and one fish in another. Seventeen milliliters of acid waste were added to the tank (1:6678 dilution) containing the two fish. The fish immediately swam away from the area where the acid was poured. Within a few minutes the fish showed stress; after two hours one fish was lying on the bottom and the other had trouble maintaining its orientation. Both fish were dead after 17 hours; the control fish remained healthy. The pH was 7.2 in the test tank and 7.5 in the control tank.

More extensive experiments are planned for the spring when young bluefish and mackerel, *Scomber scombrus*, are available for experimentation. These tests will include short and long-term exposures to determine effects of the waste materials on the feeding, growth, and chemical content of the test animals. Kinne and Rosenthal (1967) have already demonstrated that industrial acid waste cause abnormal growth and mortality in mackerel eggs and larvae. Our experiments will be run with sulfuric acid waste and those chemicals known to make up the acid waste as well as sewage sludge, dredge spoil, and the various chemical components which we have found in dredge spoil.

HYDROGRAPHIC STUDIES

A complete study of the hydrographic conditions in the New York Bight area is necessary to understand the fate of the sewage sludge after it has been dumped. Knowledge of the patterns of water movement is especially important in this respect.

The hydrographic data in this report represent work in progress, and are presented with little interpretation. Analysis must await additional data to be connected in the next year.

The New York Bight region extends from Montauk, New York, to Cape May, New Jersey. The area of our study extends from Jones Inlet, N.Y. to Monmouth Beach, N.J. encompassed by both the New York and New Jersey shore lines and co-ordinates 40°20'N and 73°30'W. The study area is rather shallow (0-15 fm) with a deep trough, the Hudson Channel (= Hudson Gorge) running through the area out to the edge of the continental shelf. In our study area the Hudson Channel is delineated by the 15-25 fm isobaths. The study area is directly adjacent to a major estuarine system, often referred to as the Lower New York Bay.

Materials and methods

We have normally occupied 26 sampling stations covering the study area once or twice a month. Each cruise requires two 10-hour days. At each station we measured temperature and salinity at 4 meter depth intervals and oxygen at the bottom. At 21 of the 26 stations we released sea-bed drifters and surface drifters.

In addition to our hydrographic cruises, we have placed current meters and thermographs at four fixed stations within the study area. These measure current velocity and direction and temperature at the bottom and at approximately forty feet from the bottom.

Temperature

We measured as follows:

1. Bucket temperatures read with a mercury thermometer.
2. From surface to bottom with an electrical resistance thermistor incorporated in the sensing probe of a Beckman RS-5-3.
3. With recording thermometers located at fixed stations in the study area.

Bucket temperatures.—The mercury thermometers used for measuring bucket temperatures have a precision of 0.05°C . and were calibrated and are accurate to $\pm 0.1^{\circ}\text{C}$. The temperatures obtained from bucket samples are used to check the validity of those taken with the RS-5-3 using the surface readings as a reference. Salinity samples were also taken from the same bucket sample to verify the salinity readings of the RS-5-3.

Electrical resistance thermistor.—The electrical resistance thermistor is incorporated in the sensing probe of a Beckman RS-5-3. This instrument gives temperature readings to 0.01°C . and is accurate to $\pm 0.1^{\circ}\text{C}$. The RS-5-3 was calibrated in the laboratory and found accurate within these limits which were specified by the manufacturer. The accuracy was rechecked at each sampling location by comparing surface readings with a mercury thermometer.

Temperature recorders.—Geodyne Temperature Recorders, Model A-119-4 were placed at fixed locations in conjunction with current meters. These instruments record temperature on a waxed paper strip chart which is advanced every half hour .066 in. by a timer-activated electric motor. The temperature sensing element consists of a coiled Bourdon tube which moves a stylus across the strip chart as the liquid within the tube expands or contracts. The stylus scratches a trace on the waxed chart which can be read visually or by a computer. This instrument can record temperatures for a 180-day period before either the 50 feet of chart or the battery is expended. An accuracy of $\pm 0.25^{\circ}\text{C}$. is obtained with this temperature recorder. Each temperature recorder is calibrated in the laboratory for a minimum of four days in Foxboro Temperature Recorder monitored constant temperature baths before being placed at the test location.

Currents

We measured currents in our study area with surface drift bottles, sea-bed drifters and permanently fixed recording current meters.

Surface drifters.—Surface drift bottles were 277 cc (8 oz) soft drink bottles. Each bottle was ballasted with dry sand, containing a serially numbered fluorescent red card and was sealed with a cork. The card bore a message requesting the finder to report the date, time, and location on the self-addressed pre-stamped card and mail to the W.H.O.I. A 50 cent reward is offered the finder for this service. The ballasted bottle floats downward with about 5 cm (2 in) of freeboard. The purpose of ballasting is to reduce the direct effect of wind and thus make the bottles' motion primarily dependent on the actual surface currents.

Sea-bed drifters.—The sea-bed drifters, patterned after the model designed by P. M. J. Woodhead, consist of a shallow plastic dome approximately 18 cm in diameter. A 5 mm thick plastic rod approximately 54 cm in length and weighted at the bottom, extends vertically from the center of the dome. The assembled unit resembles a parasol.

The dome portion of the drifter is serially numbered and has a message requesting the finder to report the number on the drifter, time, date and location of recovery. A 50 cent reward is paid for each recovery.

The drift bottle and bottom drifter information are sent directly to the Woods Hole Oceanographic Institution where the data are processed and entered into a computer program operated by Dean Bumpus. The results are sent to the Sandy Hook Marine Laboratory monthly.

Current meters.—Model A-100 Woods Hole current meters were used at our fixed stations. These current meters are manufactured by Geodyne Corporation and are long-term interval and continuous recording current meters. Current velocity and direction are recorded every half hour for 180 days. To insure accuracy and avoid problems caused by electrolysis, fouling or malfunction

tion, the instruments were serviced every 120 days. This allows 60 days of reserve time for the recorder and provides us with ample time reserve in case conditions prohibit retrieval.

The model A-100 measures current velocity and direction. Direction is measured by a vane magnetically coupled to an oil dampened vane-follower and compared with a magnetic compass located within the pressure case. It is sensitive within 10° at 2.58 cm/sec, 2° at 1.29 cm/sec and has a resolution of 2.8° .

Velocity is measured by a Savonius rotor magnetically coupled to a switch that closes upon each revolution of the rotor. The rated accuracy is within 2.58 cm/sec at speeds over 51.58 cm/sec as long as the instrument remains within 5° of vertical.

All data are recorded on standard 16 mm film. One hundred feet of film permits 5000 sets of rotor speed, vane and compass direction readings to be taken with a film advance rate of .240"/min. Film speed is controlled by an electronically actuated clock timer. The measurement of time depends also on the clock-controlled film advance.

Current meters are pre-tested and calibrated in the laboratory by making test film strips. This is done by mounting the assembled current meters on 1 rpm turntable and exposing the rotor and vane to air currents produced by an electric fan. The instrument is set to operate continuously and a test film is recorded over a 24-hour period. The purpose of this test is to make sure the reference compass is working properly, and to detect improper rotor or vane function. The timing mechanism is checked by switching the instrument to interval sampling and allowing it to run for several days. The test film strips are checked visually after processing in the laboratory's dark room. This also provides an opportunity to check the recording camera. The clock itself is checked and calibrated with a Boliva Watch Master before the instrument is set.

Temperature recorders and current meters were placed at fixed stations in the study area by SCUBA divers. The stations were located near navigational buoys which are maintained by the U.S. Coast Guard. A 2000 pound concrete sinker is placed on the bottom near the buoy anchor with a polypropylene rope connecting the two. This line served as a guide to the divers in locating the instrument assembly which was attached to the 2000 pound weight. The instrument assembly consists of a temperature recorder attached directly to the weight with a current meter shackled above it; a length of chain connects the bottom instruments to a second set of instruments which were located at variable mid-water depths. A subsurface buoy was attached to the top of the string of instruments which suspended the assembly vertically. Fiberglass-encased styrofoam subsurface buoys were used at the beginning of the study. These are being replaced with heavy duty plastic longline floats which are more easily handled, less easily damaged and not as susceptible to deterioration as are the styrofoam floats.

Salinity

We measured salinity with a Beckman RS-5-3 salinometer. This is a portable, battery operated, inductively coupled salinometer. The salinometer gives a direct reading in parts per thousand of salinity. The accuracy of the instrument is rated at $\pm 0.3\%$ for salinities in the 0-40 range over a temperature range of $0-27^\circ\text{C}$.

We checked the accuracy of the RS-5-3 by taking surface samples at each station and determining the salinity by titration using the Harvey Method. The precipitable halides are determined according to the Harvey Method by titrating 10 ml of each sample with a silver nitrate solution using a chromate end point. The silver solution is standardized against 10 ml of sea water of known chlorosity. Field calibration was maintained by using a fifty-ohm calibration loop.

Dissolved oxygen

We used the Alsterberg Modification of the Winkler Method to determine dissolved oxygen in ppm.

Temperature characteristics of study area

The surface temperature cycle of the study area is characterized by a low in March rising to a peak in June or July, dropping sharply in July or August, rising to a high in September-October, then dropping sharply thereafter. During the summer the study area is touched by the edge of a huge "cell" of cold water that extends from about Montauk, N.Y. to Cape May, N.J. and is surrounded on all sides by warmer water. Quick changes of bottom temperature are caused by the movement of this "cell" of cold water.

When compared with average temperatures in 1969 surface temperatures were consistently above normal from June through November.

Surface temperature patterns

The surface temperature patterns of the study area from February through September, 1969 were as follows:

February 6, 7, 1969.—We found the coldest water to be at the head of the bay area between Sandy Hook and Coney Island. The warmest water was over the Hudson Channel near the southern end of the study area. A finger of cold water originating in the bay area was probably pushed out by strong prevailing northwest winds.

March 18, 19, 1969.—The beginning of the spring pattern appeared. Now the coldest water was in the southeast corner of the study area and the warmest inshore near the Long Island coast.

April 8, 10, 1969.—A large finger of warm water extruded east from Sandy Hook and the bay area. As in the February pattern, the surface water was evidently pushed out from the bay area by strong northwest winds.

April 23, 24, 1969.—This period is characterized by a small temperature gradient. The warm water was close to the bay area and became progressively colder in a southeast direction.

May 15, 16, 1969.—An interesting characteristic of this period is the cell of cold water near the head of the Hudson Channel. It is surrounded on all sides by warmer water and apparently is the result of an upwelling process. We will discuss this possibility later.

June 5, 6, 1969.—The only features of interest during this period are areas of relatively cool water along the Rockaway and New Jersey beaches. Presumably these result from isolated upwellings.

June 26, 27, 1969.—The interesting features of this period are two relatively cool areas, one along the New Jersey coast extending north to Rockaway, N.Y., the other in the southeast corner of the study area appearing as a finger of cool water pushing in from the east.

June 31–August 1, 1969.—Although the temperatures of the study area were relatively homogenous during this period there still was a cell of slightly cooler water over the head of the Hudson Channel. As in May this may also have resulted from upwelling.

August 18, 19, 1969.—The surface temperature pattern of this period is complicated. A mass of relatively cool water north of the Hudson Channel paralleling the shore, was surrounded by warmer water and apparently resulted from upwelling.

September 15, 16, 1969.—A cell of relatively cool water suggests a weak upwelling off Sandy Hook, N.J. The rest of the study area is characterized by warm water that presumably moved in from offshore.

Bottom temperature patterns

February 6, 7, 1969.—The warmest water during this period was found in and about the Hudson Channel. The isotherms form a finger of relatively warm water which gets progressively colder toward the Long Island coast. The overall pattern suggests a mass of relatively warm bottom water originating in the Hudson Channel and moving north and east.

March 18, 19, 1969.—The March bottom temperature pattern changed abruptly from that of February. We found the warmest water to be inshore near the Long Island shore and the coldest water offshore at the southeast corner of the study area. Unlike the February 6–7 period, there was no indication of a movement of water up the Hudson Channel.

April 8, 10, 1969.—An extension into the ocean of relatively warm water from the bay is similar to the pattern of salinity for the same period.

April 23, 24, 1969.—A pattern similar to that of summer is forming during this period. The warmest isotherms are near the shore line, and the coolest are still in the southeastern corner of the study area. The isotherms generally run east and west along the Long Island coast, curving around the Bight then running north and south along the New Jersey coast.

May 15, 16, 1969.—A pattern that prevailed through the summer appeared during this period. Relatively cool water isotherms curved around the Hudson Channel.

June 5, 6, 1969.—During this period and throughout the summer the coolest water lies in the Hudson Channel; and the isotherms become progressively warmer towards the north, giving the appearance of a northward impushing of water through the Hudson Channel. The significance of the southward banding of the isotherms on the east side of the Hudson Channel will be discussed further in the report.

June 26, 27, 1969.—There was little change of temperature pattern from that of the previous period.

July 31–August 31, 1969.—This is the typical summer pattern. The cool water from the Hudson Channel appears to be pushing north towards the Long Island coast, and to be turning towards the northeast, presumably influenced by the bottom contour that follows the same general pattern. There is again some southward bending of the isotherms on the east side of the Hudson Channel.

August 18, 19, 1969.—The impushing of cold water towards the north strengthened. The general pattern of temperature was colder during August 18, 19, than during July 31–August 1. The mass of cold water coming up the Hudson Channel turned in a northeast direction. A strong southerly movement of warm water to the east of the Channel is indicated by the sharp southward bending of the isotherms.

September 15, 16, 1969.—The bottom temperature pattern in September is similar to that of the previous month, but slightly warmer. The isotherms again curve to the south on the east side of the Hudson Channel, suggesting a movement of warm water to the south.

Salinity Characteristics of Study Area

Surface Salinity Patterns

February 6, 7, 1969.—The salinity readings for this period are higher than we had expected. It is possible that the instrument for measuring salinities was not calibrated correctly. These data were collected before we had set up our titration system. Assuming the errors are relative, we will present the salinity charts for February 6, 7, only to show the general pattern.

The salinity contours show low salinity water moving from the bay area towards the southeast. The highest salinity water appears in the southern section of the study area. The bay water is probably pushed by strong northwest winds that prevail during the winter months.

Salinity measurements in the following months were calibrated by titration.

March 18, 19, 1969.—An extension of relatively high salinity water from the eastern end of the study area towards the bay area is shown. A gradient of salinity to the west appears to indicate movement of fresh water along the New Jersey coast.

April 8, 10, 1969.—This period is characterized by a strong freshet flowing from the bay area, reaching out far beyond the study area. The furthest seaward extension of the fresh water occurred about mid-April. Salinity data collected by Pearce (Benthos section) during April 17 are lower than our salinity readings during the April 8, 10 and April 23, 24 cruises.

