

THE CONTINENTAL SHELF - CANADA'S FINAL FRONTIER

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by

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I am a Canadian, standing somewhat alone in a swirl and surge of activity that is called the American "Man-In-Sea" program. This activity is a reflection of a concept being materialized. The concept is that the world's oceans hold enormous potential for the benefit of mankind and that the most efficacious manner in which to unlock this potential is to place man beneath the sea - to live and to work there.

Let us begin by examining that vast watery mantle that envelopes almost three-quarters of the earth's surface. Down through the centuries man has used the sea as a highway for exploration and commerce and as an arena for fishing. Until recently man has always considered the sea a two-dimensional entity having only length and breadth. Little was he aware of its third dimension, and unknowingly beneath the keels of his magnificent ships lay an unbelievable world. In the past few years he has discovered that the sea's third dimension - its depth - contains a world of color and rhythm that is completely unfamiliar to terrestrial eyes. And, more important, he has learned that this world beneath the sea contains an incredible inventory of wealth in the form of minerals, fossil fuels, and an enormous harvest of protein. Man has decided that he is no longer content to leave over 70 per cent of the earth's surface to the exclusive use of other species.

Although we are currently concerned with the total ocean, one particular sub-sea territory has captured the primary focus of our interest. This territory is called the Continental Shelf. The Continental Shelf is the submerged land mass which begins at the beach where the waves mold the shoreline and extends down and out to about 650 feet of water depth. Incidentally, 650 feet of water would just about cover the new Toronto-Dominion Center on King Street. It is called the Continental Shelf because it is a strip of undersea area adjacent to all the world's continents. It is, in fact, an extension of the continental land mass, and was formed some 25,000 years ago when the huge glaciers of the last Ice Age retreated and their melt caused the world's oceans to rise some 300-400 feet. Hence, the average depth of the water column above the Shelf is about 300-400 feet. It is significant that - throughout the world - the Continental Shelves cover some 11,500,000 square miles - an area equal to the surface of the moon.

Why are we focusing our attention on this particular part of the world? What are the incentives for man's descent into this watery realm to live and work? There are the obvious scientific and military incentives which are inherent in ownership of any new territory, be it on land, in outer space, or underwater. However, since this audience is made up

primarily of businessmen, it is appropriate to focus on some of the economic implications of the Continental Shelf. Since we now know that the Shelf is nothing more than a seaward extension of the continent, we can anticipate that the submerged seabed will contain reservoirs of minerals and fossil fuels similar to those located on the adjacent land. For example, the states of Louisiana and Texas whose soils hold vast pockets of oil and gas is today the scene of the most intense offshore oil and gas recovery in the world. In the North Sea recently six offshore gas strikes indicate that this region holds promise of being one of the world's most productive Shelf areas. It is significant that some authorities have estimated that over 25 per cent of the world's oil and gas reservoirs lie beneath the Continental Shelf. I have only pointed out one area of Shelf activity - primarily because it is the biggest in terms of dollars spent. In fact, over five billion dollars was spent in world-wide search and location in 1965.

Other mineral sources certainly exist beneath the sea, but their economic potential varies enormously depending upon depth, location, and geological setting. Surface ores deposits are being mined on various Continental Shelves around the world. For example, tin off southeastern Asia, iron ores off Japan, diamonds off Southwest Africa, and sulphur from the Gulf of Mexico. While the potential mineral resources of the Shelf are enormous, it should be noted that the reality of the market place, at least today, indicates that the economic potential is much less. It should, however, be remembered that demands from a world population that will double to six billion by the year 2000 indicate that in the future we must look to the sea for energy, mineral, and protein requirements.

The key to the realization of the full potential of the sea in the years to come is man - "Man In The Sea" - man the free-diver free to exercise the full flexibility of his mind and the controlled creativity of his hands. Man no longer restricted to the surface - and held at arms length from the new environment - but by means of submarines, undersea habitations, and breathing devices free to use the sea for the same purposes and with equal effectiveness as he uses the terrestrial environment.

Recently, bold steps have been taken to satisfy this design. Both in the United States and France, quantum advances in diving technology have occurred which allow man to live and to work on the deep Continental Shelf for long periods of submergence. During the past three years, a sophisticated "systems" approach to diving has been developed.

