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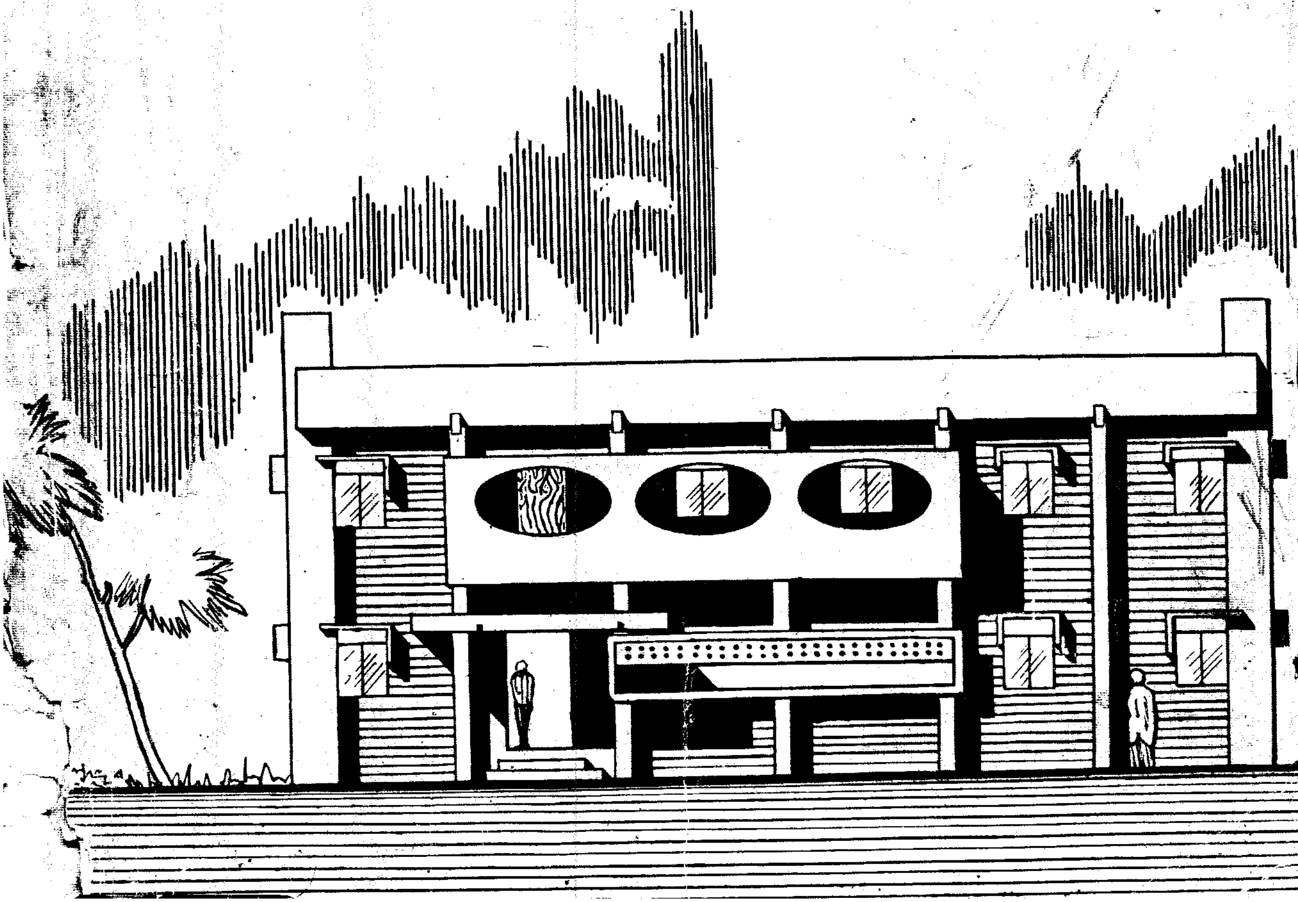

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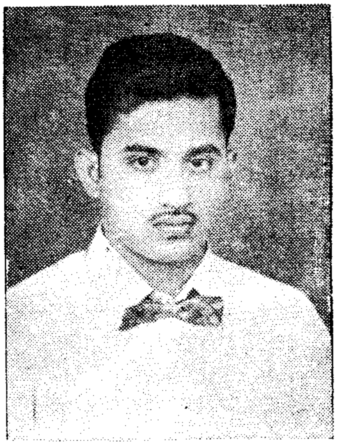
Promise of the Future



P. G. JACOB
C. M. F. R. I., Cochin - 11

Thousands of years ago a drop of molten matter placed itself in the universe and began an independent life. It turned on its own axis and gradually assumed a spherical form all the while moving in an elliptical orbit around the sun, its parent. That drop was earth.

