

Oceanography Chapter 1

Oceanography

Oceanus would be a better name for Earth, since oceans cover 70% surface (most major cities, resources, etc. are near the ocean)

Life began in the ocean – 4 billion years before present

- ◆ Stayed there for over 3 billion years before venturing out onto the surface

Living things carry an ocean within themselves

Blood, eggs, fluids are all saline

Earth's oceans are subdivided by name for our benefit – actually is one world ocean.

97% water is in oceans

3% Land Ice, GW, Lakes and Rivers

Scales:

Human Scale – ocean is impressively large (361 million square km or 139 million square miles)

Planetary Scale – its average depth is a tiny fraction of the Earth's radius

Marine Science (or oceanography) is the process of discovering unifying principles in data obtained from the ocean, it's associated life forms and the bordering lands.

Subfields: Marine Geology – climate, composition

Physical Oceanography – waves, currents, atmosphere

Marine Biologists

Chemical Oceanography

Marine Engineers

Science – Systematic process of asking question about the observable world and then testing the answers to those questions.

Figure 1.4

Scientific Method (used to solve problems)

1. Hypothesis – informed guess
2. Experiment – test hypothesis \Rightarrow retest
3. Evaluate and retest
4. Empirical evidence \Rightarrow theory
5. Unvarying uniformity – Low

Truth never changes, it's only our perception that does.

The History of Oceanography

Early Voyaging

The first evidence of voyaging (or traveling on the ocean for a purpose) comes from the trade records of the Mediterranean Sea.

- *Egyptians utilized the Nile River and created a commerce based on ship-based trade (4000 BC).

- *The first traders were probably from Crete (around 1200 BC), but it was the Phoenicians that became the dominant traders of the Mediterranean after the Cretan civilizations were disabled by earthquakes and politics.

- *The Greeks (about 900 BC) sailed out into the Atlantic from the Mediterranean Sea, and noticed a current running north to south. They believed only rivers had currents, and named this mass of water okeanos (meaning river), from which we derived our term ocean.

Early mariners began to record information about their journeys and developed charts for navigational reasons. These chart makers (our first cartographers) were probably Mediterranean traders that made routine journeys about the area.

- *The Chinese began to engineer inland waterways that connected to the Pacific Ocean.

- *Polynesian civilizations had been moving among the islands since 3000 BC. All of these early travelers used the stars and sun to navigate.

Library of Alexandria

Progress in marine science began in Egypt in the third century BC, with the founding of this great library by Alexander the Great.

- *Knowledge of all kinds was stored there, and new knowledge was extracted from anyone who sailed or caravanned into the area around Egypt.

- *The second librarian was Eratosthenes (235 BC to 192 BC), an accomplished astronomer, philosopher and poet. He calculated the circumference of the Earth within about 500 miles (See figure 1.7 in your book).

- *Library researches developed astronomical, geometric and a mathematical base of celestial navigation.

- *Cartography became a very important science. Latitude and Longitude (also invented by Eratosthenes) were developed.

- *Hipparchus (165-127 BC) invented the present Latitude and Longitude grid, by dividing the Earth into 360 degrees.

- *Ptolemy (90-168 AD) oriented charts by placing east to the right and north to the top. Ptolemy also subdivided degrees into minutes and seconds of arc.

- *The last librarian: Hypatia

 - She was a symbol of science and knowledge, concepts the early Christians identified with pagan practices. So, in 415 AD a mob murdered her and burned down the library. Many things learned before this time had to be relearned (including the Earth being round).

Polynesian Colonization

Ancestors of Polynesia spread eastward from southeast Asia or Indonesia by about 20,000 ago, and had colonized to Easter Island and Hawaii by 600 AD. Their travel was probably initiated by religious differences between groups of people.

*Important note: Hawaii and Easter Island are positioned away from prevailing ocean currents, so reaching these places over 2000 years ago is an unbelievable accomplishment.

After the fall of the Roman Empire: The Dark Ages

Vikings: Scandinavian (Swedes, Danish and Norwegian) adventurers, routinely plundered France, Ireland and Britain.

*Eventually, the Europeans banded together against the Vikings, so the Scandinavians turned west.

>Iceland by 700 AD

>Greenland by 995 AD

>In 986, Herjulfson sailed to Greenland, but was blown past due to unfavorable winds. Instead he sailed along the coast of northern North America, without landing or making charts. He told his tale, and created an interest in the new land, which prompted Leif, son of Eric the Red to go back and colonized the area. He called the colony Vinland (wine-land), which was probably located on the NE tip of New Foundland.

Chinese Contributions

While Europe was distracted, the Chinese developed the largest fleet ever recorded so far:

*317 ships, 37,000 men

This was done to show off the Ming Dynasty's superiority.

