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Irminger Sea: Oct 21
As the World Turns by Dallas Murphy

Earth rotates on its axis as it orbits the Sun. Everyone knows that, but we seldom think about it. We still talk about “sunrise” and “sunset,” but that’s only appearance. Same with tides. Tides rise and fall, but not really; it only seems that way. Actually, the gravitational pull of the Sun and Moon (mostly the Moon because it’s closer) draw up bulges of water on either side of Earth, and Earth rotates under them. Here’s this enormous sphere whirling around its axis at 1,000 miles per hour at the equator, about 500 miles an hour in the vicinity of Iceland. One reason why we still talk about the “apparent” effects of Earth’s rotation is that we can’t feel it, as you feel the speed of a car when you stick your hand out the window, because our atmosphere is moving right along with us. If we did feel it, only earthworms and other burrowers could survive on our planet.

However, this rapidly rotating sphere exerts a powerful force on things less firmly attached to the surface than, say, mountains and, by gravity, us. One of these less firmly attached things is ocean water.

My heroes have always been marine explorers. One of the greatest was the Norwegian Fridtjof Nansen. In 1887, Nansen and several other tough guys put ashore somewhere near where we were yesterday on the wild, rugged east coast of Greenland and then crossed the ice sheet, on skis, to the west coast, a feat thought impossible at the time that made Nansen world famous. Three years later, he had another idea: There were currents crossing the Arctic Ocean, and if he could build a ship capable of surviving the ice, he could ride the current across the ocean, perhaps right over the North Pole. Remember no one had ever been to the North Pole in 1890; no one had ever even been close.

He built his ship, called *Fram* ("forward" in Norwegian), with a round bottom in order that she ride up on the ice rather than be crushed by it. In 1893 he and his crew entered the ice and began to drift with it. Fram drifted within about 200 miles of the Pole, but when it became clear that she would not actually cross the Pole, Nansen, one other tough Norwegian, and 15 dogs left their ship, knowing they could never regain her, and made for the Pole. They did not reach the Pole due to bad ice, but the story of their survival and eventual return to Norway is among the most amazing and fantastic in the history of exploration, but it isn’t exactly our story.

Before he left the ship, Nansen noticed that the current he’d surmised wasn’t very strong. It was wind that carried the ship and the ice she rode on across the Arctic Ocean. Nansen noticed something else: Fram wasn’t drifting dead downwind. Instead, her track bent consistently to the right of the wind. Nansen, who was also an accomplished ocean scientist, as well as an explorer, knew why. It was because Earth rotated, the “Coriolis factor,” named for the French mathematician who first described it (1836); yet Gaspard Coriolis never applied his theory to oceans. Nansen was among the first to do so. (The first, 1856, was a West Virginia, U.S., schoolteacher named William Ferrell, but he was too painfully shy to push his work to a broad audience, and so he is largely forgotten.)

Nansen logged his observations about the rightward drift aboard *Fram* and carried them back to Norway. And here is another example of how science works. Nansen formed a hypothesis: The course of a wind-driven current is not directly downwind, but to the right of the wind, because—in the Northern Hemisphere—Earth’s rotation becomes a real force acting on currents and wind deflecting them rightward. (The opposite happens in the Southern Hemisphere.) But just how far rightward and over what distance? Nansen recognized that to turn his hypothesis into a theory required higher math. (Just trust me on this) So he carried his raw data to a bright young Swede named Vagn Walfrid Ekman.

What is the actual effect of wind on ocean currents? That’s the question Ekman posed for himself using Nansen’s raw data as a starting point. He meant to remove all variables from his “model” oceans, to create a universal ocean. All oceans, he concluded, were alike in certain basic ways: Water is a fluid; what’s more it is a “stratified” fluid, containing, as we said in an earlier post, layers, a thin warm layer riding atop a larger cold layer. Second, all oceans are subject to winds blowing across their surfaces. And third, all oceans are situated on this rapidly rotating sphere. It must follow, then, that all oceans behaved in similar ways due to the laws of physics applied to wind, water, and rotation. Then he blew an abstract, mathematical wind across his model ocean.

What he came up with was the first satisfactory theory of the behavior of wind-driven currents. There are multiple parts to his theory, but for us the most relevant aspect has come to be called Ekman transport: When wind blows steadily across an ocean, the net flow of water is directed 90 degrees to the right of the wind direction in the Northern Hemisphere. This was consistent with Nansen’s observations, but now it had numbers attached to it. It had been pinned down. That’s how science works.

In a couple of days, we’ll discuss why and how this matters in the real world, and how it relates to Dr. Bob’s present study aboard *Knorr* here in the Irminger Sea.

Sila naalagaavoq by Nick M?ller

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