CARLETON RAY

A MARINE REVOLUTIONIST SPEAKS OUT

By Hillary Hauser

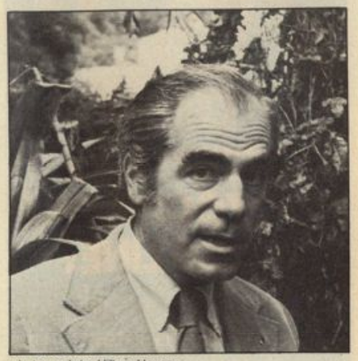
In the winter of 1969 a CBS television crew filmed a one-hour documentary concerning regions of the world most of us will probably never see — the Arctic and Antarctic. Cameras were focused on a noted marine mammalogist who has made many expeditions to both regions. The man was Dr. G. Carleton Ray and the film was *The Frozen World of Seals and Walruses*. Carleton Ray, an associate professor at The Johns Hopkins University, Maryland, was the first man in the Antarctic to take a detailed look at marine mammals underwater. Since those dives, in 1963, he has made three expeditions there. More often, as many as three times a year, he travels to the Arctic to gain firsthand knowledge of seals, whales and walruses, which are his specialty.

Carleton Ray was born in New York in 1928 and received his bachelor's degree from Yale in 1950, his masters from UC Berkeley in 1953, and his Ph.D. from Columbia in 1960 — all in zoology. In a laboratory at Columbia he met Elgin Ciampi, noted marine author and photographer, and together they built scuba gear of their own design. Carleton made his first dive in 1953, in Bermuda, and in 1954 Ray and Ciampi came up with the idea of setting aside underwater parks for non-spearfishing divers and underwater photographers. Their book, *Underwater Guide to Marine Life*, published by A. S. Barnes in 1956, described their plan. The idea was picked up by several conservationists and scientists, and in 1958 Carleton Ray and the late Ilia A. Tolstoy (grandson of Leo Tolstoy, who helped to design and build Marineland of Florida) headed an expedition to the Exuma Cays, Bahamas. Here, their team proposed the first land-and-sea park in the world. Consequently, the Bahamas National Trust was formed. By this time Carleton had become assistant to the director of the New York Aquarium. He eventually became assistant curator and finally curator. In 1962, at the First World Conference of National Parks in Seattle, Ray and Sir Peter Scott of England helped draft Resolution No. 15, which called for underwater marine parks. In 1967 Ray returned to education and research, aligning himself with Johns Hopkins, where he remains today.

Carleton Ray has been heavily involved in the ocean story in many ways. He is a consultant to the International Union for the Conservation of Nature in Switzerland for which he heads the Critical Marine Habitats Project. In this capacity, he is helping to define and identify the critical marine habitats of the world. He has published over two dozen papers on the subject of marine conservation and in one of them he coined the term "Marine Revolution." This concept describes human dependency on the ocean, and is revolutionary because of the implied change in our way of looking at and using the sea. Thus, the Marine Revolution could take its place beside the Agricultural and Industrial Revolutions in altering basic human behavior on this planet.

While critical marine habitats and conservation issues are a primary part of Ray's work, he is perhaps even better known for his studies of marine mammals. He has served with the nation's Committee of Scientific Advisors to the Marine Mammal Commission, and has functioned as a research associate for the Smithsonian. In his work, Carleton Ray has dived in every ocean of the world, but the Arctic is his favorite laboratory and you'll find him there for a good part of the year. We caught him in Los Angeles on his way to Japan and Alaska, and talked at length with him about his work with walruses, as well as his views on marine conservation, a subject about which he is very outspoken.

HH: How did you become involved in marine oriented research?