By this time, they had invented the compass, central rudder and sophisticated sails along with watertight compartments.

The Chinese explored from 1405-1433.

AGE OF DISCOVERY

Prince Henry the Navigator of Portugal

*His captains explored for him from 1451-1470.

*He knew the Earth was round, but due to Ptolemy's size estimation, was way off on its circumference.

Christopher Columbus

*Also underestimated the size of the Earth.

*Was looking for China and the east.

*He never saw the mainland of N. America, but thought that he made it to the islands of India or Japan.

Soon others followed Columbus with fortune on their minds, with the earliest charts dating back to 1507.

Ferdinand Magellan

- *First voyage around the world (1519-1522)
- *Probably inspired by the new charts and maps generated
- *Only 36 of 260 of Magellan's crew survived the journey (Magellan himself died before the journey ended in the Philippines)
- *marks the end of the Age of Discovery

Great quote from your book:

“The Magellan expedition's return to Spain in 1522 marks the end of the Age of European Discovery. An unpleasant era of exploitation of the human and natural resources of the Americas followed. Native empires were destroyed, and objects of priceless cultural value were melted into coin to fund European warfare and greed.”

Voyaging for Science

French Admiral Le Bougainville – South Pacific
mid – 1760's (French Polynesia)

Scientific Oceanography

James Cook – 1768- HMS Endeavor very talented navigator, cartographer, writer, artist diplomat, sailor, scientist, dietitian

Scientific Contributions:

1. Transit of Venus across the sun verified orbits
 2. Looked for continent – found New Zealand, Great barrier reef, numerous small islands
- *Cook survived dysentery, kept a clean ship

Promoted to commander in 1772, was given command of Resolution and Adventure

- Resolution – sailing mentor, William Bligh (of the famous Bounty)
 - 1. Charted Tonga and Easter Islands
 - 2. First to circumnavigate the world at high latitudes
- Returned in 1775, did not see Antarctica

1776 – Last Voyage

- Found Hawaii
- Was looking for passage through Siberia
- Charted West Coast

Returned to Hawaii before going back home, but
Ticked off Hawaiians and was killed in the fight

How did any of these guys know where they were?

Latitude is easy- line up with Polaris (the north star)

Problem : Longitude is more difficult

- find it with a clock
- Rotation in 24 hours, that's $15^\circ/\text{hr}$
($360/24 = 15$)
(3 hr difference = 45° movement West)

In Columbus's time no good watches

1728 – John Harrison – built time keepers - #4 – Won award British Board of Longitude because people were getting lost at sea

His watches are in Greenwich, England = the 0° Longitude line.

Sampling Ocean Floor – another Problem

Cook did some

Currents affect it, hard to tell when it hits bottom

First Researchers – sample – Sir John Ross (1818) & Sir James Ross
>1919 m (6294 ft)
>Near Greenland

Sir James Clark Ross – Ross Sea, Victoria L of Antarctica – depth soundings, measurements of south Atlantic

Matthew Maury - discovered MOR

Fridtjof Nansen – sampling bottle

First Science only Expeditions

US – Charles Wilkes – 1838

- Bit of a jerk
- Prepared in volumes of maps, texts, illustrations

Matthew F Maury

1. Compiled data about winds (obtained much data from Ben Franklin Physical Geography of the Seas – 1855
2. First person to sense World Wide surface winds and currents.

Charles Darwin

- First contributions in Marine Biology
- Structure and Distribution of Coral Reefs

Thomas and Murray

HMS Challenger

- Coined the term oceanography
- Challenger Report – 50 volume set
- Found lots of life below 1800 feet (4717 new species)

Modern Sea Travel – 20th Century

Mahan (1892) – Influence of Sea Power on History

Nansen – designed ship Fram

(Nobel Peace Prize 1922)

- Frozen in pack ice – drift to North Pole
- Proved no continent existed in the Arctic
- Student Amundsen - South Pole
- Professor Christiania University

Glomar Challenger

- Obtained sea floor sediments
- Oldest sediments at continents

Rise of Oceanographic Institutions:

- Prince Albert I of Monaco – Musée' Oceanographique
- Jacques Cousteau
- JAMSTEC – Japan Marine Science and technology center
- US- Woods Hole, Scripps, La Mont- Doherty
MIT USCD Columbia

Ocean Satellites

1992 – Nasa/ French

Topex/Poseidon: currents, wind speeds and locations

Jason I – Sea Atmosphere

Sea Star (Seawifs) – Marine productivity

Aqua- water cycle

(Terra, Aura)

GPS – Global Positioning

Alphabet Oceanography P.31