In course of time it started to cool. More than 70% of its surface got covered by a liquid — water. Matter took a peculiar turn in it's evolution and a mysterious process called life started in these waters. Gradually life culminated in a thinking, tool making bipedal mammalnamed man. He called the vast expanses of water, oceans.

Oceans are the life blood of the earth. They regulate the earth's climate by acting as huge storage houses of the heat from the sun. They are inexaustable sources of power. They contain immense mineral deposits. They have vast stores of plant and animal life which can be effectively used as food for the growing population on earth. But still we know very little about these oceans and seas. We lack the technical knowhow to tap their power, their food and mineral resources. It is true that we have started to utilise some of their resources, but still these constitute only about one thousandth of what the oceans have to offer us. The exploding human population, especially in the developing countries has already shown signs of food shortage. For fully utilising the resources of the oceans like animals, plants, chemicals, thermal and tidal energy, we have to develop new technologies, drastically different from the conventional ones we are following at present. Then only the dreams for the future based on the oceans will come true. It will be interesting to have a peep into the future impacts that these new technologies will produce in the utilisation of the oceans.

Drastic changes are expected in the field of production and harvest of food from the oceans. About 130,000 million tonnes of organic matter is produced in the oceans annually. This is about 10 times the living matter that is produced by all the forests and farms, the men and animals, insects, bacteria, fungi and all other living things that flourish on land. But presently, mankind is utilising only about 1/2000th of this. This vast amount of untapped organic matter can be used to feed millions of people. Our present techniques of fishing are not conducive to rapid expansion of the fishing industry. By employing advanced methods of detecting fish schools like space crafts and sonar devices and by resorting to electric fishing we can increase the fish production many times. By the introduction of electric fishing the old saying "to catch without wetting the hand" will become a reality. Things like nets, yarns of bait are not required in this type of fishing. Cranes, winches and other similar machines are also unnecessary. Just dip the Cathode and Anode into the water. When the electric current flows, fishes are automatically attracted to the Anode. Connected to the Anode is a wide mouthed tube. When fishes gather around the Anode the tube sucks them in and passes them on to the cold storage. Sea water is filtered out on the way. Machines sort out the fishes according to size and store them in boxes. Much human labour is saved in this manner.

Another method of increasing food production from the sea is the direct harvest of plankton. Both on land and in the sea higher forms of life are dependent on lower forms. Directly or indirectly, all forms of life other than plants, are dependent on lower forms. Plants are the primary producers of organic matter. They are converted into animal protein by millions of small planktonic animals. They are the secondary producers. Fishes, whales and all other higher animals feed on them. They are the last link in the food chain. Today man is mainly making use of this last link only. But there is a tremendous waste of energy when matter is transferred from one link to the other. It is calculated that for getting 4 million tonnes of fish, about 40 million tonnes of secondary producers and 1C0 million tonnes of primary producers are used. This is like giving, instead of harvesting directly, rice and wheat to cows and goats, then giving them to carnivorous animals like Lion and Tiger and then ultimately using these carnivorous animals as food. This is exactly what we are doing at present with respect to the sea. If we can avoid atleast tertiary producers and can directly harvest the primary and secondary producers we can avoid this tremendous waste. The nutritive value of plankton, especially Zooplankton, is high. Modern methods of processing food stuffs can make Zooplankton both pleasing to the eye and palatable. But, as yet, there are no implements to gather them on a commercial scale. In the future, powerful pumps and filtering devices installed on deck or on floating platforms in the sea will probably be used for this purpose. The day is not far away when we shall see, in our food shops; tinned copepods in tomato sauce, krill paste and such other things. When we have begun to use Zooplankton as food, the food resources of the sea within our reach will have increased by 50 — 100 percent.

Culturing and harvesting plankton is also a possibility for the future. It is estimated that if one million hectare area of the sea is used for plankton culture, it will give enough protein for all the people in the world.

For using the incoming solar energy fully, the cultivation of plants yielding a maximum of organic matter is a method.

