Part IV

MANAGEMENT AND FACILITIES

This past year has seen some substantial changes in the way the Project is organized, the manner of Internal accounting, and the facilities available for research. The organization chart in Appendix A indicates how control of the various divisions and research topics is exercised. Each division leader is responsible for supervising the day-to-day research and the preparation of reports. The leaders meet as a group about once a month (or when important decisions must be made) to consider the overall direction and progress of our work. Continual discussion between the various researchers ensures maximum cooperation and interchange of ideas.

The staff began the year by carefully formulating a research plan that incorporated the best of our ideas about what subjects should be studied and how. We then reviewed and revised these ideas and submitted the plan to our Consulting Board for review. Priorities were established; laboratory facilities were defined; budgets were estimated. We believe we have successfully carried out the revised version of that plan. Some of the items were later deemed to be unworthy of the originally suggested effort; other pro-grams were enlarged and expanded. The plan did not specify time limits, but several of the programs are well along, and most will be completed within the coming year. New ideas for study are continually being considered, and we are now investigating new areas of research in microbiology, inter-tidal and subtidal biota, and sedimentation.

Our official accounting of funds is kept by the County Sanitation Districts of Los Angeles County on a cash basis and audited by the Controller of Los Angeles County. In addition, our administrative officer keeps data that can be used to (l) obtain the status of the Project on an accrual basis, and (2) control the costs of each research task. This permits financial planning and cost allocation based on our research plan. Our financial statement is shown in Figure 1.

In this year, our facilities for research have improved greatly, to the point where we now feel confident of our ability to do top grade experimental and analysis work on nearly any kind of an ecology problem in our area. Our first laboratory, built last year to study trace amounts of chlorinated hydrocarbons, has been improved, and we have added a series of new laboratories for the study of toxicity and trace metals. We now have facilities for taxonomy and microbiology work (the latter is located on the campus of California State University at Long Beach).

The Project has also made progress in developing new kinds of ocean sampling and measuring equipment and in obtaining the use of ship and data processing facilities. The following paragraphs describe the laboratories and equipment that we have available.

TRACE METALS LABORATORY

One of the Project's major scientific findings is that fish living adjacent to highly contaminated sediments do not concentrate metals in their body tissues. We decided to further investigate this phenomenon by examining the quantities of metals in seawater, in wastewater effluent particulates, in the interstitial water of sediments, and in other marine animals. We felt that it would be necessary to perform toxicity experiments, which require careful quality control. Accordingly, a trace metals laboratory was built around an atomic absorption spectrophotometer (Varian Techtron AA 6). A feature of this instrument is that it uses a carbon rod atomizer (a heated carbon filament on which microliter samples are atomized). This makes it possible to obtain repeatable results at the parts per billion level for cadmium, chromium, copper, nickel, manganese, silver, and zinc. To date, the principal uses of this instrument have been to obtain metal background in seawater and to support our chromium toxicity studies. The results are calibrated with those of other laboratories, and excellent agreement has been obtained.

The metals laboratory also contains a special photometer for analysis of trace amounts of mercury. With the proper sample preparation, this instrument is capable of measuring mercury at levels as low as 20 parts per billion in sediments or biological samples and as low as 10 parts per trillion in water samples.

Figure 1. Estimated financial statement (modified cash basis)

Accretions		
Balance forwarded 1 July 1973		38,600
County Sanitation Districts of		
Los Angeles County	$191,800	
City of Los Angeles	176,450	
County Sanitation Districts of		
Orange County	73,350	
City of San Diego	48,100	
Ventura County	10,300	
		500,000
Environmental Protection Agency		
Grant R801152		114,600
Grant R801153		80,000
Miscellaneous		14,600
		$747,800
Expenditures		
Payroll		
Scientists and technicians	$268,000	
Administration and management	93,000	
Employee benefits	27,000	
Capital equipment	55,000	
Materials and supplies	29,000	
Research grants to universities	30,000	
Professional services	22,000	
Consulting Board fees	17,000	
Office rental	30,000	
Maintenance and alterations	20,000	
Utilities, telephone	15,000	
Travel	14,000	
Printing	11,000	
Commission and legal counsel	5,000	
Miscellaneous	40,000	
		$675,000
Balance forwarded 30 June 1974		72,800
		$747,800

TRACE ORGANICS LABORATORY

This laboratory was set up in February 1973 under an EPA grant to make precise measurements of chlorinated pesticides and polychlorinated biphenyls. Concentrations of these com-pounds have since been measured extensively in the body parts of fish and invertebrates and in bottom sediments, river runoff during storms, sewage effluent, fallout, and ocean water.

