Part II

FORTIETH ANNIVERSARY SYMPOSIUM OF THE CALCOFI CONFERENCE

La Jolla, California

October 27, 1989

OCEAN OUTLOOK: GLOBAL CHANGE AND THE MARINE ENVIRONMENT

The fortieth anniversary symposium was held on the final day of the 1989 CalCOFI Conference. The morning session featured an award to Roger Revelle and talks by Lieutenant Governor Leo McCarthy and Under Secretary of Commerce for Oceans and Atmosphere John Knauss. The afternoon session was devoted to a panel discussion of the question "What does society need from ocean scientists in preparing for global change?" Panelists were seven distinguished representatives of scientific, governmental, and environmental agencies.

Proceedings for both sessions were recorded, transcribed, edited for clarity, and reviewed by the speakers. We trust that the transcribed talks will be as informative and enjoyable to read as they were to hear.

The CalCOFI Committee

Edward A. Frieman: I'd like to welcome all of you on behalf of the faculty, staff, and students of the Scripps Institution of Oceanography of the University of California, San Diego. I'd like to express our appreciation for CalCOFI's selecting our campus for the location of this fortieth anniversary celebration. It gives an opportunity for many of us to hear and participate in what you are doing and, of course, to allow members of the San Diego community to join in.

I'd also like to give special greetings to a few people. I really appreciate the presence of the Honorable Leo McCarthy, lieutenant governor of California, and of the Honorable John Knauss, who is the under secretary of commerce for oceans and atmosphere, and, as it's been pointed out many times, one of us — a Scripps graduate. John still has a home here, so I think we can claim some special attention on his time.

There are many others I would like to welcome. I would like to give a special welcome to Roy Brophy, who is the chairman of the Board of Regents of the University of California. We are clearly delighted that he has taken the time to come down and listen to what we're doing here. I'd also like to welcome Claire Dedrick, executive director of the State Lands Commission; Mike McCollum, chief deputy director of the California Department of Fish and Game; and Mario Martinez, director of our sister university system in Mexico, CICESE. We have strong and ongoing relations across the border; we try very hard to maintain them and keep up our end of the bargain. I think it's extremely important that we do this. I'd also like to welcome Howard Ness, who is the U.S. regional fisheries attaché for the American embassy in Mexico City; Craig Denisoff, who is representing California Senator Barry Keene; Alicia Wenbourne, representing Assemblyman Gerald Felando; and representatives of the office of City Councilman Bruce Henderson. There are probably others here whom I should have recognized and didn't; my apologies.

Of course a very special welcome to — I guess I'd have to call him a Renaissance man — Roger Revelle.

This conference comes at a difficult time in our history, when humankind is being stressed by severe environmental change. And clearly the combined efforts of science and society will be required to meet this challenge. It seems to me that there's a growing appreciation of the strong linkages that exist between environmental policy, energy policymaking, and economic policymaking throughout many sectors of society. There's a growing realization in the international arena that action is needed. We see Maggie Thatcher and President Mitterand proposing major conferences and international action in this regard. And there's a slower-growing realization that a strong science base is needed, much more so than in the past, to support this kind of policymaking. So it seems very fitting that CalCOFI

sponsor a symposium on global change, bringing together scientists, government leaders, and those with environmental concerns to focus attention on these matters of science and public policy.

It's also noteworthy that part of our understanding of the impact that the oceans have on climate came from CalCOFI, whose primary goal is understanding the marine life of the California Current. CalCOFI has led in many areas of research on air-sea interaction, the dynamics of ocean currents, the El Niño phenomenon, and other insights vital to our understanding of both short-lived and long-lived, short-range and long-range weather predictions. I'm told that there was a CalCOFI meeting in the late 1950s that brought together some of the nation's leaders in ocean and atmospheric science, including many from Scripps, to discuss the role of the oceans in determining climate.

It's my contention that those in the political arena, worrying about the issues of global warming, tend to think of it purely as the province of the atmospheric sciences. The major role of the oceans, which perhaps will be discussed today in later sessions, is often disregarded, poorly understood, swept aside. It is not part of the national agenda in this debate, and I think one of the outcomes of meetings like this will be to help us focus on this issue, which is a very serious issue for the future.

An outgrowth of the work of CalCOFI was the establishment of the Scripps Center for Climate Research. Later on, the nation's first experimental long-range forecasting center was established at Scripps in the 1970s. CalCOFI has assembled an enormous data base on ocean temperature, salinity, and circulation patterns, along with comprehensive marine life collections from larvae to adult fishes and including marine mammals and birds. This is all invaluable to our research in global change. We must have data of high quality and continuity for projecting changes in climate and species.