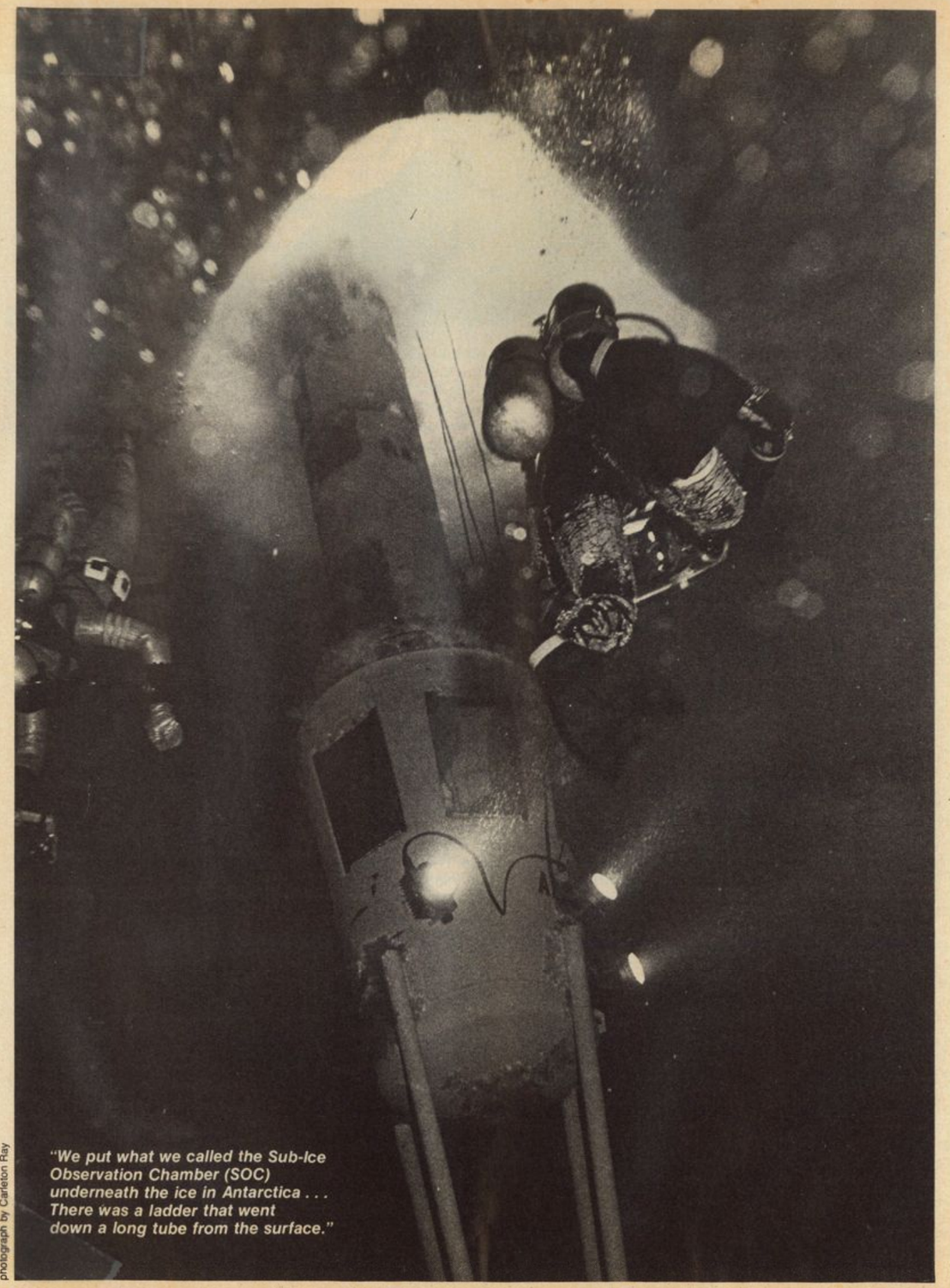


photograph by Hillary Hauser

Ray: When a graduate student gets through, he really doesn't know where his exact future is going to lie. Often it's according to chance and luck. The great Fairfield Osborn offered me a job with the New York Zoological Society's Aquarium because I'd done a lot of diving and I had thoughts on marine conservation. One day a couple of walruses came to the aquarium, sent by a collector from Alaska, and they arrived dead. That made me mad. I thought, a bit cockily, that I could ship walruses better than that. My boss, Christopher Coates, said, "Okay, you try it." And that's how I got into marine mammals. At first, I had a lot of failures. I started out collecting beluga whales and walruses in Alaska. Eventually, some of the walruses I shipped became the first ever brought out of Alaska to survive the trip and grow normally. Soon after, this became almost commonplace, but still the animals are very difficult to keep in captivity.

HH: How did the matter of being a curator lead you to studying these animals?

Ray: In bringing these creatures back, I became involved in the biggest challenge of my life: trying to understand marine mammals. I became fascinated with them. I went up there and brought



photograph by Carleton Ray

"We put what we called the Sub-Ice Observation Chamber (SOC) underneath the ice in Antarctica . . . There was a ladder that went down a long tube from the surface."

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photograph by John Beier

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the animals back and had a hell of a time keeping them alive. I spent a lot of time devising diets, artificial diets, and in the process had a lot of tragedies. However, we succeeded in keeping walruses from the newborn stage, and no one had ever done that before. By the early 60's, after being at the aquarium for about nine years, I decided I really didn't want to live out my life in the public exhibit business since the research potential isn't there. So I left and went down to Johns Hopkins, and got back into the education and research field.

HH: What part does diving play in your type of research?

