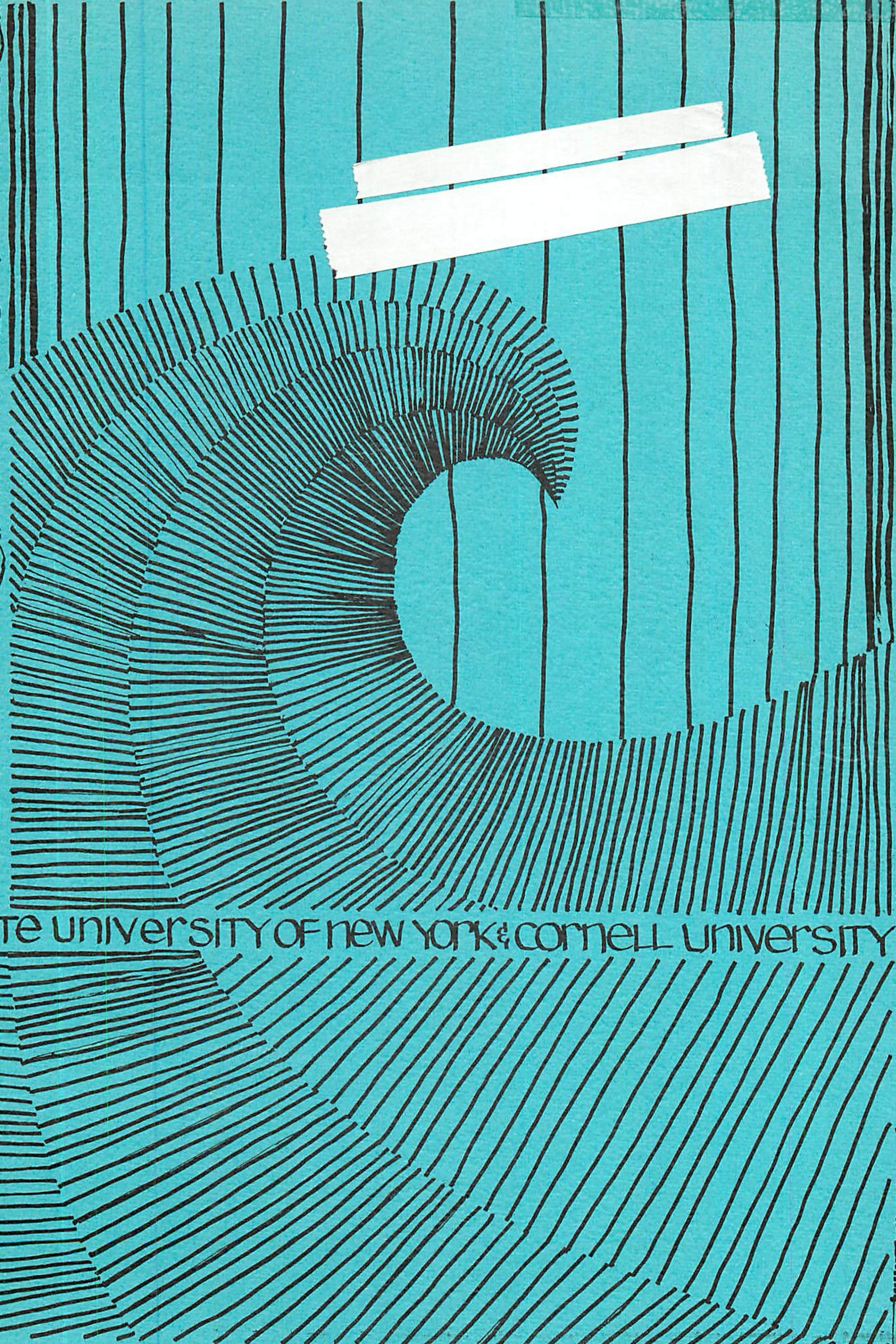
sea grant pr

new york state



STATE UNIVERSITY OF NEW YORK & CORNELL UNIVERSITY

NNUAL REPORT FOR YEAR I

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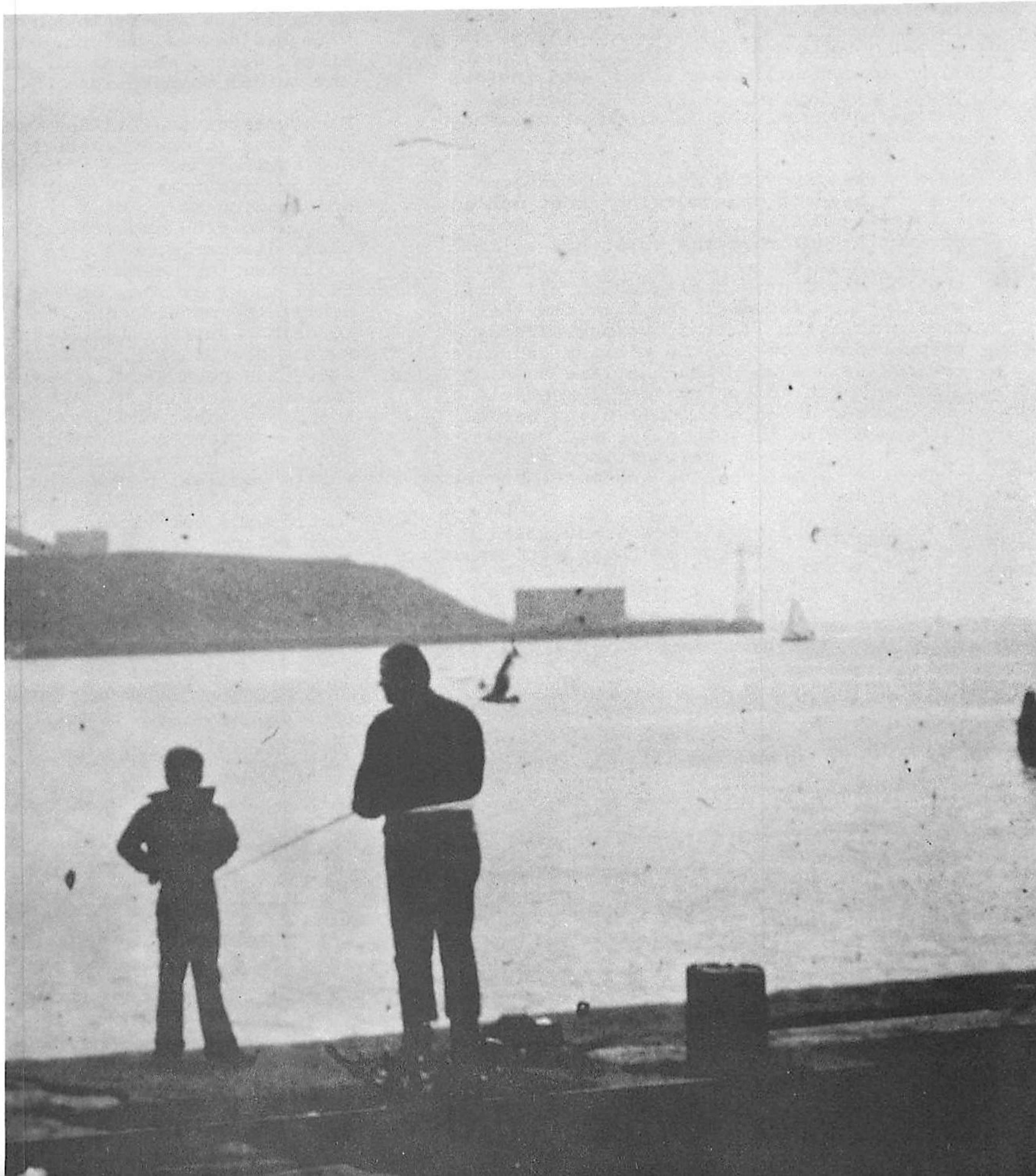


INTRODUCTION

The United States is only just beginning to recognize the immense significance and potential value of the sea around us. Scientific knowledge of the sea has collected slowly, and the science itself has only recently begun to reach its stride. Each bit of new knowledge seems to uncover another unknown. Technological applications of what we already know are proliferating. Now, almost suddenly, we glimpse the beauty--a functional beauty--and the utility of that strange and surprising region of the depths and the surface and the shores of the ocean. We are realizing that an asset exists there, almost untapped and of extraordinary potential for enhancing our lives, and that we should not delay putting into use the marine advances other nations are already practising.

We are also suddenly realizing our compelling need to do something about man's burgeoning pollution of the seas. Somehow we thought that the ocean had a limitless capacity to absorb and detoxify the world's contaminants, which all ultimately reach the sea. We know now that the capacity is limited; we may already be exceeding some of the limits. We have to look at sea and lake and land uses on a scale large enough to find reasonable compromises among our conflicting needs. Perhaps we can't stop polluting, but we can try to isolate the practices most destructive to our present and most lethal to our future.

The originators of the Sea Grant idea recognized the urgency of these problems. They also saw the duplication and conflict resulting from a jumble of government agencies, university departments, and corporate research departments, each operating more or less independently in its own domain. To avoid such provincialism, they based the Sea Grant design on the pattern of the land grant college system, giving elements with a common marine interest ways to work together on problems. Congressional approval in 1966 established Sea Grant as a multi-level program in which research and development, universities and state agencies and private businesses, interact to support each other, with a maximum of communication and mutual cooperation.

Each coastal state's Sea Grant organization acts through research, education, and advisory service to conserve and improve its coastal region. The dominant orientation is problem-solving: research geared to find uses for power plant hot-water discharge, a way to keep oil from polluting the ocean when tankers clean their tanks at sea, or workable environmental-law enforcement around Lake Erie to help resurrect that dying lake. New York's Sea Grant Program, begun in October 1971, has been tackling problems on the two coastlines of New York State, one on the Great Lakes and one on the Atlantic Ocean--serious and immediate problems brought on by the size and scope of New York's population and industry. In this report, we list and discuss the problems towards the solution of which our first year's work has been directed.

THE ENERGY PROBLEM

The energy crisis is much in the news in mid-1973. While scientists and the public are searching for ways to meet our society's demand for gasoline, electricity, and other sources of energy, they are also anxious about the environmental damage that may follow. One area of Sea Grant research during Year I focused on precisely this problem. What impact is being made on the water and air of Lake Ontario by a concentration of electric generating facilities begun there in 1971? In a short stretch of shoreline between Rochester and Nine Mile Point near Oswego, power generators are being built sufficient to supply a whole state the size of Kansas. How is the hot water they discharge into the lake affecting the lake temperatures, the water circulation, and air temperatures over the water? Sea Grant research has made progress toward answering these questions. Is it possible that the hot water discharge can actually be an asset? Yes, we are finding potential good uses.