Surface salinity data from the April 17 cruise are as follows:

	Salinity
Station 11 -----	23.2
Station 27 -----	20.8
Station 32 -----	22.2
Station 66 -----	22.6
Station 71 -----	22.3
Station 72 -----	24.8
Section 73 -----	25.1
Station 83 -----	21.7

April 23, 24, 1969.—Strong southerly and easterly movements of low salinity water from the bay area is characteristic of this period. A narrow finger of fresh water moved from the bay southward along the New Jersey shore. Although the entire study area was covered by the fresh water, the salinity readings are higher than those collected during the April 17 cruise.

May 15, 16, 1969.—The salinity of water inflow from the bay area increased by the time of this cruise. As in the previous months, the isohalines indicate a movement of fresh water south along the New Jersey coast. Some pushing of fresh water eastward and a "cell" of relatively high salinity water in the southeast corner of the study area are characteristic of this period.

June 5, 6, 1969.—The freshet during this period is relatively weak. The outstanding characteristic shown is the apparent flowing of fresh water south along the New Jersey coast.

June 26, 27, 1969.—A gradient of salinity paralleling the New Jersey shore and extending into the bay area is a dominant feature of this period. The highest salinity water appears as a bubble in the east section of the study area.

July 31–August 1, 1969.—Relatively fresh water from the bay moved southward along the New Jersey coast. A finger of relatively fresh water also pushed far out to the eastern end of the study area.

August 18, 19, 1969.—The pattern of isohalines suggest an outpushing of water from the bay. A bubble of somewhat high salinity water near the New Jersey shore is the probable result of an upwelling that also appears in the August 18, 19 temperature pattern.

September 15, 16, 1969.—Low salinity water from the bay area evidently moved south along the New Jersey coast during this period. It appears to hug the shore line with very little eastward extension.

Bottom salinity patterns

February 6, 7, 1969.—As discussed before, owing to the possibility that our instrument was faulty, the February 6, 7, salinity readings are probably useful only to indicate patterns. The general salinity pattern is similar to the February 6, 7 bottom temperature pattern.

March 18, 19, 1969.—The patterns of bottom salinity, as of temperature, indicate no dominant feature.

April 8, 10, 1969.—A strong gradient indicating a flow of fresh water from the bay extended throughout the water column. Some movement of fresh bottom water southward along the New Jersey coast is suggested.

April 23, 24, 1969.—The bottom run-off during this period was considerably weaker than in the April 8, 10 cruise. The gradient was weakened and the eastward extension of fresh water was about a mile and one half less. Again, the low salinity bottom water appeared to be moving down along the New Jersey coast. The overall bottom salinity pattern of the study area is similar to the temperature pattern for the same period. The isotherms are roughly parallel to the coasts of New York and New Jersey. The highest salinity water was in the Hudson Channel.

May 15, 16, 1969.—Low salinity water from the bay area extended south along the New Jersey coast. Relatively high salinity water occurred in the Hudson Channel.

June 5, 6, 1969.—An extension of low salinity bay water into the ocean is the dominant feature of this period.

June 26, 27, 1969.—Although the pattern is similar to that of the June 5, 6 period the salinity values are somewhat higher.

July 31–August 1, 1969.—This period was characterized by a gradient of salinity across the mouth of the bay area, and some extension of fresh water south along the New Jersey coast. The bottom water in the rest of the study area had a salinity of 31 o/oo.

August 18, 19, 1969.—We found between 31.5 and 32.0 o/oo salinities in most of the study area. The exception was near the bay area where low salinity water pushed a short distance to the east and south along the New Jersey coast.

September 15, 16, 1969.—A bubble of relatively high salinity water extends towards the base of Sandy Hook, N.J. The bending-in of isohalines in this particular area seems to be a prevalent feature of bottom salinities for a number of months.

Surface drifter returns

We released about 2000 surface drifters in the study area between October 1968 and November 1969. In October, November, and December, we released 100 surface drifters only in the area of the sewage sludge dumping area. Starting in February, we released 200 surface drifters at twenty-three stations. We did not receive any returns during October, November, December, and February and assume that the prevailing northwest winds during this period moved the surface drifters offshore. However, the returns were high for the period March through September.

Releases in February 1969.—There were no returns from the February releases. We assume that the prevailing northwest winds moved all of the bottles out to sea. Bumpus (1965) also recognizes the offshore movement of surface water in the winter months.

Releases in March 1969.—The surface current trend which is clearly shown in the recovery chart of the March releases is to the northeast. All but a few of the 23 bottles recovered moved in this direction.

Releases in April 1969.—The trend of surface drifter movements of April releases is similar to those of March. Sixteen of the 20 bottles recovered had moved northeasterly.

Releases in May 1969.—We received a large return of surface drifters that had been released in May. The pattern shown is confusing but those bottles released in the middle of the study area from the Hudson Channel to the east moved in a general northeasterly direction. Bottles released elsewhere moved generally to the north-northeast. A few moved in a more northwesterly direction. Most of the recoveries from the station in the far southeast corner of the study area moved in a definite northwesterly direction.

Releases in June 1969.—Bottles recovered from releases made at stations near the Long Island coast moved generally shoreward. Releases made near and to the north of the Hudson Channel moved in a northeasterly direction and releases made in the middle eastern section and toward the southwest section of the study area moved southwesterly.

Releases in July 1969.—Although only a few returns are thus far recovered, the general trend of movement was in a northeasterly direction. Two bottles recovered to the south had been released in the southeast section of the study area.

Releases in August 1969.—Sixteen of the 25 bottle recoveries moved almost directly south of the study area. The others moved in a general northeasterly direction.

Releases in September 1969.—Most of the 35 bottle recoveries released in September moved southwesterly. Several released near the Long Island coast moved generally in a northeasterly direction.

Sea-bed drifter returns

We have released nearly 3000 sea-bed drifters (SBD) from October 1968 through November 1969. During October, November, and December 1968 we released 100 SBD per month at station 2-3 in the sewer sludge dumping area. Starting in February 1969 we released 300 SBD per month at 23 stations.

About 70 SBD returns came from the October 1969 releases. All of the recoveries were from or near the Long Island coast, from Rockaway to somewhere beyond Fire Island Inlet. These returns indicate a strong northerly flow of bottom water from the dumping area to the Long Island coast. Apparently, the wide scattering of the SBDs was due to a strong littoral current which spread them out after reaching some point on the Long Island shore line.

The pattern of returns from November and December was similar to the October pattern. However, the number of returns was not nearly so large as in October. Starting in February we released the SBDs in a grid pattern hoping to get a better picture of the bottom current patterns within the study area.

The returns in general were high in every month. Until we make a complete analysis of the SBD returns the patterns are rather confusing. We can, however, deduce some trends at this time which might be useful as a preliminary indication of bottom current patterns.

Releases in May 1969.—Only 23 returns are recorded from releases made in May. Most of the recoveries are from release points in the northeast corner of the study area. The majority of the SBD recovered had moved northwesterly although four released just below Buffer buoy "NC" moved northerly.

Releases in June 1969.—The SBD returns from releases made at stations on the eastern half of the study area moved in a general northerly direction. SBD returns from the western half of the study area moved northwesterly. A total of 33 SBDs were recovered from the 300 released in June.

Releases in July 1969.—Most of the 23 SBD returns for July were released at stations in the middle of the study area. The general movement of the SBD recoveries was northerly or northwesterly.

Releases in August 1969.—A total of 49 SBD were recovered from August releases. The general trend of their movement was northwesterly. As in previous months, the majority of recoveries were made on the Long Island shore.

Releases in September 1969.—Only 23 returns have been received for this month. A backlog of data are still waiting to be processed. However, the few returns show a general northerly movement in the top section of the study area. Inshore SBD releases near the New Jersey coast moved directly inshore.

Releases in February 1969.—Thus far we have records of 46 returns from the February releases. The greatest number of returns were from release stations recoveries were made on the Long Island beaches although a few were recovered on the northern tip of Sandy Hook and several others from Raritan Bay and the ocean by bottom trawlers. The general movement of bottom water from the dumping area is northerly to northwesterly.

Releases in March 1969.—We have recovered 54 of the 300 SBD releases in March. The general area of the release points from which most of the recoveries were made is similar to that in February, that is, between Jones Inlet and the sewage sludge dumping area. Again, the great majority of the recoveries in this area was made on the Long Island beaches. Releases made at stations nearest the New Jersey coast moved inshore in a northwesterly direction. Sandy Hook seems to be a point where many SBDs eventually are beached. The overall movement of bottom water in the dumping area and to the northeast is northwesterly to northeasterly.

Releases in April 1969.—The general trend in SBD drift direction shifted to the northwest in April. Most of the 55 recoveries were from release points around the middle of the study area. Thirteen SBDs were recovered on the tip of Sandy Hook, most of the others on or near the Long Island shore.

Current meter results

Only one short period of bottom current data are presented. Other data are now being processed and will be available soon.

The summation of vectors on a chart of the New York area indicates a theoretical possibility of a parcel of water moving to a point 24 miles to the east of the Obstruction buoy. However, it is not likely that the water actually moved in such a way. The current meter was placed near the edge of the Hudson Channel in an area that is close to the strong northern flow of bottom water. Eddies and counter-currents might have been created by the Hudson Channel current so that a direct plot of the current meter vector summation would be invalid. It is more likely that the changes in current direction and speed indicated on the progressive vector summation is local and indicates changes in flow through the Hudson Channel.

In light of data we have collected we are presently placing current meters in strategic locations.

Dissolved oxygen (bottom)

July 31–August 1, 1969.—The lowest oxygen readings from July 31–August 1 were along the New Jersey shore. The oxygen readings on the Shrewsbury Rocks were 1.5 ppm, with fingers of 0.5 ppm intervals to 3.0 ppm pointing north.

August 18, 19, 1969.—A significant drop in oxygen reading from the July 31–August 1 cruise is the outstanding feature of this period.

September 15, 16, 1969.—The oxygen readings were relatively high throughout the study area with the exception of a pool of low oxygen off the lower Sandy Hook coast.

Discussion

We are conducting a hydrographic study of the New York Bight to determine the movements of water in this region and their possible effects on the location of the waste disposal grounds.

Although the study is incomplete and will continue for another year, some hydrographic features reveal patterns indicating certain movements of water. Preliminary analysis of retrieved sea-bed and surface drifters, as well as of temperature and salinity data gives us some idea of the monthly current patterns of the New York Bight. Analyses of current meter data is underway and will be reported upon in the final report.

We did not obtain as many returns from sea-bed drifters released in the Hudson Channel as expected, perhaps because deep, soft mud on the bottom of the channel trapped some of the drifters. We intend to use divers to observe the behavior of the sea-bed drifters in the Hudson Channel in the next few months. We will then make conclusions about the reliability of the drifter data in that area.

In February, the bottom temperature and salinity distributions suggest a movement of relatively warm high-salinity bottom water up the Hudson Channel and to the north or northeast.

The pattern of the bottom isotherms and isohalines generally reflect the depth contours of the study area. The topography of the Hudson Channel becomes shallower and turns to the northeast at its northern extreme. The isotherm pattern also turns to the northeast at the head of the Hudson Channel. Cross sections of temperatures and salinity show a dome of warm-high salinity water over the Hudson Channel. The dome is skewed several miles to the east and suggests that the Channel water was pushed to the east as it flowed north.

By diagrammatically joining stations from which were obtained equal numbers of drifter returns, we found the elliptical pattern of the contours near the Hudson Channel superimposed on the temperature and salinity charts, to suggest a movement east and somewhat north.

Movement of bottom water up the Hudson Channel is evident in most months in which we collected data. As mentioned before, the turning to the northeast of bottom water at the head of the Channel is due mainly to the bottom contours which form a natural channel that turns to the northeast. Pearce (Benthos section) found that organic waste and iron settlement is distributed from the dumping area to the northeast, indicating that bottom currents may carry the waste in that direction.

During each month from June through September, cool bottom water appears to push up towards the Long Island coast. This movement evidently became strongest in August when the bottom temperatures of the study area were cooler than in July and September. The cool water seemed to come from the Hudson Channel. The pattern of returns from bottom drifters released in August, 1969 suggests a path of sea-bed drifter returns from the Hudson Channel northeasterly to the Long Island coast. This path correlates with the pattern of bottom temperature for August. There is some evidence that the pushing of the cold bottom water into the New York Bight is an annual summer phenomenon which normally is strongest in July (1969 was an anomalous year).

During the summer the bottom isotherms east of the Hudson Channel bend southward, indicating a bottom current of a relatively warm water moving south. This might be a current running counter to the northward flowing Hudson Channel bottom water. The most dramatic movement of warm water to the south is shown in the August 18-19 bottom temperature chart during the time when the cold water in the Hudson Channel moved north. Cross sections of the study area during August 18-19 show isotherms bending down and touching bottom in the areas of the southward flowing current. More supporting evidence of a southerly flowing counter-current is the absence of SBD returns in the areas where the isotherms curve to the south.

We plotted lines between stations from which equal numbers of seabed drifter returns have been obtained since the beginning of our study and found two release areas yielded the fewest recoveries. One of these areas was in the southeast corner of the study area. Two factors could account for the small returns from this area: 1) it is the farthest away from the shore and 2) the counter current moving south in that area could have carried the drifters away from shore.

The other area of fewest returns is in the northwest section of the study area, some miles east of Sandy Hook, N.J. This area is surrounded by high return areas of SBD and is close to the N.J. shore line. A possible explanation for this low SBD return area is the existence of a rotary current which keeps the SBDs moving in a circular path. Unfortunately, this area is an unimportant commercial fishing ground and the chance of trawl fishermen recovering them is slight.

During the late spring and summer there was a persistent bubble of cool water at the surface near the head of the Hudson Channel. Its size and shape varied from time to time. The bubble was several degrees cooler than the surrounding water. Ketchum, *et al* (1948) also found this cool area in 1949 and attributed this to a tidal upwelling.

Cross sections through the cool water bubble show a bending upward towards the surface of several isotherms above the thermocline. It is possible that the movement north of the Hudson Channel water has some effect on this weak upwelling.

Ketchum *et al* (1948) described the salinity of freshets that pushed out from the bay area to become distributed in a narrow band along the New Jersey coast. We found virtually the same pattern where, in 1969, fresh water was distributed south along the New Jersey coast during most cruises.

Murky water prevailed along the northern New Jersey coast throughout the year. The murky water apparently moved south with the fresh water flow.

Our preliminary studies indicate that the present sewer sludge dumping ground is in the middle of a very dynamic hydrographic system in which strong inshore and alongshore movements of bottom water are among the most important features.

Future work

The most significant part of our hydrographic study thus far is the development of a series of hypotheses regarding current patterns which we will test in the next year's work.