A minute unicellular alga called Chlorella can be cultivated in water for this. If we fertilize the water with phosphorus, nitrogen salts, microelements and carbondioxide, it is possible to harvest upto 43 tonnes of dry vegetable matter per hectare. It is interesting to note here that the greatest wheat crops does not exceed 6 tonnes per hectare. Moreover, wheat contains only 12% of portein while chlorella contains, 50% of it. Chlorella farming is still in its infancy. But in the coastal waters of China, Japan, France and the USA, there are already submarine plantations of seaweeds. They yield about 15 tonnes of organic matter per hectare. They are used as cattle feed and as raw material for the manufacture of valuable chemicals Expansion of submarine plantations of seaweeds holds out a big promise for the coastal population. It is to be noted here that the calorific value of algae exceeds that of Chocolate.

Phytoplankton production in the sea is dependent on the availability of nutrients like nitrates, phosphates and trace elements. The dead organic matter which sinks to the bottom is reacted upon by a number of bacteria and the component chemicals are liberated. These chemicals are used by plants. They are brought to the sea surface where photosynthesis takes place by the slow raising of bottom waters. This phenomenon is known as 'upwelling'. Creating artificial upwelling by the use of thermal power from nuclear reactors at the sea bottom or by other mechanical means will enhance primary production. According to certain oceanographers, if a pipe is lowered to about 6,000 feet it would need only little pumping up through it to start a foundation. This is because, in the depths, water will be cooler and less saline. As it rises up the pipe water will get warmer and less dense than the water outside the pipe. So it would then rise on its own accord and the process will go on automatically. This seems to be a simple method for creating artificial upwelling. But, may be because of the practical difficulties, none has tried it so far.

Transplantation of fish and edible invertebrates from crowded areas to seas with similar bottoms but which are less crowded has produced higher animals. Plaice from the coasts of Holland have been transplanted half way up the North Sea, Salmon is also similarly transplanted in Newzealand and crabs and Bass in U.S.A. Similar transplantations of mussels, sea weeds and other animals will take place in future.

Minerals are the foundations on which industrial nations are built. Oceans contain many types of minerals in immense quantities. Valuable metals oil and natural gas are all found in the oceans. For their extraction newtypes of machines and technologies are already being developed. At present 17% of the world's oil comes from offshore wells and by 1980 it is expected that this figure will rise to about 30%.

Many of the marine organisms are able to concentrate particular elements in their bodies. As an example, 200 times more iodine is found in sea weeds than in the surrounding water. In future for extracting rare elements from sea water by 'biological means' shallow water Lagoons and adjacent seas will be used for culturing organisms which will concentrate valuable elements like Nickel, Cobalt, Cerium, Vanadium or Molybdenum. From these 'culture ponds ' these organisms will be harvested at intervals. Then these ' biological ores ' will be processed to get these elements.

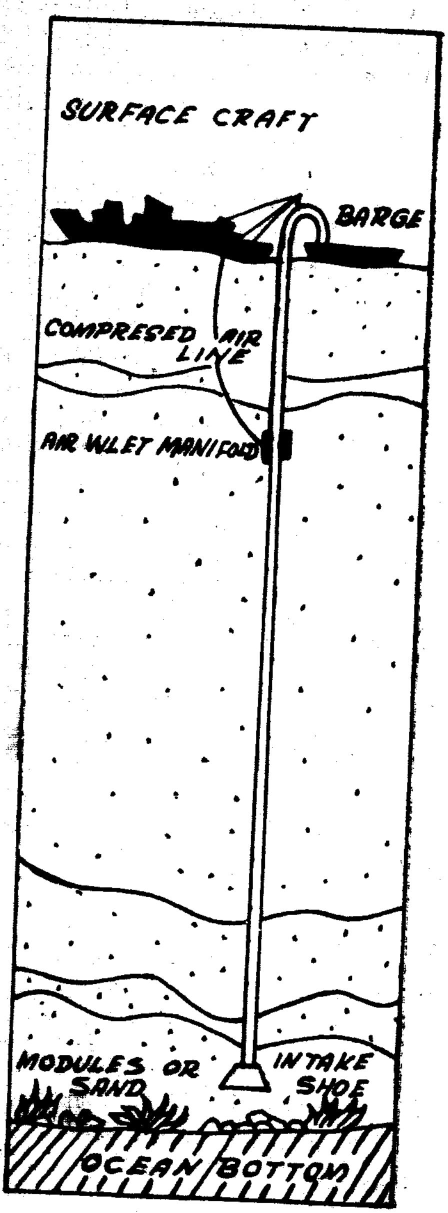


Fig. 1. *Airlitt method of mining minerals from the sea bottom*

Water is the most important resource from the sea for living beings on earth. Fresh water from the sea can be obtained by desalination. Large scale desalination of sea water using nuclear power is progressing in the world. The Indian Atomic Energy Commission also has a plan to construct similar desalination plants.

