DIRECTOR'S SYNOPSIS

The past year has been productive. It has been characterized by growth and accomplishment and a continuing rise in our stature in the scientific community. The character of our work has evolved from reviews of the work of other investigators to extensive original field and laboratory research.

The scientists of this project are trying to understand the ecology of the waters off southern California; we are particularly hopeful of discovering which of man's wastes are damaging to the creatures of the ocean. This is a difficult mystery in which the clues are such things as the parts per billion concentrations of some metal or organic compound hidden in minute organs of strange marine animals.

The object of this report is to explain what we have done in the past year—the problems we have attacked, the goals we have reached, and the discoveries we have made. It is not intended to be a rigorous scientific document complete with all details and references. Rather the pieces by individual scientists are summaries of work that will eventually be described in full in the scientific journals. Many of these are reports on our progress to date in following scientific leads. No one yet knows which of these will turn out to be important or unproductive. Time will tell whether our effort has been wisely spent.

For the reader's convenience, a short summary of important findings is presented immediately after this statement.

We began our studies this year by debating which of the many possible tasks would yield the most useful results; the best of these were then submitted to our consulting board for review. After further discussion, we established priorities and prepared a formal research plan, which we have followed closely.

The research plan called for the development of laboratory facilities in previously unused storage space. These laboratories were carefully designed, built at minimum cost, and are now operating successfully. The trace metals laboratory is capable of determining the minute amount of metal in sea-water and animal tissue as well as the dosage used in our toxicity experiments. The wet chemistry laboratory allows us to monitor the chemical conditions in our fish tanks and determine particle size in sewage effluents. A microbiology laboratory has been set up on the campus at California State University at Long Beach to investigate the kinds of bacteria discharged in wastewater and to measure their survival under various marine conditions. A working museum collection of the marine animals of southern California has been assembled and is in constant use by marine biologists from many organizations. Finally, an aquarium room containing 20 tanks of circulating seawater with some flow-through capability has been built. Temperature is held at 12°C so that bottom fish not usually kept in captivity survive very well.

The previously existing trace organics laboratory continues to perform well, turning out many analyses of fallout, animal tissue, and seawater. Routine intercalibrations with other laboratories give us confidence in the accuracy of these measurements.

The Project has made considerable progress in developing new sampling and observing techniques; when these are fully operational, we expect that they will permit much greater insight into the nature of the water, the bottom, and the biota. Our underwater television is now in use as an exploratory tool, permitting observers on a ship to see the sea floor beneath them in detail. Video tapes of these inspections are brought back for review by biologists and sanitary engineers.

The automatic baited cine camera has given us new insights into the changes in the populations from night to day and revealed much about the nature of the bottom and the deep currents.

A device for systematically sampling floatables has been invented, and components are now undergoing tests. Another device for taking precise samples of soft and hard bottoms is also being tested. Hopefully it will replace the rather sad array of ineffective hardware now available for taking samples of the bottom in outfall areas.

Sediment catchers have been installed at ten locations along the Palos Verdes-Santa Monica coast, where they collect samples of the particulate material in the water. Recording current meters and temperature meters are attached to some of these, so we have an idea of the conditions under which the particles move.

We are attempting to define "ocean sludge"—a rather loosely used term, which as yet has no specific meaning—so that we can determine where this material exists and at what concentrations. Since most wastewater treatment plants remove ordinary sewage sludge and bury it in landfill, ocean sludge will be defined as some combination of organic mate- rial with heavy metals. There are difficult questions of what organic component to measure and how to separate natural organic material from sewage organics, but eventually we expect to be able to draw contour lines on a map around areas where sludge exists on the sea floor.

Our knowledge of the currents in areas where wastewater is discharged is increasing, but we need much more information on the net transport of receiving water, the motions of gyres, the relation between the movement of water above and below the thermocline, and the dispersion of water from a mass involved in to-and-fro motion. We intend to make more measurements and improve our models of seawater motion in the coming year.

We need to define the limits of wastewater effects and to select control areas that are oceanographically similar to the discharge sites and yet are completely uncontaminated. But this is difficult because the detailed biological history of most areas is not known and the effects of waste-water a few kilometers from most outfalls are unmeasurable. We continue to try to make use of samples taken in past years, but the changes in equipment used, the lack of replicates, and the frequent absence of necessary data on oceanographic conditions (such as temperature or amount of dissolved oxygen) tends to cast doubt on some past samples.

At most locations, it is difficult to distinguish bio-logical changes caused by pollution from those brought about by natural phenomena. Many species of animals vary markedly in number depending on the temperature, currents, season, interaction with other species, or unknown factors. They often come and go because of changes we do not recognize in some set of ocean conditions; even within a small area, the animal populations are not homogeneous. This "biological noise" level may be ten times the signal due to waste. To some extent, the uncertainties can be reduced by repeated sampling throughout the seasons and by extensive replication, but the cost of taking and analyzing these additional samples can be great.

Our studies of taxonomy (the identification and classification of animals) have proven to be very useful. We have discovered that certain animals previously thought to be missing from some coastal areas were simply misidentified and that others had as many as 15 names. A series of meetings of coastal biologists under Project auspices has succeeded in straightening out much of the nomenclature; in another 6 months, we hope to have a complete index of the principal marine forms off southern California to a depth of 200 m.

By working at sea with about ten groups who tow trawl nets and take samples, our marine engineers have made some progress in standardizing techniques and improving catches. Whereas there was previously believed to be major differences in the number and species of fish in several areas, we now see that once all groups are using similar methods and nets, the result is much the same.

We expect that there will be increasing interest in deeper water, including the bottoms of the offshore basins

which are as deep as 1,000 meters. Therefore, we have begun extending our surveys in that direction and in making some increasingly deep oceanographic casts. In the coming year, we hope to sample and photograph the basin floors to deter-mine whether the environmental quality may be changing.

Generally, we believe that considerable progress has been made during the last year in all phases of our research — biological, chemical, and engineering. We are hopeful that the results will be utilized in developing a more effective monitoring program, so that the results obtained in each area are readily comparable.

Our main objective remains the understanding of the ecology of the coastal waters of southern California. In progressing towards that goal, we believe that we are considered by our scientific peers to be one of the country's foremost ecology laboratories. The support and confidence of the Federal Environmental Protection Agency is gratefully acknowledged; it has contributed substantially to our development.

With the future in mind, we have made a conscious effort to reach out to interested persons and explain what we are doing and why. Somehow, the various groups—all of which have California's best interests at heart, but each from a different point of view—must be brought together. A logical point of beginning will be agreement on the facts about waste discharges and their effects on the ocean and its life. As new bits of evidence are discovered, documented and published, there should be an improved basis for agreement between those concerned mainly with conservation and those charged with disposing of man's wastes. The wastes must go somewhere, and they must be put where they will improve the environment or at least damage our world as little as possible. No one yet knows the best way to treat wastes or the best place to put them, but a continuing effort will produce increasingly better answers.

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