Besides the continuation of the past year's sampling techniques we plan to do the following during the ensuing year:

1. Place current meters and thermographs in specific locations such as the bottom of the Hudson Channel, to test the hypothesis that a current flows north up through that natural channel.
2. Locate current meters and thermographs east of the Hudson Channel to test the hypothesis that a counter current flows south in this area, and locate current meters east of Sandy Hook to test whether there is a rotary current in that area.
3. Revise the array of the sampling stations. Examine more closely certain features within the study area.
4. Analyze the drifter data for current vector patterns. Mr. Norcross of the Virginia Institute of Marine Science has expressed a willingness to help us work up a drifter analysis program similar to one he used on a Chesapeake Bight study.
5. Analyze wind data collected at Ambrose Light in relation to movements of surface and bottom water.

DISCUSSION

This is a preliminary report on the results of 15 months of studies in the New York Bight to chart the dispersal of various pollutants which are dumped at sea, and to measure their biological effects.

Our program has included a biweekly survey to determine hydrographic patterns and the composition and relative number of species in the benthos, plankton and, to a more limited extent the ichthyofauna over the study area.

The weight of our evidence to date shows that sewage sludge (which in the first year has been the principal subject of our attention) has spread out in a northerly direction from the designated sewage dumping grounds over an area of 14 square miles. Here the benthic macrofauna has become severely impoverished in contrast to that of the surrounding area. Several species which may be tolerant of polluted conditions, nematodes and the rhynchocoelan rubber worms, were absent from the impoverished area.

The center of the designated dumping ground for dredge spoil is about four miles from that of the sewage sludge. The dredge spoils, which are heavier than the sewer sludge, evidently do not disperse far from the dumping site, so that the dispersal area is only about 7 square miles in extent even though a greater mass of spoils is disposed of. According to our studies to date, the impoverishing effect of the dredge spoils is even more severe than that of the sewage sludge.

A large area east of the sewage sludge grounds is covered with organic matter whose origin we have not yet determined. Judging from our hydrographic studies, it may have originated from the sewage sludge. This will be the subject of further investigation.

The impoverishing effect of these pollutants may result from a multiplicity of factors. These include low dissolved oxygen during the summer, heavy metals and pesticides which are toxic to marine organisms, and a variety of microorganisms which can invade the tissues of invertebrates and fishes resulting in debilitating disease. Furthermore water contaminated with sewage sludge inhibits cell division of phytoplankters.

The results of our investigation also indicate that materials having their derivation in the sewage disposal area are moved principally to the northeast towards the shores of Long Island. Distribution patterns of organic materials associated with bottom sediments, organic matter in the water, and heavy metals, all corroborate the dominant northeast movement of water indicated by our hydrographic studies.

We have not yet found any major effects resulting from the disposal of industrial acid wastes. Our preliminary investigation does indicate, however, that certain species of zooplankters contain heavy metals, the origin of which we have not yet determined. We plan to pursue these studies further during the early part of 1970. In particular we would like to sample more intensively the benthic environment underlying the acid waste disposal area. This would involve both laboratory and field studies of the animals living there.

We are presently conducting additional field and laboratory studies to fill in gaps indicated by our work to date and to integrate and interpret the mass of our hydrographic, meteorological, and biological data.

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Mr. HOWARD. We thank you also for the report that we will be receiving of the information that you gave us with the slides, and with the commentary which explains in full just what your report indicates as the result of the dumping of sludge off the Sandy Hook area; and we hope you will be available for further hearings of the subcommittee which will be held in Washington in the near future. Thank you very much.

Mr. MEACHAM. Thank you very much.

We will be seeing a great deal more of each other, I am sure, and I think, as Congressman Olsen indicated, we spent years and years developing techniques and methods and progress of how to haul these things to population centers; and we have not spent much time determining how to haul the residue away.

Now we have to put on the price-tag, whether it is on the transportation end, or whether we have to pay for this separately; but it is time to face up to the issue that we have to take it away—

Mr. OLSEN. We pay for a bottle of pop, and we are willing to pay for it; but we are not willing to pay to get rid of the bottle.

Somehow it has got to get across to everybody that you have to pay for getting rid of this debris, just as you pay for getting the product and the package that the product is in.

Mr. MEACHAM. Yes, sir; you are quite correct.

Mr. HOWARD. Thank you very much.

We are going to have to have about a 15-minute limit on the final witnesses that we do have.

Our next witness, who we are very happy to welcome before the subcommittee, is one of the top men in the area of clean air and clean water in the State of New Jersey, the director of the New Jersey State Division of Clean Air and Water, representing the State government and representing our Governor, William T. Cahill, Mr. Richard J. Sullivan.

Mr. Sullivan, welcome to the subcommittee. Our chief counsel is also Richard J. Sullivan, so we are very happy to have both of you in the field of preservation of our air and water.

Please identify the gentleman who is with you and then proceed, please. We hope you will be able to summarize, so there may be a few minutes for questioning from the members of the committee.

STATEMENT OF RICHARD J. SULLIVAN, DIRECTOR, NEW JERSEY STATE DIVISION OF CLEAN AIR AND WATER; ACCOMPANIED BY ERNEST SEGESSER, CHIEF, NEW JERSEY STATE WATER POLLUTION CONTROL PROGRAM

Mr. SULLIVAN. Thank you, Mr. Chairman.

The gentleman with me is Ernest Segesser, who is chief of the State's water pollution control program.

Water pollution control is part of clean air and water.

Mr. Chairman, I have a statement that was issued by Governor Cahill on the 15th of February, that bears on this issue. It was released

to the press at that time, and I think it would be of interest to the committee to have it made a part of the record.

Mr. HOWARD. Without objection, so ordered.

(Statement by Governor Cahill follows:)

STATEMENT BY HON. WILLIAM T. CAHILL, GOVERNOR OF THE STATE OF NEW JERSEY,
ON SLUDGE BARGING TO SEA

Earlier this week, it became necessary for me to proclaim a state of emergency in New Jersey in order to prevent horrendous pollution of our northeast rivers and bays. Under my statutory powers to protect the public in an emergency, it was further necessary for this State to commandeer three ocean-going barges and their crews to effect the disposal of sludge—the material removed from sewage by treatment—from six of the State's largest sewage treatment plants. Still further, it was necessary for me to seek, and obtain, through the offices of the President of the United States the use of U.S. Coast Guard tugs to propel these barges to sea for dumping. Our inability or failure to take any one of these steps would have resulted in the release into our rivers and bays of 500 million gallons per day of untreated sewage and industrial wastes. This amounts to about one-half of the wastes treated in all of New Jersey's sewage plants and its raw release is clearly intolerable.

The immediate cause of this emergency was the labor strike of tugboat operators. It seems to me, however, that much larger issues are involved than that of the strike.

In the last fifty years, the citizens of New Jersey have invested almost \$1 billion in sewage collection and disposal systems for the convenience and water quality protection they would provide. With the aid of our 1969 clean water bond issue we are now launched on another \$1 billion construction program for water pollution control. For the operation of a substantial part of these facilities precariously to depend on whether or not there is a tugboat strike, or a strike of barge operators, or upon the vagaries of weather affecting ocean-going travel, or upon other such uncertainties is wrong and unacceptable. Such brinkmanship is incompatible with our ambitious efforts to eliminate the pollution of our waterways.

In addition there is the question of the impact upon our marine environment of the continued practice of dumping millions of tons of sewage sludge, harbor dredgings and certain chemicals in disposal areas less than twelve miles off the Sandy Hook beach. A study of this impact has been underway for more than a year by the Sandy Hook Marine Laboratory on behalf of the U.S. Army Corps of Engineers. An interim report of the findings of this study was made available to us late yesterday. I have discussed this issue and the significance of the report with officials of the State Health Department.

The report offers evidence that harbor dredgings dumped at the sea disposal site are finding their way to the New Jersey coastline. Evidence has not yet been adduced that sludge dumpings reach our surf waters. It is clear that the disposal sites and their environs are devoid of marine life. I am also informed that the invasion of the red tide—a proliferation of toxic microorganisms—which afflicted our beaches two summers ago may have its genesis in the nutrient materials at the dump site.

While the report deals exclusively with dumping off Sandy Hook, similar questions can be raised about dump sites ten miles from the entrance to Delaware Bay used by the cities of Camden, Philadelphia, Baltimore and others.

All things considered, it is my judgment that the ocean dumping of harbor dredgings and sewage sludge a scant twelve miles from our coast is a primitive, insensitive, and unacceptable method of disposal. I realize that as is usually the case in environment protection, there is not a clear choice between the right way and the wrong way. There is a need to make a choice among several somewhat unsatisfactory alternatives. In my opinion we should do the following:

1. Begin phasing out ocean dumping as a regular, accepted, method of disposal of sewage sludge off our coast, and of toxic industrial materials off the continental shelf one hundred miles to sea.
2. For the next few years that it will inevitably take to provide on-land sludge disposal facilities require that all dumping of sewage sludge and harbor dredgings be one hundred miles at sea off the continental shelf. This can be accomplished by agreement or by Congressional enactment requiring that such deep sea dumping be a condition of all permits issued by the Army Corps of Engineers.

3. Incorporate in the design of all new sewage treatment plants facilities for sludge disposal other than by dumping at sea.

4. Seek through agreement or by Congressional enactment the requirement by the Army Corps of Engineers that a condition of ocean dumping permits will be a showing by the applicant that some steps are being taken to provide for on-shore treatment and disposal in the future.

5. Seek the agreement of New York State in this changed approach to sludge disposal in recognition of the fact that New York City and other communities now dump more than twice as much sludge as does the State of New Jersey; and, as well, to seek the concurrence of the States of Pennsylvania and Maryland.

I am informed that sludge disposal by landfill or by incineration are not without their own problems—problems of potential land and air pollution, as well as the high cost of facilities. I am also informed that many of the toxic industrial chemicals now disposed of by deep-sea dumping are difficult and expensive to treat otherwise. We hope that in all of these areas technology, upon demand, will give us innovative improvements. In any case, however, hard choices must be made now if we are to restore and protect the quality of our physical environment.

Mr. SULLIVAN. Instead of taking time to repeat that statement, I would like to refer to it and make observations on problems in general.

What the Governor said at that time was, noting a week previously, it was necessary for him to declare a state of emergency in New Jersey because of the tugboat strike.

The tugboat strike prevented the hauling of sludge in barges out to sea to be dumped in the area that is under study now. It threatened a crisis, our treatment plants, to process more than half the waste of all of New Jersey; that would have shut down in a matter of hours had not the declaration been made, and had not the State seized the barges, had not the White House itself instructed the Coast Guard to provide tugs to take these vessels to sea.

The Governor made a comment in his statement, and I would like to quote, there is one sentence that says:

For the operation of a substantial part of these facilities precariously to depend on whether or not there is a tugboat strike, or a strike of barge operators, or upon the vagaries of weather affecting ocean-going travel, or upon other such uncertainties is wrong and unacceptable. Such brinkmanship is incompatible with our ambitious efforts to eliminate the pollution of our waterways.

That is one reason why the statement goes on to say, in effect, that the ocean dumping of these wastes is contrary to the public interest.

The other reason is the question that has been dealt with in previous testimony, and that is the effect of this practice on the marine environment.

The interim report has occasioned these conferences. We have heard testimony upon the effect of the environment. It is our judgment, looking at all of the facts that are available to us now, that we should begin now to phase-out ocean dumping as a regular method of the disposal of sewage sludge and of industrial chemicals; and that in the interim, while we are busily engaged in developing onshore disposal facilities that do not now exist, that all of these wastes and all of the harbor dredgings be taken to the edge of the Continental Shelf or about 110 miles to sea.

Our position is really uncomplicated. Right now these vast quantities of sewage sludge of harbor dredgings and of certain chemicals are disposed of within 12 miles of our coast. The really awful stuff, the toxic materials, are taken to the edge of the Continental Shelf, so that all we are really recommending at this point is that we decide that all of this

stuff is really pretty awful, and take it all to the edge of the Continental Shelf in order to resolve the doubts that we may have in favor of environment, instead of in favor of lower cost.

There are a couple or arguments that I will talk to very briefly as to why this should not be done.

The first one, for example, and we have all seen it in the press, is that there is now inconclusive proof of harm caused by present dumping methods. We have not found the sludge on the beach, I take this argument to mean.

That this is only an interim report, and we should wait until the report is finished—well, in the business of pollution control, the proof of harm is always inconclusive; and my feeling is that when this study is concluded, with the best scientific expertise provided, a year from now it still will not be possible to say that no harm is coming to the beaches; certainly would not be possible to say that no harm is coming to the marine environment.

We run upon this argument in any area where steps need to be taken for pollution control purposes.

When the State of New Jersey, two years ago, promulgated a code of regulated fuel, to keep the sulphur dioxide out of our atmosphere, there were pages and pages of testimony that there is no proof that sulphur dioxide has increased the incidence of emphysema or lung cancer or anything else.

It is preposterous to take that position.

Our view, in both air and water, of pollution is: the less the merrier. And in this case, the less simply means the extra margin of safety gained by the distance and by the great depth if all these wastes are transported off the Continental Shelf.

The next argument that I have seen in the press says that to transfer the location from where it is now to 100 miles to sea will delude the public into believing that the problem has been solved, that it will be out of sight and out of mind, that we ought to take it out to, say, 25 miles; so it will still be close enough to home that the public will continue to worry about it.

That argument has also been raised in other pollution areas, too. It has been suggested to us that however diligent our enforcement in air pollution control, we should leave untouched a couple really glorious, stinky and obvious pollution sources, so they will be around to remind the public that the problem is here and that we will need their support to deal with the more difficult and more important sources of pollution, which are not, in themselves, noticeable and objectionable.

It is also a little bit like hoping we will have a couple cases of small-pox each year so parents will be persuaded to continue the vaccination of their children.

In our view, it is an unacceptable argument. I think it is even more unacceptable to consider the possibility here of having crapped up a 15 square mile area with this dumping; that we will now pick up our equipment and move, say, another 12 miles to sea, where we do not have the greater depth that we have off the edge of the Shelf, and begin systematically to crop up another 15 square miles.

So, in our view, the zone should be transferred to the edge of the Continental Shelf.

The third argument is there is not enough equipment available in order to transport these materials to that great distance. I think there is validity to this argument.

The argument is often made when proposals are offered, however, for pollution control. There was not, the testimony said, enough low-sulphur oil to meet the sulphur requirements of New Jersey, back in 1968 when hearings were held.

It did not exist, the testimony said, from honest witnesses. But when it was put down in black and white, it turned out, at midnight of the day before the effective date, there was enough; and there has continued to be for the year and a half the code has been in effect.

It is part of the function, I think, of Government to mandate the market; and if it is put down in black and white, that the requirements are changing and that these materials must be taken this great distance, that we will soon find out whether or not there are contract services that can aid industries and municipalities in transporting these materials to 100 miles.

I do not see any reason, for example, why the transportation equipment has to be limited to the barge types that are now in use. If, by statute, a market is created for the transportation of this material greater distances, I have the feeling that capitalism will shortly thereafter provide the equipment to do so.

The last argument is that the cost is excessive. No one ever attended a public hearing on pollution control where excessive cost was not offered as a reason why something should not be done.