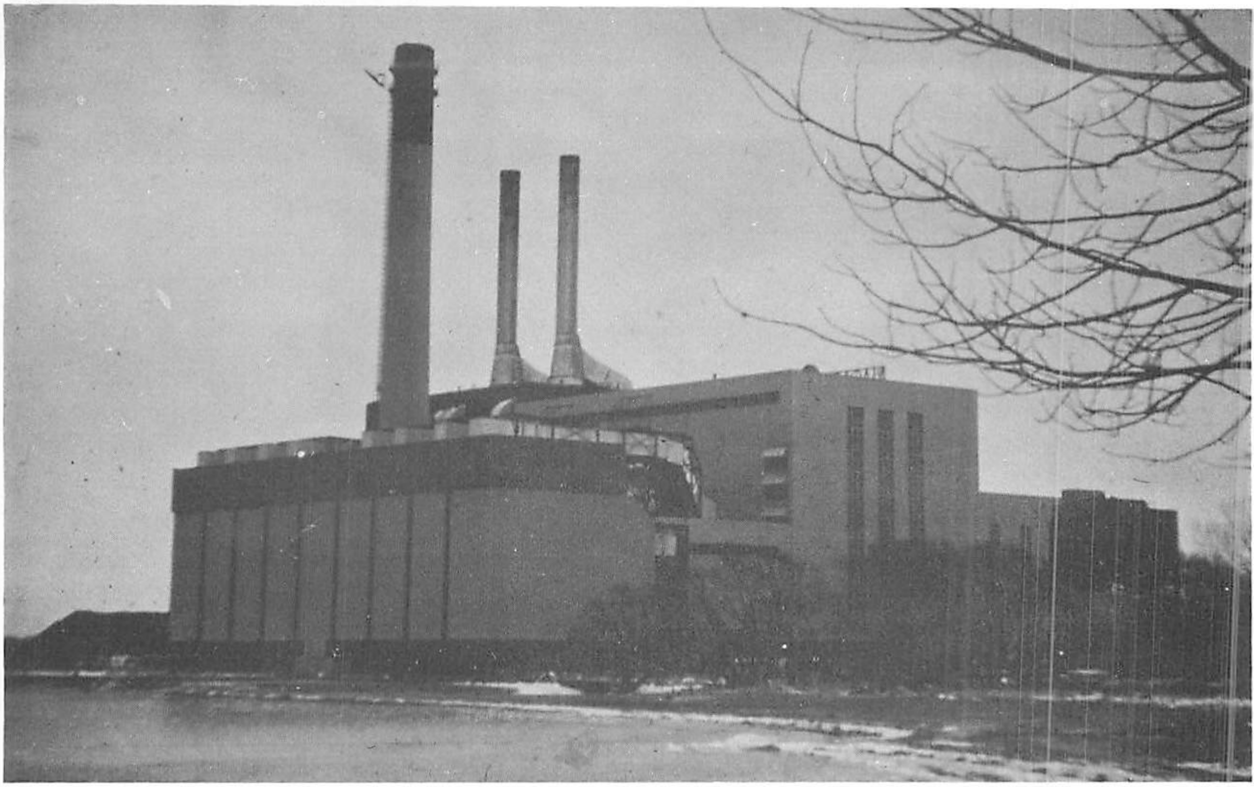
The power plants clustered together on the shore of Lake Ontario are all water-cooled: that is, they use water to cool their condensers. They all also discharge this heated water into the lake--the "once-through" method--rather than using alternative methods like cooling towers, spray cooling, or cooling ponds. Ultimately, power stations in that 80-mile stretch will be constantly pouring out six million gallons per minute of water averaging 20°F warmer than the surrounding water.

Professor Eugene Chermack (SUC at Oswego) did detailed mapping of Lake Ontario surface temperatures near four power facilities, by airplane. Temperature measurements taken on the surface from a boat are too slow to record rapid changes due to wind, cloud cover, air temperature, or solar angle. Moreover, the water streaming out of the discharge pipe rarely holds its position long enough for good delineation from a boat, and a boat cannot survey quickly enough the large area necessary to establish a reliable figure for surrounding water temperature.

Chermack used an infrared thermometer carried by a Cessna 172 flying at altitudes between 500 and 1000 feet to measure the infrared radiation from warm water. This thermometer reads out directly in temperature of the water surface (upper 70 micrometers) with an accuracy of about ±0.5°C. During every season and over each electric plant site, he made several flights spaced roughly 1000 feet apart and at nearly right angles to the coastline. Air temperature, wind direction at flight altitude, sky state, and lake surface condition were noted for each flight. Chermack's data, not yet fully analyzed covers two nuclear and two fossil fuel plants. These plants have different generating capacities and modes of releasing heated effluents into the lake. (Three use surface release of one type or another and the fourth has under-water discharge ducts.) Chermack found great variations from one observation to another in the sizes, shapes, and temperatures of the effluent "pools."

Preliminary conclusions indicate that all four plants create effluent pools much larger than present state criteria would allow. The New York State Guidelines for Thermal Emissions suggest a maximum of 6.5 acres, 3°F; the guidelines, however, have not been applied and tested under actual conditions. One key contribution of Chermack's research is that it helps

A power plant at Dunkirk, Lake Erie.



establish the natural "ambient" lake temperature against which effluents are measured--a prerequisite in evaluating the guidelines.

Professor Jon Scott (SUNY at Albany) investigated how heat from power station effluents is dispersed by nearshore lake circulation. He also investigated whether heat affects the circulation pattern itself. A large volume of data, provided jointly by the International Field Year on the Great Lakes and by N.Y.S. Sea Grant, is still being analyzed. Scott determined the rate of heat loss and gain from the water effluent; Dr. Czapski (see below), using Scott's figures, discovered that a much larger amount of heat than previously estimated goes into the air immediately above the outflow area.

On the previous point, Scott's research points toward the conclusion that several power plants within a few miles of each other could have a significant impact on circulation, and could produce a cyclonic pattern (eastward along the south shore of the lake). This might appreciably affect the dispersal of materials (river outflow, wastes, etc.) along the coast.

"Once-through" cooling--pumping lake water once through the electric generator to take heat off and sending the heated water back into the lake--is thought to spread the heat most widely and thus have minimum local effect on the air. But much less is known about what once-through cooling actually does to the air than what it does to the water. Professor Ulrich Czapski (SUNY at Albany) studied this problem. He set up an instrument tower in the lake near the outfall of the Nine Mile Point generating station, and recorded its readouts ashore. Final interpretation of the data is incomplete, awaiting results from the International Field Year on the Great Lakes, but some preliminary observations are possible. It appears that the heated effluent can lose heat to the air even when the rest of the lake is being warmed by the air (air warmer than lake water). Under some conditions the heat loss to the air over the central part of the water plume (a few tenths of a square kilometer) is actually greater than that reported for a tropical ocean location. Perhaps 30 percent of the heat given off by the power station may be transferred to the atmosphere within an area of one square kilometer. This is enough to modify local weather, triggering preexisting atmospheric instabilities and sometimes resulting in tumbling cumulus clouds or thunderstorms.

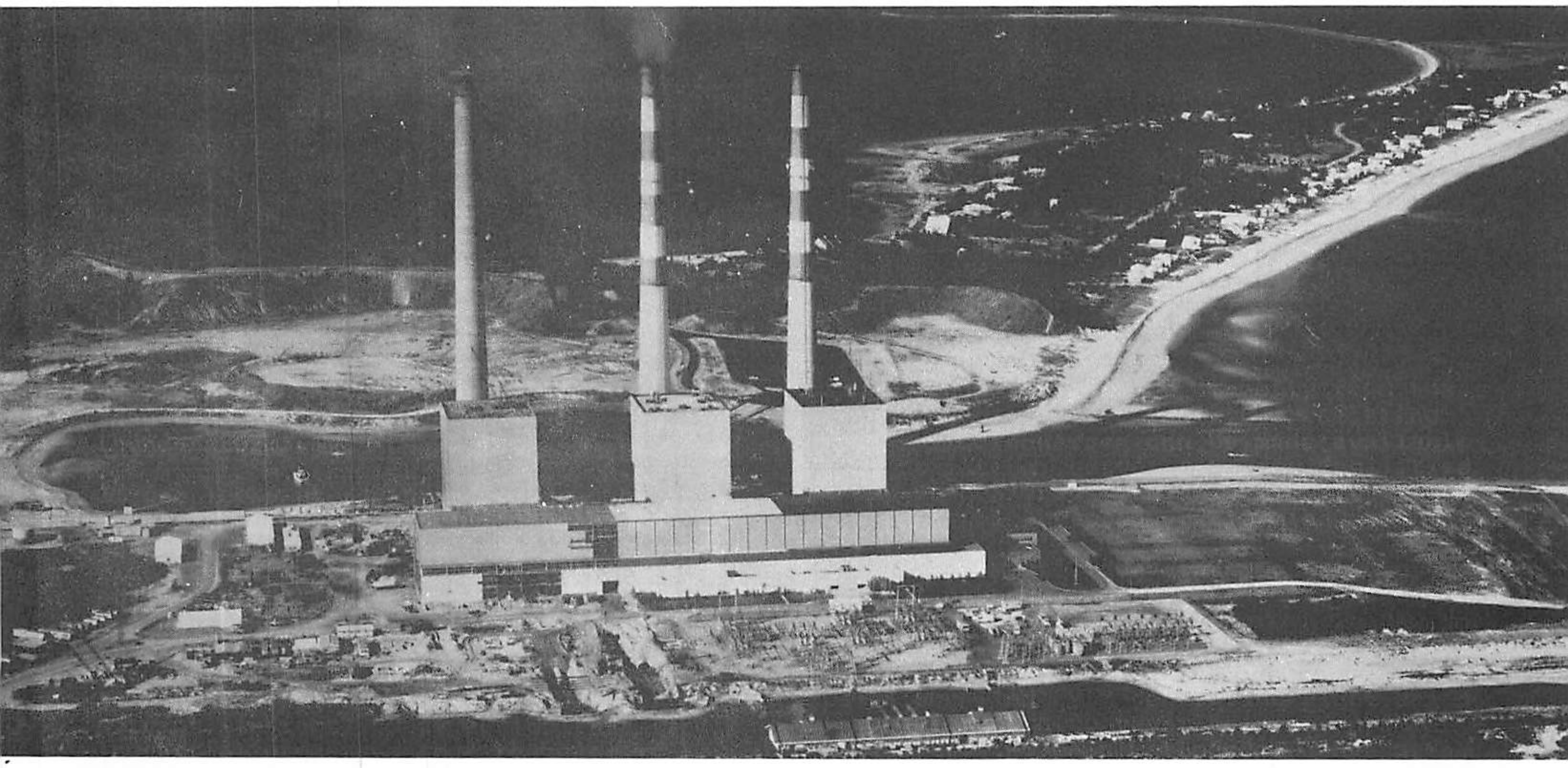
If one looks at the heat produced by an electric generating facility not as an unwanted leftover, something to be gotten rid of, but as part of the total energy output of the facility--electric energy and heat energy--then it becomes clear that the power facilities are wasting a big part of their "product" when they return heated water into the lake: over 60 percent, in fact. Many agricultural and industrial processes require heat; if they could use some of the "heat product," their fuel needs would go down at a time when the general fuel shortage is becoming critical.

Professor Ron Stewart (SUNY at Albany) and four associates investigated various agricultural and industrial uses for this heat now wasted. Seed drying, dehydration of vegetables and fruits, freeze-drying of various foods, tobacco drying, and kiln-drying of lumber are all potentially important to the New York economy. All these processes involve warm air drying at temperatures from 90° to 170°F, obtainable by heat exchange with either the condenser unit or directly from the turbine of a power facility. Existing thermal discharges can be made available by refitting; better yet, new facilities can be designed with an agricultural or industrial "by-product" in mind.

Of the commonly dehydrated vegetables, carrots, cabbage, beets, potatoes, sweet corn, onions, and tomatoes are grown in New York. Peaches, pears, grapes, and apples are New York fruits that can be dehydrated. Hot air supplied by a generating plant can be used for both conveyor-belt and drum drying, the two main methods of dehydrating food. Freeze drying by thermal discharge is feasible only in certain stages using a low temperature range.

Tobacco drying is another use for thermal discharge. Heat is needed for the curing process, which may be done by the farmer, and for the redrying process, which is usually done by the manufacturer. Both processes may be applicable to New York and both use heat at temperatures obtainable from thermal discharge.

Wood drying is particularly important for New York State; many small kilns are in operation. A 1000 megawatt nuclear plant,

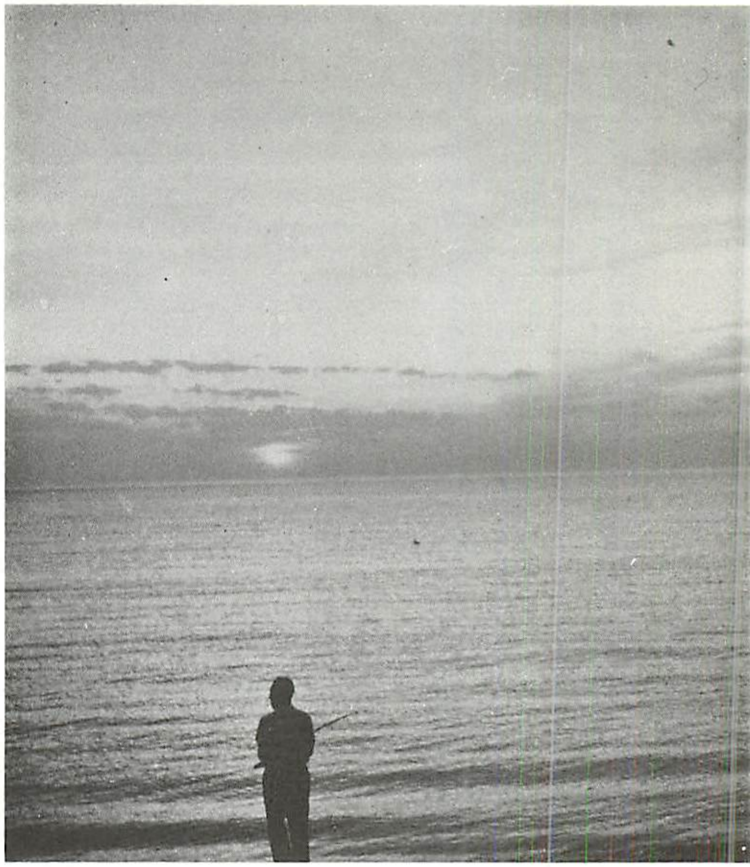


The Long Island Lighting Company power plant at Northport, Long Island. In the canal in the foreground, Long Island Oyster Farms Inc. is carrying on aquaculture.

using 10 percent of the heat discharged, could blow hot air through stacked lumber and dry about 300,000 board feet per hour. Lumber statistics for 1963 show that New York State produced 79 million board feet of soft woods and 338 million board feet of hard woods. Electric facilities on Lake Ontario alone could dry 15 percent of that, if properly fitted. A 120 megawatt dry-cooling tower in Rugeley, England, is a possible model. The area in side the tower represents about two acres of dry, protected space suitable for drying lumber or grain. If something similar were erected in the United States, it would obviate the need for an extra building, decrease total land use, and eliminate fuel bills. As dry-cooling-tower technology improves in Europe and pressure for remote siting increases in the United States, dry cooling may become a necessary design element for new sites.