The principal instrument is a gas chromatograph (the Tracer MT 220) containing dual ^{63}Ni electron capture detectors recording on a strip chart recorder. Other laboratory equipment includes hoods for preparing samples, a rotary evaporator, a cell-disrupting homogenizer, an analytical balance, and suitable glassware. In the next fiscal year, we hope to increase these facilities by the addition of dualflame ionization detectors and a Coulson detector.

At present, we can process 20 to 100 samples per week in the laboratory, depending on the preparation requirements (some types of samples require as many as 15 steps). Measurements of concentrations to parts per trillion, necessary for seawater samples, are frequently made. Our procedures are reviewed from time to time by distinguished consultants, and we have a regular program of calibrating replicate samples with other laboratories to ensure the accuracy of the measurements.

FISH DISEASE AND TOXICITY LABORATORY

Many questions have arisen concerning the amounts of various toxic compounds that cause damage to marine animals. We are studying these creatures in their natural environment, but to obtain consistent and useful results, laboratory experiments must also be conducted.

Therefore, we have established an aquarium room, which contains a number of all-glass tanks filled with flowing seawater. Some are used to hold key coastal species for behavioral observations; some contain diseased fish that are being studied; some are being used in toxicity experiments.

The laboratory contains six large cooling baths in which water at 12°C is circulated. The baths hold a total of sixteen 40-gallon and four 90-gallon aquaria. Each aquarium has its individual pump and filter so that natural seawater is recirculated through the filter several times a day.

Smaller aquaria for toxicity experiments use a flow-through system, the water in each one being replaced at short intervals.

A 1,000-gallon polypropylene tank in the laboratory holds the water supply, which is replenished weekly by hauling seawater from Marineland. Filters of our own design seem to do an excellent job of keeping the water quality high.

Ammonia, nitrites, pH, dissolved oxygen, temperature, and salinity are monitored in the adjacent wet laboratory.

This laboratory is also used for short-term toxicity experiments on very small animals (Neanthes) in small flasks. Our techniques for keeping animals, measuring their reactions, and monitoring their environmental conditions are steadily improving, and we expect this laboratory to provide much new scientific data on metals toxicity next year.

TAXONOMY LABORATORY

The purpose of the taxonomy program is to properly identify and preserve reference specimens of the marine animals of southern California. To compare the animals sampled by various investigators, it is necessary that all agree on the same name and means of recognition. Therefore, this laboratory serves as a center for the marine biologists of southern California, who meet there periodically to agree on nomenclature.

The walls are lined with shelves containing a reference collection selected from over 130 trawl and grab samples taken in California coastal waters in the last few years. Together, the 8,000 invertebrates (300 species) and 150 fish (60 species) represent about 20 percent of the species of bottom fauna found in our coastal waters to a depth of 200 meters. One section of the collection contains examples of diseased and abnormal specimens of fish. The normal fish are used for reference in our studies of feeding roles and fish community structure.

In addition to the benthic fauna collection, the laboratory also contains a reference library of taxonomic literature and a working area for examining and dissecting organisms. A Leitz compound microscope with a magnification range of 100X to l,000X and phase contrast, brightfield and darkfield capabilities is effective in examining both living and stained material. This microscope is used in fine-scale identification of benthic invertebrates and in examining slides of normal and diseased fish tissues. A second microscope, the Aus Jena stereoscope, has a power of 4X to 100X and is used in identifying and drawing whole animals and overall structures of animals.

