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REVIEWS

The Atmosphere – A Challenge. Edited by R. S. LINDZEN, E. N. LORENZ and G. W. PLATZMAN. American Meteorological Society, 1990. 321 pp.

Jule Charney was perhaps the most prominent meteorologist of the post-World-War-II era and ranks with V. Bjerknes and C. G. Rossby in his influence on the field. The present memorial volume explores Charney's contributions with emphasis on numerical weather prediction, which, in its modern form, originated with his collaboration with John von Neumann. It comprises a CV, a seven-page biographical sketch by Morton Wurtele, a seventy-two-page condensation of a tape-recorded interview with George Platzman less than a year before Charney's death, appreciations of Charney's influence and achievements by ten of his colleagues, reprints of five of his most significant papers†, and a list of his primary publications. It provides fascinating reading, and I recommend it to all with an interest in geophysical fluid dynamics.

Charney was born in San Francisco in 1917 and, at the age of five, moved to Los Angeles, where he remained until 1946. He did both his undergraduate (1934–8) and graduate work at UCLA, initially in mathematics and ultimately (1941–6) in meteorology. UCLA was essentially an undergraduate school before World War II, but graduate study in meteorology was anticipated with the appointments of Jacob Bjerknes and Jörgen Holmboe *c.* 1940. In 1941, Holmboe recruited Charney to teach in a training programme for the military and civil services and to carry out his dissertation research in meteorology. That research was nominally supervised by Holmboe, but it seems clear from Charney's interview with Platzman that he worked almost entirely on his own and that his primary inspiration came from the papers of Rossby (whom he later described as his 'intellectual godfather').

After receiving his PhD, Charney spent 1946–7 with Rossby's group at Chicago and 1947–8 at Oslo. He then joined von Neumann at the Institute for Advanced Study in Princeton, where he served as Director of the Theoretical Meteorology Project until 1956, after which he became Professor of Meteorology at MIT and remained there until his death in 1981.

Charney's thesis was published as 'The dynamics of long waves in a baroclinic westerly current' in 1947. It was immediately, and has continued to be, recognized by the meteorological community as a seminal paper on the fundamental problem of baroclinic stability. It also established, for all to see, the power and importance of (what is now known as) the quasi-geostrophic approximation. As Pedlosky comments, in his appreciation (this volume, p. 169),

> The breadth of Charney's attack on the problem is breathtaking. The analysis of the mathematical problem is praiseworthy on its own, but much more impressive

† The reprinted papers are:

1947 The dynamics of long waves in a baroclinic westerly current. *J. Meteorology* **4**, 135–162.

1948 On the scale of atmospheric motions. *Geofysiske Publikasjoner* **17**(2), 17 pp.

1950 Numerical integration of the barotropic vorticity equation. *Tellus* **2**, 237–254 (with Fjörtoft, R. & von Neumann, J.).

1955 The Gulf Stream as an inertial boundary layer. *Proceedings of the National Academy of Sciences* **41**, 731–740.

1961 Propagation of planetary-scale disturbances from the lower into the upper atmosphere. *Journal of Geophysical Research* **66**, 83–109 (with Drazin, P. G.).

> is the insightful formulation of the physical model in its simplicity, the spectacular clearing away of the nongeostrophic underbrush to reveal the central problem and the recognition of the proper direction for theoretical development. In lesser hands there are many places in the development where the analysis would become blocked, diverted, or thoroughly unhinged. Without the geostrophic approximation, the stability problem is still possible, although only just feasible, and the success of Charney's analysis must be laid to an *a priori* physical understanding of the importance of that approximation. It was a step few dynamicists could take at that time.

It should be noted here that the baroclinic stability problem was solved independently by Eady (*Tellus* **1**, 33–52 (1949)), using a simpler model with a rigid upper boundary and uniform Coriolis term.

Charney, in his interview with Platzman, clearly regarded his 1947 paper as his most important scientific contribution. That it *was* the most important for him seems to be beyond doubt: 'what it did for me personally was to at last convince me that I could do research, and it solidified my love of meteorology. Here was a field where I thought I could accomplish something'. And, as Pedlosky adds, 'Accomplish, he did'. But, in my view, it is at least arguable that his 1948 paper 'On the scale of atmospheric motions' had a more profound and far-reaching effect in that it illuminated and cleared the path to numerical weather prediction. In this paper (which, to be sure, is informed by his 1947 paper), Charney gives a complete deduction of the quasi-geostrophic equations from the full equations of motion through a scale analysis of the sort that goes back to Prandtl's development of boundary-layer theory but that appears to have been new in the meteorological literature. Perhaps the most important virtue of the quasi-geostrophic equations is the filtering out of the acoustic and gravity waves, which appear to have been responsible, at least in part, for the failure of L. F. Richardson's 1922 attempt at numerical prediction. Almost equally important is their elimination of the horizontal divergence, which appears in the original equations as the difference between two large but nearly cancelling terms and also had proved to be a major difficulty for numerical prediction. These eliminations yield a system that, in Charney's words, embodies the following physical principle (quoted by Phillips on p. 177 of the present volume):

> the motion of large-scale atmospheric disturbances is governed by the laws of conservation of potential temperature and absolute potential vorticity, and by the conditions that the horizontal velocity be quasi-geostrophic and the pressure quasi-hydrostatic.

As Phillips comments, 'These 35 words must be considered among the most effective meteorological statements of this century. In Charney's hands... they led at once to successful methods for numerical weather prediction'.