Obviously, the cost will be higher. We will have several million dollars, at least, for added cost in transporting the materials 100 miles instead of 12 miles.

We have capital costs of constructing onshore disposal facilities, which ultimately should be the method of choice. Control itself, in this area, is enormously expensive.

My judgment is that, as a professional bureaucrat in this field, that the public has come to recognize that this is the case, that it is willing to spend its money to solve its problem, and as a ratification of that theory I invite your attention to our Clean Water Bond Issue last November, where our voters decided, three to one, to tax themselves \$271 million to help solve this problem.

Now, in the press and elsewhere, some people have been yelling at the Army Corps of Engineers over this pollution problem at 12 miles at sea. I think it must be remembered, however, and we do not find ourselves in complete agreement with the Corps, either, but I think it must be remembered that this is not Army Corps pollution we are talking about. This is the dredging from our polluted waterways which have been carted out to sea. It is the sludge from our sewage treatment plants as well as the chemicals from many industries.

I do not think that the Army Corps should be thrust in the position, administratively, to decide whether or not the public should bear the cost of transporting these materials 100 miles.

I think that is a question for the political process, and in my own judgment the best way that political process can be exercised is for this committee and the Congress to approve an enactment that will set the rules from now on.

I would like, in concluding, to make a couple of comments about the proposed bill itself.

First, a rather technical point, if you will pardon my whimsy, that the Ambrose Light not be the point of reference. The bill gives the impression that its purpose is to avoid pollution of the Ambrose Light, and that if one were to dump the waste in the surf of the New Jersey beaches, it is okay, so long as it is 25 miles away from the Light.

I think, furthermore, consistent with the testimony already given, that the limit should not be 25 miles, but that it should be to the edge of the Continental Shelf. I think there ought to be some one or some agency of government empowered to affect an outright prohibition of ocean dumping at some predictable time in the future.

There is relatively little work going on right now on land to provide other methods of disposal of these materials because there is always a barge there to put them in. I think if we set a deadline in the statute, whether it is three or four or even five years from now, after which ocean dumping will be outlawed, that incentive will be increased.

One final point. We are dealing today with Sandy Hook, because the Interim Study has been done in the waters off Sandy Hook. We also have dump sites outside of the bay of the Delaware River, and where we think we have problems here, there is no regulation in that area, there are no Army Corps of Engineer permits, there is no harbor supervisor; and anybody can dump anything he wants at any place.

I understand that this dumping also takes place at the mouth of the Potomac, but that is an area outside of my jurisdiction, and I will not worry about it there.

I would recommend to this committee, however, that the jurisdiction of whatever bill it recommends into the whole committee be expanded to deal with the problem of offshore dumping of these harmful materials.

Mr. HOWARD. Thank you, Mr. Sullivan.

The Chair stated at the beginning of the hearings that the legislation in question was a taking-off point for discussions and information, and it was expected that this bill, or any legislation which might go before the full House, would probably be very different from that which is in print at the present time.

The bill was prepared by the staff of the committee in a very short time. It was not done in a whimsical manner, and we hope that we will be able to use your expertise and information we have already received it from you and others, which would permit us to amend it in a manner other than whimsical.

To a great degree, though, what probably pollutes the Ambrose Light pollutes the New Jersey shore; so maybe it could stay in there. I am very happy that New Jersey has one of the finest men in water pollution control in the country. Your reputation has gone down past the Potomac to the Halls of Congress, and I believe that States like New Jersey and New York, with the leadership that you provide in this area, will help the Congress so that we can clean up one of our most polluted areas, the Potomac, which is not just a disgrace for the Congress or the District of Columbia, but really a disgrace for the United States.

To return to the dumping—you have stated that the ocean should not be a dumping ground at all. I agree with you, and I am sure that the committee does as well. In the end, elimination of pollution will eliminate your job; and I am certain you will be glad to see your job end when there is no pollution to worry about.

I would like to ask you a question now, regarding the disposition of this material on land, until we get the kind of treatment which will pose no sludge problem at all. I believe you have the technical expertise to assist the committee in this area. We have heard discussion for many years now about the possibility of putting many of these materials together, or certain of them, in a method known as composting, which converts materials to a low-grade fertilizer.

Would this method be a possibility, and do you know whether scientifically we are that far?

When I was speaking with people in Europe, the Public Works Director in Switzerland told me they do it rather profitably. But many people in the United States told me this was not very practical, because there was not a market for low-grade fertilizer in the United States. You can get good fertilizer so cheaply here.

Landfill is another one of our pollution problems besides our air and water; we know our country may suffocate some day in our own garbage.

Do you have any ideas that you could add to your statement at the very beginning about where we ought to be going today as far as sludge is concerned, other than the ocean?

MR. SULLIVAN. In my judgment, all available methods of sludge disposal are bad. We need to make a choice from among unsatisfactory alternatives. We either dump it in the ocean and thereby pollute that waterway; we incinerate it and pollute the atmosphere to some extent; or we bury it and pollute the land.

It is not true, as has been suggested by a few questions earlier, that if we improve the kind of treatment facilities in the future by spending all this money that this problem will be solved. It will not.

But I would like to ask our Chief Engineer a question, to let him observe, give his own opinion on this matter of sludge disposal, and whether there are any hopes of whether things will be improved a little bit in the future.

MR. HOWARD. Fine.

MR. SEGESSER. One of the reasons that we are faced with the problem, at least in the shore areas, is that barging is very cheap, and, as a consequence, very little effort, and I suppose it is understandable, very little effort has been directed in the coastal municipalities to provide for some other means of sludge disposal than that of the cheapest available.

There is absolutely no question that sludge disposal and conditioning should receive top priority, particularly on the part of the Federal Water Pollution Control Administration in its research and development activities.

We have many problems with regard to disposal and conditioning of sludge in this area, in that because of the toxicity that prevails and is a residue, but it is a problem that will not be resolved overnight; that it requires the diligence of the technocrats and, I think, the political

people in order to avail ourselves of alternatives that I think are going to be necessary in the future.

Mr. HOWARD. Thank you.

In the interest of time, I will not ask any questions, but just make one observation which I think you brought before us, Mr. Sullivan.

In 1965, when the Federal Government really began its first Clean Waters Act, the major problem in the country, for water pollution, was the need for sewage treatment. It was not industrial, particularly, but more residential, where communities were growing up and did not have the facilities. At that time a great amount of the Federal funds that were to be appropriated were to be to help States in the sewage treatment plants construction. A relatively small amount, really, went into research for new methods of eliminating such problems as we now have with the sludge.

We almost thought we had all the answers at that time.

It is very obvious now, and you point it out so well in your testimony, that we do not. And in our future legislation I believe that we will find the need for finding a lot more answers. It used to always be said that the only simple solution for all kinds of pollution is money. It really is not.

In some areas of pollution, when we have enough money we can clean up that kind of pollution. There are other areas in which I think we must improve, because we really do have a problem here, even, as I say, if tertiary treatment will not be the final answer. Thank you very much, Mr. Sullivan. Mr. McCarthy?

Mr. MCCARTHY. Mr. Sullivan, I can see that you have done a lot of research on this. I wonder if you determined, by what authority would the United States unilaterally legislate regarding dumping in international waters?

Mr. SULLIVAN. I have done no research on this question whatsoever.

Mr. MCCARTHY. But you recommended it?

Mr. SULLIVAN. We are doing it now. We are simply recommending an extension of the practice to include the materials that are now being dumped close to shore.

Mr. MCCARTHY. Well, you were in the room when Colonel Barnett did not really have an answer to a similar question I put to him. I think it is clear that we do not have this authority. In order to obtain this authority, it would be necessary to negotiate an international treaty.

Mr. SULLIVAN. I think there is a question as to whether we have the authority to make these people take it that far, which I think is distinct from, is there any prohibition against us using international waters for those purposes?

Mr. MCCARTHY. There is. There are treaties that prohibit pollution. If we say 100 miles from the U.S., why should we not say 100 miles from the coast of Ireland?

Mr. SULLIVAN. I will not answer that one!

Mr. MCCARTHY. Now, looking ahead, you say tertiary treatment is not the answer, either. Well, what is?

Mr. SULLIVAN. The reason I make that point is that the impression might have been given that if we only improved the treatment, that we would not have this nasty sludge, but the sludge is essentially what is taken out by treatment, it is left off by treatment.

So we need to improve treatment, but it will not solve this problem.

Mr. OLSEN. Why not?

Mr. MCCARTHY. Because we will still have sludge to dispose of, even if treatment is improved.

Mr. OLSEN. We are talking about treatment, we are not talking about dumping something that continues to be toxic or noxious. We are talking about treatment, are we not? Is there a chemical limitation?

Mr. SULLIVAN. I do not know if there is any limitation. In the operation of treatment facilities, to get it right down to basic terms, we are trying to separate the dirt from the clean water.

Mr. OLSEN. Let me give you an example.

I was in Congress long enough ago, when we were arguing with the people that were developing the detergents, and it was not chemically possible, absolutely was not engineeringly chemically possible to develop a chemical that would substitute for the detergents and give us a degenerable detergent.

And they got all that testimony in, and then, one fine day, one late summer, we learned that the country of West Germany was that very October going to prohibit the manufacture of that product any further.

Well, what happened?

Everybody had to come back in and remedy their lie. They had to come in and tell the truth, that what they really meant was that they did not want to do it, but when we put them to the question, how soon they could do it, they decided they could get it done in 18 months.

That is the point that I want to address ourselves to, that it is chemically possible; and we are kidding ourselves if we say taking it out 100 miles solves it.

Because you do not know. It may come back to the New Jersey shore from 100 miles just as easily as it can come back from this "flashlight" out here.

Mr. SULLIVAN. That is entirely true.

Mr. HOWARD. Off the record.

(Discussion off the record.)

Mr. HOWARD. Mr. Hammerschmidt.

Mr. HAMMERSCHMIDT. No questions.

Mr. HOWARD. Thank you very much, Mr. Sullivan.

We hope we can be in touch with you in the near future, before we complete our work on this. We are very grateful for the information you have already given us.

Mr. HAMMERSCHMIDT. Mr. Chairman, if I could just take 10 seconds to thank the gentleman for his testimony and to tell the Governor how much we miss his fine services in the House and to send him our best regards.

Mr. OLSEN. Bring him my greeting, too.

Jim Cahill and I are good friends. I wish him the very best, and I hope everyone gives him cooperation, because he is a real leader.

Mr. HOWARD. We are running closer to our deadline for departure. We are very happy to next have before us the Water Chairman of a group which has been involved in water pollution control and other progressive legislation for many years, and a group which has, especially during the past several months, involved itself in this par-

ticular sludge problem of Monmouth County, Mrs. R. O. Rippere, the Water Chairman of Monmouth County League of Women Voters.

Mrs. Rippere, we are very pleased to have you before the committee. If you would proceed as you wish.

**STATEMENT OF MRS. R. O. RIPPERE, WATER CHAIRMAN,
MONMOUTH COUNTY LEAGUE OF WOMEN VOTERS**

Mrs. RIPPERE. You realize at this point I have nothing to say that has not been said.

Mr. HOWARD. We know that most of the things have been said, but when you follow politicians you find that all the bases have usually been covered; but please give us the benefit of your views, and if you wish to add to them later, the committee will certainly accept it.

Mrs. RIPPERE. I have four beautiful pages of literature here, and I wonder if you want me to select or just go through it—it takes about six minutes if I just read it.

Mrs. HOWARD. Six minutes you may have.

Mrs. RIPPERE. I am Water Chairman of the Monmouth County League of Women Voters.

We are happy to have this opportunity to state our position in regard to the dumping of waste sludges in the ocean. We are gratified that the problem is getting so much attention from the various levels of government.

It has consistently been our contention that the matter deserves public consideration. The ocean and its productivity belong to the people, the cost of sewage plants is borne by the people, and the end results of sewage treatment should rightly be the concern of the people.

It is the belief of the League that, in view of the growing world population, the increasing destruction of fertile farmlands and the mounting evidence of serious disruption of our environment, we can no longer afford to take unnecessary chances with the health of the ocean ecology. To continue the practice of dumping sludge is, in our minds, taking such a chance.

We have given this question a great deal of study and thought over the past year. We are aware that there are few, if any, simple answers. Nevertheless, one undeniable fact stands out in our minds: that when 15 square miles of productive ocean bottom have been literally killed by the dumping of waste sludges, the practice is harmful and should be stopped with all possible speed.

Reading the Interim Report on the effects of sludge dumping prepared by the Sandy Hook Marine Laboratory leads us to the conclusion that there are other evidences of potentially serious environmental damage.

I would like to quote from one section of the report:

On 9 September 1969 David Barber, Woods Hole Oceanographic Institution, collected bottom and surface water samples from Raritan Bay, Verrazano Narrows and the sewage sludge dumping grounds. Phytoplankton organisms indigenous to surface waters survived well and continued to photosynthesize and undergo cell division in filtered bottom water from Raritan Bay and the Narrows; Filtered bottom water collected from the sewage sludge dump area, however, completely inhibited cell growth. Several replicate experiments were performed, all with similar results.

On October 30, Dr. Barber took samples from six of the study stations. Bottom waters from two of the stations had no inhibitory effect on phytoplankton cell division and growth. Bottom waters collected at four other stations, however, did have an inhibitory effect. The three stations showing the greatest inhibitory effect are located east or northeast of the dumping area, which suggests that the influence of the sludge extends to the east and northeast in the general direction of the current.

The inhibitory effect on phytoplankton certainly indicates that other organisms in the food chain may be similarly affected.

Although these and other tests indicate a flow of pollution from the dumps toward the fertile Hudson canyon and Long Island beaches, bottom drifters placed in the dump sites by the Marine Laboratory have also washed up on the shores of New Jersey.

Further, sludges in the dumps contain pesticides, toxic petroleum pollutants and such poisonous metals as lead, copper, and chromium.

Zooplankton on which larger fish feed have been found to contain traces of heavy metals. Magnification of the amount of pesticides and metals occurs as higher forms of life become involved.

We do not know at the present time what effect these accumulated toxins may have on the human body. The League feels, however, that any doubt as to whether or not the ocean food chain is involved is enough to warrant cessation of any possible source of contamination. We believe sludge dumping is one such source.

For this reason we heartily approve the idea that a deadline be set beyond which ocean dumping will not be permitted. We also endorse Governor Cahill's suggestion that barging permits be granted on the basis of proven steps to convert to in-plant treatment of sludge.

While we have made no study of methods of disposing of dredging spoils and metal residues, studies indicate that sewage sludges can be processed for use on land at considerably less than prohibitive cost to the individual home or building owner.

For instance, a county sewerage engineer has quoted an average cost of \$1.83 per hookup per year to provide the vacuum filtration method of sludge treatment. Such dried and processed sludge can safely be used as a soil conditioner or can be disposed of in land mining or solid waste disposal sites where it can be easily contained.