WET CHEMISTRY LABORATORY

Sanitary engineering studies must be supported by many analyses of water quality and suspended solids. Toxicity experiments require daily measurements of a number of chemical parameters in the aquaria. The Project has established a wet laboratory to serve both of these purposes.

Samples of wastewater effluent are measured to determine the amounts of particulate material they contain. Particle size is determined by a set of millipore filters ranging down to 0.44 microns. After the solids are dried, their volatile components are burned off in the muffle furnace, and the remaining material is weighed on an analytical balance. Experiments to determine the settling times of various sized particles are run in a chilled column to obtain data for use in a model of the distribution of setteables on the sea bottom.

Colorometric analyses can be made of dissolved chemic als (especially phosphate and ammonia); dissolved oxygen, pH and salinity are routinely measured in other samples. The water in toxicity experiments and fish tanks is monitored so that the environmental conditions can be maintained constant.

SHIPS

Ocean measurements can only be made from shipboard. Therefore, in the past year, we have made use of several small craft and ships to carry out the research plan. The schedules and arrangements are made by our marine coordinator, who obtains the services of the most cost-effective vessel available for each cruise. Some are loaned and others chartered, depending on the area of ocean to be studied, the time required, and the kind of work to be done.

Since July of last year, 36 formal Project cruises, each with specific objectives, were organized. Some were concerned mainly with trawling and biological sampling; some were to test instruments or install measuring devices; others were to collect water and sediment samples and to measure the physical characteristics of the water. A brief description of each is given in Appendix D.

In addition to our own cruises, our personnel participated in a dozen day-long cruises conducted by the sanitation agencies for monitoring purposes. We have been able to assist them in standardizing trawling and sampling techniques, identifying marine animals, and planning monitoring programs.

Information is freely exchanged between our group and the monitoring agencies so that we are able to evaluate the various sampling methods and techniques used. Hopefully in the future, some of these marine operations can be combined in a fashion that will make them more efficient and less costly.

SPECIAL EQUIPMENT

The engineering support division is mainly concerned with devising and building equipment that makes it easier for our scientists to take samples, make measurements at sea, and inspect or photograph the bottom and the biota. Certain new items of special equipment are now regularly used at sea: These include an underwater television set for bottom viewing, a sediment squeezer for obtaining samples of the interstitial water in bottom muds, an automatic baited movie camera for assessing benthic fish and their predators, a BM box corer for obtaining precise, undisturbed sediment samples, and a sedimentation sampler for directly catching sediment as it falls to the bottom. We are also using recording current meters, recording temperature meters, and t nets of our own design, and other devices are in development.

The underwater television equipment is designed to operate at depths to 350 m and to present high-quality pictures from light levels as low as 10 foot-candles. The camera is a Jaymar 1000; the cable is 400 m of RG-59 coaxial, plus other conductors; the monitor is a Shibaden with a resolution (real-time picture) of 600 lines. When the image is taped on the Shibaden 110U half-inch video recorder and replayed, the resolution drops to 300 lines. Even so, the clarity of the taped picture is equivalent to that of a good grade home television set. The tape becomes a "sample": The scientists can replay it in our conference room and identify small sea animals, catalog fish and plants, study the nature of the bottom, and obtain an approximation of current velocity by watching small particles move in the water column.

A sediment squeezer has been designed for the purpose of removing water from soft surface sediments; the water can then be subjected to analysis for metal and sulfide content. The squeezer consists mainly of a stout steel frame holding a 1-liter PVC container. A hydraulic jack is used to drive a piston downwards; this compresses the sediment, forcing the liquid it contains out through filters in the bottom into a sealed sample bottle.

The automatic movie camera is a development of Prof. John Isaacs and Richard Shutts of Scripps Institute of Oceanography. This camera was built for use as a "free" instrument in very deep water, but it performed very satisfactorily when operated by the Project in depths of 20 to 350 m. It is battery-powered, timed to turn itself on and (.for example) take pictures for 20 seconds out of every 20 minutes at 24 frames per second. The focus is fixed on some bait (dead fish in a plastic container) held about 3 m away from the camera by a pipe extension. The object of this photography is to identify the species of fish and invertebrates that live in an area and to record any day/night migrations of the species. The results of our successful test with this equipment are described in Part I; we hope to do similar work on a larger scale in the next year. We will build a smaller, lighter camera with lower power requirements, which will be more suitable for the modest depths of our investigation.