Another type of potential use is irrigation. Turf farms would benefit greatly from warm-water irrigation, which would enhance the growth rate of turf and, especially important in dry years, would eliminate some pumping costs. Such farms would need only a small portion of the discharge from a 1000 megawatt facility. Spray irrigation of regular farmland, using thermal discharge, has been going on in Oregon for four years. The spray protects crops from frost in spring and fall and provides air cooling in summer. Peaches, pears, apples, cherries, walnuts, and hazelnuts have been grown under this system, with little damage to trees. Strawberries, potatoes, pole beans, corn, and tomatoes are also being grown. Experimentation now includes soil heating by diversion through plastic piping, a process which has also been tested in New York State. The Vitro Corporation in Eugene, Oregon has voluminous economic data on the profit margins to be expected from spray irrigation and soil heating. Being able to produce crops out of season is obviously a big economic plus. The integrated system of the Arizona Environmental Research Laboratory will produce power, water, and food even on a desert seacoast. Their greenhouse experimentation in Mexico and commercial operation in Aba Dabhi on the Persian Gulf have elicited business inquiries and one contract.

Other possibilities still in the future include heating fish tanks, drying hay and fish, and actually improving lake water quality by using thermal discharge.



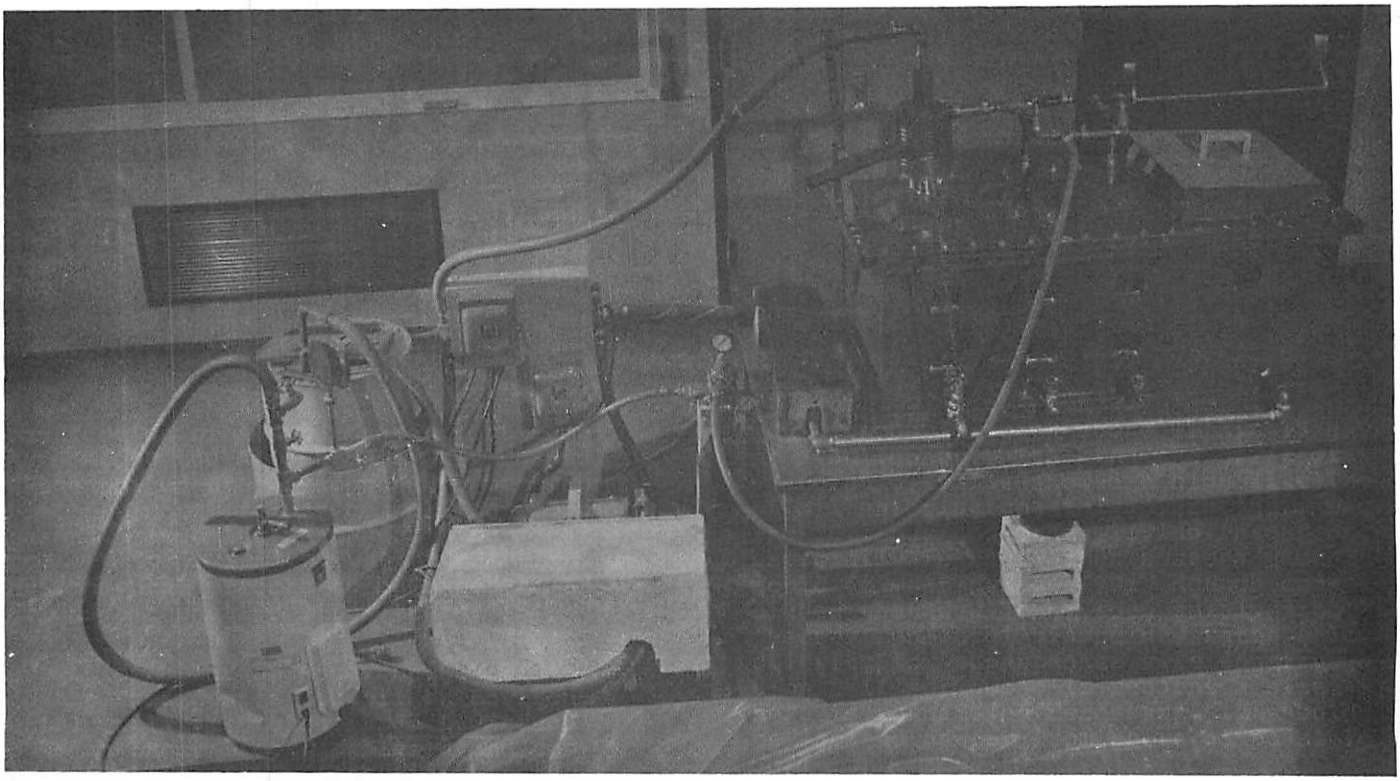
A second energy-related area of Sea Grant research was in oil transportation. What about building a supertanker port in the New York coastal area? What would be the relative hazard of spills in various places? A Sea Grant researcher looked into this question, and came away shaking his head: the hazard is great at any of the potential sites. Is there any good way to separate the oil from oily ballast or bilge water now discharged at sea when tankers clean their tanks? Under present methods, hundreds of barrels of oil now go into the ocean water with every cleaning operation. A Sea Grant researcher found a new and effective separating method whereby the oil can even be used again. What happens to oil that spreads on the sea surface? Does the sea cleanse itself? Eventually, yes. Previous theories about emulsified droplets and dissolving didn't account for the rate of disappearance, however. Another Sea Grant researcher found new information on a natural process that disperses 90 percent of the oil.

Construction of a supertanker port somewhere along the Atlantic or Gulf coasts of the United States appears to be probable, for more or less compelling economic reasons. Assuming that such a terminal is approved for a region, what are the environmental effects to be expected at various alternative sites there?

As part of a larger study by Sea Grant and the President's Council on Environmental Quality, Professor J. L. McHugh (SUNY at Stony Brook) analyzed and compared three tentative locations in the New York area: 1) in Sandy Hook Bay, 2) in the New York Bight 8 miles east of Sandy Hook, and 3) in the Bight 35 miles east of New Jersey and 18 miles south of Long Island. McHugh found that the danger of damage to the coastal environment increases proportionately with nearness to shore. The Sandy Hook Bay location would require extensive dredging for construction and for maintenance, with accompanying environmental damage. Heavy ship traffic around site #2 increases the danger of collision, and in turn the risk of spills near important recreational areas. At site #3, no dredging would be needed; oil spills there, however, despite more time and space for cleanup, would probably reach shore within 19 days, or even sooner. Tracking the drift of postulated spills showed a high likelihood of oil entering coastal inlets and damaging wetlands and other living resources, especially in the warmer seasons when it would do most damage. Dr. McHugh concluded that New York, seen solely from the environmental viewpoint, rates a low priority for supertanker site construction. If for economic reasons a site here is considered necessary, it should be located as far from shore as possible.

Farther out in the ocean, oil discharged deliberately is a major cause of sea pollution. A significant fraction of this oil is discharged by tanker crews cleaning ships' tanks or releasing oily ballast water. Immediately after a cargo of oil has been off-loaded, the empty tanks are filled with large quantities of ballast water, to maintain the vessel's stability and seaworthiness during the return journey. The tanks have to be emptied again to reload more oil, but discharging dirty ballast in a coastal area (for example, close to a port where more oil will be loaded) is prohibited by law. Tanker crews therefore pump out the dirty water at sea, clean out the tanks, and

Dr. Femenia's oil-water separator



re-ballast with clean water when the ship is next loaded with oil.

Various ways of separating the oil from the ballast water have been tried. The oil-water mixture from the cleaning operation is usually pumped into an empty tank for separation of the oil and water by gravity before the water is pumped overboard. Good separation is not obtained, especially under stormy conditions, and considerable pollution results. Mechanical oil-water separators have been developed and are in use on many ships, but a better alternative is needed to meet increasingly stringent national and international restrictions on oil discharge.

Professor Jose Femenia (SUNY Maritime College) studied various inexpensive and easy-to-operate separation methods, trying to come up with a closed recycling system permitting immediate cleaning while the vessel is still unloading, thus eliminating discharge of dirty ballast altogether. Dr. Femenia finally selected a gravity method based on a dense magnesium sulfate salt brine in water. Magnesium sulfate performed well in tests; compared with other salts, fresh water, and sea water, it cleaned effectively and was less corrosive. While certain salts can be dangerous contaminants in oil, magnesium sulfate has even been used successfully as a fuel additive.

Dr. Femenia then built a tanker simulator model to test the brine recycling system under rolling shipboard conditions. After many modifications he developed an oil-brine separator that satisfactorily removes the oil accumulated in the cleaning process. He then designed a complete closed-cycle cleaning system for tankers in the prevalent 40,000- to 100,000-ton range. Reclaimed oil from this separator can be used in the ship's engines, returned to a cargo tank, or discharged ashore as a special grade of oil.

Results of the study indicate that the system is economically feasible for tankers, will reduce oil pollution, and will bring appreciable savings of oil. After Dr. Femenia's presentation of a paper on the separator system at the annual forum of The Society of Marine Port Engineers in New York City, an oil company began negotiations for its use on their vessels. Application for a patent on the equipment is under consideration.

Oil and petroleum products spilled into the sea eventually disappear from its surface through natural processes. After a large oil spill is cleaned up, even by the best methods yet developed, some oil remains; finally, it too disappears. What are these natural clean-up processes? According to a previous theory, the churning surface emulsifies the floating oil into tiny submerged droplets. These droplets were thought to lose their low-density components by rapid dissolving and thus increase in density until they sink to the sea bottom.

Professor Edward R. Baylor (SUNY at Stony Brook) found that although this mixing and dissolving process does occur in the sea, it is not at all a major factor and does not explain the observed rates of disappearance. Baylor's experimental results show that approximately 9/10 of the volume of oil lost from the sea surface is ejected into the atmosphere in droplets, the so-called Woodcock-Blanchard ejection effect. This loss is much accelerated under windy conditions. Dissolving, chemical and biological degrading, and sand particle accretion probably account for the disappearance of the remaining 1/10. Baylor next proposes to study the effect on airborne oil droplets of photooxidation and the carcinogens which result from this process.

THE POLLUTION PROBLEM

"Water pollution no longer merely offends esthetically; it threatens to collapse the entire economic system upon which urban man is delicately balanced." Robert Ford, a Buffalo sociologist, puts his finger on a real impetus to do something about pollution: the fear of economic dismemberment. Industrialists like hard facts and pragmatic solutions: prove to us that our papermill effluent is really harming significant organisms, and prove to us that cleaning up the effluent will really reverse the damage and be worth the cost; we'll be more likely to respond to accurate information than to doomsday prophecies. One project showed that small animals, part of Lake Ontario's food chain, did recover when a papermill's discharge flow was given sewage treatment. Another project studied exactly how a turbid river flowing into Lake Ontario affects plankton and the small creatures that graze on it. Several projects investigated heavy metals like mercury, copper, zinc, and arsenic--which are discharged in industrial wastes, get into the food chain, are consumed and gradually concentrated in larger and larger fish which, if eaten by humans, may have damaging or even fatal effects. How well are anti-pollution laws working, and how much do the laws themselves need rewriting? And finally, a really big challenge: Can we put together a workable plan to save and improve a heavily-impacted urban area like western Long Island Sound? Does much of Greater New York's sewage really collect there? Is what we suspect true: that the tides and currents don't flush adequately to clean the water because of the conformation of the land? How can we plan until we know what we need to know?