We do not feel qualified to take a position on a preferred distance offshore or on a less detrimental site for dumping in the interim period before in-plant treatment can be established.

However, the cost of barging further from the plant sites must be considered. We have been told that barging further offshore will require, in some cases, the purchase of larger and stronger barges.

In addition, more trips will have to be provided to carry the same amount of sludge further out. Consideration must also be given to the fact that some of our choicest food fish lay their eggs far out to sea. What effect moving the dump sites to that vicinity would have, we can only surmise without experimenting.

Further, we feel that discussion of barging and ocean dumping grounds must include consideration of the possibility of escalating costs. The price of solid waste disposal on land has become a serious problem in some areas and we wonder if this might not also occur at sea once preparations for barging are completed and contracts ready to be signed.

Although, in all probability, better policing of dump sites would be advantageous, it seems to us that real enforcement will remain a problem. As long as storms or strikes can interfere with regular barging schedules, strains on land storage capacity will inevitably occur, which may necessitate, as they do now, dumping before the prescribed distance can be reached.

Therefore, while new dump sites may be the best interim solution, they certainly cannot be justified as a long-continuing or ultimate answer. We would like to see the costs of any interim measure held to a reasonable minimum.

To sum up, because of the death of a highly productive part of the Continental Shelf, the indication of pollution spreading beyond the boundaries of the dumps and the questionable costs of barging, the League believes that immediate orders should be given to all sewer plants in the planning stage or in the initial phases of construction or modernization to provide some form of in-plant sludge disposal.

Federal and State impetus to construction of sewer systems makes the immediate issuance of such orders imperative.

Here in Monmouth County, where we are on the threshold of providing new sewer systems to a large portion of the county, delay will cause heavy financial loss as well as a continued threat to our water-oriented economy.

I want to read a telegram which was sent by a number of organizations to the President yesterday.

A serious environmental problem threatens ocean resources. We urge you to direct the Army Corps of Engineers to terminate present dumping of sewer sludge and dredge spoils in the coastal waters of New York bight to protect the ecology of the rich coastal zone.

Mrs. RIPPERE. This was signed by the Monmouth County Conservation Council; Hudson River Fishermen's Association; Monmouth County Council, League of Women Voters; Highlands (N.J.) Baymen's Protective Association; North Jersey Commercial Fishermen's Association; Conservation Commission of Fair Haven, Little Silver, Middletown; American Littoral Society; Sierra Club, Atlantic Council; Save Our Stripers Committee; National Audubon Society; Suffolk County Fish and Game Association; Suffolk County Conservation Council; Suffolk County Federation of Sportsmen's Clubs; Citizens Committee for the Hudson River; Izaak Walton League of America, a total of 17 organizations.

Mr. HOWARD. Thank you so much, Mrs. Rippere, for your testimony. Although I am certainly aware of the activities of your organization in so many areas, including education, your work toward conservation, the efforts of your group throughout the country, has certainly been one of the reasons that we have developed comprehensive water pollution control legislation. All through the hearings in 1964 with the Clean Waters Act, the Wild Rivers Act, and so many, many other pieces of legislation, representatives of the League of Women Voters are always on hand throughout all of the hearings to testify and to listen to the others who testify and to make constructive recommendations.

We are very happy that once again the League of Women Voters has concerned itself in the field of pollution control and wish to thank

you for your testimony. I am sure that I will have the benefit of your feelings on all aspects of the legislation in the future, as I have received it in the past.

I am also thankful that you read into the record the telegram that had been sent to the President concerning this problem from the many organizations throughout the New Jersey and New York area. I know that some of them are represented here and will not unfortunately have the opportunity to publicly testify, but I know that they are going to send us testimony which will be a part of the committee file on the hearings on this legislation. My thanks to you and to all of them.

A little over a year ago Monmouth County, which I believe is one of the most conservation conscious counties in America, had a series of seminars on pollution. It was conducted by the local newspapers and the American Association of University Women. The series was not for professionals only. It was for anyone who was concerned about pollution and an amazing thing happened in Monmouth County where these seminars were held. We found that the huge auditorium that was available was not nearly large enough to hold the crowds that came. I believe Mr. Richard Sullivan from the State of New Jersey was one of the speakers. On another night I had the honor of addressing the group. In this series of seminars we found that the halls were overflowing, as they are now from a much larger room than we have available for us today.

A video tape system was used so that people in other rooms could see and hear the speakers. It was a tremendous turnout and showed tremendous concern. Of course the greatest thing about it is that it did not stop with the end of the seminar. From that was established an ongoing committee, the Committee Against Water Pollution. That committee has been very active since that time in concerning itself with pollution in the Monmouth County area, often on its own, going to a certain body of water, making its own bacteria count, finding out how much pollution is there, and then publishing the results, which brings about immediate reaction from local officials in that area. It is a good constructive organization, and the person who was really behind it is with us today. We are very happy to have Mrs. Jane Blaisdell from the Monmouth County Citizens Against Water Pollution here, and we are very happy to have her come up to the witness stand. She has Dr. Miller with her, who I believe will testify before the Committee.

Welcome to the Committee, Mrs. Blaisdell, and again I wish to compliment you and your group for the work they have done concerning water pollution in the area. Due to your work I am sure—well, I cannot claim in front of my colleagues that Monmouth County is the most conservation conscious in America, but I will say there is no county in America more conservation conscious than Monmouth County, and that ought to leave me on safe ground.

Mrs. Blaisdell, welcome to the Committee. Say anything you wish, and please introduce the person who is accompanying you. Then you may proceed at your own rate, which I hope will be a rate that will conclude in about 10 minutes, unfortunately.

**STATEMENT OF MRS. JANE BLAISDELL, MONMOUTH COUNTY
CITIZENS AGAINST WATER POLLUTION; ACCOMPANIED BY
BRINTON M. MILLER, SECTION HEAD, DEPARTMENT OF PARA-
SITOLOGY, MERCK INSTITUTE FOR THERAPEUTIC RESEARCH,
RAHWAY, N.J.**

Mrs. BLAISDELL. I would like to read the names of some groups that gave me statements. I will not try to go into the statements because I have quite a few of them here.

Mr. HOWARD. The statements will be a part of the Committee file of the hearings, but please read the names of the organizations.

Mrs. BLAISDELL. The statements are from The Jersey Shore Woman's Club of Asbury Park, New Jersey; Federation of Conservationists, United Societies, Inc.; a new group that has been formed by a group of youths in the area called CAGES. They are the Citizens Action Group for Environmental Study. They not only have a statement supporting our statement, but accompanying there statement is a lengthy list of supporters.

Also, the American Association of University Women a letter from the State president; Pioneer Seven Rod and Gun Club, Asbury Park, New Jersey; and also, the Jersey Shore Branch of the American Association of University Women.

Mr. HOWARD. I think when we consider that we did not know we were going to hold these hearings until last Wednesday, this is a tremendous outpouring of concern by people in this area, and I want to congratulate you and all of them.

(Statements referred to were placed in the committee files.)

Mrs. BLAISDELL. I would like to present Dr. Brinton Miller, our spokesman, for the Citizens Against Water Pollution. Dr. Miller has a Ph.D. in microbiology. He has been a laboratory instructor in general botany and zoology. He is presently the section head of Protozoal Parasitology at Merck Institute. He is also with the Citizens Against Water Pollution, and had set up our testing surveillance group or subcommittee.

Mr. HOWARD. Please proceed, Dr. Miller.

Dr. MILLER. We have a statement which we would like to make part of the record.

Mr. HOWARD. Without objection, it is so ordered.

(The statement referred to follows:)

**STATEMENT OF CITIZENS AGAINST WATER POLLUTION POLICY ON SEWAGE
TREATMENT PLANT SLUDGE DISPOSAL**

Dumping sewerage sludge no longer **THREATENS** to destroy our marine environment—the process **IS** destroying our waters right now.

CAWP believes that the waters into which the solid products of sewerage treatment plants and other wastes are disposed should meet the Federal Water Pollution Control Administration's quality recommendations for (1) **Contact Recreation Waters** and (2) for **Fish, other Aquatic Life and Wildlife**.

Waters in areas at or near where solid wastes are currently being dumped fall far short of meeting these requirements.

CAWP believes that the ocean environment closely offshore from major centers of population is being irreparably damaged, the beaches defiled, and our citizens' birthrights destroyed.

Alternative methods for disposing of solid products from sewage treatment plants are available, and are in practical use in many localities today.

In view of the above CAWP urges that ocean dumping be discontinued at the earliest practicable moment and that all sewage treatment facilities employ other, more acceptable methods of solid waste disposal.

CAWP recommends to the Corps of Engineers that within five years they revoke the present applicable dumping permits. It is felt that during the five year interim period less damage will result to the beaches if the present dumping sites were immediately moved to a distance not less than 25 miles SE of Ambrose Light.

1 a. Strict controls should be instituted to insure that dumping is confined to the designated areas.

1 b. Such action will, to a greatly increased extent, protect the coastal environment against beach-pollution from sludge and other waste sources.

Dr. MILLER. Dumping sewage sludge no longer threatens to destroy our marine environment—the process is destroying our waters right now.

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In view of the above CAWP urges that ocean dumping be discontinued at the earliest practicable moment and that all sewage treatment facilities employ other, more acceptable methods of solid waste disposal.

CAWP recommends to the Corps of Engineers, and actually now to this Committee because this statement was drawn up several weeks ago, that within five years they revoke the present applicable dumping permits. It is felt that during the five-year interim period less damage will result to the beaches if the present dumping sites were immediately removed to a distance not less than 25 miles southeast of Ambrose Light.

1. Strict controls should be instituted to insure that dumping is confined to the designated areas.

2. Such action will, to a greatly increased extent, protect the coastal environment against beach-pollution from sludge and other waste sources.

If I may, just a few comments, Congressman Howard. You and I must have read the same statement last year. I too read that the interim report, I quote: "that this report did not indicate any immediate change in the dumping area is either necessary or desirable." If one reads the report, it is quite easy to see that the bottom drifters, which were demonstrated I think for you today, ended up on the beaches of Long Island. Furthermore, a representative of the Food and Drug Administration was going to recommend closing or not allowing clams to be taken from an area about six miles offshore because of the high coliform count in those clams.

Present dumping has indeed polluted these beaches and these waters. I think the dead sea is like a malnourished patient. It has been overworked. It has not been given the nourishment that it should have, and what do you do with a malnourished sick patient? You give him some rest and you stop him from working. We had better stop this dead sea out here from getting any bigger. I think we should make a plea now, because nothing has been said during these sessions this afternoon that enough money be provided for the Sandy Hook Marine Laboratory and any of the other marine labs that are operating off our coast to continue this very important work.

Obviously the Corps of Engineers contract which ends, I think it is at the end of this year, will not finish the work. These scientists must be given the opportunity to continue this work.

Finally I would like to say to you, Congressman Howard, that I was very glad and happy to hear that your proposed legislation will carry a provision for the restoration or healing of polluted and damaged waters. This is most encouraging. We do hope that it will be included in that legislation. Thank you.

Mr. HOWARD. Thank you very much, Doctor. You brought up one point early in your testimony, which we also had reference to this morning as we were getting some of the scientific facts about the area where the dumping is taking place. There was a study done about the oxygen content in the water and how this count goes down especially in the summer months when it is a little bit warmer. It is very high right off the shore, and then when we get to the spoil area, it goes down. Going farther out across the Hudson Canyon area, which has a flow of water, it goes back up again; but where there is sewage sludge, it is down, in some places below one, which I believe is one out of a million or ten million, although I am not sure. But it was stated that the Federal Water Pollution Control Administration recommendations, which you refer to, suggested above that as a minimum. It was stated that this is merely a recommendation by the Federal Water Pollution Control Administration. I gathered early in your statement, however, that you felt it should be mandatory that no water be permitted to reach that degree, either in oxygen content or any of the other standards that have been set. Is that correct; do you feel that it ought to be mandatory that no waters in the United States or adjacent to the United States be permitted to get into that position?

Dr. MILLER. Yes, sir, that is correct. We do make that recommendation. Of course there might be circumstances brought about by nature herself which would lower those limits, but I am talking about man-made or man-caused limits being less than that. We do recommend that these standards be made complete and the law.

Mr. HOWARD. Thank you.

I would also like to refer to your comment about the healing of the damaged waters which we have here and around the country as well. So often when we look at the total problem in America we find areas like Lake Erie, or the Cuyahoga River off of Cleveland. The river is so filled with debris that it was declared a fire hazard, and actually caused fire several months ago, doing \$50,000 damage to railroad bridges. We keep talking about stopping pollution, not healing the water. Then we look at the problem and say well, let's slow it down

a little, but we don't really get to the real responsibility that this generation has in this field, because basically, this generation caused it, so I want to thank you for bringing out that point.

Are there any comments by any of my colleagues? Mr. Hammerschmidt.

Mr. HAMMERSCHMIDT. Mr. Chairman, just before you conclude with this witness, I wanted to point out to you something I know you are already aware of, but for the record, in the President's environmental message he proposed that Federal Pollution Control Program be extended to include all navigable waters, both interstate and intrastate, all interstate ground waters, the United States portion of boundary waters, and waters of the continuous zone, which would move it from three to twelve miles. This witness and other witnesses here have stated that these waters out here would not meet that criteria once that became law and legislation has been introduced.

I congratulate you, Jim, for being a little ahead of the environmental legislation. Maybe we can move faster on yours.

Mr. HOWARD. Thank you very much, Mr. Hammerchmidt. And thank you very much, Mrs. Blaisdell and Dr. Miller.

Our next witness is a representative of Monmouth County in dealing with water pollution control. We find that especially with sewage treatment that it cannot be done by individual towns. In many areas it is better to regionalize, so we need to think in terms of larger areas than municipalities. We must consider the whole problem and recommend what is best, not just for this political entity, but what is better for this geographic area. We do have a Monmouth County sewage authority committee which has been working very hard on this question. We are very happy to invite here a gentleman who is not only the chairman of that Monmouth County Sewerage Advisory Committee, but also my former Mayor, Mr. Joseph Eheret from Wall Township.

Mr. Eheret, welcome to the Committee. We are anxious to hear what you have to say, and please identify the gentleman with you. Any statement that you have may either be read or placed in the record.

**STATEMENT OF JOSEPH EHERET, MONMOUTH COUNTY SEWERAGE
ADVISORY COMMITTEE; ACCOMPANIED BY PETER HOMACK,
CONSULTING ENGINEER**

Mr. EHERET. Thank you, Congressman. I have with me Mr. Peter Homack, a consulting engineer and, I might say, one of the outstanding hydraulic engineers in the state, if I can put that plug in for him.

In addition to that, he is also working as a consultant engineer to the County of Monmouth. There may be some statement he would like to make when I get through.

I have a prepared statement which, for the sake of time, I know you gentlemen are very busy, and being the last on the agenda, I am sure you would like for me to make it as brief as possible, and I will not read the entire statement. I would like to take various quotes from it and then turn over the statement to you.