Drs. William Campbell and Wilford Weeks of USA have suggested a very interesting idea to get fresh water from the sea. Large deserts can be made to bloom if their idea is made practical. Their method is to utilise the icebergs of the Arctic and Antarctic ice caps. More than 80% of the world's fresh water is tied up in these ice caps. According to them the large icebergs which fringe the Antarctic continent can be towed by ships to regions where the fresh water supply is poor. The selection of icebergs suitable for towing will be possible in the next few years by photography from polar orbitting satellites capable of identifying individual objects with dimensions of about 100 meters. Preliminary calculations show that an Antarctic ice berg of dimensions 2,700 x 2,700 x 250 metres towed at a speed of half a knot would reach Australia measuring 2,460 x 2,460 x 130 metres due to melting. But the remaining 1030 billion litres of water would be worth about 50 million rupees or about 10% of the cost of the same quantity of desalinated water. So iceberg towing may become a reality soon.

Because of the oil shortage and increase in the demand for fuels, our world is fast approaching a state of scarcity for power. If new resources for producing cheap power are not found soon the whole world will be paralysed in the near future. Already we are using the potential power of fresh water bodies in the form of hydroelectric power. The vertical variations of water level during the tides and the energy inherent in the temperature difference between the upper warm, and lower cold marine waters can be successfully converted into electrical energy. The best places for this type of energy production are the tropics and the subtropics. Here, the surface temperature of the oceans is above 26°C. But below 500 meters, in these places, the temperature will not be above 8°C. Thus there is a temperature difference of about 18°C between the upper and

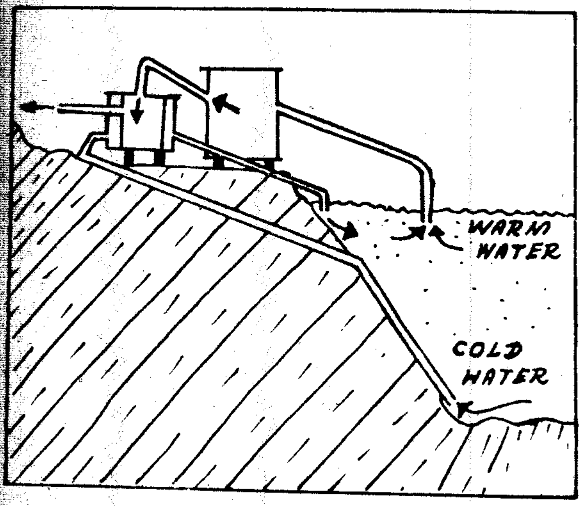


Fig. 2. *Diagrammatic sketch of the hydro-thermal electric generator in Abidjan (West Africa) built by French engineers.*

lower water layers of these regions. French engineers have succeeded in utilising this temperature difference for producing electricity. At normal pressure, water boils at 100°C. When the pressure is reduced water boils at a lower temperature. Water will boil at 25°C if the pressure is reduced to about 0.01 atmospheres. Thus if the tropical waters are subjected to lower pressures, the surface water will boil and steam will be produced. This steam can be utilised for the production of electricity. When steam cools down desalinated water, suitable for drinking can also be obtained. For cooling this steam the lower water layers of the tropical regions can be pumped up. In Abidjan of west Africa, French Engineers have already built such a thermal power station. In India also such power stations can be built. They, in addition to electricity, will give fresh water and will produce 'upwelling' by the constant pumping up of lower water layers which in turn will produce more fish.

The vertical variations of water level during the tides can also be successfully converted into electrical energy. Tidal energy was used to a limited extent from ancient times. In Britain and on the north coast of France, mills and saw mills were set in motion by the energy of the tides. The hydropower capacity of all the rivers on our planet equals 3,750 million kilowatts. The energy of the tides in the oceans is estimated at 1,000 million kilowatts. If we can use atleast 1/3rd of it, it will be a great contribution to the power resources of the world. French engineers have gone a long way in harnessing the power of the ocean tides. Tidal power stations are superior to river stations because droughts do not affect their operation. The cosmic forces which produce the tides are independent of climatic influences.

The first tidal electric power unit went into operation at the Rance station in France in 1959. Construction of several small tidal power stations was begun in China in 1958 and some are already producing power. Soviet Union also is designing several tidal power stations. The National Commission on Science and Technology (NCST) of India has made a detailed study on the possibilities of tapping tidal power from our coasts. According to the Commission's report, tidal electric power stations with 466 MW, 123 MW and 56 MW capacities can be constructed in Bhavanagar in the Gulf of cambay, in Navalakhi in the Gulf of Kutch, in Diamond island and sowgar of Hooghly river respectively.