It has been noted that CalCOFI began in the 1940s. It is really amazing in the world of science for such a cooperative program, which involves federal and state governments, universities, and support from the private sector, to be able to function for four decades. The relaxation time for political phenomena tends to be four years, yet we have functioned and stayed together over many, many political decades. I cannot think of another major scientific program that has this characteristic. From the scientific point of view, one might say it provides evidence that it can be done. I think it's important for policymakers at high levels to be aware of that.

CalCOFI, as you know, was a response to a decline in the catch of the sardine fishery, which was at that time the largest single fishery in the world. I'm told the sardine fishery is back, at least to the degree that fish have been canned again in 1988. Clearly the program would like to take credit for that, and though you are great, I think you don't yet walk on water. But you did provide the understanding that led to much of this.

An issue then is the role of CalCOFI in the future, and I look to CalCOFI for major leadership. I think there is a growing understanding throughout the oceanographic community of a new kind of unification of a number of disciplines—chemical, biological, physical, marine biological—to attack the global problems we must deal with in the future. We can no longer maintain the stance in the scientific literature, in our research, that these areas are distinct and separate. For example, there is talk in the National Science Foundation of a new initiative in global ecosystems dynamics, called GLOBEC. I would hope that the Marine Life Research Group and CalCOFI will play a major role in that new endeavor when and if it gets started.

Lastly, I would like to commend the CalCOFI Committee for their really tireless efforts over the past year to provide this forum. There are many people on the planning committee—Izadore Barrett, who is director of the Southwest Fisheries Center of NOAA's National Marine Fisheries Service; Richard Klingbeil of the California Department of Fish and Game; the current CalCOFI coordinator, Patricia Wolf, from the California Department of Fish and Game; and last, but certainly not least, Mike Mullin, director of our Scripps Marine Life Research Group; and his assistant George Hemingway. I know, from Mike's first talking to me about this, many months ago, that he has been a superb leader, tireless in his efforts on your behalf. I wish to thank you all.

Finally, on behalf of the institution, I would like to welcome you to what promises to be an exciting day of talk and debate as we explore the new roles of science and public policy in meeting this challenge.

Michael M. Mullin: I want to add my welcome to that of Professor Frieman, and I stress that this is a triple welcome, because, as you know, one of the strengths of the California Cooperative Oceanic Fisheries Investigations is the enduring partnership between the Marine Life Research Group here at Scripps; the Southwest Fisheries Center of the National Marine Fisheries Service, National Oceanic

and Atmospheric Administration; and the California Department of Fish and Game. Therefore, welcome, welcome, and welcome.

This symposium takes place on the third day of the annual scientific meeting of this consortium; together with other interested scientists, we've been sharing our developing, hard-won knowledge and speculations. The symposium today is really about the future—about the problems that may arise for society from environmental change, and the roles of marine scientists in addressing these problems.

We will hear from distinguished and diverse scientists and policymakers as they discuss and debate these issues from several perspectives, and we are very grateful for their participation. I particularly want to thank our participants from the Bay Area and Sacramento—Lieutenant Governor McCarthy, Assemblyman Sher, and Professor Scheiber—who are with us in spite of the recent earthquake and its major disruption of normal life.

Yet the symposium also honors the past—forty years of a collaborative effort to develop an understanding of the sea off California and its living resources. Put quite simply, we believe that CalCOFI exemplifies the three bases for grappling with future environmental problems. These are the fund of factual knowledge that has been accumulated; the conceptual and technical tools that have been developed (and which, incidentally, have been adopted in many parts of the world); and the model of cooperation and mutual support between organizations whose internal politics are often quite divergent. We believe, to paraphrase Santayana's oft-quoted remark about history, that those who do not understand the environmental change of the past are condemned to misinterpret what is happening to them in the present.

As proud as we are of the record of this program—and we all are proud of it—we organized this symposium for the future, so I would like to leave you with some visual images representing the CalCOFI program up to this point.

First, to demonstrate that the program has been solidly based in seagoing, though by no means limited to that, Roger Hewitt[1] put together maps of the coverage of the California Current by the CalCOFI cruises since 1949. I show these to you for an overall visual impact, not for details. The first slide (Hewitt's figure 5) shows the coverage from 1949 through 1960, during which much of the California Current was sampled each month. The second slide (Hewitt's figure 6) represents the years from 1961 through 1965. Coverage was reduced to approximately quarterly, but was still spatially extensive. The third slide (Hewitt's figure 7) is for 1966 through 1978, when extensive coverage was reduced to every third year. The final slide (Hewitt's figure 9) represents 1979 through 1987. The weakness of the triennial system was revealed in 1983, when a major El Niño had the impudence to occur in a non-CalCOFI year. Resources were begged, borrowed, and stolen to set up a single line off Del Mar, California, and in 1984 the sampling plan was changed to quarterly coverage of the segment from San Diego to San Luis Obispo. And that is the pattern that continues today. There are sound scientific reasons for reducing the area of coverage, as well as financial pressures, but I'll spare you the arguments.

