

27 MAY 1992

**INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)**

**Twenty-fifth Session of the Executive Council
UNESCO, Paris 10-18 March 1992**

ANNEX III-B

**ROGER REVELLE MEMORIAL LECTURE
13 March 1992**

**Introductory remarks
by
Mr Federico Mayor
Director-General
of the United Nations Educational,
Scientific and Cultural Organization (Unesco)**

It is a pleasure and an honour for me to introduce this first lecture in honour of Roger Revelle. I would like to share briefly with you my personal recollection and esteem for a man who was a giant in every sense of the word: physically, mentally and spiritually.

I first met Roger in the late 1970s in connection with UNESCO's research on basic human needs programme, which owed much to his dream of equity in human relationships, based on equal access to education and knowledge. This ideal was indeed reflected in every endeavour he undertook, including the rationale for an intergovernmental body for ocean research that resulted in the establishment of our Commission.

As one of the authors of the Copenhagen Declaration, he stated most clearly in 1960 the importance of the ocean to humanity as a whole and the need to study the ocean from many points of view and through the concerted action of all nations. His foresight of three decades ago was remarkable. At a time when the ocean was viewed by most as basically a source of food and a medium for transportation, Roger inserted into the Declaration the following:

"The oceans exert a profound influence on mankind and indeed upon all forms of life on earth. The oceans are inexhaustible sources of water and heat, and control the climate of many parts of the world."

Reading the other week an account of a recent article in Nature on investigations in the North Atlantic Deep Waters highlighting the links between the ocean and climate, I thought immediately of Roger and his visionary approach to everything he undertook.

His intellectual curiosity and commitment to human needs was by no means limited to ocean research itself. A man - an American - with a truly global vision of humanity, he also devoted his energy to world problems such as desertification and possible solutions through the green revolution.

Speaking with Roger on these matters was always a stimulating and rewarding experience. He was a man of dialogue and those who had the privilege of sharing ideas with him found the frontiers of their own minds considerably expanded. I would like to emphasize the solidarity of this great man with the whole world - he, for one, certainly welcomed the expansion of the IOC and its TEMA (Training, Education and Mutual Assistance) commitment

SECRET YAM 'S

to help establish marine science capabilities and sustained ocean observations in support of the development of the Third World.

His commitment to the world community led him some years ago to organize a "think-tank" session at the University of San Diego to explore with others the question of "Restructuring UNESCO" with a view to restoring the universality of the Organization. I was most honoured to receive an invitation from Roger at that time and contribute with him to the proposals that emerged from the meeting. And, only two years ago, he invited me to his house at La Jolla to once again explore the subject, but this time based on the restructuring already accomplished.

When exceptional individuals such as Roger disappear from the world community, they leave behind them a huge gap but also a mission to all of us, as individuals and in our official capacities, to further the goals to which he was committed. We can't all be giants, but each of us can contribute, knowing that his influence will be present in our endeavours.

This is the essential legacy left by Roger Revelle: not only his work as a pioneer in the field of international co-operation in ocean science and as one of the founding fathers of the IOC of UNESCO, but also his implicit call to all of us to promote to the best of our ability the vision of equity and universality that he embodied. It now gives me great pleasure to give the floor to Dr Knauss, First Vice-Chairman IOC, to speak to us about Roger Revelle and his contribution to ocean science.

**Roger Revelle and his contribution to
International Ocean Science**

**by the Honourable John A. Knauss
Under-Secretary for Oceans and Atmosphere,
U.S. Department of Commerce,
and First Vice-Chairman of IOC**

I am pleased and honored to be asked to give the first IOC Revelle lecture. My goal in this first Revelle lecture is to leave you with some measure of the man and why so many of us believe it fitting that the IOC establish a Revelle lecture series. As I will attempt to demonstrate, he was as responsible as any single person can be for the establishment of this, our own organization, the Intergovernmental Oceanographic Commission.

He was a visionary, a builder of institutions, a champion of international cooperation, a great scientist and an extraordinary warm and friendly person. He left his mark on many throughout the world.