Ray: For a long time people have studied marine mammals from the surface, where we see them like we see an iceberg, about 10 percent, but this new business of diving has given us the ability to go underwater and be like seals, so to speak. In Antarctica, we dived and dived and found out a lot of things that we couldn't have found out at the surface. In the early days — I started diving in Antarctica in 1963 — it was difficult to get much bottom time for the simple reason that in those days we didn't have drysuits and we couldn't stay underwater very long. So, I began thinking of some other techniques for looking at these amphibious animals. In 1964 we tried something similar to the more recent Sub-Igloo project of Joe MacInnis. We put what we called the Sub-Ice Observation Chamber (SOC) underneath the ice in Antarctica. Unlike Sub-Igloo, it didn't require diver entry. There was a ladder that went down a long tube from the surface, and we could climb down into it, look at seals, and stay dry. It was an upside down thing that looked like a sparbuoy, anchored under the ice rather than positioned on the ocean bottom.

HH: Who developed the SOC?

Ray: The main designer was a colleague named David Lavallee, then of the U.S. Navy. Also Bill Schevill of Woods Hole, and the National Science Foundation funded it.

HH: You have focused much of your attention on walruses. Why have you selected them — what are you learning?

Ray: They are relatively easy marine mammals to observe and may be important environmental indicators. Ice dynamics are directly related to weather dynamics of the whole northern hemisphere. Walruses move with the ice, and we're developing tools to watch what's going on, to monitor walruses with NASA remote sensing devices. The walrus could be an important indicator of Arctic pollution, which is something we have to watch, especially now that we're going for oil and gas up there. The walrus feeds on the bottom; if anything happens to bottom organisms, if benthic productivity is altered in any way, the walrus may let us know. The US and USSR have singled out the walrus as the best potential environmental indicator of the Arctic.

HH: How about the practicalities of manned underwater equipment — any available for your kind of research?

Ray: The minisubs and chambers are beautiful ideas, but the scientific output from most of them has been small in relation to their costs. An exception is undersea geology. I wonder how much scientific work is really done with all those underwater chambers and all that. Let's face it, most subs and chambers have been technologically, not scientifically, oriented. In terms of equipment design, I prefer to think in terms of a scientific result. One of my basic philosophies is that if you are going to build a new instrument or devise a new method, think of the objective first and then build it. All sorts of underwater technologies have produced data, but very often it might have been cheaper to get the data in another way.

HH: Has the study of marine mammals given insights into diving physiology?

Ray: Very much so. Marine mammals are among the best animal models by which to study human diving physiology, as well as respiratory and cardiac physiology. This is because they do the same things we do basically, but to a greater extent. They have a few little valves and other adaptations that we don't have and they have stiffer bronchioles in their lungs and that kind of thing, but actually these are but modifications of the basic mammalian scheme which we share. In the course of evolution, marine mammals have modified this system into the finest diving machine that we know among mammals. These animals have ways of increasing diving time, of mitigating effects of bends and a lot of other things. For example, when they dive they begin what surgeons would call a heart-brain preparation. That is, the circulation to all of the parts of their bodies stops except for a trickle — everything except the heart and brain. Also, their red blood cell count is much higher than ours, and they have a much higher myoglobin, which is like hemoglobin only in the muscle. They are able to tolerate more CO_2 when diving. They build up a greater oxygen debt, which they get rid of by hyperventilating. The world champion diving times as far as we know are with marine mammals. The Weddell seal has been recorded to dive a little in excess of an hour and a little in excess of 2000 feet. Its potential is probably double that, but animals usually don't go to their potential. The sperm whale has been found to dive well over a mile and stay underwater over an hour.

HH: Do you think the day will come when these physiological properties or functions can be understood well enough to be used by man?

Ray: Surely, in a sense, we're already using this knowledge in medicine and elsewhere. But I don't know the value of building a *Homo aquaticus*, as some have suggested. I think that the way it would be done best is not to alter the human directly, surgically, but by add-ons to the human machine. However, the practical uses of the study of marine mammals is not really all that matters. Life is enriched by both art and science; the two are very close. The purpose of studying is really to achieve a basic understanding of our earth/sea home. One of the things I'm concerned with right now is man's perturbations of the ocean, and we may know enough about marine mammals that perhaps we can monitor some of these. For example, we know that oil and some marine mammals don't mix too well — at least that's true for the ones that have fur, the sea otter and fur seals. We also know that pesticides and marine mammals don't mix, because marine mammals have high pesticide concentrations in their flesh, even more than predatory birds. These are direct effects. What of indirect effects on their food? What would happen if oil got under their ice?

HH: What are your thoughts, as a scientist, about the statement very often made that the oceans are in trouble, or even dying?