Mr. HOWARD. Without objection, that will become a part of the record at this point.

(The statement referred to follows:)

STATEMENT OF THE MONMOUTH COUNTY SEWERAGE ADVISORY COMMITTEE

In light of the conflicting recommendations presently being made concerning the dumping of sludge at sea and also the conflicting reports as to the effect of this sludge dumping, made by the Federal Agencies involved, the Monmouth County Sewerage Advisory Committee strongly urges that a meeting of all Federal and State Agencies including: the Governors of New Jersey and New York, Federal Water Pollution Control Administration, the U.S. Corps of Engineers, Sandy Hook Marine Laboratory, State Department of Health, and the Scientific Advisory Committee of the Smithsonian Institute, be arranged immediately so that a definite, unified policy can be established and a reasonable time table adopted to fulfill the recommendations made as a result of such a meeting.

The Monmouth County Sewerage Advisory Committee has been working with Federal and State Agencies for over a year concerning the effect of dumping sewer sludge at sea. During this period the Advisory Committee has been unable to obtain any concrete evidence, from the investigation Federal agencies, that the dumping of sludge at sea should be curtailed or prohibited. In view of the recent newspaper articles which have aroused a state of near hysteria the Advisory Committee wishes to make public their policy statement which was adopted on January 12, 1970, prior to the public uproar on sludge disposal at sea.

POLICY STATEMENT OF MONMOUTH COUNTY SEWERAGE ADVISORY COMMITTEE,
ADVISORY GROUP TO THE BOARD OF CHOSEN FREEHOLDERS

1. If any scientific evidence exists, that barging sewage sludge to sea is detrimental to the public health and/or the ecology relating to Long Island or Monmouth County, then the Sewerage Advisory Committee would urge and recommend that this practice should be eliminated at the earliest possible date.

2. As long as the N.J. State Dept. of Health and Federal Water Pollution Control Administration sets standards for, and approves barging of sludge to sea, and the U.S. Corps of Engineers issues permits to do so, the Sewerage Advisory Committee cannot prevent Monmouth County Sewerage Authorities from barging digested sludge to sea.

3. And whereas it has been indicated that these agencies cannot draw any conclusions or make any recommendations until the studies now underway are completed, the Sewerage Advisory Committee will do all in its power to secure an early determination of the effects of depositing sludge at sea.

The Advisory Committee feels it imperative, from the standpoint of public information, to release a letter received from the New York District, Corps of Engineers dated January 6, 1970 (copy of which is attached) which reads in part:

Receipt is acknowledged of your letter dated 29 December 1969 concerning the dumping of sewerage sludge in the Atlantic Ocean off the entrance to New York Harbor.

The Sandy Hook Marine Laboratory, Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior was awarded a contract by the Coastal Engineering Research Center, Corps of Engineers, U.S. Army on 7 August 1968 to conduct studies of the ecological effects of the waste disposal practices in the New York Bight. The studies are patterned to follow the guidelines which were set by a Scientific Advisory Committee formed by the Smithsonian Institution. The agreement provided that an interim report on the overall findings of the study, based on field observations, be submitted by 1 November 1969; a final report on the findings relative to the dredge spoil disposal operations by 30 June 1970 and a final report on the entire study by 1 November 1970.

Late in November an Interior Report was assembled by the Sandy Hook Marine Laboratory and submitted to the Coastal Engineering Research Center. The report was made available to the Scientific Advisory Committee who after review of the report and a visit to the laboratory in December

to discuss the field studies will shortly complete an evaluation of the significance of the studies currently underway. It is anticipated that the committee will thereafter submit their recommendations as to whether the current studies should be continued, completed or expanded and their recommendations on the study as a whole based on their evaluation of the current studies, the guidelines established in 1968 and questions which have been raised concerning the dispersal or concentration of the wastes.

The Interim Report as submitted is a preliminary report on partial results of incomplete field observations. There are several months of laboratory work required to compile the results of those tests which have been completed. Consequently, releasing the report in its present form would be premature. There have been no conclusive findings to date which would indicate that there is a general adverse effect of fisheries or water quality from the dumping. As anticipated the field observations show that sewage sludge has spread out to cover an area from 10 to 15 square miles in extent with sewage to a depth of 2 to 3 feet. The immediate area has become impoverished in contrast to surrounding areas. However, the dumping appears to have little direct effect, if any, on finny fish which are migratory in nature. There will be no changes in policy concerning the nature, extent or location of sewerage sludge dumping prior to the completion of the entire study.

The Advisory Committee has been able to obtain a copy of the interim report on "The Effects of Waste Disposal in the New York Bight" from the Coastal Engineering Research Center, U.S. Army Corps of Engineers, prepared by the Sandy Hook Marine Laboratory. This report contains no definite conclusions or recommendations concerning sludge dumping in the New York Bight. The letter of transmittal accompanying this report contains the following sentence:

The Center feels that any assessment of the results of this interim progress report can best be made after the Smithsonian Committee has completed its review.

It is our understanding that the report of the Scientific Advisory Committee, established through the Smithsonian Institution, will issue their evaluation report sometime next week. We have urgently requested a copy of this report be forwarded to the Sewerage Advisory Committee at the earliest possible date because of the vital concern the Sewerage Advisory Committee has in this matter.

On January 13, 1970, at a meeting sponsored by the Citizens Against Water Pollution held at Monmouth College, Dr. Lionel A. Walford, Director of Sandy Hook Marine Laboratory, stated in a reply to questions by Claude W. Birdsall, member of the Monmouth County Sewerage Advisory Committee and Peter Homack, County Sewer Consultant, that he, Dr. Walford, *would not* recommend that the Corps of Engineers change their current policy on sludge dumping at sea until the studies now being conducted are completed and evaluated.

In view of recent newspaper articles and in light of Dr. Walford's statement made on January 13, 1970, the Monmouth County Sewerage Advisory Committee feels that if any scientific evidence is available indicating that the present sludge dumping policies are adversely affecting the public health, then such information could be immediately made available to all effected public agencies so that needless further studies can be abandoned and a reasonable timetable established for the elimination of sludge dumping at sea.

The Sewerage Advisory Committee has carefully evaluated and monitored all reports dealing with pollution, which could affect Monmouth County either directly or indirectly, in addition to advance waste water research projects being conducted in the United States. The Advisory Committee considers the greatest threat to the quality of the ocean waters of the North Monmouth Coast, to be the massive pollution in New York Harbor and its tributaries. Reports from the Federal Water Pollution Control Administration indicate that this is the equivalent of raw sewage from a population of approximately 7,000,000 people. Recent hydrographic tests indicate that some of these polluted waters sweep around Sandy Hook and adversely affect water quality on the Northern Monmouth beaches. The elimination of this proven pollution must be considered the number one priority in protecting the health of our citizens and the resort economy of our County; and in addition we must establish a unified policy regarding the dumping of sewerage sludge in the ocean with its possible harmful effects upon the coastal waters and beaches of Monmouth County.

DEPARTMENT OF THE ARMY,
NEW YORK DISTRICT, CORPS OF ENGINEERS,
New York, N.Y., January 6, 1970.

MONMOUTH COUNTY SEWERAGE ADVISORY COMMITTEE,
Freehold, N.J.

GENTLEMEN: Receipt is acknowledged of your letter dated 29 December 1969 concerning the dumping of sewerage sludge in the Atlantic Ocean off the entrance to New York Harbor.

The Sandy Hook Marine Laboratory, Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior was awarded a contract by the Coastal Engineering Research Center, Corps of Engineers, U.S. Army on 7 August 1968 to conduct studies of the ecological effects of the waste disposal practices in the New York Bight. The studies are patterned to follow the guidelines which were set by a Scientific Advisory Committee formed by the Smithsonian Institute. The agreement provided that an interim report on the overall findings of the study, based on field observations, be submitted by 1 November 1969; a final report on the findings relative to the dredge spoil disposal operations by 30 June 1970 and a final report on the entire study by 1 November 1970.

Late in November an Interim Report was assembled by the Sandy Hook Marine Laboratory and submitted to the Coastal Engineering Research Center. The report was made available to the Scientific Advisory Committee who after review of the report and a visit to the laboratory in December to discuss the field studies will shortly complete an evaluation of the significance of the studies currently underway. It is anticipated that the committee will thereafter submit their recommendations as to whether the current studies should be continued, completed or expanded and their recommendations on the study as a whole based on their evaluation of the current studies, the guidelines established in 1968 and questions which have been raised concerning the dispersal or concentration of the wastes.

The Interim Report as submitted is a preliminary report on partial results of incomplete field observations. There are several months of laboratory work required to compile the results of those tests which have been completed. Consequently, releasing the report in its present form would be premature. There have been no conclusive findings to date which would indicate that there is a general adverse effect on fisheries or water quality from the dumping. As anticipated the field observations show that sewage sludge has spread out to cover an area from 10 to 15 square miles in extent with sewage to a depth of 2 to 3 feet. The immediate area has become impoverished in contrast to surrounding areas. However, the dumping appears to have little direct effect, if any, on finny fish which are migratory in nature. There will be no changes in policy concerning the nature, extent or location of sewerage sludge dumping prior to the completion of the entire study.

The sewer sludge dumping area in the Atlantic Ocean was established in 1924. It has been used continuously except during World War II when submarine warfare hazards curtailed its use. The area is described as being not less than 4.5 nautical miles, 124° 30' True from Ambrose Light. It is equidistant from the New Jersey and New York shores, being approximately 12.5 nautical miles offshore.

Sewerage sludge is being disposed of in the dumping area by the following agencies:

NEW JERSEY

Passaic Valley Sewerage Commission.
Linden-Roselle Sewerage Authority.
Joint Meeting Sewage Disposal Commission.
Bergen County Sewerage Authority.
Middlesex County Sewerage Authority.

NEW YORK

City of New York.
City of Glen Cove.
City of Long Beach.
Nassau County.
Westchester County.

During the 12 month period ending 30 June 1968, a total of 4,833,730 cubic yards of sewage sludge was disposed of in the dumping ground. It is estimated that approximately 53 percent of the sludge was undigested and the balance of

47 percent was digested. Approximately 60 percent of the raw sewage originated at New Jersey Pollution Control Plants.

There was a preliminary investigation of waste disposal in the New York Bight in 1966. It was conducted by the Northeast Marine Health Sciences Laboratory of the U.S. Public Health Service at Narragansett, Rhode Island. In its report released in January 1968, it was recommended that an area 6 miles in radius from any point at which sewage sludge discharge takes place should be classified as "off limits" or prohibited to shellfishing. It also stated that no relocation of the dump areas could be justifiably recommended from the limited results obtained from the preliminary type of investigation undertaken.

A considerable amount of laboratory work will have to be completed in order to compile meaningful statistics based on the field studies completed to date. A thorough evaluation of the data will have to be made by the Scientific Advisory Committee and the Coastal Engineering Research Center before valid conclusions can be drawn and recommendations made. Any conclusions or recommendations as a result of incomplete data may prove faulty. It is considered therefore that a public meeting convened for the purpose of discussing all aspects of the dumping of sewerage sludge in the Atlantic Ocean would not serve any constructive purpose until such time as the studies are completed and the final report by the Corps of Engineers on the studies is released.

Sincerely yours,

J. GELBERMAN,
Chief, Operations Division.

Mr. EHERET. One point I would like to start with, if I may, and that is, in listening to the testimony here today and following the press over the last 2 weeks, it is quite obvious there are varying opinions as to the problem being generated by the sludge at sea. I would like to make it clear at this juncture that Monmouth County is vitally concerned with this problem as well as they should be. They have been interested in it for well over a year, and they have worked with various State and Federal agencies to determine what, if any, effect this sludge dumping has.

In reviewing some of the testimony here today, and also in some of the newspaper articles, I would like to make a few comments, and these comments are not made to embarrass any particular individual, but only to point out the fact that there is a wide difference of opinion as to effect.

I would like to quote just for a moment from a letter that we had received, and I say we, I am referring to the Monmouth County Sewerage Advisory Committee, from a letter we received from the Corps of Engineers concerning the problem of dumping, and this was in response to a letter that we had sent in for their recommendations and opinions and so forth concerning this issue. I am just quoting the last paragraph, and this letter has been included in my attachment for the record:

However, the dumping appears to have little direct effect, if any, on finny fish which are migratory in nature. There will be no changes in policy concerning the nature, extent or location of sewage sludge dumping prior to the completion of the entire study.

That, of course, is referring to the interim study which has been released, and the topic of conversation here today.

In addition to that, at a meeting which was held and sponsored by CAWP—

Mr. HOWARD. Is that Committee Against Water Pollution in Monmouth County?

Mr. EHERET. Citizens Against Water Pollution.

Dr. Wallford was a speaker, and upon questions by Mr. Claude Birdsall, who was a member of the Monmouth County Sewerage Ad-

visory Committee, and Mr. Peter Homack, who is with me here today, Dr. Wallford was asked if he would recommend a change in the position of the sludge dumping grounds, and Dr. Wallford's comments were that he would not recommend such a change in the current policy on sludge dumping until the studies which are now being conducted are completed and evaluated.

From reading these two documents and entering them into the record, it is not my point to take the position that Monmouth County is opposed to moving sludge dumping grounds. The point I am really trying to make here is that there are a lot of questions that have been raised and a lot of lack of information that we do not honestly know what the effect of sludge dumping is or whether or not there is a detrimental effect as far as the bathing beaches are concerned, and if there is such a detrimental effect, what would be the purpose of moving it any further or anywhere else; and if we find to the effect that there is a detrimental effect from sludge dumping at sea, then to my way of thinking it would make a lot more sense, as Mr. Sullivan pointed out earlier, to phase out sludge dumping at sea, going to a different method, and thereby eliminate it completely.

Mr. HOWARD. I believe, Mr. Eheret, that everyone concerned feels that dumping at sea should be eliminated, and any plan that results from these hearings or from legislation would involve a phasing out of dumping at sea, so I do not believe there is any disagreement by anyone looking to the future on that score.

Mr. EHERET. Right. I was just entering that for the purpose of illustrating that perhaps moving it to a different location would be nothing more than just pushing the problem under the rug or sliding it to somebody else's situation.

I would like to read just for a moment a release that was made, a press release that was made by the Advisory Committee on Monday, February 23, concerning the position of the Monmouth County Sewerage Advisory Committee on this issue:

In light of the conflicting recommendations presently being made concerning the dumping of sludge at sea and also the conflicting reports as to the effect of this sludge dumping, made by the Federal Agencies involved, the Monmouth County Sewerage Advisory Committee strongly urges that a meeting of all Federal and State Agencies including: the Governors of New Jersey and New York, Federal Water Pollution Control Administration, the U.S. Corps of Engineers, Sandy Hook Marine Laboratory, State Department of Health, and the Scientific Advisory Committee of the Smithsonian Institute, be arranged immediately so that a definite, unified policy can be established and a reasonable time table adopted to fulfill the recommendations made as a result of such a meeting.

