Some Guardians Of Our Water

By Eric Hoffman

■ At 2 a.m. bars close and most of San Francisco's average daily 185 million gallons of sewage have found the way to the city's antiquated sewer system. As the last patrons make their way home, a group of scientists are assembling at Pier 34 for a typical outing.

Their job is to monitor nearly all forms of ocean life in the area where San Francisco's new sewage outfall will be laid on the ocean's bottom in 1981. (The outfall is the system of submerged pipes that evenly disperses treated sewage.)

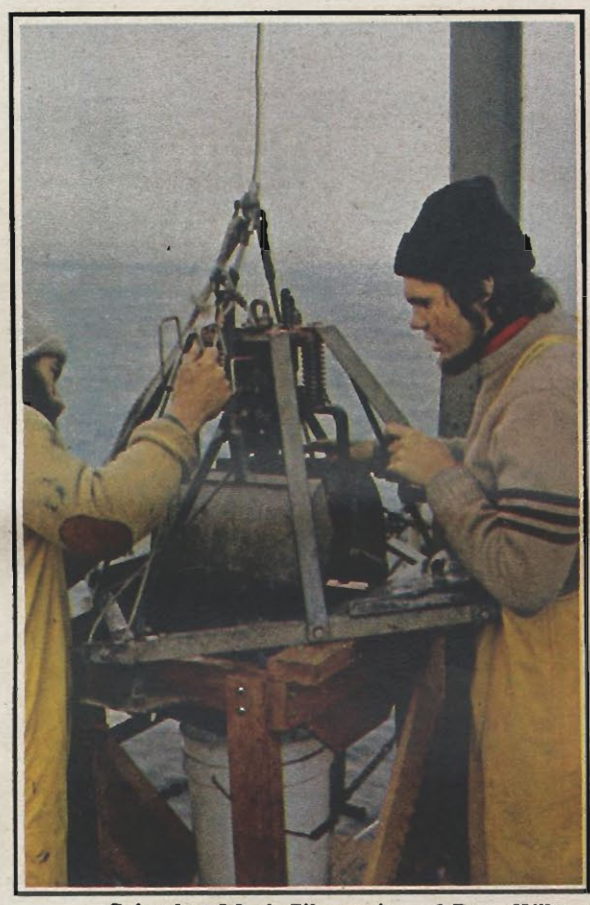
San Francisco's monitoring plan, which is required by the state and regional water quality boards before the new sewage system can be built, calls for understanding every aspect of the marine environment before treated sewage is discharged. Ideally, this will make it possible to head off an ecological catastrophe before it permanently alters the environment. (In comparison, Los Angeles and other large cities have spent millions upgrading sewage treatment and disposal but were not required to conduct studies of life forms in outfall areas until after wastewater had been discharged.) Funding for the ongoing San Francisco monitoring, which came to $900,000 for 1980, is 75 percent federal, 12 ½ percent state and 12 ½ percent local.

On this night the *Inland Seas*, an eighty-five foot converted air/sea rescue boat, sits at an otherwise empty Pier 34. Her decks are bathed in floodlights.

The four-man crew headed by Captain Paul Jones goes over the checklist: engines, bilge pump, safety equipment, sonar, electric equipment, winches, etc. Captain Jones works under a green cabin light plotting his course for the next fourteen hours.

Vans pull up; CH2M HILL is stenciled in small letters on the side. CH2M HILL (an acronym for partners Cornell, Howland, Hayes and Merryfield) is a consulting firm which has subcontracted to do marine studies and engineer the water flow for the city's new sewage system. The firm of PBQ& D (for partners Parsons, Brinkerhoff, Quade and Douglas)—engineers overseeing the construction of the BART tube—contracted for the entire project, including the building of the underwater portion of the system.