Professor John Judd (SUC at Oswego) did a before-and-after study of a papermill discharge site on the south shore of Lake Ontario, with encouraging results. During three years he sampled small invertebrate animals like fly larvae, freshwater earthworms, and small shrimp that feed on the alga *Cladophora* growing there in mats of what looks like long green hair. The first two years, until October 1971, the papermill was releasing almost 2 million gallons of effluent a day--raw effluent, completely untreated, containing paper fibers and what the mill people call "white water." After October 1971, the effluent was diverted through a primary and secondary sewage plant to remove large particles and what "bacteria-treatment" can take out. The treated wastewater now flows into the lake at a different place.

In the two years that effluent was still pouring out at the study site, Judd found that species diversity went down significantly. (Species diversity--how many different kinds of animals are found in a sample--is one major measurement of pollution's effect.) A year after October 1971, Judd found that species diversity at the old site was about the same as at a site 150 meters away--a place presumably unaffected by the outflow and therefore a "control" site. The animal population had completely recovered in one year. (Judd pointed out, however, that the recovery may have been helped by the fact that this was a rocky, exposed shore where not much paper fiber would remain after a year, and by the fact that high water levels in the lake after October 1971 covered up the boulders on which *Cladophora* likes to grow, hence supporting a healthy "pasture" for the grazing animals.)

Do the silt and metal in a river's outflow into a lake affect plankton in the lake? Plankton--drifting minute plants and animals--constitutes the first step in the food chain. Professor Robert Costa (SUC at Brockport) studied the turbid plume of the Genesee River where it flows into Lake Ontario near Rochester. Costa found about the same species diversity inside and outside the plume; species density (how many of the same kind) was greater outside but it didn't seem to affect productivity. He did find a significant difference in how much the animal organisms consumed (by carbon-14 measurement): it was consistently higher outside than inside the plume, presumably because silt particles interfered with grazing.

Costa also found more traces of heavy metals in the water and in the organisms within the plume than outside, especially iron and zinc. At Braddock Bay, a supposedly less polluted area about 10 miles away, he again found high concentrations of metals in the plankton, in this case chromium, copper, and lead and not so much iron.

Small traces of heavy metals dissolved in water are hard to analyze. Only for mercury has a satisfactory method been developed; for other metals, present methods are difficult and time-consuming and require that the metals be concentrated before analysis. Anthony VanGeet and Arjen Teitsma (SUC at Oswego) found

Table 1

Heavy Element Concentrations

in Lake Ontario Smelt

Element	Western Lake Ontario: Youngstown (513)	Western Lake Ontario: Youngstown (515)	Eastern Lake Ontario: Prince Edwards Bay (517)	Eastern Lake Ontario: Prince Edwards Bay (518)
Cadmium	0.048 ± 0.006	0.060 ± 0.007	0.047 ± 0.006	0.069 ± 0.008
Zinc	31.6 ± 1.96	29.8 ± 1.85	25.9 ± 1.61	24.0 ± 1.49
Chromium	0.35 ± 0.024	0.26 ± 0.025	0.13 ± 0.003	0.11 ± 0.006
Arsenic	0.57 ± 0.022	0.49 ± 0.019	0.39 ± 0.031	0.43 ± 0.028
Copper	1.60 ± 0.16	2.46 ± 0.16	1.23 ± 0.10	0.90 ± 0.075
Mercury	0.24 ± 0.008	0.26 ± 0.015	0.17 ± 0.023	0.16 ± 0.010
Selenium	0.39 ± 0.008	0.42 ± 0.003	0.50 ± 0.005	0.48 ± 0.011

in Lake Ontario Slimy Sculpin

Element	Western Lake Ontario: Youngstown (514)	Eastern Lake Ontario: Prince Edwards Bay (516)	Eastern Lake Ontario: Prince Edwards Bay (519)
Cadmium	0.096 ± 0.012	0.14 ± 0.017	0.15 ± 0.018
Zinc	19.8 ± 0.5	16.6 ± 1.03	17.6 ± 1.09
Chromium	0.19 ± 0.022	0.094 ± 0.015	0.13 ± 0.015
Arsenic	0.23 ± 0.010	0.33 ± 0.019	0.33 ± 0.013
Copper	2.00 ± 0.14	1.80 ± 0.14	1.92 ± 0.16
Mercury	0.51 ± 0.063	0.23 ± 0.014	0.30 ± 0.010
Selenium	0.66 ± 0.023	0.71 ± 0.043	0.73 ± 0.044

promising results with mercury-covered electrodes. Heavy metals like cadmium and lead amalgamate with the mercury and can then be stripped off at voltages that identify the individual metals. Concentrations of various metals at less than one part per billion may be capable of analysis by this simple technique. Up to now we knew very little about the amount of these heavy metals actually in the environment, even though the maximum allowable level for drinking water has been set at less than one part per million.

Dr. C. C. Thomas, Jr. (Western New York Nuclear Research Center, SUNY at Buffalo) was also interested in metals other than mercury. The Department of the Interior has initiated several projects on mercury in the Great Lakes food chain; other heavy metals have been little investigated, however, and their accumulation could pose a health hazard.

Dr. Thomas took fish (smelt and slimy sculpin) from two locations in Lake Ontario and analyzed them for chromium, copper, mercury, cadmium, zinc, arsenic, and selenium, using a nuclear reactor. When a material (like a fish sample) is bombarded with neutrons, some of the atoms become radioactive. Metal elements can then be detected by their characteristic radioactivity--sometimes several in the same sample. When other elements in the sample interfere, they can be removed by chemical separation. Even tiny amounts can be detected with these methods. (For analysis in the field, when such pinpoint accuracy isn't necessary, Van Geet and Teitsma's electroanalysis can be adapted to a pocket-portable device--a convenience you certainly can't arrange with a nuclear reactor!)

As expected, Dr. Thomas found mercury in smelt and sculpin, and at higher levels in fish taken from the western end of the lake, probably because the Niagara River enters the lake there. At the other end of the Niagara River, where it flows out of Lake Erie, smelt have similar levels of mercury (0.3 parts per million). Fish higher in the food chain can be expected to contain more mercury, probably exceeding the FDA action level (0.5 parts per million). Single specimens of great northern pike from the St. Lawrence River have contained as much as 1.3 ppm.

For zinc, Dr. Thomas found the same gradation to higher levels in the west end of the lake. The other metals did not show a clearcut geographic trend. Mercury is the only heavy metal so far for which the FDA has set a maximum permissible level in food (0.5 ppm). Dr. Thomas's findings of relatively great amounts of arsenic and selenium strongly suggest the need for investigation of their health effects and possible establishment of maximum limits.

One interesting sidelight on the heavy metals question is that sewage might actually help remove heavy metals from seawater. Eugene Schrier (professor of chemistry at SUNY/Binghamton) tested out the combining tendencies of mercury and copper (cupric ion) with large molecules such as protein molecules or organic molecules found in sewage, and showed that natural, unfiltered seawater combines most with the cupric ion, filtered seawater next, and artificial seawater least. If a metal ion has combined with a large molecule, it will be less chemically active and hence less toxic: it will be less likely to remain in a fish, for example, by combining chemically with part of the fish.

While research is continuing on what actually does and does not happen from water pollution, what results are coming from

pollution laws? Poor results: the laws are not being effectively enforced. This is the conclusion of Robert Ford (SUNY at Buffalo), who surveyed patterns of enforcement and management at the local level in the Lake Erie Basin. He concentrated mainly on Erie and Niagara counties, with their heavy dependence on manufacturing and the chemical industry and the consequently severe water pollution problems that have brought Lake Erie such notoriety.

Overlapping jurisdictions and ineffective coordination of effort were characteristic of the enforcement operations Dr. Ford observed. A surprisingly large number of relevant laws were available to all levels, but they were often ignored. Decisive action was the exception rather than the rule, and usually happened only in response to public protest. The legal authority and the expertise to control pollutants are available; the difficulty is to motivate individuals, corporations, and municipalities to apply them.

Dr. Ford found a wide divergence between "the legal model"--the authority mandated by law--and "the real model"--the actual operating of the enforcement agencies. The agencies tended to avoid using their mandated authority; they used negotiation and arbitration rather than adhering to exact standards specified by law, with scant regard for the total picture. They rarely went to court despite extensive violations, and rarely imposed penalties. Consequently, the laws on the books have been considerably diluted.

The main stumbling-block is not incompetent people or do-nothing organizations.

It is poor dovetailing of the whole water-pollution-control enterprise.

Dr. Ford's project is continuing. Many county and local groups have received his findings to date, and proposed state laws on wetlands and coastal zone planning may be improved by incorporating some of his ideas.

If one key to effective planning is well-integrated organization, another is good information. On New York's Atlantic coast, there is a problem of dimensions just as challenging as the Lake Erie problem: the deteriorating water quality of western Long Island Sound and the East River. Persistent trouble with extremely high levels of nutrients and low oxygen during summer months has focused public concern on this area. Source of the nutrient concentrations is not known; some believe it is the discharge of sewage treatment plants clustered all around the shore. The map shows only the largest sewage plants; millions of gallons of treated and raw sewage pour into the water daily--and Greater New York's millions of people would also like to swim and fish and boat there.

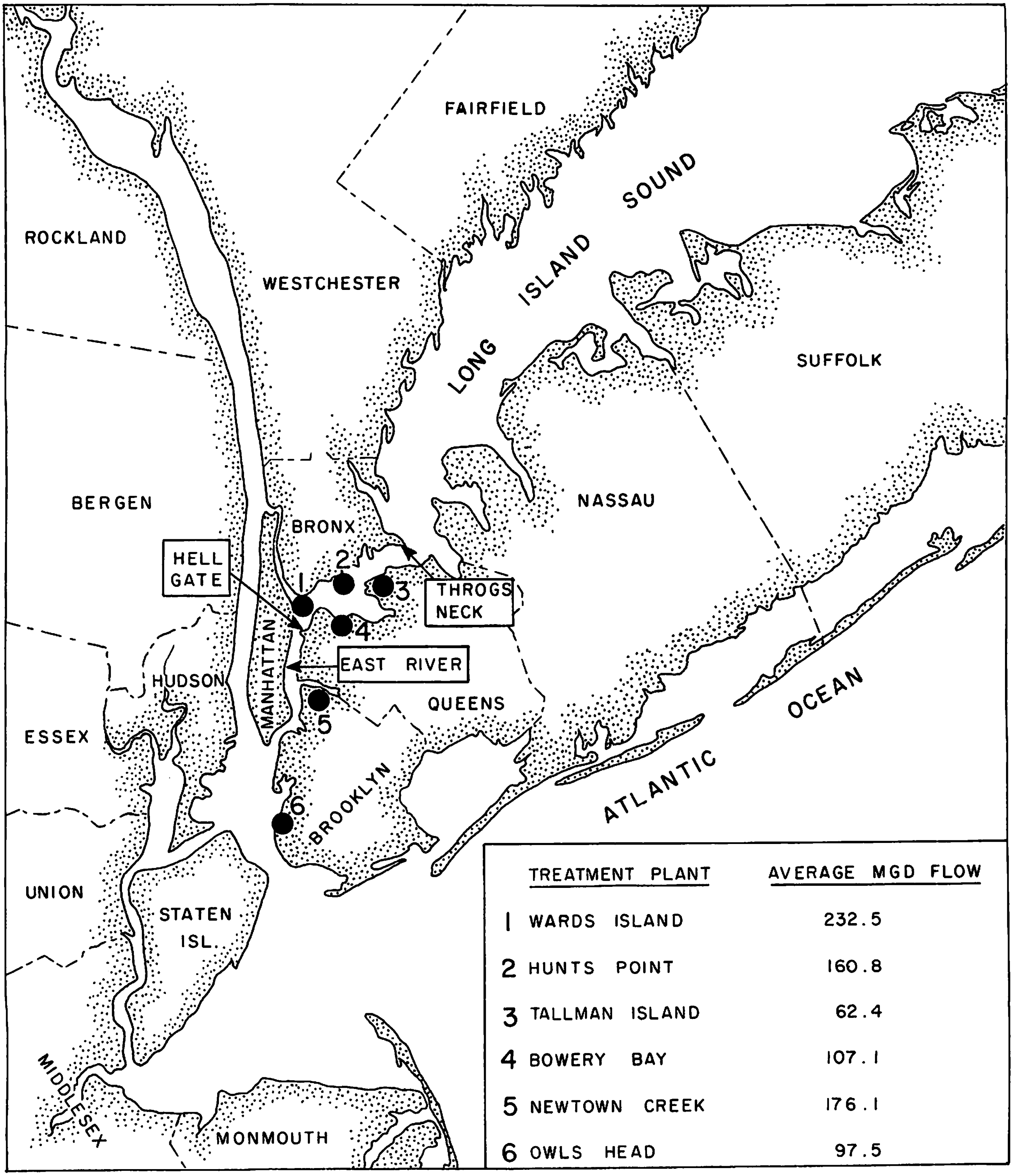
One acknowledged major factor in the water condition is a pecularity of the land shape there. Most estuaries are flushed by two kinds of currents: turbulent tidal diffusion and the downstream flow of fresh water from a river. Long Island Sound is open to ocean tides at both ends, and fresh water from the Hudson River flows down between Manhattan and the Bronx into the East River (which isn't really a river but rather a passageway connecting the Sound and New York Harbor). Even so, the daily back-and-forth of the tides and the river doesn't produce any large one-way flow, either westward or eastward, to flush out the pollutants. This much we already know.