The purpose of those organizations mentioned as being recommended to have a meeting was because they are the agencies who are responsible for setting a policy and enforcing the policy of sludge dumping, and they are the ones basically charged with responsibility of looking into the situation and having it resolved.

I think that I would like to make just one or two other comments before I ask Mr. Homack if he has any remarks. I am sorry that Mr. McCarthy is not here, he has left, but he made a comment earlier that anyone riding the ferry is in danger of having the spray blown back into his face because of the pollution in the New York Harbor area. This, I think, is a very important issue. While we recognize the fact that this sludge dumping grounds may present a problem

to the beaches of Monmouth County and also to Long Island, we also recognize the fact, and in our opinion a much more serious problem, and that is the issue of the amount of raw sludge which is being fed into the tributaries of New York Harbor, and consequently winding up in the New York Bight Area. I would just like to read this comment relating to that:

The Sewerage Advisory Committee has carefully evaluated and monitored all reports dealing with pollution, which could effect Monmouth County either directly or indirectly, in addition to advance waste water research projects being conducted in the United States. The Advisory Committee considers the greatest threat to the quality of the ocean waters of the North Monmouth Coast, to be the massive pollution in New York Harbor and its tributaries. Reports from the Federal Water Pollution Control Administration indicate that this is the equivalent of raw sewage from a population of approximately 7,000,000 people. Recent hydrographic tests indicate that some of these polluted waters sweep around Sandy Hook and adversely effect water quality on the Northern Monmouth beaches. The elimination of this proven pollution must be considered the number one priority in protecting the health of our citizens and the resort economy of our County; and in addition we must establish a unified policy regarding the dumping of sewerage sludge in the ocean with its possible harmful effects upon the coastal waters and beaches of Monmouth County.

Mr. McCarthy also indicated that in one treatment plant alone in New York, the cost of upgrading that and going to secondary treatment was \$100 million. This is very true. The cost of solving these pollution problems is tremendous, and we feel that perhaps the effort would be at the present time to direct our attention to the raw sewage which is presently being allowed to come into the tributaries and into the bay areas and get those cleaned up.

Let's put the priorities in the most important categories, and I do not mean to undersell the importance of the sludge dumping problem, but I really feel the fact that so much raw sewage is going into the tributaries, and so forth, that this does affect directly the health and well being of our citizens, and I do not mean to undersell the importance of the marine life and the effect of the sludge dumping on the marine ecology. But I do feel that the public health and welfare of our citizens must be considered equally, certainly if not more so than that.

I do not think I have anything else to add.

Mr. HOWARD. Thank you very much, Mr. Eheret, for your testimony. I believe you are quite correct in saying that there are many other areas which must be considered, some more directly affecting us. The Public Works Committee has found that when we begin thinking and talking about pollution it comes at us from all angles; not only the pollution caused by the floods and sewage, but also the fact that just breathing for 1 day in New York City is as harmful to your body as smoking a pack of cigarettes. This makes it very difficult for those of us who do smoke to go to New York and smoke a pack of cigarettes.

The aluminum beer cans, the throwaway bottles, pollution by aircraft; the problem is all around us in every conceivable way. We cannot stress only one area, as you say, and we should direct our efforts toward the most immediate problem. Still, as you indicated, we must not, in any way, ignore the problems of the coast. I think you were very right with that, and I certainly hope that the conference you have requested among the Governors, the Corps of Engineers and the De-

partment of the Interior to look for solutions is a very successful one. Although you said they are the ones who will make the policy, I believe it will be the Congress which sets the policy and that these will be the people who will carry it out. We are very happy that Monmouth County moved so many, many months ago in developing a county-wide sewerage advisory committee, so that all the efforts can be put in the proper direction. In this way we are looking at the whole problem of the county, rather than having each small community looking only at its own problems and thereby providing a less effective means of combating pollution in the county.

Mr. Olsen.

Mr. OLSEN. I just have one more thought, because it is in the form of a story. When I was a small boy, the mining companies were operating on every stream in Montana, and they were dumping their refuse there. They said if we did not let them do that, that they would lay off all the help and they would quit and leave.

I tell you, when they took all the values, when they had taken all the values out of the ground, they got up and left anyway, and there they left us with our streams polluted with their silt. We had to clean up the streams with taxpayers' money, and we did. We learned a lesson from it.

Today we have the largest, and if not the largest, one of the largest nonferrous smelters in the world, and where less than 20 years ago they polluted a stream, the large one, the Clarks Fork of the Columbia, they polluted it for 125 miles, by legislation and a big stick they do not pollute it any more. When they let go of their fluid, it is neutral, it is clear water. Now you cannot run a refinery and you cannot run a smelter without pure water, and you have a lot of refineries here in your industrial areas, and they all have to have pure water. And it is not too much to expect to return pure water. That is not too much to expect. It is just a question of our having legislation requiring this.

We will pay for it in our economy. But it is something that the public has to be aroused to, and learn a lesson that when they are through with the values, they are going to leave you with the sludge anyway. You just as well better start now, and we all should start now with one of the cheapest methods. The cheapest method is to chemically treat this debris, especially by commercial enterprise, and of course, number two, there is no good reason why we cannot treat sewage.

We do not have people problems like you have, but we have the same selfishness. The people upstream do not want to treat the sewage because they are not going to drink it. They are going to let it go downstream. So there has to be uniform legislation that says you are not going to hurt anybody else with your refuse. If you require pure water, that is the way you are going to put it back in the stream. That is the way we are going to have to live in the United States.

But more than that, I think we have to live that way with our neighbors in Newfoundland, and certainly they will complain if we put it off the continental shelf. Ultimately they will, and they will have a good beef.

The point is, it can be paid for, it ought to be paid for, and the best way to help pay for it is to absolutely prevent it.

Thank you very much for this opportunity to come to your district and meet your wonderful people. I know now why they sent you to the Congress.

Mr. HOWARD. Thank you, Congressman Olsen.

Mr. McCarthy.

Mr. McCARTHY. No questions.

Mr. HOWARD. Thank you very much, gentlemen. This ends the list of people scheduled to testify this afternoon. We do have with us Mr. Thomas Glenn, Jr., Director and Chief Engineer of the Interstate Sanitation Commission of New York, New Jersey and Connecticut.

Mr. Glenn has offered for the record copies of letters he has sent to the Assistant Secretary, Water Quality Research, U.S. Department of Interior.

Without objection, these letters will appear in the record at this point.

(The letters referred to follow:)

MAY 23, 1969.

Mr. CARL L. KLEIN,
*Assistant Secretary, Water Quality and Research, U.S. Department of Interior,
Washington, D.C.*

DEAR MR. SECRETARY: It is of great and immediate importance that the Federal Water Pollution Control Administration develop and announces a firm policy on the disposal of sludge and industrial wastes at sea. Because of its crucial importance in the Greater New York Metropolitan Area, the subject will be raised in the statement of the Interstate Sanitation Commission at the Hudson River Conference now scheduled for June 18-19, 1969. However, we believe that fruitful consideration of the matter at that time will benefit from advance thought by you.

The reason for urgency is that decisions are being made now in connection with the upgrading of domestic treatment plants. The disposal of sludge must be considered as a part of this decision. Some industrial wastes are also not amenable to treatment and one solution is to barge these wastes to sea. Whatever alternatives municipalities and industries select involve large investments. If the method chosen cannot be relied upon for some years to come, millions of dollars will have been wasted in the New York area alone, and the problem will be no closer to solution at the end of the process than it was before the expenditures were made. The costs include investments in digesters, barges, incineration equipment, and plant design and construction.

The disposal of sludge at sea appears, at first glance, to be questionable, especially if the sludge is undigested. However, we believe that proper analysis of the problem requires a consideration of available alternatives, so that governing policy will make distinctions that accord with the facts and will encourage selection of the most appropriate disposal methods.

There are only a limited number of alternatives for dealing with sludge or industrial waste that cannot be treated: 1) disposal on land, 2) disposal in underground wells, 3) disposal at sea on the Continental Shelf. The safety and cost elements involved for each method must be weighed.

(1) Disposal on Land—Land disposal of sludge would require either sludge drying beds or vacuum filtration before placing on the land. In the vicinity of large metropolitan centers, the solid waste disposal problem is already of stupendous proportions and is even further from being solved than is the water pollution problem. Instead of placing on the land, the sludge may be incinerated which may result in air pollution. While the FWPCA is not responsible for solid waste or air pollution problems, it should think very seriously before adopting a policy which would tend to intensify environmental hazards of any sort. Industrial wastes would have the same type of problem for discharge on land but in addition may be toxic. Also, industrial wastes on land could infiltrate and contaminate the ground waters.

(2) Deep Well Disposal—This alternative may remove the industrial wastes from sight, but it well may be the most dangerous of all methods of disposal. There is already evidence that wastes disposed underground have contaminated water supplies, polluted the soil and, in one instance, possibly contributed to an

earthquake. Moreover, deep well disposal is probably the most irretrievable of the alternatives. There is no known means of cleaning up, once wastes have broken out of the strata and immediate locations in which they have been deposited and such disposal lacks the dilution afforded by sea.

(3) Disposal over the Continental Shelf—Offshore discharge of sludge within a relatively few miles of the coast is an expeditious means of disposal at comparatively modest cost. Digested and undigested sludges have been discharged for years in waters adjacent to Lower New York Bay with no known harmful results. Unless studies show that it is harmful, there is every reason for continuing the discharge of at least digested sludge. Digested sludge is stable and places little if any demand on the oxygen supply of the water into which it is discharged. Industrial wastes should be banned in this area.

(4) Disposal beyond the Continental Shelf—If it is decided that the risks or objectionable effects of the discharge of undigested sludge over the Continental Shelf, even at considerable distances from the coast, are too great, it should be possible to permit dumping of sludge beyond the Continental Shelf. In the New York area, this would place the point of discharge at least 120 miles at sea. The dilution that would take place that far at sea and the great distance from population centers should reduce or obviate any reasonable objections.

However, in making such a decision, careful note should be taken of the relatively little difference in effect between the discharge of undigested and digested sludge so far from the coast. The only significant difference between digested and undigested sludge is that the latter involves biochemical oxygen demand. Oxygen is no problem in the open sea. Undigested sludge would not be toxic to fish. Over a period of time, undigested sludge is rendered stable and thus achieves the same results without the costly digestion process.

Finally, there is evidence that digestion processes at treatment plants produce side effects that could aggravate present difficulties. The liquid cycled back into treatment plants when sludge is digested is high in nutrients. These would be discharged in the treatment plant effluent and would increase the growth of phytoplankton in the receiving waters. This can be a problem of varying seriousness, depending on the point of discharge and the characteristics of the receiving waters.

Barging of industrial wastes to sea should be decided for each case and should be restricted to wastes that would be difficult to treat. However, it would be more desirable to use this alternative than the more objectionable ones as previously stated. It might be appropriate to require reasonable pretreatment before disposal at sea, to whatever degree practicable, such as neutralization of acidity.

In conclusion, we wish to point out that the problem of sludge and industrial wastes disposal is not a simple one. The question is not whether we would prefer to forego sludge and industrial waste dumping at sea, but rather whether such dumping under reasonable restrictions is the best available alternative. Also, of first importance is the need for a firm and a prompt decision. Only the Federal Government can make the decision, because only that level of government has authority over disposal beyond territorial waters.

Also, we would urge upon you that the decision be made in consultation with all of the affected interests. The environmental programs of state and local governments are materially affected, as are the plans and operations of many industries. It may not be possible to devise and implement a policy which fully satisfies everybody, but it is essential to strike the best balance that can be obtained.

If we can be of any further help in this matter, please do not hesitate to call upon us.

Very truly yours,

THOMAS R. GLENN, Jr.,
Director & Chief Engineer.

U.S. DEPARTMENT OF THE INTERIOR,
Washington, June 4, 1969.

Mr. THOMAS R. GLENN, Jr.
Director and Chief Engineer,
Interstate Sanitation Commission,
New York, N.Y.

DEAR MR. GLENN: I want to thank you for your letter of May 23, which sets out very well the important problems of coastal waste disposal and asks for the Department of the Interior to establish a policy with respect to such disposal.

I cannot give you such a policy at this time. It happens that just recently we have undertaken an effort to define such a policy and are seeking inputs, not only from the policy-making officials in the Interior Department representing interests such as fish and wildlife, oil and gas, land management, etc., but also scientific inputs. I think you will agree that we must understand the potential of the disposal of wastes into the ocean scientifically before we can enunciate a policy. For this reason, we have established a contract with the National Academy of Sciences and National Academy of Engineering to perform a study for us this summer on the subject of coastal waste disposal. The study is very closely keyed to allow us to formulate a policy based upon it.

Within the Department of the Interior, our Federal Water Pollution Control Administration is the action agency on this matter. But we must seek the advice of all other interested parties before formulating a policy which has such wide-ranging implications. Important projects costing hundreds of millions of dollars are affected by this policy. We therefore want to make sure that it is based on the best scientific input and upon the consideration of all the requirements of interested parties.

Thank you again for your letter. We hope to be in touch with you later this year.

Sincerely yours,

CARL L. KLEIN,
Assistant Secretary.

JUNE 11, 1969.

MR. CARL L. KLEIN,
Assistant Secretary, Water Quality and Research, U.S. Department of the Interior, Washington, D.C.

DEAR MR. SECRETARY: We wish to thank you for your letter of June 4, 1969, pertaining to the establishment of a policy by the Department of the Interior on waste disposal at sea.

We certainly agree that such a policy will have far-reaching effects and that the very best scientific information should be weighed before making such an important decision. However, it is unfortunate that decisions on the handling of sludge must be made now by many municipalities and authorities in this area if the implementation plans of the states to meet the Water Quality Standards are to be met as expeditiously as possible.

At the present time, the Federal Water Pollution Control Administration has made an administrative decision that all treatment plants to qualify for a Federal Construction Grant must include facilities for digestion of sludge before barging to sea. At the Federal Conference on the Lower Hudson on June 18th, we will request that this administrative policy be rescinded until your study has been completed and an overall policy has been set. Then, if it is decided that digestion will be required, the plants would be required to provide the proper digestion facilities and the schedules for the construction of treatment plants may proceed without waiting for a final policy decision.

After your study has been completed this summer, the members of the Board of Direction of the State and Interstate Water Pollution Control Administrators will be happy to meet with you to discuss some of these problems of coastal waste disposal so that you will have the benefit of their many years' experience in pollution abatement before formulating your policy.

Please let us know if we can be of any further assistance.

Sincerely yours,

THOMAS R. GLENN, JR.,
Director & Chief Engineer.

MR. HOWARD. I know that Mayor White from Highland was, or is present today with testimony, and a statement that the committee will be very happy to receive.

I wish once again to thank my colleagues for being with us today on what I believe was an extremely interesting hearing, one that is going to continue.