He certainly left his mark on me. I am an oceanographer because of him. Like many of my generation I emerged from the vastly changed world of World War II, confused and perplexed as to what I wanted to do. I had some training in meteorology and physics, was enamored of neither, and was casting about for a career when I met Roger Revelle through a mutual friend. He steered me to a temporary position with the Navy in oceanography and 43 years later I am still at it. I eventually went to Scripps, where Revelle was the director, to obtain my PhD and to learn some proper oceanography. I was adopted by the Revelle family and served for a brief period as Roger's assistant in the director's office. He was my major professor and chaired my PhD Committee. He remained a colleague, friend and adviser until his death this past July at the age of 82.

I give this resume so that you can judge my bias. In an era of too few heroes, Roger Revelle is one of mine.

Oceanography changed rapidly after World War II, nowhere more so than at Scripps where Revelle had earned his PhD before the War and where he

returned afterwards. Prior to World War II Scripps was a small coastal marine station with very limited seagoing capability. But that was the situation almost everywhere. The major deep ocean programs we are all so familiar with were, almost without exception, national expeditions--one of a kind expeditions, expeditions that took many years to plan and even more years to reduce findings to paper. They were the Challenger, the Meteor, the Dana expeditions. They were grand, marvelous affairs, and the results were published in the multivolume expedition reports.

All of that changed rapidly after World War II, and nowhere did it change more rapidly than at Scripps where Revelle was director. He wanted to expand Scripps' horizons beyond the coastal waters, and with the help of two 43 meter Navy surplus ocean going tugs he did just that. The first was a single ship three month expedition called the Mid Pac in 1950, and the second was a five month two ship expedition called Capricorn in 1952-53. Both ranged widely over the Pacific. Both were led by Revelle. Since he was the Scripps director many thought he should have remained home and be the director rather than wandering about at sea where it was difficult to communicate with those ashore. Remember that these were the days before voice ship to shore radio communications. All messages to and from the ship were by Morse code. Nevertheless, he led both expeditions from beginning to end.

In my view those two expeditions signaled a change in how oceanography was going to be done. Scientists from many disciplines were on each voyage, but no finely bound multivolume expedition reports resulted. Instead the professional literature (biological, chemical, geological, physical), was filled with results from those programs for many years thereafter. Major sea going expeditions were going to become routine, not a once in a lifetime opportunity with special expedition reports. More importantly for those of us at Scripps, it signaled a change in how we looked at our science. There were no longer any unspoken geographical boundaries. Assuming you could find the necessary funding for your program you could go wherever it was necessary to attack your problem.

Nor we soon learned were we unique. We were not the only institution or the only country sending ships far to sea. Europe was, and so, most dramatically of all, was the USSR. By the time the International Geophysical year was completed at the end of the 1950's, it was clear that the world of oceanographic research had changed. The era of the multi volume expedition reports had passed. There were many research ships in many oceans. New and wonderful discoveries were being reported regularly in the professional literature. Plans for ever larger and more complex programs were being discussed.

Was there need for better international coordination? Many thought so. The International Geophysical Year of 1957-58 was a tremendous success both scientifically and as a means of developing increasing international cooperation amongst the scientific community. I expect, however, that a close reading of the history of the IGY would show that the oceanographers came a bit late to the party. There was indeed an international oceanographic component to the IGY, and Revelle played a major role in developing it; but except for the establishment of World Data Centers, it was mostly a loosely coordinated effort by a number of groups to develop individual programs under the IGY banner. Through international planning meetings we got to know each other better, but I believe one would have been hard pressed to argue that the whole of the oceanographic IGY program was greater than the sum of its parts.

Oceanography badly needed a better means of international coordination. Many understood that. What was less clear was how. There were a number of false starts before the IGY. The International Council of Scientific Unions (ICSU) established an International Joint Commission on Oceanography in 1951. Revelle was a member. It recommended the establishment of a Deep Sea Council. But two years later in 1953 ICSU apparently thought the group was going beyond its terms of reference and abolished the Commission. ICSU tried again a year later with the establishment of a Special Committee on Deep Sea Research. Revelle was made a member of that as well. In 1955 Unesco, in a parallel effort, established

an International Advisory Committee on Marine Sciences to advise the Director General on the preparation and execution of Unesco's marine programs. Revelle, along with Anton Bruun of Denmark and George Deacon of the UK found themselves members of both committees.

