The Crucial Currents: The Crutch of Intercontinental Capitalism and Critical Consternation of Climate Change

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“Tide goes in, tide goes out. Never a miscommunication. You can't explain that.” (O’Reilley, 2011) Well, Mr. O’Reilly, despite the current climate of promoting ignorance and the dismissal of scientific studies, the tides—both their causes and their effects— can be explained. In fact, the efforts of scientists to understand the nature and motion of the Earth’s waters has raised an alarm in regard to the welfare of the planet. The scientific community has observed change in the state of normality in oceanic currents; in addition to melting polar caps, an unparalleled 15-20% decrease of the Gulf Stream’s circulation strength is a main point of evidence in supporting the hypothesis of human-caused climate change. Recent research, spearheaded by Stefan Rahmstorf, reports a noticeable change in the currents, specifically the Gulf Stream (Rahmstorf: 2015, p. 475). The troubling observations have brought intense discussion, denial, and fear in regard to climate change and the effects the motion of the ocean will have on the future of mankind’s habitat.

Scientifically speaking, currents are defined by NOAA as the gravity induced motion of water when a creek, stream, or river flows to lower elevation. Oceanic currents are the result of the gravitational attraction of the sun and moon which creates tides, the movements of wind, and thermohaline circulation. Tidal currents—found near the shore, and in estuaries and bays — are the only predictable currents which follow any pattern of regularity (*Currents: NOAA's National Ocean Service Education*, 2019).

Unsurprisingly, various kinds of currents exist throughout the waters of the world, these include: tidal currents, density currents, wind driven currents, rip currents, cold surface currents and gyres. Tidal currents are caused by flooding and forces waters to flow from one location to another and is located close to coasts; a slow moving current which averages less than .5 m/s.

Contrary to the slow moving tidal currents, wind driven currents are the strongest in the world. On average the currents, found at the ocean’s surface, can move at 2.5% of the wind speed and over time the courses, depth, and speed are subject to change.

Whereas the aforementioned currents are caused by flooding and wind, density currents are dictated by the salinity levels of the water. Waters which consist of higher salinity levels are denser, which results in denser water moving under water which has a lower salinity level. An extremely slow moving current, density currents average a movement of only a few cm/s.

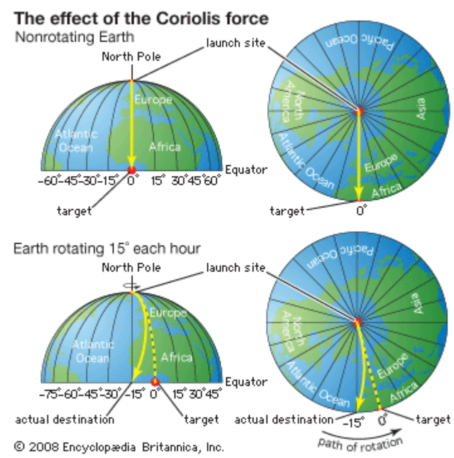
One of the more commonly known currents is a rip current— a danger to swimmers on the beach, this rapidly moving current is created by topographical changes in the ocean floor. Unable to return to the deeper water and confined to a small location, i.e. near a beach, a rapid and dangerous current is created as the water finds a narrow region in which it can flow back to deeper water.

Another variation of currents, the cold surface current, is aptly named as it derives its existence from changes in the water's temperature. These currents are found in polar and temperate latitudes and flow towards the equator. In addition to water temperature, these currents are affected by atmospheric pressure and the Earth's rotation. (Balasubramanian, 2014, pp. 4)