Six scientists — four men and two women — begin unloading equipment and supplies from the CH2M HILL vans. The scientists are young and, despite the dismal hour, cheerful. The group's field leader, Rod Hoffman, typifies the new emphasis in life science. At thirty, he is an expert in aquatic biology and holds a Ph.D. in ecology. With his rugged features, sailor's knit cap, and bright yellow coveralls, he looks like a commercial fisherman. The rest of his team are specialists in different areas: Susan McCormack and Dave Wilson — invertebrates, clams and crustaceans that are food for bottom feeding fish; Peter Dygert and Joanne Richter — water quality; and Tom Coyner — fish.



Eric Hoffman

Scientists Mark Silverstein and Dave Wilson ready the spring-loaded grab for a trip to the ocean floor to collect sea life.

Two Moss Landing Marine Laboratory scientists will aid in the study of invertebrates, and two chemists from LFE Environmental Laboratories, an East Coast based consulting firm of scientists with offices in Richmond, will remain below in an onboard laboratory during the voyage to run instant analyses of water chemistry. This field work supports the entire outfall environmental effort, which is guided by another scientist, Noel Williams, also with a Ph.D. in ecology.

By 2:30 a.m. the *Inland Seas* is underway. She purrs alongside the empty pier, turns seaward along San Francisco's waterfront and heads directly toward the Gate. The first station is three miles out from the Zoo — the area where the outfall will be placed on the ocean floor. Rod explains, "The new system will enter the water at the southern end of the Zoo. The system will have a single large pipe that will discharge the treated sewage five miles out to sea. The pipe will be large because it must have capacity for heavy flow during storms. Some cities have adequate systems until it rains. Rain water collected in storm drains can increase the volume going into the treatment plant up to five times the normal; the surplus raw sewage overflows untreated directly into a nearby body of water. This is one of San Francisco's current problems."

Captain Jones slows his boat and the scientists turn on the Mini-ranger, an expensive piece of equipment that fixes on two intersecting radio waves sent from shore. The device is accurate to within a yard. Once the station is precisely located, the crew marks it by lowering an anchored buoy over the side. The buoy is topped with a bright blinking light. The Captain attempts to keep the boat as close to the buoy as possible during the collection process. In turbulent seas, this is no easy task.

On the fog-shrouded boat, pitched about on the black ocean, the scientists begin their work. The crew secures the 350-pound spring-loaded grab to the boom cable. This device is affectionately called Biter by one member of the crew. It is designed to spring shut like a huge bear trap as soon as it touches the ocean floor, capturing all life forms in or on that spot. It can bite a man's head off just as easily. It is winched into the air. As the boat rolls, it swings over the deck with its powerful jaws open. The boom is swung out over the water and the dredge lovered into the depths. At sixty feet the dredge hits bottom, snaps shut, and is quickly retrieved. Once maneuvered back onto the deck its jaws are opened and the contents, black unappealing muck, are dumped into five-gallon buckets.

Susan and Dave carry the buckets aft where the contents are poured into stainless steel mesh sieves mounted above sinks. Low pressure hoses help the thick sediment pass through the filter. The water pressure is kept low so the delicate organisms aren't damaged in the process. It takes about thirty minutes to separate one tray of mud from the mud-dwelling life forms, mostly polychaetes (small segmented worms that live in the bottom sediments).

These small segmented worms are a primary food source for any of the fish that live on the bottom. Knowledge of polychaetes is important to commercial fishermen as well as to environmentalists. Susan explains, "If something affects the polychaetes, the entire food

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chain shows it. It's important we know all we can — fertility rates, populations, seasonal changes, and chemical makeup. In fact, it's because of these little worms that we're out here in the middle of the night. We think they may be feeding more actively at night and that they're closer to the surface, which gives us different data than daytime sampling."

The grab is reset and set back over the side. Separating invertebrates from the mud is slow going. Once separated, they're placed in marked jars and preserved to await their trip to shore, where they'll be analyzed.