Ray: "The oceans are dying." That's the opposite of "The oceans are too big to pollute." Both are wrong and are phrases you hear, sometimes from those with not-so-obvious motivations. The oceans *aren't* dying, the earth's not dying, there is going to be life here a long, long time. But, what is happening involves a breakdown of ecosystems. In using the word ecosystem, few people bother to define what that is. You are a system, a cell is a system, a bird is a system. A community of life is a system. But, if you take all the living things and the non-living things in an environment, the biotic things and the abiotic things, and if they interact as a more or less self-sustaining unit, it's an ecosystem. Also, we think there's a balance in which the animals, the plants, and the minerals are somewhat consistent or stable from one year to the next. Sure, there are changes, fluctuations. A system can lose its integrity and can be destroyed when it no longer can sustain itself. There may still be productivity, more life than ever before, but it may be the sort of life you don't want and the whole system loses predictability.

For an example, take your own body. You can cut your arm off and your legs off, you can cut a lot of things off, and you still may live. But there are a lot of things you can't do anymore. You can't run and throw and kick. Your ability to survive is very depleted. The least little thing that comes along can clobber a blind man whereas somebody who can see could get out of the way. So, what do we mean by death of the oceans? We don't mean they are dying, we mean their systems are breaking down. It behooves those that are saying that the oceans are dying to be very specific, to be very, very specific.

HH: How does the ocean picture look to you today?

Ray: If you total all of the coastline in the world, including the Arctic and Antarctic, and divide it by the number of people on the whole earth, it comes out that there are somewhere around 13 cm of coastline for each person; 13 cm — not much. In fact, you couldn't stand side by side, because most people are wider than 13 cm. Take that, and then consider the fact that man has always gone to protected coves and harbors for development, the estuarine places like Baltimore Harbor, Los Angeles and Long Beach Harbors, San Francisco Bay, all these nice, protected places which are — or were — among the richest places for living resources in the world. So, the richest places in the world are also the most populated and are also subject to man's greatest perturbations. This leads to the extremely alarming fact that man, while he's increasing his numbers, is also decreasing the earth's coastal zone capacity to provide biological living materials for him, since estuarine places are nursery grounds for most forms of ocean life. But even these areas are not dying. In fact, some are getting richer. But, they're getting richer in things you don't want to eat. Many areas are getting to be what is called eutrophic. What happens in such areas where more nutrients are added, is more oxygen depletion, and you get a vicious cycle of events which over-enriches the coastal zone and makes life for some creatures impossible. With all these lovely things in mind, it's unthinkable that in man's quest for more space there is an increase in coastal development. There are even those who have come along with ideas for man-made offshore islands and all sorts of crazy stuff.

HH: What happens ecologically during the development of coastal areas?

Ray: Islands are built by dredging or dumping spoils, which increases siltation and smothers living things. Increased siltation is one of the most deadly things for a benthic community. Most of this kind of thing is done for commercial reasons, to get more land, to boost industry, tourism, housing, recreation and marinas. There are two big problems with this. The first is that it's very damaging to life of the sea in general because over two-thirds of all the fish in the ocean that we use in some way or another depend upon the coastal zone for breeding or other life functions. The other is economic. Living resources are not so great a short term economic value as non-living ones, even though over the long term they are infinitely more so, as they are renewable. Let's be frank about it — coastal development is mostly a money-making proposition, a sacrifice of non-renewable resources and values for short-range economical benefits.

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HH: You have also been concerned about the pressure of too many divers on coral reefs. . .

Ray: It's what we call carrying capacity. Just like a field can hold just so many cows, so a reef can hold just so many divers without damage. It's not sufficient to protect a reef from spearfishing and the collecting of corals, seafans and shells. The very presence of continuous, high-intensity use disturbs fish and corals, causes some silting and breakage of delicate coral structures.

HH: What can we do about it?

Ray: We have to develop management plans so that some reefs will have diver relief from time to time, so that a ceiling is put on numbers of visitors. Many terrestrial national parks have had to do this.

HH: On a broader scale, is there yet any plan for ocean management?

Ray: Law of the Sea is still evolving, but through the Geneva Convention, four schemes of management have been defined, which take in areas such as the territorial sea, sea bottom, rights of innocent passage, fisheries, research, and so on. The chief question to ask, when exploiting any of these zones, is if you do one thing in one area, will it affect another? Like oil and mineral exploitation — that's fine — get the oil and minerals, but don't wreck the rest of the ocean while you're doing it. If the restraint costs us more, so be it — we save in the end. Right now we are talking about not wrecking the ocean, but we're exploiting it haphazardly. We've got to understand the ecosystems of the ocean and put our knowledge to work.