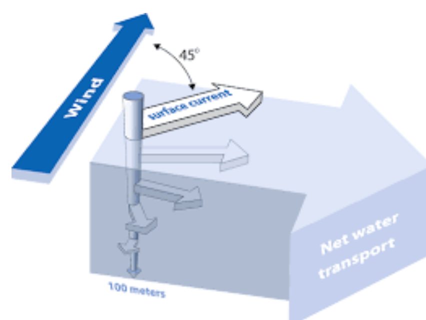
On a grand scale, Gyres are characterized as being large scale circular patterns of flowing ocean. The Earth's oceans are composed of five major gyres: North Atlantic, South Atlantic, North Pacific, South Pacific, and Indian Ocean. Each gyre is created by a forceful yet confined western current and a less powerful and wider eastern current (*Currents: Winds Drive Surface Ocean Currents, 2019).* In the nineteenth century the discovery of the Coriolis effect and the Ekman Spiral offered an explanation to the causes of the aforementioned natural phenomenon.

First observed by Gaspord Gustave de Coriolis (1792-1843), the Coriolis effect studied the transfer of energy in rotating wheels. While a water wheel was Coriolis' initial subject of study, the concept of study was extended to a substantially larger, round, object— i.e. Earth. Coriolis reasoned, the rotation and curvature of the Earth forces wind to be deflected along the surface of the water. Thus, the deflection of winds goes on to create a movement in the surface of the water which, in addition to thermohaline circulation and gravitational pull, results in the creation of currents (de Coriolis: 1835, p.144-145).

In the northern hemisphere warm air flows around the equator and rises; the movement thus pushes the currents towards the North Pole. Adversely, winds of the Southern Hemisphere create currents which flow towards the South Pole. In between the Northern as Southern movement are the Prevailing winds, commonly known as the Trade Winds. These historically influential winds meet at the coordinates between 5°N and -5°S (*Currents: Winds Drive Surface Ocean Currents, 2019).* The location is of the utmost importance for commercial maritime movement and is commonly referred to as the Doldrums and less commonly, but more scientifically, known as the Intertropical Convergence Zone. The remaining air, which is not pulled towards the equator, continues in its natural movement towards its respective poles, creating a wind stream and current known as the Westerlies (Ross: 1995, pp.199-226).



While the Corialis effect is one aspect in understanding the physics of the ocean, another main component is the Ekman Spiral which was discovered by the Swedish Oceanographer Vagn Walfrid Ekman (1893–1896). His observations led to the realization that as surface water molecules move via the force of the wind, molecules at surface level drag deeper layers of water molecules with them (Ekman: 1905, pp. 1-52). Due to the friction created in the molecule's movement, a molecule at a deeper depth moves slower than a molecule closer the surface.



The Ekman spiral occurs as a consequence of the Coriolis effect.

Contrary to the movement of shallower molecules, deeper water molecules tend to "twist around" and flow in the opposite direction of shallower layers; the ensuing motion leads to differing currents at various depths and the creation of a current's movement akin to a conveyor belt (*Currents: The Global Conveyor Belt, 2019)*. However, the movement of water molecules ceases circa 100 meters; as a result of the lack of movement and lower water temperature, oceanic currents are subject to less variation post 100 meters.

Historically, the currents of the waters have led to the rise and fall of civilizations; the understanding and navigation of the movement of the water led to trade, education, innovation, and the migration of populations all over the globe. In fact, the Age of Exploration was possible due to the growing understanding of the trade winds and development of enduring marine vessels, such as caravels (Hobson: 2013, p. 142). The fundamental understanding of the currents as well as a burgeoning concept of physics enabled European explorers—such as Columbus, Vespucci, Magellan, and Polo— to circumnavigate the globe and usher in the Enlightenment which commenced the growth of a never-before-seen global economy (Lincoln: 2013, p. 345).

In short, the currents of the Earth have not only influenced the physical existence of the planet, but enabled humanity to achieve unparalleled accomplishments in growth and development as a species. Conversely, as a result of the relentless expansion of capitalism, an ongoing search to increase investment returns, the capitalistic system has started to affect currents. While currents gave rise to capitalism via the Age of Exploration, unrestricted pollution leading to an unhealthy waste byproduct of carbon dioxide has led to a slow and worrying change in the behavioral patters of currents.

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