What we don't know, but are investigating, is the *net flow*--how much water ultimately moves in one direction after we subtract the back-and-forth--and the *direction* of that net flow--eastward into the Sound or westward into the East River. Joseph Longobardi (SUNY Maritime College) and Malcolm Bowman (SUNY at Stony Brook) are each working on facets of these two questions. On different days Longobardi recorded water current direction throughout the tidal cycle from surface to bottom (a cross-section), just west of Throgs Neck Bridge, the approximate boundary between the Sound and East River. He found a net transport eastward at all depths on the north side of the channel, and westward on the south side. On the average, the north side current diminished from surface to bottom; the south side current increased with depth. On August 23, 1972, the day's average net flow for the whole channel was calculated at 102 cubic meters per second eastward. Longobardi is still analyzing data taken on other days and at other cross-sections. Net flow varies greatly with changing weather and tide conditions; interrelating all the data is very complex.

Dr. Bowman and his associates added a new twist to a familiar oceanographic instrument: a drogue with a radio transmitter. A drogue is a float with an 8.5-meter parachute suspended in the water beneath. Each drogue floats free and is moved by current pressure on the parachute underneath. With the radio transmitter, activated at intervals by radio signals from shore, its movements can be plotted. A PADROS unit (Parachute Drogue Data Acquisition System) can measure top and bottom temperature, salinity, oxygen, wind direction and speed, and can transmit this data to the master station for tape recording.

Dr. Bowman also organized two large-scale volunteer field operations to learn more about circulation patterns. He concentrated the two field operations on New York Harbor, especially East River's Hell Gate. On April 8, 1972, more than 50 volunteers on land and on boats provided by the Army Corps of Engineers, the U.S. Coast Guard, the Environmental Protection Agency, and SUNY Maritime College, set out to measure surface salinity, temperature, and tide heights over a tidal cycle. They were in radio and telephone communication with a central desk in the Port Authority Building in Manhattan. On September 23, an even broader field study was conducted, using 13 boat stations and repositioned land stations. This time, 80 volunteers from 6 schools helped.

A daring yet simple way of preventing East River pollutants from entering the Sound has been proposed by Dr. Bowman. As indicated above, the *net flow* of water leaving the west end of the Sound through the East River is much smaller than the total flow back and forth through Hell Gate with the tidal cycle. If this back-and-forth movement could be converted into a one-way current westward, by blocking return flow into the Sound, a much-increased daily transport into the East



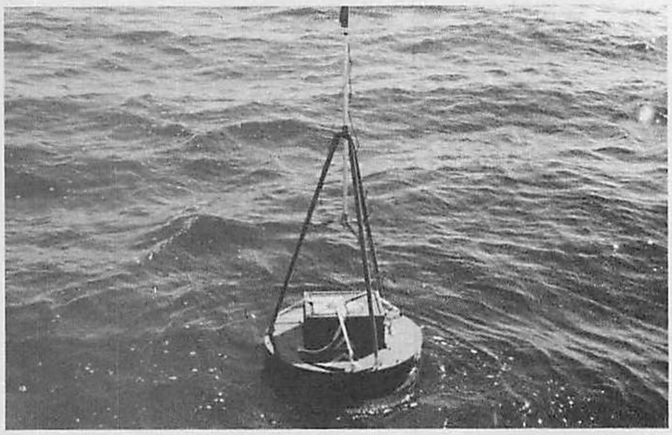
TREATMENT PLANT	AVERAGE MGD FLOW
1 WARDS ISLAND	232.5
2 HUNTS POINT	160.8
3 TALLMAN ISLAND	62.4
4 BOWERY BAY	107.1
5 NEWTOWN CREEK	176.1
6 OWLS HEAD	97.5

MAJOR (> 50 MGD AVERAGE FLOW) SEWAGE TREATMENT PLANTS IN EAST RIVER AREA.

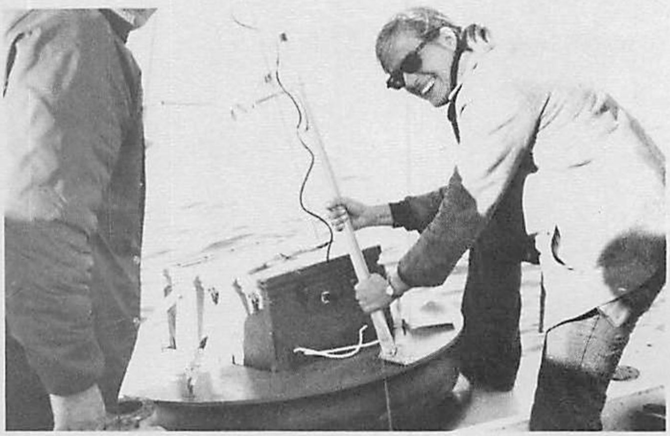
River would result. This could be done by installing one-way tide gates at Hell Gate or at Throgs Neck.

An adjusted tidal flow from the Sound into East River would substantially improve water quality in the western Sound and, surprisingly, also in the River and New York Harbor. Pollution levels in the Harbor would drop to between 32 and 78 percent of existing levels: in the western Sound (just east of the tide gates) they would fall to an amazing 15 percent of present levels. We would find significant improvements in both bodies of water 3 to 4 weeks from the time the system is put into operation. In effect, the plan would allow natural tidal flow of relatively clean Sound water to flush the pollutants down the East River but would prevent the return flow from the River which now occurs.

Construction of tide gates would cause at least one obvious problem: interference with ship navigation through the East River channel. A system of locks would be necessary to permit ship passage through the gate structure while the gates were closed. Or it might be feasible to schedule ship traffic only for periods when the gates were open--that is, half the time. In addition, salinity in the Sound would go up since the present fresh water flow would be excluded. In the western end of the Sound, salinity would increase by 2.5 parts per thousand and in the central basin by 1.2 parts per thousand, with possible effects on living things. Increased salinity does not appear to be as significant as the expected improvement in water quality; further studies of the potential effect are being made.



In the course of assembling information about water quality in western Long Island Sound, coupled with extensive earlier work done by State University's Marine Sciences Research Center at Stony Brook, four men put together a book describing the impact of urbanization on the Sound over the past twenty years. *Long Island Sound: The Urban Sea* (in press), by P.K. Weyl and M. Grant Gross of the MSRC, and Lee Koppelman and DeWitt Davies of the Nassau-Suffolk Regional Planning Board, summarizes our present knowledge of the geological, physical, and chemical oceanography of the Sound, and of man's impact upon the Sound. The book makes it clear that for Long Island Sound, at least, we do know enough to make plans: plans for well-coordinated, comprehensive coastal zone management.



CONGRESSMAN GROVER SPEAKS FOR SEA GR

Mr. Speaker, I welcome this opportunity to express my support for the Sea Grant College and Program Act. Since its inception in 1966, the financial backing of Sea Grant and, more importantly, the leadership have brought together many diverse elements within our academic institutions, Federal, and State governments, and the business community, to investigate and promote the rational and beneficial use of our marine environment.

Sea Grant has been a catalyst, giving momentum to such projects as the rearing of pan-size salmon on both the Atlantic and Pacific coasts, a commercial endeavor of rapidly growing importance, as our ocean stocks of the most highly sought species are being depleted by intensive foreign-flag fishing off our shores. Related efforts in the field of shellfish culture have yielded dramatic results.

Sea Grant Colleges have been a unifying force in their service areas, conducting wide-ranging studies and conferences on coastal zone management, resource management, deep water and off-shore ports, and other environmental problems confronting our coastal and estuarine areas. The Sea Grant advisory services distribute the results of such efforts throughout the system, stimulating a broad interaction between the various institutional and regional segments of our marine-oriented community. The lead role of Sea Grant in promoting such communication may well be its most significant accomplishment.

An unhealthy degree of competition between academic institutions for Federal support and rivalry among individual researchers

Congressman James R. Grover, Jr.,

Second C.D., Long Island

Congressional Record, May 8, 1973

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has been an unfortunate hallmark of federal support for scientific research in the United States. This has led to an isolation of researchers at the most critical stage of their work when gathering and analyzing the basic raw data upon which their published works are premised. The Sea Grant approach, on the contrary, has stressed bringing together consortia of universities and State agencies traditionally competing for limited State and Federal funds. Sea Grant has even brought the university systems of neighboring States together under common program management to tackle problems of mutual concern.

This unifying approach to the funding of research at the institutional level has its counterpart at the personal level, drawing upon individuals with diverse scientific and business interests to work as a team rather than in isolation.

The development of a resource or of a scientific technique and its application in a manner which yields measurable benefits is a multilevel process, which may in time succeed when these various levels of research and application proceed apart from each other; but Sea Grant has demonstrated that far-reaching results can be achieved within a truly modest financial structure when there is a maximum degree of communication and cooperation between institutions and individuals.

Mr. Speaker, this [funding] authorization will insure the continued steady growth of the Sea Grant program over the next three years. It enjoys broad bipartisan support in the Congress, and I urge its passage.

THE COASTAL MANAGEMENT PROBLEM

For nearly two hundred years this country dealt with its coastal problems either ignorantly or piecemeal, dealing with each newly-perceived problem without plan or comprehensive attack. Growing public awareness of our rapidly-deteriorating environment spurred governments toward regulation of environmental use, largely by limiting the discharge of noxious substances into water and atmosphere. In late 1972 the U.S. Congress, recognizing that such regulations were treating only the symptoms of the problem, took a major forward step in the evolution of a scheme for the wise use of our coastal resources--the Coastal Zone Management Act. Sea Grant programs around the nation played a major role in the development of this legislation and will be central to its implementation, assisting states to develop their coastal zone plans and management programs.

What is coastal zone management? It is a two-part concept: first, development of a *plan* for the utilization of the coastal region, and second, initiation of a *program* to put the plan into effect through legislation and enforcement. To qualify for federal grants under the Coastal Zone Management Act, both elements must be developed within a state framework. Most important, the concept of coastal zone management embodies the interrelationship between land and water; lands adjacent to the coast whose use has a direct and significant impact upon the coastal waters are placed under the aegis of the program. States must now be aware of how coastal lands are used, how much that affects the coastal waters, and what limits such interaction places upon uses of coastal lands.

Development of a coastal zone plan will be a difficult task for all states, for we have all too few answers to many vexing problems. The plan must be developed, however, even in the face of inadequate knowledge. Every day, decisions are made that irrevocably limit future alternatives. Every day, in small ways, access to coastal waters diminishes; water quality is damaged; unknowingly, esthetic and economic barriers are raised against future development of this finite resource--our coastal frontage.