Indeed, immediately following this work, Charney began his collaboration with von Neumann in the project that led to the first really successful numerical weather prediction and laid the foundations that changed that prediction from an art to a science. With this in mind, I conclude with the thought that Jule Charney was one of those happy few who could have said, as Hardy did of *his* collaborations with Littlewood and Ramanujan, 'I have collaborated with von Neumann on something like equal terms'.

JOHN MILES

Writing Successfully in Science. By MAEVE O'CONNOR. Harper Collins, 1991. 229 pp. £25.00 (hardcover) or £8.95 (paperback).

The preparation of papers for publication is an essential part of research, although many scientists find the task difficult and some find it uncongenial. As Maeve O'Connor says in her introduction, 'Many scientists, even the most successful ones, would rather get on with their next piece of work than settle down to reporting the last piece'. The aim of this book is to make science writing easier and 'perhaps more enjoyable' for both experienced authors and beginners, including those for whom English is a second language, 'gently guiding readers through the necessary steps to successful publication'. Most of the book concerns journal articles, but there are also chapters on the preparation of short talks and posters, theses, review articles and book reviews, grant proposals and *curricula vitae*. Use of computer disc copy and graphics packages is also included.

The first eleven chapters, on journal articles, are arranged chronologically, each concerning a different stage in the publication process. Thus chapters 1 and 2, which are clear, short and easy to read, deal with matters to be sorted out before starting to write, such as assessing when, whether and what to write, which journal to submit to, and deciding authorship.

There follow two detailed chapters on the preparation of figures and tables. Examples of bad ones are shown, together with suggestions for how they could be improved (unfortunately in a couple of cases comparisons of 'before' and 'after' are hindered by them not appearing on the same page). Much useful practical information and advice is given, although some of it is not universally applicable, such as making photographs of hand-drawn line drawings. Greater emphasis could have been given to the need to cut out superfluous figures, a common failing among authors.

Chapter 6 deals with references, and contains some information on building a database, although since each journal has its own style, much of the information may be unnecessary and can be replaced by a look at the relevant journal. However, I agree with her final paragraph on the importance of getting the details right, otherwise publication can be delayed. Also referees tend to dislike papers with carelessly presented references, since this could imply a similar approach to other details.

The various stages in writing the main body of the paper are discussed in chapters 5, 7, 8, and 9: the first draft; revising the first draft; revising the second draft; preparing the final version. Each is self-contained and intended to be read when that stage is reached, which leads to a little repetition. Chapter 5 is an easy read, making useful general points on practical preparations, style, and drafting each section. The author advises strongmindedness: 'these few hours are the culmination of long and expensive research... Lock the door, unplug the telephone, ban other potential distractions...'. More specific information is given in the following chapters on revision of the first draft, once it has been 'buried' for a while. Chapter 7 involves checking the overall structure and content for logic, order, accuracy, nomenclature, etc. while chapter 8, which is much longer, is devoted to grammar and style of writing. It contains many examples of common errors, emphasizing the importance of simple and clear expression rather than strictly correct grammar. There is a useful summary checklist of grammar and technical style, and an appendix listing terms to avoid, such as 'accounted for by the fact that' instead of 'because' and 'in a considerable number of cases' instead of 'often'. The author rightly stresses the need to make each word earn its place: cutting out superfluous material can be time consuming, but the result will be viewed with more enthusiasm by referees, editors and readers alike.

Everyone in the publication business will be pleased to see chapter 9 on preparing the final version. While the points made may seem trivial compared to doing the work and writing it up, paying attention to details of presentation and cross-checking can smooth and speed the paper's path through the printing process and result in fewer printing errors.

Chapters 10 and 11 on submitting the paper and, if it is accepted, checking proofs, contain useful information (although not all journals would welcome authors enquiring whether a paper has been accepted as early as six weeks after submission).

Much of the information given in these chapters on journal articles is relevant to the following ones on talks, posters, theses, etc. and additional advice is offered where appropriate in the same clear informative style. The book ends with a long list of references for those wishing to pursue particular points, and a comprehensive index.

This book may look a little long to someone eager to get on with putting pen to paper, but the format is such that it is not intended to be read at one sitting (although I did without much difficulty). However, its length can be criticized in that it contains much detail that is a matter of 'house style', such as references, spelling, presentation of artwork, where a potential author could simply refer to the appropriate journal, as the author does, in any case, on many occasions advise them to do. Her examples are drawn mainly from biology, but on the whole they are general enough to be of value to readers of this journal (although few mathematicians will need to note her comments regarding ethical standards). There are only a couple of short paragraphs on mathematics, concerning typography.

The presentation is clear, although I found the use of different typefaces for weights of subsection a little confusing. I prefer the decimal system, which Maeve O'Connor describes as 'hard to grasp'. The list of topics covered at the start of each chapter and the numbered summary at the end are helpful.

A book similar in content to this, *How to Write and Publish a Scientific Paper* by Robert Day (Cambridge University Press, 1989), was recently reviewed in this journal (vol. 207, 1989, p. 629). Coincidentally (or perhaps not) Day's background is also in the biological sciences. His approach is more informal and light-hearted and less detailed than that of O'Connor. His book is intended mainly to be read before getting down to writing, with the part devoted to journal articles containing a separate chapter on how to write each section of a paper, grammar, nomenclature, submission, etc. rather than O'Connor's division in terms of the stages in the publication process.

Day's book was highly recommended and so too is the one reviewed here. Maeve O'Connor's editing experience ensures that much relevant detail on the publication process and presentation of information is included. I think that most potential authors would benefit from reading this book, and even some copy editors – I shall dip into the chapter on grammar and style again, I am sure.

L. DRATH