The old and clumsy "hard-hat" diver who was tied by an umbilical to the surface has now given way to the mobile free-swimmer who can exist for long periods independent of the surface. Today's diver lives in undersea habitations, breathes exotic gases, and is supported by a fleet of small submersibles. We are today witnessing the birth of a new technology - that of ocean and undersea engineering - which is designed to give man the same work capability beneath the sea that he enjoys on land. Soon he will be able to approximate terrestrial tasks such as construction, mining, salvage, and repair beneath the sea with almost the same dexterity that he enjoys on land. In fact, water's positive buoyancy effect actually enhances certain work tasks such as lifting heavy objects and allowing three-dimensional diver mobility. The first step was to overcome the primary medical hurdles that prevent easy access to this hostile frontier. Once this was accomplished, we were able to employ undersea engineering techniques that currently allow us to perform useful work for periods of several minutes and up to many days of continuous submergence at depths in excess of 600 feet. Let us look now at some of these milestone steps in undersea exploration.

In 1964 two men lived and worked for two days in 432 feet of water from a small undersea dwelling. The dwelling was filled with a synthetic breathing gas of oxygen and helium at a pressure equal to the surrounding water pressure. This prevented the dwelling from filling with water and permitted the two divers to swim out through an opening in the bottom of the dwelling. They worked in the sea during the day and returned to their dwelling to rest at night. The dwelling itself illustrates an important point - its small size and shape resemble that of a tent and confirms the fact that at least during the initial exploration of any frontier territory the first explorers must be mobile and able to travel lightly. Incidentally, one of the pioneers of this particular expedition was Jon Lindbergh, whose flying father pioneered in a different environment. From the spartan limitations of the tent we now advance several degrees of undersea technology to the more recent underwater dwelling - the United States Navy "SEALAB". It is 57 feet by 12 feet and will comfortably house eight men. In 1965 28 men, including the astronaut-aquanaut Scott Carpenter, lived in it and worked from it for 45 days off the coast of California. It lay on the Continental Shelf in 205 feet of water. In nine months it will again be inhabited by four teams of eight men who will occupy it for 60 days. The habitation will be positioned in 450 feet of water. From this location beneath the sea, United States Navy divers will carry out over 100 different underwater experiments and work tasks including vertical excursion dives to 600 feet.

Further illustration of the recent quantum advance in diving technology is evidenced in the rapid growth in numbers of small submersibles. The submarine, the PC-3B, is operated and leased by Ocean Systems, Inc., and was instrumental in the shallow water search phase during the location

and recovery of the hydrogen bomb off the coast of Spain last April. Our most advanced undersea vehicle is the "Deep Diver". It carries a crew of two pilots in the forward compartment and two divers in the aft compartment. It is possible for these divers to "lock-out" into the sea to do work in the water at depths down to 1250 feet.

It should be emphasized that the human body was not designed to operate outside the narrow envelope of air that surrounds the earth. The diver who descends into the sea and down through the water column faces many hazards, including extremely cold water, sight-limiting visibility, and energy-consuming currents. The effects of pressure and contact with dangerous marine animals further compromises his safety.

Circumventing these diving hazards and controlling the undersea environment has many implications. For a physician, like myself, it means job security. For the ocean engineer, it has meant the evolution of what I call advanced diving systems. At this point, I want to again compliment the oil industry whose interest in the location and recovery of offshore oil and gas in deeper waters have catalysed today's diving technology. Each offshore rig, such as the "Ocean Traveler" operated by ESSO-Norway, requires a substantial degree of diver support. The diver, in this case, works 425 feet below the ocean's surface and carries out a variety of tasks such as welding, rigging, and repair. I have recently been to Norway and on this particular rig, which is one of the largest floating platforms in the world (it is larger in surface area than a football field) and is able to drill in 600 feet of water. Its capital cost was in the order of eight million dollars and its operating cost is approximately \$1000 per hour.

To work on the sea floor at 425 feet, the divers enter a spherical diving chamber which we call the ADS IV and are lowered into the sea. Protected from the water, they remain at sea-level pressure during descent to the work site. Once on the bottom, they pressurize the inside of the chamber with a special gas mixture until the inside gas pressure equalizes the outside water pressure. At this point, the hatch is opened and they swim out to the work site. When the task is completed, they return to the chamber, lock themselves in, and are returned to the surface - still carrying the inside gas pressure with them. This pressure must be removed from their bodies according to a pre-calculated and meticulously controlled decompression schedule. Deviation from this schedule could mean death for the diver. However, once he returns to the sea's surface in his capsule and transfers under pressure into a deck decompression chamber, he is able to remove the pressure in a warm, safe, and comfortable manner.