All of this was going on while the International Geophysical Year of 1957-58 was being planned. As the IGY was about to start the president of ICSU, Lloyd Berkner, suggested to Revelle that a suitable follow-on to the IGY would be an international cooperative program in oceanography. He then asked Revelle to organize a special committee for that purpose.

I believe Berkner's decision signaled the end of the confusion. From that date one can clearly trace the establishment of SCOR, the Special Committee for Oceanographic Research, the IOC, the Intergovernmental Oceanographic Commission and the great joint effort of both organizations in their formative years--the International Indian Ocean Expedition.

SCOR was established in 1957, the year of the IGY. At its first meeting in Woods Hole Roger Revelle was elected chairman, George Deacon of the UK was vice chairman and Gunter Bohnnecke of Germany was secretary. It was agreed that the principal objective of SCOR should be "to encourage and coordinate an international program of observations and measurements of deep ocean water." Also from that first meeting came agreement to mount a major international oceanographic effort on that most unknown of oceans, the Indian Ocean.

The history of how that expedition developed is told in a charming book published some years ago by The Unesco Press entitled "Assault on the Largest Unknown, The International Indian Ocean Expedition" by Daniel Behrman. As an active participant of that expedition I can vouch for its authenticity.

Once it was clear that there was to be a concerted effort to study the Indian Ocean, ideas flowed quickly. What began as a one year highly structured program became a six year multifaceted effort. The original concept of a systematic survey was lost in the entrepreneurial enthusiasm of many scientists from all over the world.

Revelle, Deacon and Bruun spent the summer of 1960 in Copenhagen pulling together the various components of the International Indian Ocean Expedition (IIOE), into a coherent plan that could be presented to SCOR and to governments. It was not an easy task. Warren Wooster who was the first IOC Secretary has written, "I think the International Indian Ocean Expedition was the greatest uncoordinated expedition in oceanographic history. I ought to know. I was coordinator part of the time. It was the only way to explore such a region. Scientists with curiosity would not have come in if it had been done any other way."

The reason why Wooster was the Indian Ocean coordinator was that the IOC took over from SCOR the responsibility of the Indian Ocean Expedition in 1962, and the reason it did so was that Roger Revelle and others realized that there were limits to what a non governmental organization like SCOR could do.

In the summer of 1959, that same Copenhagen summer that Revelle, Deacon and Bruun were attempting to pull together the various strands of what was to be the International Indian Ocean Expedition, Unesco held an Intergovernmental Conference on Oceanographic Research in Copenhagen. Roger Revelle led the US delegation. The Conference recommended the establishment of the Intergovernmental Oceanographic Commission, the IOC; a recommendation that was subsequently approved by the Unesco General Conference. In 1962 the IOC took over the coordination of the International Indian Ocean Expedition with SCOR remaining in an advisory role.

The need for the IOC flowed directly from the plans of SCOR and the Indian Ocean program. As Revelle and others noted, the aspirations of oceanographers to continue the momentum of the IGY, to carry out the vast international cooperative programs envisaged for the Indian Ocean, required some form of intergovernmental organization. It could not be left to non

governmental organizations alone. Programs of this size and complexity often require formal government commitments.

During this period Roger Revelle managed two other projects I would like to note. As President of SCOR he arranged with the American Association for the Advancement of Science to hold the first International Oceanographic Congress in 1959. He was President of the Conference and with typical Revelle aplomb he managed somehow to have the Congress held in the United Nations headquarters in New York. I was fortunate to participate in that first Congress, and I still remember my sense of wonder as I watched some of my more senior colleagues delivering their plenary addresses from the same lectern that heads of state had addressed the U.N. General Assembly just a few months previously.

It was also during this period that Roger Revelle and Harry Wexler of the U.S. Weather Bureau agreed to sponsor a young PhD chemist who was convinced that he could make continuous carbon dioxide measurements with a routine accuracy that no one had yet attained. These were the start of what many have referred to as the most important set of environmental measurements of this century, the carbon dioxide observations of the Mauna Loa Observatory in Hawaii which began in 1958 and continue to this day under the same watchful eye of Charles David Keeling.

There had been suggestions for some time that perhaps there was an increase in the carbon dioxide content of the atmosphere as a result of the burning of fossil fuels. Revelle agreed. He had done early research on ocean carbonates and the ocean carbon dioxide cycle. He and Hans Suess published a paper in 1957 in which they predicted that the ocean could not absorb more than fifty percent of the carbon dioxide released by the current rate of burning of fossil fuels; carbon that had been secreted by the earth for millions of years.