Coastal zone planning will have to grapple with many complex issues. We must have a basic understanding of the physical and chemical processes governing the waters of our coasts and the life that can survive in those waters. We must assess the naturally-occurring resources of our coastal regions: sand and gravel, shellfish, fin-fish, oil and gas, and new resources not yet economically significant but potentially necessary to harvest. We must recognize that the exploitation of any one resource affects the quantity and quality of others: it is not technically feasible to mine sand and gravel and in the same location maintain beds of shellfish--not yet, at least. Unlimited recreational fishing has a significant impact upon the numbers of fish present and sets up direct conflicts between commercial and sports fishermen. We must plan to use our coastal region in multiple ways without any single way being excessive. Realizing we can't stop the energy of nature or stay the tides, we must harness natural forces to flush polluted water bodies and slow down erosion. We also need to consider the current state of our many coastal-based industries: what are economic factors affecting them? what hurdles do they face in coping with current and future environmental regulations? are there technological cures for their problems? We must look at industry and education as related: is the pool of manpower to staff existing and emerging industries adequate and properly trained in marine specialties?

The underlying foundation of coastal management is knowledge of the physical and chemical processes of the water along the coasts. During Sea Grant's Year I, three investigators did research within this area.

The mixing process in the upper layers of oceans and lakes is vitally significant to all aspects of life on earth. Mixing establishes or strongly influences the levels of dissolved oxygen, the thermal structure of water bodies, the exchange of water vapor and heat between water surface and atmosphere (evaporation), and the mechanical coupling of water to the atmosphere which produces wind-driven currents. Current systems, in turn, affect atmospheric circulation. Transport by mixing determines the ultimate disposition of contaminants such as waste heat, nutrients, and pesticides.

One important mixing process in large water bodies is the so-called Langmuir circulation, in which wind-driven rotating cells are observed to form in the water with their long axis parallel to the surface and to the wind. The cross-sectional diameter of these cells tends to be uniform from cell to cell, so that they are spaced approximately the same distance apart, and adjoining sides of cells move in the same direction. This situation produces the long streaks (windrows) of foam or floating debris often seen on the sea surface.

Professor Sidney Leibovich (Cornell University) successfully developed a mathematical "model" of Langmuir circulations; this is the only model which allows prediction from wind state and wave conditions of 1) the spacing of characteristic Langmuir circulation windrows, 2) velocities in the Langmuir cells, and 3) the calculation of how much below-the-surface water is transported to the surface by the circulation. Dr. Leibovich is planning to publish a paper jointly with Dr. A. D. D. Craik of the University of St. Andrews, Scotland, and to apply the theory directly to compute oil spill dispersion and oxygen transfer from the atmosphere.

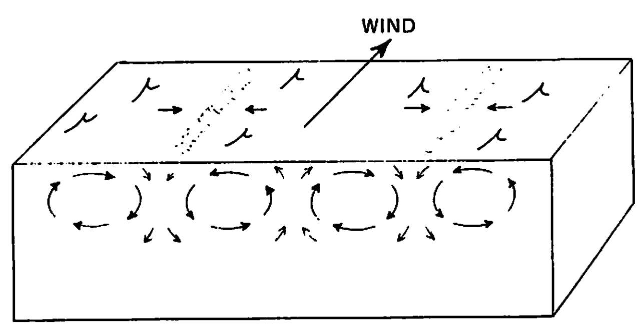
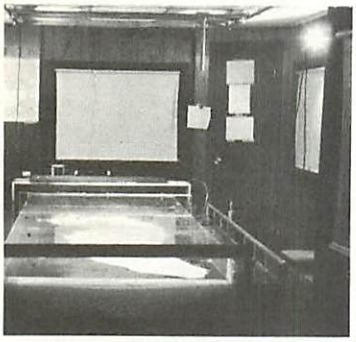
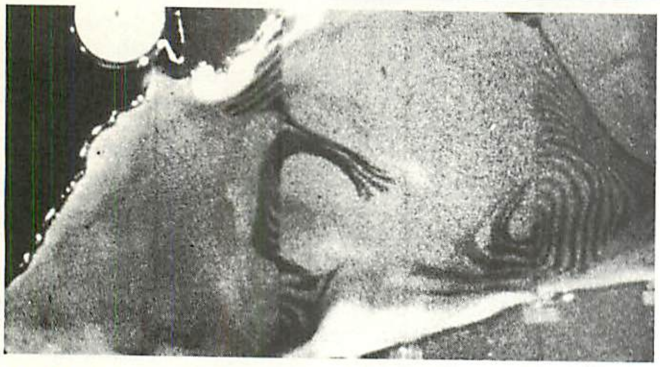


Diagram of Langmuir circulation

Another way of studying circulation is to build a physical (rather than mathematical) model. Professor R. R. Rumer, Jr. (SUNY at Buffalo) and his associates have built a model of Lake Ontario and are carrying on experiments about wind-driven currents, thermal stratification, and the major inflows and outflows. So far, promising preliminary results verify that the model behaves very much like the real lake, so that future data taken from the model will be valid. Rumer uses electric fans to simulate wind, and an electrochemical technique to produce colored plumes to measure currents and inflow/outflow. So far, Rumer's physical model shows considerably more complex surface circulation patterns than did an earlier, mathematical model developed by Paskansky.





The Lake Ontario physical model; flow plumes

Sampling water under Lake Erie ice

Lake Erie, another of the Great Lakes, turned up some real surprises when Kenton M. Stewart (SUNY at Buffalo) did airborne studies of water conditions under the ice between February and April, 1972. Erie is the only one of the Great Lakes that usually freezes over completely, and it was presumed to behave like small lakes: when ice covers them, mixing stops, surface oxygen doesn't get down to the bottom where decay is going on (decay being a kind of oxidation, using up oxygen); the bottom water therefore can become quite anoxic. The floor of Erie's central basin was already known to be anoxic during summer, because of detritus from large algae blooms sinking to the bottom and decaying.

Stewart set out to test the assumptions. Very little information was available, probably because of the cost and risk of systematic observations in winter. He used float-equipped commercial Bell 206 and G model helicopters for four major "cruises" of two or three days each. Navigation had to be by dead reckoning (calculation) since good radio fixes were next to impossible. At 50 to 80 sampling stations he measured temperatures from top to bottom at one-meter intervals, and took samples to analyze for oxygen, chlorides, phosphorus, alkalinity, acidity, and conductivity.

He found that, contrary to all expectations, the water beneath Erie's ice was amazingly uniform from top to bottom. Temperatures, chemical analyses, everything confirmed that the slow, thorough vertical mix occurring in other Great Lakes during the winter months also occurs in Erie. This means that anoxic conditions do not develop on the bottom during winter (so that fish can stay there instead of moving elsewhere). He also found that the water in all three basins--shallow western, central, and deep eastern basin--is very cold, mostly less than 0.1°C, and apparently is not warmed up by thermal discharges along the shores.

Stewart also found a way to prolong shipping in winter. He observed a zone of relatively thin, passable ice along the north shore, at least that particular winter. He watched ships, lacking the airborne viewpoint, steaming into thick ice in the central regions of the lake, apparently determined to follow a straight line from Buffalo to Cleveland. Stewart's observations confirm that winter ship navigation in Lake Erie has more potential than is generally realized.

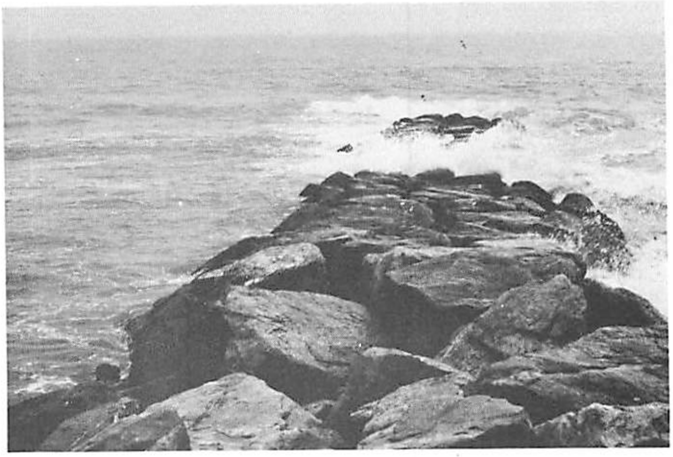
Besides encouraging research on basic physical marine features like the circulation at the surface and under the ice, coastal management has to face urgent problems like erosion. The barrier beaches along the south shore of Long Island, especially Fire Island, are being hard hit by erosion, and many individuals and groups are extremely concerned. Professor Donald Coates, a geologist (SUNY at Binghamton), is in the midst of a five-year study of south shore geomorphology, together with a number of students and associates. Geomorphology is the study of physical processes, including erosion, that shape and change the land. In a series of meetings with county, state, and federal officials, he asked them to help set priorities for study of this area. The National Park Service wants to know the causes of accelerated dune erosion on the bayside of Fire Island. The Corps of Engineers and many ferry operators want to know details about how and why the ferry channels in Great South Bay are shoaling up. Suffolk County administrators want to know how to stabilize dunes east of Smith Point Park. Many people are concerned about the "human use pressure" being put on parts of Fire Island.

Dr. Coates and his colleagues are responding in various ways. They have established baseline stations to help determine erosion rates. An extensive study of aerial photographs from the 1930's to the present is revealing erosion cycles; extrapolating this data to predict future erosion may be valuable for preventative action, especially against erosion damage by hurricanes and severe storms. Sea Grant stimulated a symposium on coastal geomorphology at Binghamton in September 1972. Over 300 participants presented papers, many of them on Long Island problems; proceedings of the symposium have been published. A new geology course on coastal geomorphology, offered in the fall of 1972 at Binghamton, contributes insight on this particular aspect of coastal management.

Another promising benefit that can come from coastal management is to turn a liability into an asset. The liability provides its own impetus--"Let's get rid of this, or stop this, or just do something!" Coastal management harnesses research to come up with an asset. Take the case of seaweed: accumulations of marine plants sometimes constitute a serious

Trying to slow down erosion at Westhampton Beach:

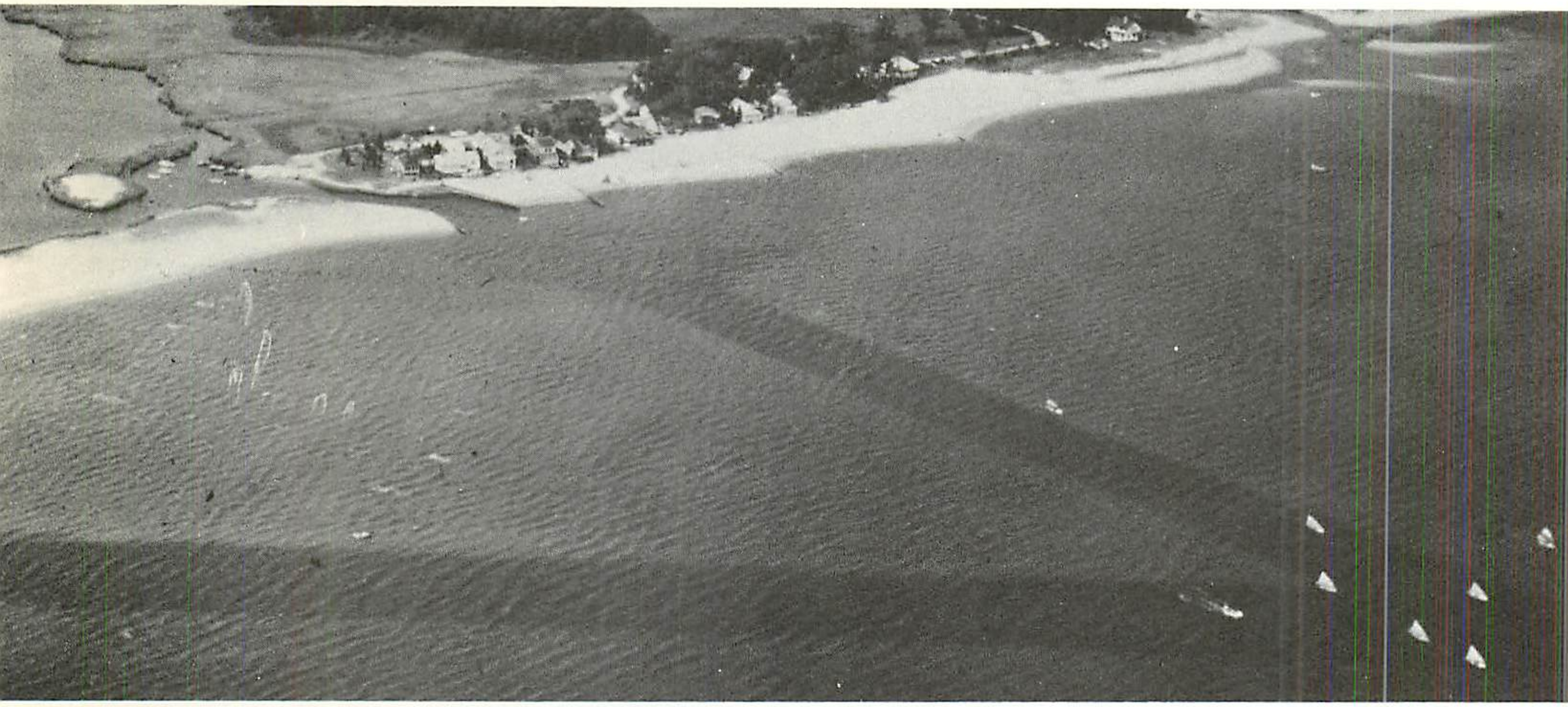
Using snowfences to hold sand. These fences have not been carefully placed or properly maintained.