The BM box corer is in development, and we expect to have a convenient version available soon. This tool is designed to replace snap or grab bottom samplers and other kinds of core tools, which are often ineffective where the bottom is made of easily-dispersed, low-density material. It is also designed to replace the large and cumbersome box corers used in the past. The BM box corer will take an undisturbed core 1 m long in soft or hard bottom. This tool is lowered to the bottom on an electric cable, where it lands on metal pads that hold it vertical. When a current is sent down the cable, vibrators drive it to depth (which will take only a minute in most bottoms). Upon recovery, the top is capped and the barrel turned to a horizontal position. Then one side is removed so that subsamples can be taken from any level.

The sedimentation sampler is a device built by Andrew Soutar, Scripps Institution of Oceanography, to directly measure the amount of sediment that falls to the sea floor. It consists of a funnel-shaped fiberglass catcher with a 0.1-sq m plastic grating at the top. The bottom of the funnel leads to a PVC pipe 6 cm in diameter; sediment and organic material collect at the bottom. Previously, these samplers were rigged on buoyed lines in deep water, but Project engineers decided to place them on three-legged stands about 2.5 m high to make certain that the catchment surface was horizontal. We also attached a current meter to one such stand to give a record of water motion during the period of collection. Twelve successful placements and recoveries have been made to date.

The current meters referred to above were purchased from General Oceanics (Model 2010 film-recording). Two operate to 50 m depth; two others to 4,500 m. These are selfcontained units that record on Super 8 film for periods of 1 to 143 days. They measure currents as low as 0.05 knots and direction to ±5 degrees. These meters are cheap, so several of them can be used simultaneously for the same cost as more expensive meters. Since any instrument left for a month at sea is likely to be lost, this is an important consideration. A similar meter for recording sea temperature is also used in our studies.

We have devised a floatables sampler that will take a sample of the small particulate material on the sea surface in a swath 1 m wide and 50 m long every half hour. The system will use a slotted rotating cylinder one meter long mounted horizontally between two slender hulls (a catamaran) .

At regular intervals, the cylinder rotates in such a way as to propel the catamaran 50 m forward on its slack anchor line while taking a sample at the same time. Then the motor stops, and the unit drifts backward until the anchor line is taut again. Component tests are just beginning.

Dozens of concepts were sketched and considered before this one was decided upon. We believe it to be the simplest method, to use the least energy, and to be less affected by wave action than any competing system.

DATA PROCESSING

In the spring of 1973, it became apparent that the Project would have to expand its use of digital computers to efficiently and accurately handle the vast quantities of data X generated by our research programs. This capability was particularly needed for the management and summarization of our biological data. A number of existing data management programs were reviewed, but none of these met our specific requirements, so we have designed and implemented our own system.

In addition to data related to our oceanographic and modeling programs, data from more than 1,800 otter trawls and 750 benthic grab samples have been incorporated into the system. To efficiently process this data, several large computers are utilized. These include an IBM 360-91 at the University of California, Los Angeles, and a CDC 3600 and Burroughs B6700 at the University of California, San Diego.

The basic biological data management programs are now fully operational providing data cataloguing and summarization capability. The system has been used extensively in a number of our research projects.

Some of the computations are performed using standard programs that provide basic statistical parameters such as means, standard deviations, and correlation coefficients. Frequently, however, somewhat more specialized programs are required. In a few cases, we have been able to use programs developed outside the Project, such as the basic invertebrate data summary program (from Los Angeles County Sanitation Districts) and an extensive cluster analysis program (R.W. Smith, Allan Hancock Foundation) that is being used to investigate community structure. However, most of the specialized programs have been designed by Project personnel; these include summary and selection programs for fish data, alternate forms of cluster analysis, and programs for summarizing data on the transport of materials by winds and currents, performing harmonic analysis of currents, and developing simulation models of dispersion and deposition of trace metals.