Another interesting proposition is damming the sea to prevent harmful currents. The northern states of Russia are covered with ice for most of the year. For utilising these Siberian wastes for agricultural purposes, the ice which accumulates in these areas has to be melted. The energy required for this is beyond our imagination But Russians have found an easy solution for this. They are planning to put a dam across the Berring Straits between Russia and Alaska and to pump the cold water out of the Arctic into the Pacific. This would make the warm waters to flow into the Arctic from the Atlantic and would melt the polar ice cap. In three years the water temperature in the region would rise to 8°C and will enable vast new areas of Russia to grow plants. Europe also will become warmer and plants will grow in the Sahara desert. As a side effect, the world's sea level will rise and Moscow may become a seaport. But then London, New York and many other cities will go under water. Russians are only planning about this gigantic engineering task. But England, U.S.A. and other concerned countries have already protested against this scheme.

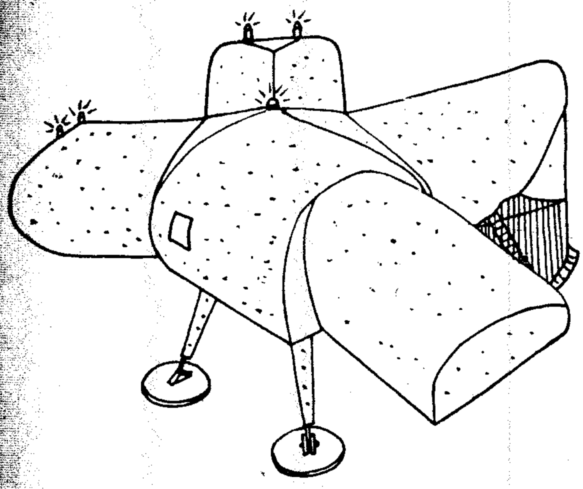


Fig. 3. *'Starfish', a manned under water vehicle, used by Captain Cousteau and fellow oceanauts.*

For under water exploration new types of vehicles are needed. Glass is used more and more for the construction of deep sea diving vehicles because of its strength under compression, its lack of corrosion problems, its light weight and above all its transparency which make it attractive for direct observation of the deep sea environment. Many types of newly designed vehicles are already used. Ushering in a fantastic technology, these curious machines are exploring the continental shelves and also the darkest depths that are less familiar than the dark side of the moon. The sea lab, Alvin, Hikino diving crafts, Conestoga wagons and Diving saucers of the USA are some of these vehicles. In addition to the new machines, 'natives' of the oceans can be trained to assist man in various activities. Marine mammals like seals and dolphins can dive upto 500 feet and back in 150 seconds without any fear of decompression. They are intelligent creatures and are good at delivering messages and tools. They can locate objects by sound signal. Some breeds of seals can dive upto 2000 feet and can remain submerged for 45 minutes. Domestication of these marine mammals is another possibility of the future.

Land is becoming more and more scarce. If the population of the world is increasing at the present rate, after about 500 years, each man will have only a square meter of living space on land. Captain J. Y. Cousteau, the well known French under water explorer, believes that one day man will have to turn to the sea for living space. Cousteau's under water explorations and the sea lab experiments of the USA have shown that man can live and work under the sea surface indefinitely. There are reasons to think that in future under water cities and industrial complexes for extracting the mineral wealth of the oceans will come up.

Man has always considered the oceans as a common property. Even today, in general, this concept remains in tact. As the exploitation of sea bottom riches starts, there will be some sort of struggle to possess the bottom lands unless suitable agreements are reached between the maritime nations. The United Nations Organisation is already considering the question of internationalisation of the seabeds.

A number of organisations are involved in marine research in India. Proper co-ordination among these organisations is urgently needed for the effective development of technical know how to solve the problems connected with the sea here. The research projects which are being carried out in these institutions should be directed to fulfill the actual needs of our country. What we have gained from these organisations so far is an important question. It is high time to make fundamental changes in the organisation and mode of research of our marine research organisations. Research done by individuals for getting degrees, working on problems of academic interest only and production of research papers which have no direct relation to our problems should be stopped atleast in the institutes of the government. Academic research should be confined to be the universities. The research programmes of the government's institutes must be aimed at solving our practical problems like increasing food production. The creation of a Marine Resources Commission, which should co-ordinate and control the activities of all the marine research organisations will solve many of the problems. It is clear that we have not given proper attention to the potentialities of the sea so far. But our very existence may depend on it.