I don't want to leave you with the impression, though, that all of the seagoing science has been confined to the California Current. The basic methods have been used by CalCOFI scientists and others to map most of the North Pacific. Furthermore, not shown on these maps are extensive and intensive cruises within the current, specifically designed to assess the abundance of eggs and larvae of commercial species of fish.

The second visual image is a videotape that Chuck Colgan and Bill Call of Scripps prepared for this anniversary celebration, starring one of our own researchers. We plan to distribute this widely as a source of information about CalCOFI and about how large-scale issues in the marine environment have been tackled. *(videotape)*

As you can see, we are very proud of the cooperative aspect of this program, and although it's certainly evident to those of us in it, I should point out to newcomers that there has also been a very long-standing and fruitful cooperation with marine researchers and fisheries biologists in Mexico. They are regular participants in the CalCOFI conference, and we welcome their continuing involvement, because the problems that we face simply don't recognize national borders.

Finally, to remind you again of the reason for this symposium in words from outside CalCOFI, I quote from *Our Changing Planet, An Executive Summary of the U.S. Global Change Research Program*:

> Although human activities may have the potential to alter the Earth system, it is clear that variations occur naturally over a wide range. For many of these changes, current knowledge is insufficient to reliably predict the

[1]Historical review of the oceanographic approach to fishery research, Calif. Coop. Oceanic Fish. Invest. Rep. 29:27–41.

likely debate, rate, or timing of these changes. To understand and ultimately predict the impact of both natural processes and human activities on these changes, it is necessary to improve our understanding of the underlying physical, geological, chemical, biological, and social processes that control the earth's environment. . . . An effective and well-coordinated national and international research program will be required to dramatically improve our knowledge of these complex earth processes — to provide the basis to discriminate between natural and man-influenced changes and ultimately to predict global change.

So much for background. My distinguished predecessor as director of the Marine Life Research Group was Professor Joseph Reid, who led the university's part of the CalCOFI program for many years. Joe is, as most of you know, a physical oceanographer, but he has published on chemistry and biology as well, and represents an integrative, large-scale view of the ocean. I have asked Joe to make a special presentation to Roger Revelle, one of the great men in CalCOFI's history and in American environmental science.

Joseph Reid: Hello, Roger. At the time the CalCOFI program was first conceived, Roger wasn't here. That was in the middle forties; I believe he was off as a sailor in Washington at that time. But a little later he did manage to get two ships — stealing ships from the navy in 1944 would have been awkward, but in 1947 or 1948 it was a little easier; there was a surplus. And he did this so quickly that the university president at that time, Gordon Sproul, complained to Harald Sverdrup that he'd only learned by memorandum after the event that he was now responsible for a fleet.

Well, getting ships out of the navy at that time was the easiest part of the job. When Roger came to Scripps as associate director in 1948, he had to use them. One of his many responsibilities was to see that these ships were equipped and manned with people who knew how to carry out the work at sea. This was much the hardest part of the job.

In the earlier part of the Scripps career, the faculty had done much of their own work at sea. Because most of the cruises were fairly short, this had worked out well. But monthly cruises of three ships were a different order, of course. And they would need more trained people. Starting, I believe, with a core of one experienced marine technician in 1948, and enough gear for one ship, Roger somehow managed to find enough instruments and trained people for three ships. So that in March of 1949 the Scripps vessels *Horizon* and *Crest* and the Cal Fish and Game vessel *N.B. Scofield* were able to go to sea. Much of the work on the first few cruises was done by students and at least one professor, Norris Rakestraw (he was on cruise 1 when I was).

Well, Roger supported this Marine Life Research Program of the Scripps Institution, a component of CalCOFI and its sardine study, arguing with his characteristic vigor for a type of environmental approach now called fisheries oceanography. He pursued his aims with so much vigor that some of the non-Scripps scientists of the time complained that, lacking the mandates that the federal and state agencies had, Roger was sometimes insensitive to their concerns and interagency rivalries.

Roger became director in 1950, and he was, with Carl Hubbs, the consistent Scripps presence on the Marine Research Committee, which managed the CalCOFI program. He remained actively involved in that committee until 1959. Without losing sight of the concern for the economically important, but failing, sardine industry, Roger was a vocal and eloquent proponent of the central idea of modern ecology: that any particular species is part of a physical and biological environment and must be studied from the broad perspective by experts in a variety of fields. He combined broad vision with great energy and persuasive powers. He was certainly one of the first marine scientists to become interested in the possibility that adding carbon dioxide to the atmosphere from the burning of fossil fuels might cause global warming — the greenhouse effect.

