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Oceanography: A Journey in Search of Root

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The seed of oceanography germinated out of man's interest about the regions beneath the ocean surface as well as waves, the rise and fall of the tides and other coastal processes. Gradually this curiosity extended to the search for food, minerals, energy, oil and natural gas, which ultimately laid the foundation stone of oceanography. The early history of oceanography dates back to 7250 B.C. when sea trading used to occur between the Greek mainland and Aegian island of Melos. However, people in those days had very little concept on ocean piloting and vessel manufacturing technology. This made their voyages unsafe and risky particularly during storms, strong waves and other natural calamities. The period from 4000 to 2000 B.C. was the age of construction and the development of the art of ship building, ocean piloting etc. by the Egyptians and Polynesians.

Around 1500 B.C., the Phoenicians, traded from North Africa across the Mediterranean Sea and made long voyages of discovery in the Pacific Ocean. Between 1500 and 500 B.C., the Arab traders explored the Indian Ocean. However at this time, the sea was only a dangerous route for these early sailors and this situation continued for hundreds of years. In A.D. 127-151, Ptolemy, produced the first world atlas and established world boundaries with a value of 29,000 km for the earth's circumference. His atlas listed more than 8000 places by latitude and longitude. However the atlas was faulty from various points of view. After Ptolemy, the Vikings (A.D. 700-1000) colonized Iceland by 900 and settled Greenland, where they remained until the fourteenth century. Extending their voyages farther west, they reached Vinland, or northeastern North America, in 985. Early in the fifteenth century the Chinese organized seven voyages to explore the Pacific and Indian Oceans. The great age of European discovery began in 1487 when Bartholomeu Dias sailed around the Cape of Good Hope into the Indian Ocean. Sir Martin Frobisher made three voyages in 1570s and Henry Hudson made four voyages between 1607 and 1610 around the north side of North America.

In the beginning of seventeenth century, there was renewed interest among navigators in developing better charts and more accurate navigation techniques. Captain James Cook made three great voyages to chart the Pacific Ocean between 1768 and 1779. During his voyages, he explored and charted much of the South Pacific and the coasts of New Zealand, Australia and northwest North America. He made soundings to depths of 400 m and logged accurate observations of winds, currents and water temperatures.

In the United States, Benjamin Franklin gave information about the amount of time required for news and cargo to travel between England and America and in this way the oceans captured the interest of naturalists and biologists in the eighteenth century.

One of the early professional naturalists who made significant contributions to marine biology was Charles Darwin. He has become famous for his theories on evolution, which was commissioned early in his life as a naturalist on the H.M.S. Beagle expeditions (1831-1836). He collected and studied numerous marine organisms during this famous voyage, which eventually lead to his famous subsidence theory of coral reef formation and a classification of barnacles that is still used by the modern biologists as the foundation of their research works. Another English naturalist, Edward Forbes (1815-54) began a systematic survey of marine life around the British Isles and the Mediterranean and Aegean Seas. He collected organisms from deep water and proposed a system of ocean depth zones, on the basis of distribution of animal populations. He stated in his "Azoic theory" that marine life did not exist on seabed at depths exceeding 300 fathoms (1800 ft). However, this concept was soon disproved when the Artic explorer Sir John Ross had found worms and other animals in the bottom samples at over 1800 m (6000 ft) depth in Baffin Bay. The investigation of the minute drifting plants and animals of the ocean was not seriously undertaken until the German scientist Johannes Muller began to examine these organisms microscopically. Victor Hensen introduced the quantitative study of these minute drifting organisms and gave them the name *plankton* in 1887. Although science developed in the seventeenth and eighteenth centuries, there was little scientific interest in the sea beyond the practical needs for navigation, harnessing food resources and safety. The sea was considered during the early period as the reservoir of fishes, edible molluscs and seaweeds.

Oceanography as a modern science is usually dated from the *Challenger* expedition. The *Challenger Reports* laid the foundation for the science of oceanography. British naturalist John Murray and Scottish naturalist Charles Wyville Thompson led the expedition between 1872-1876.It was the first expedition organized specifically to gather data on a wide range of ocean features, including ocean temperatures, seawater chemistry, currents, marine life and the geology of the seafloor. The Challenger expedition revealed the existence of the Mariana Trench in the western Pacific, where the seafloor is 26,850 ft, or more than 4 miles deep (8,200 m). The deepest place in all oceans is near where the *Challenger* took its sounding. It is called the '*Challenger Deep*' and it is 37,800 ft deep (11,524 m). The expedition also revealed the first broad outline of the shape of the ocean basin, including a rise in the middle of the Atlantic Ocean that is now known as the Mid-Atlantic Ridge. Scientists compiled the first systematic plots of currents and temperatures in the oceans. The *Challenger Expedition's* exciting discoveries encouraged other countries to take interest in the scientific research on oceans and since then oceanography started to transform from the science of mere description to the science of quantification.