Our chairman Mr. Fallon has said that we will have hearings on this legislation and on this problem in Washington.

I am very hopeful that this will be only the beginning in one area of concern with the sludge dumping, because I am sure there are

other areas throughout the country, along the ocean, and certainly along the Great Lakes, Mr. McCarthy, and other areas where we should be receiving information as we study this difficult problem.

I would like to say to my colleagues, happy holiday, and thank you very much for being with us. To all the people from the Federal agencies and those who have come up with us from Washington, I wish to say thank you. Also to those who have testified and given us the benefit of your information and expertise, either verbally or through submission to the committee for the record, I want to thank you. Most especially, I wish to thank all of the interested citizens of the Monmouth County area who have shown by your presence here that you are concerned, and that you are willing to make the sacrifices that will be necessary to obtain a better environment for your children and your grandchildren.

We wish to tell all of you, that although we have a problem here, I think we also have the beginning of a solution, and it is because of your work and your efforts.

We all wish to promise you, as we leave here and go back to our Nation's Capitol, that this is just the beginning.

Thank you very much. The hearing is adjourned.

(Whereupon, at 5:05 p.m., the hearing in the above-entitled matter was adjourned.)

(The following was received for the record:)

PROFESSIONAL ENGINEERS IN INDUSTRY: A PRACTICE SECTION OF NEW JERSEY SOCIETY OF PROFESSIONAL ENGINEERS—STATEMENT OF WASTE DISPOSAL AT SEA

We understand from listening to a review of the preliminary biological survey of dumping areas approximately 12 miles off Sandy Hook, that the present practices of dumping industrial and sewage sludges have damaged marine life proximate to the dumping sites.

Our group, the Professional Engineers-in-Industry, a practice section of the New Jersey Society of Professional Engineers believes that correction of environmental matters such as these must be given the highest public priority. The ability of our natural systems to absorb biological and the new categories of chemical wastes, which result from our "higher standard of living", has been reduced—in fact—overcome, in too many areas.

It has recently been reported that high ranking scientists in the Department of Health, Education and Welfare believe that the amount of oxygen consumed in the United States, is greater than that which is generated. This is not a matter of sensationalism or scare propaganda. We are dependent on phytoplankton in our oceans to generate our most vital resource—oxygen. As our population and our per capita consumption of chemical and metal products continue to increase, we become even more dependent of the ecology of the ocean. Money must be spent to develop new solutions for ultimate disposal of wastes, in such a manner that our total environment—air, water and land, is not permanently degraded.

Dilution can no longer be tolerated as an acceptable solution to pollution.

The lack of other waste disposal schemes, as cheap as disposal at sea, does not justify continued marine disposal. Our lack of data on the exact degree of biological damage caused by dumping at sea, certainly should not be used to justify continued dumping—rather it should be the basis for the decision to stop.

We believe that development of the national policy for disposal of wastes at sea is imperative. The ultimate disposal of sludges and other waste materials is not simply a coastal metropolitan problem. Cities and industries in the interior proportion of the United States are confronted with the same responsibilities. Consequently, we need national goals, with specific objectives, as a prerequisite to national legislation.

Such objectives should be concerned with new legislation to fund public, and encourage private, research. The research should embrace studies of ecological systems (as compared to present practice which is to treat each type of pollu-

tion separately, with inadequate regard of the interaction of one phenomena on the other). The research should also: develop data on limits of acceptable tolerances of temporary degradation, recommend certain products which should be banned, and contribute to discovery and development of useful by-products.

Findings of the research should be the basis for new technology that is required to process present day chemical and other wastes. Subsequently this work should be the basis of national action to assign priorities, construct the system(s), and subsequently evaluate the operation(s).

We endorse the position of Governor William T. Cahill which calls for phasing out of all sludge and waste dumping at sea, and recommends dump sites be located further out to sea until treatment plants are built.

W. A. POILLON, P.E.,

Chairman, Professional Engineers in Industry.

VICTOR COTZ, P.E.,

Chairman, Conservation of National Resources Committee.

NEW YORK SCIENTISTS' COMMITTEE FOR PUBLIC INFORMATION, INC.,

New York, N.Y., March 30, 1970.

Congressman JAMES HOWARD,

Chairman, River and Harbors Subcommittee, Committee on Public Works, House of Representatives, Washington, D.C.

DEAR CONGRESSMAN HOWARD: In accordance with your instructions at the hearing held at Sandy Hook, N.J. on February 23, 1970, that interested parties submit testimony to you in Washington, we are enclosing the following testimony. We trust that this testimony will not be too late to serve a useful purpose.

We are submitting this testimony on behalf of the subcommittee on water pollution of the Scientists' Committee for Public Information.

This testimony has been prepared by:

Raul R. Cardenas: Chairman of Subcommittee on water pollution; Instructor, Dept. of Civil Engineering, New York University.

Bruce A. Bell: Sanitary Engineer; Instructor, Department of Civil Engineering, New York University; Research and Development in advanced waste water treatment.

Theodore M. Zaferatos: Sanitary Engineers; Research and Development in advanced waste water treatment, Ecolo Research, Inc.

As a result of listening to the testimony at the hearing of February 23, 1970, it was felt that, because of the time limitation, the roles of waste water treatment and sludge disposal were at times unclear and should be clarified.

The intent of this testimony is to provide working definitions and descriptions of treatment methods relating to the problem of ocean sludge disposal so that the effects of the ocean sludge disposal in question can best be studied using the expert testimony of others.

Sincerely,

RAUL R. CARDENAS,

Chairman, Water Pollution Subcommittee,

GLENN L. PAULSON,

Co-Chairman, Scientists' Committee for Public Information.

TESTIMONY

DEFINITIONS

The following definitions are general in nature and have been defined according to "normal" usage in the field of Sanitary Engineering and will generally apply to the problem of ocean sewage disposal.

Waste Water

Waste water has been defined as the used water supply of a community, together with such industrial wastes, ground water, and surface runoff as may be mixed with it. An average domestic sewage, or waste water, contains 99.94% pure water and about 0.06% solid contaminants by weight.

Waste Water Treatment

A series of steps for the purpose of separating the solid contaminants from the water so that the water may be safely discharged to the receiving body of water or reused. In a broader context, waste water treatment can include the

removal of any potentially harmful materials, e.g., this might include toxic ions, radioactivity or heat.

Preliminary Treatment

Generally consists of screening, comminuting, and grit removal for the purpose of removing large objects, and heavy inorganic material.

Primary Treatment

The process of removing settleable solids by sedimentation which is a purely physical process.

Secondary Treatment

Refers to the aerobic biological stabilization of settleable, colloidal, and some soluble organic contaminants followed by Secondary Sedimentation. Secondary treatment follows primary treatment.

Tertiary Treatment

Additional treatment following secondary treatment to produce a high quality product water by removing, by physical and chemical means, most of the remaining organic contaminants.

Advanced Treatment

Treatment to produce a high quality product water. Advanced treatment is differentiated from tertiary treatment in that advanced treatment may be applied to a raw waste, primary effluent or secondary effluent.

Sludge

The solids residue from waste treatment processes including entrapped water.

Preliminary Residue

Consists of the screenings and grit removed in preliminary treatment.

Primary Sludge

Contains the settleable solids removed in primary treatment. The sludge consists of approximately 2 to 5% solids in weight. The remainder is water.

Secondary Sludge

Contains the settleable solids removed by secondary treatment plus the biological mass produced during secondary treatment. The sludge contains approximately 0.5 to 2% solids by weight. The remainder is water.

Tertiary Sludge

Contains primary and secondary sludge plus any chemical sludges produced during tertiary treatment. The sludge contains approximately 0.5 to 8% solids by weight. The remainder is water.

Advanced Treatment Sludge

The residue produced in advanced treatment processes is usually a chemical sludge containing settleable and colloidal solids. The sludge contains 2 to 8% solids by weight. The remainder is water.

SLUDGE HANDLING AND DISPOSAL METHODS

The sludge produced in the various waste water treatment processes is usually dewatered, and/or otherwise treated prior to disposal. The sludge with or without sludge treatment must be eventually disposed. The disposal must necessarily then be to the land, the water, or the air, thereby contaminating the environment.

Sludge is generally dewatered to reduce its volume. Methods commonly used are thickening, vacuum filtration, centrifugation, and drying beds. These methods can be used alone or in various combinations.

Sludge treatment, in order to render the sludge safer and more readily disposable or reusable, may consist of aerobic or anaerobic digestion, and/or chemical treatment. Sludge treatment does not in general kill pathogenic bacteria, fungi or cyst forming protozoa.

The methods of ultimate sludge disposal in use today are landfill, incineration, use as soil conditioner, and ocean disposal. These methods are used alone or in various combinations.

The use of sludge for landfill is preceded by dewatering, or concentrating, digestion and/or chemical treatment. The problems associated with the use of

this technique include the possible leaching of organic materials into the ground-water table through the soil, rendering land unusable for long periods of time, possible public health hazards and the limited availability of land.

The sludge may be processed by dewatering, digestion, and/or chemical treatment, drying and sometimes pasteurizing for use as a soil conditioner. A limited market and a lack of public acceptance restricts the use of this method of disposal. In addition, there exists potential danger of a public health hazard from improperly processed sludge.

Sludge may also be dewatered, digested, and/or chemically treated and then incinerated. The resulting ash is usually used for landfill or disposed of at sea. Problems associated with incineration include possible air pollution and high cost. In addition, incineration is ecologically wasteful.

Another method of ultimate sludge disposal is ocean disposal. Prior to barging to sea, the sludge is dewatered to reduce its volume and is sometimes treated by digestion. Ocean disposal may produce a public health hazard due to the contamination of shellfish, fish, and recreational areas. In addition, ocean disposal can lead to ecological upsets, and loss of productive ocean areas. Ocean disposal may also be in violation of international treaties.

Waste water treatment is necessary to protect our water resources which are no longer unlimited. Increasing population and water usage will demand higher quality waste water treatment for direct or indirect reuse. Since the major purpose of waste water treatment is the removal of the contaminating solids from the water, treatment processes will produce a sludge which must ultimately be disposed of. This sludge disposal must eventually be to the air, water or land. Thus, consideration must be given to minimizing the damage to our environment.

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NEW JERSEY CHAPTER NATURAL FOOD ASSOCIATES, INC.,
Farmingdale, N.J., March 10, 1970.

Congressman JAMES J. HOWARD,
House of Representatives,
Washington, D.C.

DEAR MR. HOWARD: I attended the hearing at the Marine Laboratory, Sandy Hook, February 23, 1970 concerning sludge dumping in the ocean because I am vitally interested as an official of the N.J. Chapter of Natural Food Associates. I realize that the main purpose of the hearing was for solutions to the immediate problem, however, coinciding with other testimony heard at the hearing; we would like to provide information for the hearing records pertaining to the long-term solution.

Most testimony heard at the February 23rd hearing seemed to offer no solution for the long-term, let alone the immediate problem. Each testimony seemed to be in the same area: That of complaining about the pollution problem. The Natural Food Associates had complained many years ago, but, we were looked upon as something that crawled out from under a rock. We were considered quacks, faddists, and health nuts. Now, more authoritative people are on the band wagon complaining when it is almost too late. The NFA ended the complaint stage long ago. They are now offering a solution. Had this organization been invited to give testimony at the recent hearing, a solution would have been given.

I must agree with the representative of the N.J. State Pollution Control. Future tertiary treatment will not solve the problem concerning sludge. Although this type of treatment can be successful in producing potable water to be emptied into

our streams, rivers, and oceans. There will still be sludge and there will still be a problem on where to put this sludge.

There seems to be only one answer to the world's waste problem, and that is: To OBEY NATURE'S LAWS! Nature's laws tell us to create a CYCLE. We must create a recycling phase that permits our soil to produce plant life, which will be consumed by man and animal and in turn the waste of man and animal is returned to the soil to enrich it for more growth. The present system works against nature by not putting back into our soil what we remove! We end up with a condition where all mankind will drown in his own garbage and sewage.

Nature's method CAN be accomplished, and CAN be successful. Individual communities and cities can operate their own sewage-garbage disposal plants. They will be much like the tertiary treatment plants that have been proposed for the future. The difference being: Raw garbage will be mixed with raw sewage after passing thru separate grinders. The individual householder will be under rigid rules compelling him to separate food waste from trash. Trash can be handled separately for special treatment that will be processed into non-deteriorating compressed blocks that can be used for construction purposes.

The garbage-sewage slurry will break down much quicker than it will in the conventional sewage plant. This slurry will enter a primary stage where bacteria will rapidly break down solids. It will then go to a secondary phase of aeration and then to a final settling tank with a return to the secondary for re-aerating. The sludge from the settling tank will then go to a digester and finally to oven-dryers which will produce the finest fertilizer for farm and woodland.

It has been said that composted fertilizer from sewage is a low-grade type which has little use in this country. It's true that this type fertilizer does not have super amounts of nitrogen, potash and potassium like a commercial powdered type does, however, composted sewage has these same elements in more natural proportions which will produce more natural growth. This fertilizer also contains many trace minerals and other factors, unknown as well as known that will produce a completely healthy plant that will resist insect damage thereby decreasing pesticide sprays. Sewage that has been composted with garbage is a much higher grade fertilizer than fertilizer made from sewage alone! This is considered an organic fertilizer. Organic matter has been called "the storehouse of the soil's nutrients." Briefly, the reasons it is so vital to soils are that it (1) improves tilth and structure, (2) improves water-holding capacity, (3) aids in nitrogen fixation and (4) makes nutrients available to plants. Here again, this fertilizer does not contain super amounts of nitrogen. Organic forms of nitrogen are more stable in the soil and become available for plant growth more gradually than nitrogen from chemical fertilizers. When concentrated chemical nitrogen is applied to the soil, it produces a shot-in-the-arm effect to plant growth. The plants are subjected to too much nitrogen at one time. Then, if a sudden heavy rain storm drenches the field, the chemical form of nitrogen is to a large extent washed out, and the plants can become nitrogen-starved.

In summary, by following nature's teachings, by creating a recycling situation, the sludge problem, the garbage problem, and the trash problem will have been minimized. Also, the water coming from this type sewage plant will be potable and will not cause pollution in streams, rivers or oceans.

Here and there, an intelligent effort is being made to process sewage, rendering it more or less innocuous before its final disposal, but this is only a faint beginning. Milwaukee was one of the first communities in this country to adopt a far-sighted program. Not only is the sewage broken down, but all the solid wastes (sludge) are dried, and sold as fertilizer under the trade name "Milorganite." Even if a profit is not realized in selling this product, surely the money made can go toward operating the plant.

If every large city would adopt this program with the improvements that the NFA has recommended, not only would our streams, lakes and oceans be freed from this burden of filth, but the valuable organic material could be returned to the hungry soils from which it originally came.

Thank you.

Sincerely yours,

ROSS E. STAUFFER, *Second Vice President.*



