

PREFACE

Carl Wunsch Special Issue

This special issue of the *Journal of Physical Oceanography (JPO)* celebrates the accomplishments of Carl Wunsch, in honor of his 65th birthday on 5 May 2006. Through the power of his vision, the rigor of his approach, and the generosity with which he has shared his ideas and resources, Carl has shaped the landscape of physical oceanography. Most scientists would be proud if they had effected one revolution in their field. Carl created four, not counting the ones before the time we entered the field. On these, suffice it to say that one is left in awe by the fact that a stellar academic career and a string of awards, including the American Geophysical Union's Macelwane Award and election to the National Academy of Sciences, were all for work that is now more than 25 years old.

The four revolutions we mentioned, from the past 25 years, are as follows:

- 1) Carl Wunsch and Walter Munk invented acoustic tomography, for the first time giving the field a way of remotely and continuously observing horizontally and vertically integrated ocean heat content and the three-dimensional structure of the ocean interior.
- 2) Carl convinced the National Aeronautics and Space Administration (and the community) to establish the Ocean Topography Experiment (TOPEX)/Poseidon altimetric satellite mission, probably the most successful single oceanographic observing system ever, to give us the first global synoptic view of the variability in large-scale ocean circulation. One of us (Marotzke) vividly remembers, from the pre-TOPEX/Poseidon days, how a seminar participant scoffed: "Of course it's the frequency. Have you ever seen an observed [oceanic] wavenumber spectrum?" This certainty is gone for good!
- 3) Carl was the intellectual creator and scientific driving force behind the largest oceanographic experiment ever, the World Ocean Circulation Experiment (WOCE), the in situ counterpart to global altimetry. For the first time, physical oceanography took a global perspective—at a time when the prevailing prejudice was that all interesting science was in small-scale process studies. WOCE has been instrumental in spreading modern physical oceanography around the world and in creating funding in countries that had little previous history in that field.
- 4) Carl introduced the machinery of inverse modeling to physical oceanography, transferring it from geophysics. The estimation of the large-scale flow field from hydrographic data was transformed and put on a rigorous footing, leading to today's highly accurate estimates of global ocean transports of mass, heat, and freshwater. The approach is now so pervasive that it is routinely used without explicit reference to its original author in the field. Carl was the principal lecturer at the Les Houches Winter School on "Combining Data and Dynamics" in 1988. Now, almost 20 years later, the list of participants reads like a who's who in that field, and almost everyone has at some point come through the Massachusetts Institute of Technology to work with Carl.

This list is phenomenal, but what unites the three of us—and the much larger number of contributors to this volume—in even greater admiration is that Carl has not only produced the most creative science for as long as we can remember, he has also been a role model concerning every aspect of being a scientist. He has been a wonderful Ph.D. (for Tziperman and Fu) and postdoctoral (for Marotzke) advisor, challenging but generous with his time and ideas. Whenever he saw that one of his protégés had a chance of carving out a career with one of Carl's ideas, Carl gently withdrew—still interested and supportive, but giving the young scientist a chance to prove himself or

herself. It is surprisingly common to find students and postdocs of Carl's with papers in which he had a significant contribution, yet on which he did not wish to be a coauthor. The three of us are definitely examples of this.

Even after he ceased to be our formal advisor, Carl has been a mentor who showed us how to be a faculty member at a large research university or how to persevere to achieve goals in a government laboratory. Carl never shirked responsibility. He taught us to face unpleasant encounters—we all dread the conversation with a student who has just failed the “general examination.” Carl did not lecture anyone about these things—he just did them, the right way, firmly but with tact and sympathy. Witnessing this, one could not help aspiring to similar standards, albeit knowing that they would be unattainably high.

Given Carl's stature, it was clear that his 65th birthday deserved something special. But how does one go about this? Immediately, the comparison with the monumental accomplishment commemorating Henry Stommel's 60th birthday comes to mind. Characteristically, Carl, together with Bruce Warren as editors, was the driving force behind that legendary book, *Evolution of Physical Oceanography—Scientific Surveys in Honor of Henry Stommel* (1981, MIT Press) which in 18 solicited reviews summarized what was known about the field in 1980. Countless discussions have been held around the world about updating *EPO*, as it came to be known, with the only legitimate attempt to follow on arising from the 1998 first WOCE conference in Halifax, Nova Scotia, Canada (*Ocean Circulation and Climate—Observing and Modelling the Global Ocean*, G. Siedler, J. Church, and J. Gould, Eds., International Geophysics Series, Vol. 77, Academic Press)—again characteristically, given Carl's role in WOCE.

Given the major developments in physical oceanography over the past 25 years, it seems that *EPO*'s combination of breadth and depth, making it eminently suitable even as a major graduate-level reference, is no longer attainable. Instead, we decided to put together a special issue of a leading journal in the field, and, to make it truly special, its contributions should come exclusively from Carl's graduate students and postdocs. So, rather than collecting reviews or essays for a book, we would document the research that Carl's disciples were pursuing *right now*. So even if Carl perhaps might not be too happy about “all the fuss,” he could not possibly object to seeing cutting-edge research being assembled in this way!

A poll of Carl's former students and postdocs revealed enthusiastic support. Indeed, the biggest problem arose from the recognition that we could not include everyone, lest we exceed the acceptable size of a single journal volume. With two notable exceptions, we thus had to restrict the invitation to those of Carl's students and postdocs for whom significant time had elapsed since obtaining their Ph.D. The two exceptions were Peter Huybers, the most recent of Carl's students at that time, and Walter Munk, whom we included as Carl's student *honoris causa* because no such volume could be complete without Walter.

We quickly settled on the *JPO* as the preeminent journal in our field and luckily secured the support of its chief editor Peter Müller and the Council of the American Meteorological Society, which we gratefully appreciate. One, perhaps inevitable, consequence of going the journal route was that the schedule could not be kept exactly. After all, new research is not created by decree, and the *JPO* reviewing process followed its usual rigorous path, thus creating some delay until all of the papers had the sufficient quality. We also thank the reviewers of the papers, and we thank Sharon Sakamoto for running the reviewing system and Kornelia Müller for keeping an eye on the overall process for us.

Jochem Marotzke

Max-Planck-Institut für Meteorologie, Hamburg, Germany

Lee-Lueng Fu

Jet Propulsion Laboratory, Pasadena, California

Eli Tziperman

Department of Earth and Planetary Sciences, and Division of Engineering and Applied Sciences, Harvard University, Cambridge, Massachusetts