During the late nineteenth century and the early twentieth century, the Scandinavian oceanographers were particularly active in the study of water movement. A Norwegian zoologist Fridtj of Nansen collected valuable oceanographic, magnetic and meteorological information in the Arctic. He conducted a series of tests on the direction of ice drift in the Arctic by freezing a vessel into the polar ice pack and drifting with it.

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He expected to reach the North Pole through a specially designed vessel (*Fram*) that could withstand huge ice pressure during the journey. This laid the groundwork for future Arctic research. Deep-sea circulation could not be systematically explored until approximately 1910, when Nansen's water-sampling bottles were combined with thermometers designed for deep-sea temperature measurements and an accurate method for determining the aquatic salt content was devised by the chemist Martin Knudsen. The *Fram* paid another visit to polar waters carrying the Norwegian explorers Ronald Amundsen to Antarctica on his successful 1911 expedition to the South Pole.

The role of private institutions in uplifting the subject of oceanography (during 19th century) cannot be ignored. The Carnegie Institution funded a series of exploratory cruises including investigations of the earth's magnetic field and also maintained a biological laboratory. The Rockefeller Foundation provided financial support in 1930 for marine research programmes.

The subject of oceanography started to spread its multidisciplinary branches during World War II, when defense related problems needed to be solved within a very short period of time. For safe landing, secured passage and predicting ocean currents and waves, the knowledge of the subject was greatly used by the defense sector of United States and its allies. The basic research on oceanography thus attained a plateau stage during this war phase as all the academicians were pooled to render service for the cause of the nation. However, in the beginning of 1950's, the International Geophysical Year (1957-58) programme was brought about in which sixty-seven nations cooperated to explore the sea floor and made discoveries that totally imparted a new dimension to the branch of geology and geophysics. In 1963-64 another multinational endeavor, the Indian Ocean Expedition, was undertaken. The ten-year International Decade of Ocean Exploration in the 1970s was also a multinational effort, which aimed to survey seabed mineral resources, improve environmental forecasting, investigate coastal ecosystems and modernize the marine data collection system. SEASAT, a specialized oceanographic satellite, was launched in June 1978. Its radar could measure the distance between the satellite and sea surface with an accuracy of about 5 cm, allowing the measurement of wave heights. Sea surface temperatures, wind speeds, sea ice cover, currents and plant production were also monitored.

During the 1970s and 1980s earth scientists began to recognize the signs of global degradation and the need for management of living and nonliving resources. In the 1990s the thrust areas for oceanographic research included the effect of ocean circulation on the earth's climate balance, the transport of materials from the land to the deep ocean basins, the chemistry of the interaction of seawater with the earth's crust, the dynamics of the continental margins and the ocean seabed, the energy sources of the sea, the exchange of gases between the oceans and the atmosphere, methods of decreasing the cost of ocean transport and increasing food availability. In 1993, the joint U.S–French TOPEX/POSEIDON system initiated a three-year programme for measuring global sea levels and circulation patterns, tides and the interaction between the atmosphere and ocean surface. The European Environmental Remote Sensing launched ERS-1 in 1991 and ERS-2 in 1995 with the aim to carry out all weather radar and microwave systems allowing data to be taken even when clouds and darkness obscure the satellite's view. SEASTAR carries an instrument package known as SeaWIFS or Sea Wide Field Sensor that allows the study of the distribution of chlorophyll and plant life in the oceans. The science behind the prediction of Potential Fishing Zone (PFZ) emerged from this stock. Today, PFZ has great relevance in the sector of fishery particularly for the fisherman engaged in deep-sea fishing. The 21st century oceanography finds its application in several sectors like geology, marine biology, aquaculture, chemistry and atmospheric science and even in upcoming areas like coastal zone management, biotechnology, bioinformatics and ecotourism.

The subject of oceanography has several verticals in the present century. Oceanography is a multidisciplinary subject in which the knowledge of geology, geophysics, chemistry, physics, meteorology, computer science and biology are used to understand the oceans. Physical oceanography critically investigates about the marine meteorology, the study of heat transfer, water cycles, ocean current and air-sea interactions. Chemical oceanography studies the composition and history of seawater, its processes and interactions. Geological oceanography deals with various processes of ocean surface and ocean basins. Biological oceanography restricts itself in the domain of marine biota and the relationship between marine biodiversity and ocean environment. Ocean engineering is the discipline of designing and planning equipment's used for sea exploration.

The job prospects of oceanographers are also bright. Researchers with knowledge on oceanography are readily absorbed in climate related research laboratories, aqua cultural sector, fisheries departments, oil and natural gas related companies, port authorities, geological services, disaster management sector and several NGOs and companies involved in EIA, marine animal and blue carbon conservation programmes, coastal eco-tourism etc.