This is the fortieth anniversary of CalCOFI, but I was reminded by Saul Alvarez-Borrego yesterday that it's also the fiftieth anniversary of your trip, Roger, on the *E.W. Scripps* to the Gulf of California in 1939. And that merits some mention too.

I have heard, and it's only a rumor, that while the ship was down there and you were engaged on your work on the sediments in some of the basins, the captain had to leave, and you brought the *E.W. Scripps* back to San Diego. I don't know whether this is true or not, but it's rather frightening to think of the scientific leader of a cruise all of a sudden becoming the navigator. Those of you who have been to sea know what sort of scientists we've got. All are very competent in their own particular fields, which may be deep, but not necessarily very wide. I'm afraid that there are some of us who, given the problem of navigating a ship, once we've gotten offshore far enough not to see North America, couldn't find it again. . . . And there are some of us who can do anything. I don't know whether Roger really

brought that ship back by himself, but in his case, I don't think there's any doubt that if he'd put his hand to it, he could have done that, as well.

Today, as a symbol of our recognition of what he's done for this program, we present Roger with a scale model of the Scripps vessel *Ellen B. Scripps*, which has been used for research in the California waters. This model was made by George Snyder, who has cared for the plankton collections at Scripps for many years. He has received, cataloged, and preserved plankton samples collected by Scripps vessels from all the world's oceans. And he certainly knows what goes on the fantail of a Scripps vessel. This is not the largest or the newest of the Scripps vessels. It's a workhorse for much of the research Scripps has carried out in the inshore waters. A small token, but given sincerely. Thank you, Roger.

Roger Revelle: Thank you very much, Joe. And thank you all.

This occasion brings back a flood of memories of the early days of this remarkable program. It is quite right that we went to the Gulf of California in 1938. Harald Sverdrup led that expedition. In 1939 Francis Shepard and Charlie Anderson and I led a geological expedition on the old *E.W. Scripps*. On the way back, the engine broke down. To get out of the gulf and to get along the coast of Baja California, we had to sail. We sailed a very long tack to the westward—about 800 miles, as I remember—and then sailed back again, a total distance of about 1600 miles, and we made 20 miles good. *(laughter)* This was a very difficult way to get from Baja California to San Diego. Fortunately we did have some professional sailors on board (we were not all amateurs), and the sailors could see that unless we got that engine fixed we'd never get home. So they doubled and redoubled and quadrupled their efforts, and pretty soon the engine was working again. So the last part of the trip was a lot easier.

In those days, the scientists literally were the sailors—not the only sailors, there were also a few pros on board—but we all had to stand watches. We stood six hours on and six off. That's really a very difficult kind of watch to stand. It's awfully boring about 5 or 6 o'clock in the morning, particularly after you've been up since 12. Nothing ever really happened, of course, but just staying awake was a serious problem.

This occasion makes me think of some people who aren't here, particularly Harald Sverdrup and John Isaacs. Harald was the man who really conceived this CalCOFI program more any other person. And although Joe gives me the credit for thinking about the problem from an ecological point of view, Harald, in spite of the fact that he was primarily a geophysicist, also had ecological ideas, very much so.

The other man who pushed CalCOFI very hard and had many original insights was John Isaacs, who was director of the Marine Life Research Group for several years. I think that was perhaps the happiest time of his life. He was a biologist manqué. He was trained as an engineer and a physicist, but all his life he wanted to be a biologist. And to a considerable extent he *was* a biologist. One of the most interesting things he did was to start a program of coring in the Santa Cruz Basin, south and west of Santa Barbara, where there are varved sediments deposited under anaerobic conditions. The study of the fish remains in those sediments showed that long before there were any fishermen, any Cannery Row, any John Steinbeck, any collection of Portuguese and Italian fishermen in California, the sardines fluctuated just about as much over several hundred years as they have since 1930.. And there was an alternation between the populations of sardines and of anchovies long before any human activities affected the fishery.

Another man who was very much involved in this program is still alive. He is Jack Marr, who's sitting right here in this room. He played a major role in the early days of the program. John McGowan, who is also here, was another one.

What's remarkable to me is that the CalCOFI program is still being enthusiastically pursued after more than forty years. People still think about it hard and work hard on it, and obtain interesting new results. It's quite a remarkable scientific operation to have gone on so long and so effectively. I'm very proud to have been involved with it in the early days. Thank you very much. *(applause)*

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Mullin: It was a great pleasure for us to be able to choose a gift so close to Roger's seagoing abilities. I hope he can navigate this one home as well as he navigated the *E.W. Scripps*.

Next, it's my honor and pleasure to introduce the Honorable Leo McCarthy, lieutenant governor of California. His most notable environmental role is on the State Lands Commission, but of course he has been connected with lands in California much more intensively during the last two weeks, and we're very happy that he could join us today.