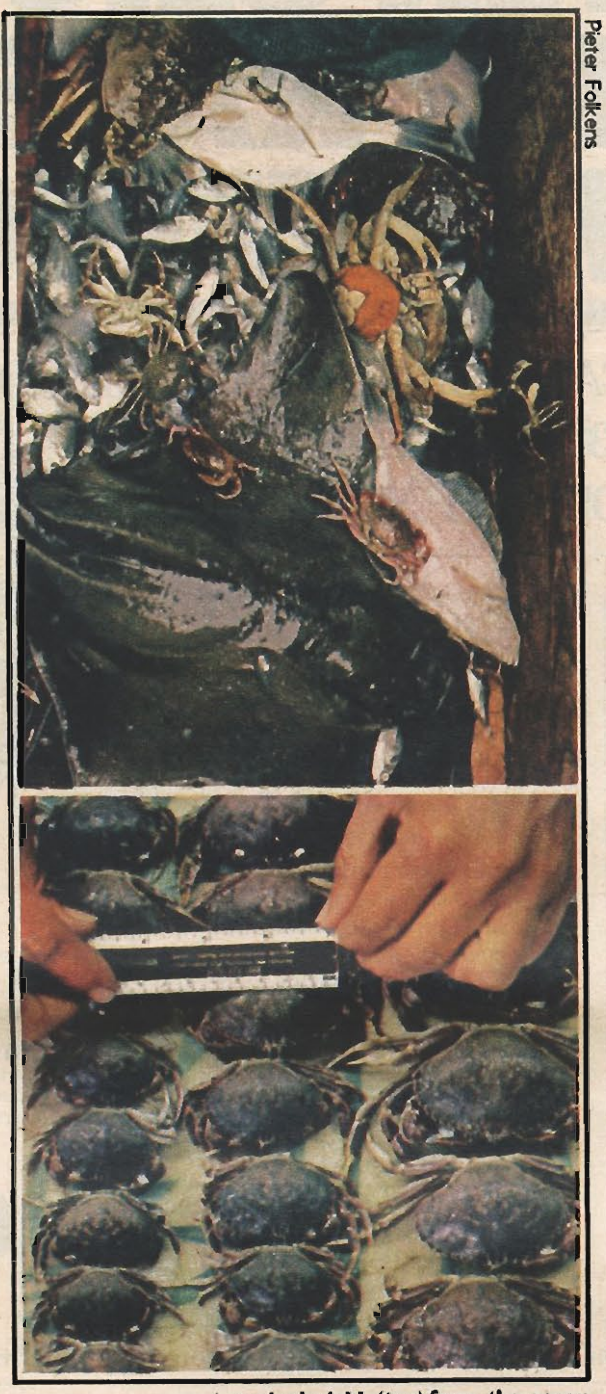
With the crew and most of the scientists busily collecting invertebrates on the aft deck, Peter and Joanne disappear into the fog on the way to the bow where they'll perform water quality tests. Starting at the surface and working downward at six-foot intervals, they will carefully record turbidity, temperature, pH, salinity, oxygen and light penetration. It's been foggy for a few days, which will probably be reflected in their findings. "Because of coastal upwelling (cold water coming up to the surface), the water temperature should be a little cooler," Peter explains. "It should be more saline, and have less oxygen than you'd find during other times of the year. Deeper water, with more salt and less oxygen, rises when the winds and currents change, and fog results because of the combination of cool water and winds."

The two chemists emerge to collect some water and disappear quickly to conduct sensitive tests that measure the amount of nutrients and bacteria in the water. The tests, conducted in a windowless lab below deck, are done immediately before the sample changes in a way that would distort their findings.

Throughout this activity the boat relentlessly rolls and pitches on a black sea punctuated with a blinking buoy light. When the grab has completed eight collections the buoy is retrieved and Captain Jones navigates to each of the next five stations. Between stops everyone pitches in to finish sifting through the mud as the boat plunges along through zero visibility.

