

Sea versus PC

William H. Press

A View of the Sea: A Discussion Between a Chief Engineer and an Oceanographer about the Machinery of the Ocean Circulation. By Henry Stommel. Princeton University Press: 1987. Pp. 165. \$19.95, £12.60.

HENRY Stommel, who is now approaching the age of retirement, is an extraordinary figure in post-war physical oceanography. He was responsible for the foundations of our modern understanding of oceanic circulation, and is famous as a raconteur, tinkerer, amateur explosives maker, backyard railroader. More importantly, he is celebrated for an uncanny physical intuition about how the ocean works.

A few years ago, Stommel began to write fascinating, off-beat, popular books: one, *Volcano Weather* on the so-called Year Without A Summer (1816), another on islands which appear on historical nautical charts, but subsequently vanish. No surprise, then, that the Sloan Foundation should ask him to contribute a personal autobiography to their distinguished series. In these times, scientists no less than starlets are encouraged to bare all.

Stommel did decide to write a personal book, but not under the Sloan Foundation's auspices. *A View of the Sea* is personal, after a fashion: cranky, idiosyncratic, uncompromising. There is little more than an occasional paragraph or two of autobiography in this book, and only a tease of shipboard anecdote. Stommel's idea of a personal book is not to take us into his life, but rather to try to take us into his mental spaces, to show us exactly *how he thinks* about ocean circulation. The result is fascinating, even when it can hardly be termed accessible.

Stommel thinks not in equations (certainly not in partial differential equations), but rather in pictures and force diagrams. Slabs of ocean water overlay other slabs. They tilt, slide on each other, thicken, thin, react to the strong constraints of the Coriolis force and the geometry of the two-sphere. "Then, by Rule 2, I found the GV [geostrophic velocity] in *a* relative to *b*. Now, Rule 3 demands that the actual GV in layer *a* (let's call it GV_{*a*}) must be parallel to the PT [potential thickness: thickness divided by sine of latitude] lines in *a*, and that GV_{*b*} must lie parallel to the PT lines in *b*." There are pages and pages of this kind of thing.

What does one learn by working (I do mean *working*) it through? Quite a lot, if, like me, you are not an oceanographer. Because of the Coriolis force, ocean water does not flow in the direction that the wind pushes it, but at right angles to that

direction. Westerlies in the North Atlantic (which blow to the east) thus drive water south; but trade winds to the south blow to the west and drive water north. The water has nowhere to go but down (this is Ekman pumping). Then where does it go? To accept the further fluid pumped down on top of it, and to be geostrophic, it has to move to a region where the Coriolis force is weaker, that is, south.

This cold, broad layer of North Atlantic water continues to be driven south. It goes deeper, and spreads laterally, as successively warmer layers are laid down on top of it. Conservation of mass must require a reverse, northwards, flow somewhere. However, geostrophic flow and conservation of potential vorticity (Stommel has his own odd way of explaining this) explicitly forbid such a return. Something has to give, and it does. At the western edge of the basin there can be a dissipative boundary layer which breaks some conservation laws. The result is the Gulf Stream (in the Pacific, the Kuroshio), with a fast core jet that is able to cross isobars (violate geostrophy), and transport vorticity internally. It all fits together. Stommel calls it a Chinese puzzle.

In Chapter 11, the narrative takes a

bizarre and unexpected turn. The author announces that on Thanksgiving Day 1984 he bought himself an IBM/PC-compatible personal computer, with a colour/graphics card and spinwriter. He then devotes the rest of the book to the details of nine computer programs, printed in BASIC in the back of the book, for calculating ocean flows. The programming style is unstructured and virtually unreadable. We are caught in a melodrama of grand proportions: just when (at no small investment of concentration) we have come to appreciate, and have begun to understand, our narrator's deep geometric insight, he becomes infected with a classic, perhaps terminal, case of PC addiction. Insight is thrown away. He is transformed into, simply, a hacker.

There is thus a kind of moral lesson in this book. A diskette with Stommel's programs is available separately. The programs do run. One of them is babbling away on my computer screen right now. □

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The ice man

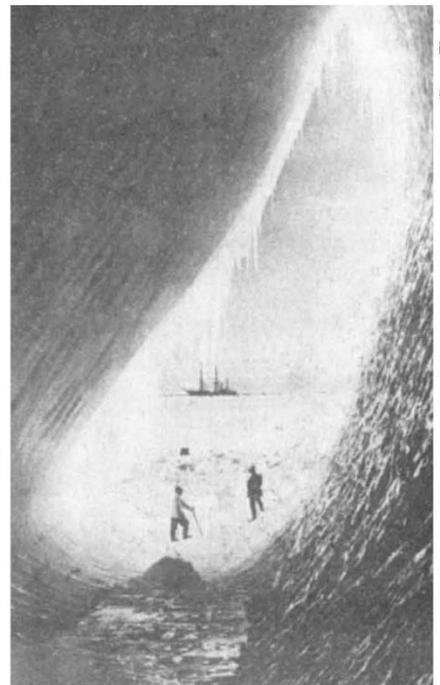
Derek Fordham

The Ice: A Journey to Antarctica. By Stephen J. Pyne. University of Iowa Press/Arlington Books, 15-17 King Street, St James's, London SW1: 1986-1987. Pp.428. \$37.50, £12.95.

A NACREOUS mass spins in the gyre of the Antarctic Ocean; almost imperceptibly it hesitates and disappears in a veil of fog and pack ice. This is ice, the ice of the title and *The Ice* (always in capitals) which is the book's leitmotiv. All its forms, from frazil to vuggy, are encountered and meticulously described as succeeding pages follow the gyrating iceberg from diamond dust to disintegration.

At first, mankind has little place in Stephen Pyne's narrative; ice, we are told, is the only component of Antarctic geography. Certainly the author's story owes little allegiance to Apsley Cherry Garrard's philosophy, expressed in *The Worst Journey in the World* — perhaps the best book ever written on Antarctica — that it is the spirit of man that has shaped that continent.

Man is conceded one resounding achievement — his success in establishing a tenuous foothold on the continent. Pyne's intense awareness of the special nature of man's relationship with *The Ice* has distinct parallels with the views of the



In perspective — the Antarctic exploration ship Terra Nova seen from an ice cave. Photograph taken by Herbert Ponting.

geographer, Yi Fu Tuan, who wrote that, "in open space once can become intensely aware of a place, and in the solitude of a sheltered place the vastness of space acquires a haunting presence". This presence has inspired Pyne to write intense and perceptive sections on the oceanography, geology, glaciology, art,