Other examples of the Ocean Systems Advanced Diving Systems (ADS) are the ADS III and the ADS II.

A glimpse at the future permits me to accurately forecast technical innovations such as glass submarines. If you were aboard this submarine, you could take comfort from two facts: (1) that it is very difficult to throw stones underwater, and (2) glass grows stronger with depth.

There is no question that in the near future each profession represented in this room will be influenced by the sea. Engineers will have to build the systems that will allow us safe and efficient trespass beneath the sea, while farmers and fisherman must be prepared to recover their harvest from the sea floor and the water column above it. Mining and petroleum personnel will be concerned with a different harvest. However, in the future, both harvests will be more effectively recovered by men living in undersea settlements independent from the surface. Transportation experts among you will hopefully solve the problems of returning the raw mineral, petroleum, and protein products to the terrestrial consumer. Of course, the economist, equipped with waterproof pen, will plot growth rates according to the reality of the marketplace. And the inevitable army of lawyers will be required to straighten out the inevitable mess which will result when man reaches out to grab the economic fruits of any new territory.

The more observant will have noticed that my time is almost up and not once have I mentioned the country included in the title of my talk. The arresting fact is that although Canada has almost one tenth of the world's Continental Shelf, it has no concerted or coordinated program to develop the Shelf's potential. It should be emphasized that we in this country are blessed with a number of fine oceanographic institutions and ocean-oriented individuals on both coasts. In fact, the city of Toronto has the excellent Great Lakes Research group and a small, but effective, team of scientists working on diving problems at the Defense Research Medical Laboratories. There is currently no "Man-In-Sea" program in Canada such as there is in the United States and France. There is also no overall governmental policy to direct Canada in more effective use of its seas. I cannot begin to tell you what the scientific, economic, and military implications are if we continue to ignore our offshore territories. We can be certain that other countries will not ignore them. I must emphasize that today is the time to initiate the scientific and technological foundations that will allow us the advance into our final frontier that must come during the next decades.

Let me be more specific. Canada, with the world's longest ocean shoreline, needs a statement of goals for a national program to serve its overall marine interests, and to define the Federal role in pursuit of these goals. An immediate effort must be made by both the government and by industry to identify and pursue new and major opportunities in the ocean. Leaders in Canadian government, industry, and academic institutions should become aware that this country must begin today to pursue the objective so clearly defined in a recent White House report: that is, "the effective use of the sea by man for all purposes currently considered for the terrestrial environment: commerce, industry, recreation, and settlement; as well as for knowledge and understanding." This means the initiation of many ocean projects at all levels throughout the country. I would particularly like to see a "Man In Sea" type project at the university level. It would be of great value and interest for the students at the University of Toronto to have a shallow undersea classroom where biomedical experiments could be carried out and undersea engineering experience could be gained. Such a program is currently in effect at Florida Atlantic University.

However, at this stage, more than specific projects, this country needs leadership and a coordinated statement of aims in the ocean. Such a statement would include Naval, industrial, oceanographic disciplines and would focus primarily on the Continental Shelf and our share of the vast inland seas known as the Great Lakes. Such a statement must necessarily include among its aims: national security, marine food, energy and mineral resources, conservation of the near-shore environment, and education and research requirements. Throughout the statement must run a unity of environmental sciences and an integration of many professional disciplines.

The cost of a national ocean program would not be prohibitive if the United States' efforts in this area are used as a guide post. It should be emphasized that while we cannot afford a space program, we cannot afford not to have an ocean program.

It is my hope that, as a result, 1967 will be known as the year Canada established a policy to explore and exploit its final frontier - the Continental Shelf.

Several weeks ago I visited Ottawa. As I entered the Parliament Buildings, I was struck by the following inscription over the main entrance:

"THE WHOLESOME SEA IS AT HER GATES . . . HER GATES
BOTH EAST AND WEST. "

Let's open those gates. Let's get wet.

References:

1. MacInnis, J. B. , "Living Under the Sea, " Scientific American,
March 1966.
2. PSAC Report, "Effective Use of the Sea, " The White House,
Washington, D. C.