Dawn comes slowly. The buoy's bright light begins to to dim. The ocean turns brown and the whitecaps lose their phosphorescent quality. When the fifth dredging has been completed and while the last batch of muck is being sifted, people slip below to quickly consume a sandwich and soft drink. It is 6:30 a.m.; time for lunch.

With yards of ocean floor sifted, and polychaetes and accompanying organisms secure for the trip to the laboratory, the second phase of the study begins: collecting fish, large crustaceans, and other large life forms found on the bottom. A drag net is brought forth and laid on the deck. Again stations will be pinpointed with the Mini-ranger. Catch boxes are readied with dry ice. The drudgery of sifting



Pieter Folkens

A typical yield *(top)* from the ocean off San Francisco. The scientists *(bottom)* record the size and general health of various species of crabs.

through mud had dampened spirits, but the anticipation of the fisherman's catch brings new life back to the group. With Rod and Joanne on one side, Dave and Peter on the other, the net is played off the stern. After it is on the bottom ten minutes, the winch cranks it back to the surface. The design of the net prevents the winch from pulling it all the way in, so the squirming net full of sea life has to be wrestled on board. It takes five scientists struggling and clutching to hoist the net onto the deck.

Yellow, red and Dungeness crabs are quickly gathered before they can escape back into the sea. The fish (English sole, sand sole, sculpins, white croakers, skates and others) flap madly and an unlucky octopus draws everyone's attention. The catch is gathered, sorted and measured. Dave, Peter and Tom closely look over each fish for external parasites, disease and other abnormalities.

"About five percent of the bottom fish have tumors, disease, or some other abnormality," Tom explains. "By charting the frequency of disease and tumors we'll be in a good position to know if a change has occurred. With other studies on this project we should be able to focus directly on the problem area. Since many of the fish we're catching are commercially harvested, this study should interest commercial fisherman and anybody who eats fish." As each net of sea life is heaved onto the deck, the crew and scientists huddle around it. The diseased fish are photographed and put on dry ice with the rest of the fish for the trip to shore where their organs will be analyzed for toxicant levels. Fertility rates, age of population and general health of species will be recorded. Rod comments on the complexities involved in not upsetting the intricate interrelationships of marine life.

"We're trying to get as clear a picture as possible so we'll be in a position to react if necessary. If we notice an increase in toxicants in the fish after the outfall is operating we can determine if the toxicants are from the treatment plant and change it. However, other changes can occur. Sometimes outfalls favor some critters. Perhaps, due to increase in nutriments, mollusks will grow too large to be adequate food for small fish who had eaten them. This may adversely affect the fish population. Sometimes interrelationships between organisms are affected by seemingly subtle environmental changes."

By 4:30 p.m. the last fish have been readied for their journey to the lab. The *Inland Seas* churns for the Golden Gate. The sun is out and the sea is calm. The researchers stretch out on the deck. The talk is light and punctuated with laughter. Dave recounts the time the Coast Coast Guard pulled alongside, thinking they'd caught illegal fishermen. Someone had forgotten to phone the Coast Guard that day to tell them the CH2M HILL would be collecting. Then there was the time most everyone was seasick, and they were overtaken by a squall. . . .

There is a darker side. Several scientists on board had been close friends of those researchers who had disappeared when the *HoloHolo* went down out of Honolulu without a trace.

Next week Rod would be off to Washington to conduct a water quality test for a coastal city while hovering in a helicopter above a windswept bay. Others were bound for the Arctic to dive into freezing bays where grey whales commonly plow up the bottom while feeding. Members of this team had been to the impoverished African nation of Chad to try to figure a way to keep that country's huge inland lake healthy enough to produce a fish harvest for its starving people. Others had been to New Guinea, Egypt, and our Great Lakes on environmental studies.

The next day the *Inland Sea* would be near the Farallones with most of this same group on board. They would be guaranteed a fourteen-hour day, 4 a.m. starting time, and the everchanging mood of the ocean. □