A rock groin to break wave impact. Part of this groin has already been partly breached.

Christmas trees planted at the dune line to help stabilize sand and build up a man-made dune.

Great South Bay, Long Island, showing boat channels.



nuisance for coastal residents, clogging propellers of fishing and pleasure boats, and decomposing in malodorous heaps on the shores. Eelgrass *(Zostera)* on the south shore of Long Island and *Cladophora* on the Great Lakes, especially Lake Ontario, are examples in New York State. Algicides have provided only local and temporary improvement, and mechanical removal is costly. If a practical use for this plant material can be found, then the problem will be at least partly alleviated.

Dr. John Judd (SUC at Oswego) investigated the amount and characteristics of *Cladophora* growth and its value as a mulch and nutrient for garden plants. At Mexico Point on the southeastern shore of Lake Ontario, Judd sampled *Cladophora* from shore to a depth of 5 meters. In June and July, the heaviest growth occurred at water depths of 1 and 2 meters; by the end of July the heaviest accumulations were at the surface near shore. The total standing crop increased until about the middle of July, then decreased through the rest of the summer. Apparently, growth is inhibited by summer temperatures in the lake, which also cause the alga to break loose in floating masses of "long green hair." Dr. Judd's data will be combined with that of other researchers in the International Field Year on the Great Lakes to provide information on quantity and distribution patterns over the whole lake.

Mixing fresh *Cladophora* with sand and with soil, Dr. Judd grew grass, beans and corn, and measured the height of the plants. Beans grown in sand or soil, and corn grown in soil, showed no response to *Cladophora*. Corn grown in sand with 25% and 50% *Cladophora*, however, was 1.5 to 1.8 times taller than in sand alone. Grass *(Poa partensis)* grew 2.7 times as tall in 50% sand/50% *Cladophora*, and 1.6 times higher in 50% soil/50% *Cladophora*. This accelerated growth could come from the alga's considerable nutrient content or from its effect on soil condition and water-holding capacity. *Cladophora* appears to be a good mulch material, especially for grass.

Besides soil improvement, another possible use for seaweeds is in paper or paper products, since they are fibrous and have a high cellulose content. Bengt Leopold and Renata Marton (SUNY College of Environmental Science and Forestry) chose to test *Zostera* and *Cladophora* with the soda and the sulfite paper-making processes; these two processes tend to minimize air and water pollution.

Zostera was successfully made into a paper with good physical properties by a novel oxygen-soda treatment, but the yield was much lower than from other materials such as straw, bagasse and some other grasses. The yield can probably be improved by experimenting with the pulping conditions.

Cladophora also was processed by the newly developed oxygen-soda method. The paper was inferior in some respects to *Zostera* paper and again the yield was low. More work is necessary to get good pulp and to find how it can best be put to use among paper products like towels, newsprint, book paper, wall paper, or fiberboard.

Coastal management people can see a potential resource sometimes in the unlikeliest stuff; to give a new turn to an old saying, "Eelgrass is so ugly that only a coastal manager could love it." But sometimes an every-day kind of coastal-management function turns up a hitherto-unsuspected potential resource. Fish spawning--how, when, where, and how much--is obviously relevant to coastal management. But to find fish spawning in a bay in greater numbers than in another location you thought was their favorite spot really changes the whole management and resource picture of that bay.

That's what the research of George Williams (SUNY at Stony Brook) is doing for the Peconic Bays, between the forks of eastern Long Island. He regularly sampled the plankton there in 1971 and from March to November 1972. He has preserved all the samples for counting the eggs and larvae of every species present, under a dissecting microscope. So far he's only counted for the menhaden fish, and already it's clear that the Peconics are a richer spawning ground for menhaden than anyone knew. Much higher egg and larvae concentrations appeared than any reported for Long Island Sound. He can also see extremely abundant eggs and larvae for other species, although they're not all counted yet.

The counting process also can answer many specific questions: How many adult fish? Distribution of the spawning grounds? When does spawning take place--in what seasons, at what time of day, at what point in the tidal cycle? Mortality rates? This information is available because marine fish produce slightly buoyant eggs that drift freely in the water. Both eggs and larvae are distinct enough to be species-identifiable. The more numerous the eggs, the greater the mass of spawning adults. They develop rapidly, and early stages are found only close to where they were first released by the adult fish: that tells us distribution. The early stages also tell us when spawning takes place; Dr. Williams found that menhaden spawn in the spring with a lesser peak in the fall, and at dawn or shortly before. Mortality rates can be calculated from the ratio of earlier to later stages and of eggs to larvae.

If the Peconic Bays are suddenly recognized to be an important spawning ground, that adds even greater significance to a study done by Daniel J. Brennan (SUC at Cortland). He and his students sampled the bottom sediments of the entire Peconics to see how feasible dredging for sand and gravel would be. The Peconics are already popular for recreation and fishing. They used to be an important oyster area, and starting up aquaculture again has been suggested. Duck farms are located on the shores. Williams's study adds fish spawning to the list of important potential resources. This is what is called multiple utilization: one area used for many different purposes--harmoniously, if possible. Meanwhile, mining sand and gravel on land is becoming difficult as sources dwindle. Could the Peconics add another utilization without undue harm?

Brennan and his students found chemical properties in the sediment, especially in the center of the bays, that may indicate the beginning stages of eutrophication (abundant nutrients, very little oxygen). The average depth of Great Peconic Bay is 22 to 25 feet; hence the bottom is not stirred except in the most severe storms. The center sediment is a very fine-grained, blackish gelatinous mass, which smells of hydrogen sulfide (like rotten eggs) in fresh samples and of decaying organic matter when drying in the air. Brennan noted abundant undecayed organic matter in the sediment, possibly from the duck farms. Dredging in this sediment would stir up a lot of fine-grained material into suspension and cause widespread muddying of the normally clear bay waters.

Where the water is shallow or tidal currents flow, oxygen helps prevent accumulation of such sediment, and dredging would not damage water quality very much; but it might disrupt current patterns and fish feeding there.

Animals along the bottom were sparse--mostly crabs, sponges, bryozoans, clams, worms, and mollusks. Surprisingly, this formerly important oyster culture area didn't seem to have any living oysters. Brennan is next planning to study sediment cores to learn the "history" of changes and man's impact on the Peconics.

Industries related to the sea are another area of coastal management concern. The present outlook for marine industry and employment in New York, as in the New England coastal states, is bleak. Coastal zone planning for an improved future legitimately must cope with the situation described by sociologist Joe Francis (Cornell University), based on separate analyses for the past 20 years of the 16 major sea-related industries operating in New York State.

Francis summarizes the situation: "Sea-related industries in New York are generally in trouble. Most of the industries have been declining for some time. Although there are specific reasons for declines in each industry, the fading prominence of the Port of New York and the collapse of New York's commercial fisheries are two major reasons for the overall decay. The only industries with discernible growth are some seafood processing and water recreation industries."

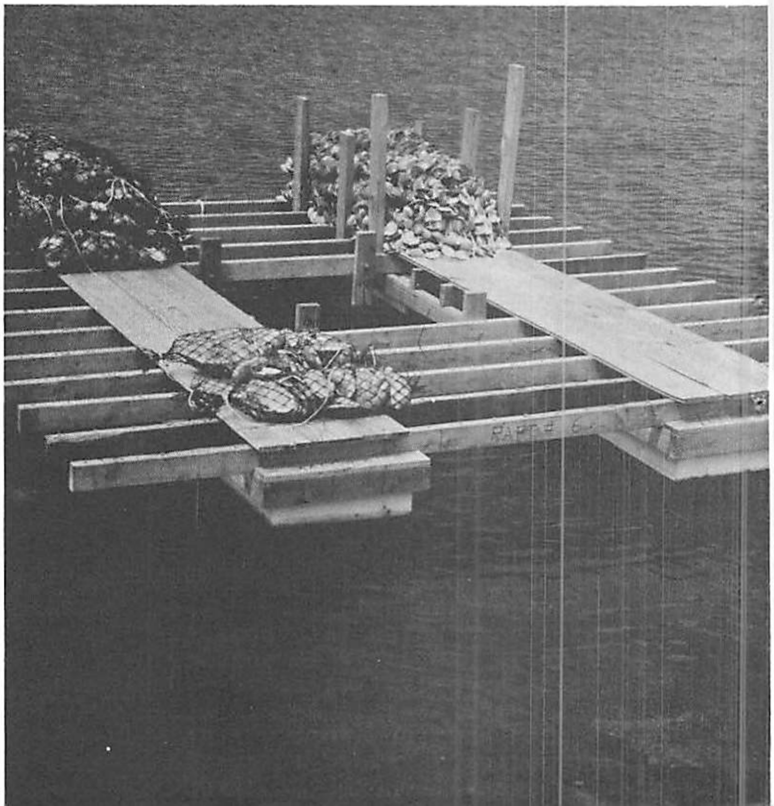
FISHING: The demand for seafood, although increasing, is being met from foreign sources. Most major fisheries in New York State are declining because of overfishing. Particularly damaging to shellfish production, but also to general commercial fishing, is pollution: silt, sewage, and industrial waste. On the Great Lakes the number of fishermen and of total landings has declined drastically since the early 1950's. In Lake Erie there are now only 18 casual fishermen. Shad fishing on the Hudson has been similarly affected. "The problem for manpower planners is not . . . training new entrants but helping the thousands of commercial fishermen likely to be displaced in the next 10 to 15 years find new jobs elsewhere in the economy."

FOOD PROCESSING: "The wholesale fish and seafood industry is perhaps the most antiquated of all the industries studied in this report." Dr. Francis sees no opportunity for growth in this industry, but wages will continue to rise because the unusual working hours and difficult conditions make it hard to attract labor. The picture for canned and cured seafood sales is much better. This appears to be a growth industry, with a trend toward fewer but larger and more efficient firms. Frozen seafood is growing even more rapidly, but widespread use of automated equipment means little improvement of employment.

SHIPPING: The shipbuilding and repair industry shows declining employment: barring Congressional action, the trend will continue downward. In any case only 1% of ship construction nationwide in 1969 was done in New York State shipyards.

Cargo handling is increasing nationwide, but New York is losing out compared to other states. Facilities of the Port of New York are gradually being transferred from obsolete buildings in Manhattan to new semi-automated facilities in New Jersey. Albany, the state's third-largest port, handles less tonnage than before except in petroleum, which requires little handling. Buffalo, second-largest, didn't yield sufficient data for prediction. Because of the shift to containerization, the number of longshoremen employed has decreased despite increases in total tonnage.

RECREATION: Water recreation-related industries experienced fantastic growth in the last decade, but now seem to be leveling off. The best predictions are for a stabilized boat-building industry in the mid-70's. Trends are similar for boat dealers and marina operators. Recreational fishing activity has also greatly increased over the past 30 years, but continued expansion will still have negligible effects on employment.



For at least one of the industrial areas mentioned above, good coastal management may offer some hope. Overfishing and pollution have wreaked havoc with commercial fishing and shellfish production; promising aquaculture techniques, though probably small-scale, may be able to overcome these obstacles--not right away, but the potential is there.

Dr. Orville W. Terry (SUNY at Stony Brook) did a status and feasibility study of all branches of aquaculture for New York's Atlantic coast. He concluded that the existence of a producing aquaculture industry, small and problem-beset though it may be, constitutes an important plus. Oyster culture is probably the oldest and formerly one of the largest marine industries in the United States. Many of Long Island's shallow bays are natural oyster grounds, a fact reflected in such place names as Oyster Bay and Oyster Ponds. The early colonists had no need to culture the crop, but their successors soon developed techniques for transplanting seed stock and for pest control--the initial stages of an oyster culture. In recent years a more advanced technology has been developed for spawning and rearing seed stock--oyster spat--in tanks. The same advanced method is now being applied to the hard clam and on an experimental scale to other shellfish. Whether these hatchery techniques are yet economically self-sustaining even for the oyster is a matter of some controversy among fishery scientists, but they are in fairly large-scale use and appear likely to survive, if for nothing more than as a form of insurance against disastrous losses of the natural crop to storms or pollutants. Such losses have occurred rather frequently.