As Revelle noted in one of his oft quoted epigrams, "we are now carrying out a large scale geophysical experiment of a kind that could not be carried out in the past or be reproduced in the future."

Keeling quickly justified Revelle's and Wexler's faith. The first results were confusing; the CO₂ level first rose then fell and often there were gaps in the data because of an inconsistent power supply at that remote mountain side location. But by the end of the second year, however, the pattern was clear. There is a seasonal pattern tied to the plant cycle superimposed on a yearly increase of carbon dioxide of about a half a percent a year.

Thus began the set of measurements that have convinced the world that mankind can indeed have a global effect on climate. The now familiar saw tooth curve of carbon dioxide which shows about a half a percent per year increase in carbon dioxide now graces every report pertaining to global warming. One may argue about how much warming will take place and how fast it will take place because of the slow but inexorable climb in CO₂ concentrations, but there is no argument about the data.

In 1964 Roger Revelle took an eleven year leave of absence from oceanography when he left the University of California at San Diego to establish the Harvard University Center for Population Studies. He returned in 1975 at the time of his Harvard retirement.

His enthusiasm for international science never flagged. He strongly supported the internationalization of the Ocean Drilling Program which had begun as a U.S. program. He continued to serve, and often lead international programs. He was the first chairman of the United States Committee for the International Biological Program. He served as a U.S. delegate to Unesco General Conference on four occasions and to the General Assemblies of ICSU for 22 years. He served as an adviser to the governments of India, Pakistan, Bangladesh, Nepal and Sri Lanka.

In 1979 Roger Revelle returned to the IOC he had helped to form. He came as chairman of a new joint SCOR-IOC Committee on Climate Change and

the Ocean, the CCCO. His 1979 address on climate to the Eleventh IOC Assembly was a typical Revelle tour de force. He began with the words, "I am about to describe what I believe to be the most important programme that has challenged the IOC in many years." He then proceeded to strip a very complex subject to its essence without trivializing it, having something to say to the expert as well as to the layman. He evoked the excitement of the present scientific studies and plans for the future. He held out hope of the extraordinary social and economic benefits that would result if we could indeed predict the strength and timing of the Indian Monsoon, the East Pacific El Nino, or the yearly rainfall in Russia or Northern Africa. Most importantly for his IOC audience he demonstrated the role of the ocean in climate variability.

He finished with these words, "In concluding, let me say that there are two important aspects of the world climate problem. One is statistics, that is the average conditions and variance. And second is the possibility of actually forecasting climate. We cannot forecast it now; we may never be able to forecast it, but if we could, the results would be so valuable that the gamble is worth taking. And I conclude by emphasizing what I have said in the beginning, that the World Climate Programme and the possible role of the IOC in that programme represents the greatest challenge and the greatest responsibility that this body in my experience has ever had."

Roger Revelle was largely responsible for the formation of SCOR, the International Indian Ocean Expedition and the IOC, an IOC whose major effort during its first 15 years was the facilitation of ocean science. I find it interesting that Revelle should have resurfaced at IOC in 1979, some eighteen years after the 1961 meeting, to sound the call for a new challenge for IOC, the development of the necessary programmes that will allow us to monitor and perhaps to predict climate variability.

We have made progress in meeting the challenge that Revelle laid before us in 1979, but we have much more to do. That task is more important now than it was a dozen years ago. Revelle was properly cautious in not claiming that we would be able to forecast climate variability. He only held out the promise that if we could the rewards would be great and therefore the risk was worth taking.

We are increasingly confident that we will succeed. Our understanding of the tropical Pacific Southern Oscillation is sufficient that we are already having some success in forecasting El Nino events. Most believe it is only a matter of time before other climate forecasts will be possible.

All such forecasts, however, require better monitoring of the ocean. We must develop a global ocean observing system comparable to the international weather observing system.

In conclusion, I hope that whoever gives the Revelle lecture in the year 2000 can look back at the IOC and note that Roger Revelle's call in 1979 for the IOC to address climate variability was as important in shaping the IOC of the year 2000 as was his insistence in 1960 that there be an intergovernmental body such as IOC to facilitate international marine science.