An existing, producing aquaculture industry means an economic base for experimental and pilot-scale work. Much of the expensive capital equipment, expert personnel and marketing know-how is available from existing industry. This is not to say that industry can solve its own problems even though with enough time this might happen. The role of Sea Grant is to speed up the development process, to the advantage of producer and consumer alike, by providing research support and communication on a scale that industry alone could not afford. Benefits comparable to those derived in agriculture from the Land Grant College system can reasonably be anticipated.

Aside from an existing base, can the New York coastal region meet the other environmental requirements of potential new aquaculture enterprises? On balance, the answer is a somewhat qualified yes. The purity of marine waters over large parts of the area is still adequate. Markets and excellent research facilities are close at hand. In most cases land and water space is available. Though space competition from other potential users of an "exurban" location is an important consideration, and some extensive aquacultures are therefore probably not feasible, Long Island's advantages will largely overbalance its disadvantages for aquaculture.

Dr. Terry said it would be only guesswork to try any detailed prediction of the time sequence in which specific aquacultured crops will reach commercial production in New York. One research breakthrough might drastically improve the prospects of any given culture. Based on present knowledge, two areas for research concentration have been chosen: 1) to improve microscopic algae culture for better food for hatchery shellfish, and 2) to initiate an experimental culture of the northern lobster, aiming to reach pilot culture level. The Marine Sciences Research Center at Stony Brook will conduct both enterprises in cooperation with the local aquaculture industry. The lobster study has the advantage of the interest and support of the National Sea Grant Office and other Sea Grant institutions on three coasts, whose information and direct assistance

will greatly benefit MSRC's research.

The MSRC will make full use of the Sea Grant system to improve existing cultures of other organisms whenever possible. Here again it is primarily because New York has an aquaculture industry that almost immediate field testing of experimental results is possible at minimum cost.

Coastal management per se is a relatively new idea, though aspects of it have been operating from the beginning of human history. Education in coastal management specialties like marine technology and ocean engineering is one of the prime concerns of Sea Grant, and is also relatively new. The marine technology program at Suffolk County Community College is billed as "one of the nation's oldest." It is; it was established in 1964. Suffolk Community College is expanding to a second campus, at Riverhead, with new laboratory facilities for marine technology on the shore at Cedar Beach. Pending completion of construction, students worked at the laboratory of the Shelter Island Oyster Company at Greenport, assisting Company and MSRC personnel with research on oysters and other shellfish. Until transportation difficulties stopped them, the students were getting first-hand experience under Sea Grant's philosophy of bringing industry and college together, reports Professor Walter Smith, head of the Marine Technology Program at SCCC.

Students in the ocean engineering curriculum at SUNY at Stony Brook under the direction of Professors Herbert Herman and Herbert Carleton developed two structures of useful potential with Sea Grant project funds. One was a model-scale version of a floating platform made from plastics and aluminum cans like beer cans. The honey-comb structure is both light and strong, and can be escalated to a diameter of 50 feet to support an aquaculture system, for example, or to study various marine subjects. The other structure was an underwater habitat suitable for shallow waters. The student designer ingeniously adapted a donated cement-mixing tank from a cement truck by adding legs and other gear.

An innovative education program directly interfacing Sea Grant and the New York State Legislature is being conducted by Donald F. Squires (SUNY Central Administration and New York Sea Grant Program Director) and Seville Chapman (Science Advisor to the New York State Assembly).

Interns in a degree program choose sea-related research projects of explicit interest for potential legislation; they work under the direction of participating professors.

The first project has been completed. It was a study of the plans for handling oil spills at the federal, state, and local levels. The study shows that while all governmental levels have good plans, little interaction between them can lead to duplication or confusion.

These complex and numerous facets of coastal management are all interacting with Sea Grant and with each other so rapidly and variously that some kind of overview or survey was imperative. A coastal zone management task force was assembled under the leadership of Professor Paul Marr (SUNY at Albany). Working across the state from the western regions of Lake Erie to the St. Lawrence River, from the City of New York to the easternmost tip of Long Island, Professor Marr visited each of the existing county, regional, intrastate, and interstate bodies currently active in coastal zone planning. He assessed their activities, their capacities for further work, and the ways they have identified problems and priorities. The picture is good. Many regional planning bodies have done extensive work in accumulating knowledge about their own coastal region. Coordination among them is still far from the level desired; they themselves feel the lack most keenly. Based upon Dr. Marr's survey conclusions about the need for statewide coordination, Sea Grant sponsored the first meeting of regional planning directors in New York State, and from that discussion went ahead jointly with the directors to plan the coastal zone management conference held in Albany on February 20 and 21, 1973. The keynote speaker at that conference, the Honorable Perry B. Duryea, Speaker of the New York State Assembly, called on the conferees to work together toward the development of statewide coastal zone legislation.

Coastal zone management has far to go in New York State. Many links between regions and among state agencies are yet to be made. The Coastal Zone Task Force has initiated work in that direction and will continue the effort with coastal communities, regions, and state agencies as New York State moves forward toward a comprehensive plans for its coastal resources.

THE SEA GRANT PROGRAM

Program Management

The National Sea Grant Program, administered by the National Oceanographic and Atmospheric Administration, U. S. Department of Commerce, awarded institutional support funds to the State University of New York to set up a program of research, education, and advisory services commencing October 1971. The program in New York State is conducted by the combined capabilities of the State University of New York and Cornell University, New York's land grant college. The program is administratively located in Albany in the Central Administration of the State University of New York, and maintains research and advisory services activities at more than a dozen localities throughout the state.

The New York State Sea Grant Program responds to a Governing Board of ten senior campus administrators and the Commissioner of the New York State Department of Environmental Conservation. The Governing Board is appointed by the Chancellor of the State University of New York. To assist the program in formulating its goals and priorities, two Advisory Councils, one for the Great Lakes Coast (Lakes Erie and Ontario) and one for the Atlantic Coast (New York City and Long Island), have been appointed by the Provost of the State University of New York. These Councils meet regularly, discuss and significantly influence the evolving New York Sea Grant Program. Their members are active leaders in industry, government, and citizen organizations. They provide an invaluable hard look at the real-world feasibility of the plans and work of the Program.

The federal legislation establishing Sea Grant specifies that at least one-third of the program costs must be borne by state or local sources. During the period covered by this report, a total of $993,600 was devoted to Sea Grant activities (see next page).

Sea Grant Year I began with 24 projects. One of these projects was terminated early in the year when transportation difficulties became insurmountable (see p. 25). Seven new projects were initiated with planning funds during the course of the year. Of the 24 projects, six were completed. Six others have been terminated because the results, while

	Federal Sea Grant Program	The Universities and Industry
Research	$436,000	$242,000
The Energy Problem	126,000	45,000
The Pollution Problem	124,000	70,000
The Coastal Management Problem	160,000	61,000
Manpower and Education	26,000	56,000
Advisory Services	150,000	91,000
Program Management and Development	39,600	35,000
Total	$625,600	$368,000

The budget presented above is approximate only. A fully audited statement is filed with the U.S. Department of Commerce in accordance with standard auditing principles.

not conclusive, were adequate for the purpose of the program. Eight projects have been redirected from their original course as a result of the findings and will move in new but related directions, building upon the experience of this year. Only four projects will continue relatively unchanged from Year I into the next round of Sea Grant support in Year II.

Advisory Services

New York is a large and diverse state, with not one but two marine coastlines. The interests and problems of the Great Lakes shore are far separated both physically and conceptually from those of the Atlantic coastal region. Because a very

high priority is given to Advisory Services in the New York Sea Grant Program, a large and widely dispersed organization is necessary. For good communication with the state's Cooperative Extension Service, the Advisory Services Program Leader's office is located in Ithaca; the Program Leader, Dr. Bruce Wilkins, is a faculty member of Cornell University. Two field offices are situated at the Marine Sciences Research Center (SUNY at Stony Brook) and at SUNY/Brockport, serving the Long Island and Great Lakes regions respectively. A third field office, at SUC/Oswego, goes into operation for Year II. The Advisory Services staff is a complementary team of specialists: a biologist, an environmental engineer, a water resource specialist, a resource economist, a recreation specialist, a planner, a marine educator, and a natural resource specialist.

Year I's primary emphasis was necessarily on establishing communication with other agencies with interests and responsibilities in the marine field, and on creating an awareness among New York citizens of Sea Grant's existence and potential. In addition to the usual methods--brochures, meetings, conferences, and press releases--the Advisory Services staff made extensive use of broadcasts and TV shorts and helped to produce a 13-minute color film describing the New York Program. Later films will show specific subject areas like wetlands and coastal erosion, and tape cassettes on marine subjects are already being produced.

Advisory Services has sponsored educational meetings on power-plant siting problems and on the state's commercial fisheries, tidal wetlands, and recreation industry. These are areas of intense public interest and controversy at the present time, and all are under close scrutiny by planning agencies. Legislation is being considered at various governmental levels; the time is ideal for significant Sea Grant input to the planning and legislating process.

The commercial fishing industry in New York is as depressed as in the other northeastern states. Problems cover the whole gamut, from foreign competition to fishery science to legislation. Advisory Services meetings have been held on shellfish resource management and on various much-needed services for fishermen such as health insurance, tax information, loans, and professional organization. From New York and all the other coastal states, Sea Grant can draw on a wealth of technical service expertise largely inaccessible to the busy individual fisherman through other agencies.

The first day-long conference co-sponsored by Sea Grant and the Long Island Environmental Council focused on wetlands and the problems involved in attempts to preserve them. Local experts presented their viewpoints to a large audience that included representatives from all the Long Island townships. Many of Long Island's tidal wetlands are under heavy development pressure despite intense efforts by conservation groups to save them. Here the problem is not so much the lack of technical information as it is the lack of communication and, ultimately, political action. Few people oppose wetland preservation or dispute the need for it, but those who do have strong economic incentives. Sea Grant can facilitate an expression of the public interest in preservation and increase the chances that it will prevail. As a result of the meeting, at least one township began negotiating with the State Department of Environmental Conservation toward cooperative management of some of its marshes.

Direct response to unsolicited user inquiries is also a major Advisory Services function. The information requested may already exist and can often be obtained within Sea Grant or from other sources. Or it may pinpoint an apparent knowledge gap significant enough to be suggested to Sea Grant as a potential research area. This feedback mechanism is as important in the Sea Grant plan as it has been in the Land Grant and Cooperative Extension systems. For example, can flies breeding in an oyster shell cultch pile be controlled by insecticides without poisoning the seed oysters which will later set on that cultch? A simple question, with a quick answer found by phone calls to the appropriate experts: there is indeed an apparently safe insecticide for this application.

Inquiries cannot always be so easily dealt with. Some are requests for information which does not yet exist or touches serious differences of opinion in the research community. This is particularly true of problems with existing or proposed legislative or management decisions. Clam production in Great South Bay is threatened by pollution as the population of the neighboring land continues to rise. There is no consensus among fishery scientists on what, if anything, can be done to counter this threat to the industry, but it is possible for Sea Grant to draw attention to the problem and to try to interest the research community in seeking solutions. For instance, better information might enable clam shippers to apply a depuration process to clams not now salable because of pollutant impurities. An Advisory Services economist participated in meetings with Department of Environmental Conservation administrators and with Sea Grant scientists to study the feasibility of research in this area.

In local crisis situations, Advisory Services acts as a catalyst. High water levels in the Great Lakes are causing severe problems for coast residents, whose houses and belongings are repeatedly being drenched with spray from storm waves, or being washed away altogether, whose roads are flooded, and whose businesses are being damaged. Responding to this acute situation, Advisory Services has set up a temporary staff person there to work with individuals and communities on pragmatic solutions, and is trying to get permanent funding through Sea Grant. As Year I ended, Advisory Services was planning a conference in Detroit on the high-water situation, bringing together NOAA personnel and Advisory Services staff from every state around the Great Lakes, as well as an Ontario/Canadian Government representative (a member of New York's Great Lakes Advisory Council, from the Canada Center for Inland Waters).

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