and will almost certainly see the peak in consumption of global oil and gas as well as witnessing their decline to scarcity. This is not a shock statement but one of simple virtual certainty and something very pertinent to all parents." The mark of current generations upon the Earth will be evident for many generations. Cowie then drives home the point later in the book that scientists must have "good communications with politicians." Reconciliation of the differences in perspectives between scientists and policy makers must come quickly to minimize the damage and ensure solutions. Cowie's final point is that understanding needs to come from science—we will be the point of origin for solutions to the problem of climate change.

In summary, this is not the book a climate scientist would have written, but it is a book a climate scientist should read. The descriptions of the biological interactions with climate are enlightening. The scientist reader will come away with a better idea of how his/her work applies to policy, and will gain a better perspective on the big picture. However, that perspective will be more accessible to patient and informed readers, as the book often meanders and rambles.

—Paul A. Dirmeyer

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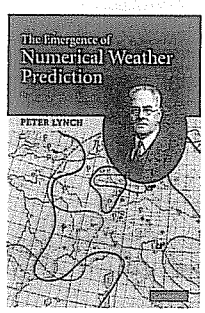
THE EMERGENCE OF NUMERICAL WEATHER PREDICTION: RICHARDSON'S DREAM

Peter Lynch, 2006, 279 pp., $75.00, hardbound, Cambridge University Press, ISBN 0-521-85729-5

Following George Platzman's historical study of Lewis Fry Richardson and his classic treatise, *Weather Prediction by Numerical Process*, many meteorologists have been stimulated and captivated by the aura of Richardson. And, indeed, in the past several decades there have been a series of articles and books on the man and his work. Thus, when I was invited to review Peter Lynch's contribution to this subject, I wondered: What more can be added? Nevertheless, I was optimistic, since Lynch is a solid theoretician who has never lost sight of the importance of weather forecasting.



Lynch's knowledge of advances in dynamical meteorology and operational numerical weather prediction (NWP), along with his scholarly acquisition of historical information, has led to a valued expansion and elaboration on Platzman's work. Additionally, Lynch has reappraised Richardson's work through his own numerical experiments. The book is not biographical; rather, it concentrates on Richardson's calculation—his forecast, or more precisely, his calculation of the tendencies of the meteorological variables at two points near Munich, Germany on 20 May 1910 (0700 GMT). With this focal point, Lynch builds the story by carefully identifying steps that led Richardson to his governing equations, choice of case study, and the subsequent numerical experiment. The underpinning of math and physics is skillfully mixed with history that links Richardson to the work of Vilhelm Bjerknes, Max Margules, and the gifted amateur William Henry Dines, among others.

For those who have seriously read *Weather Prediction by Numerical Process* (hereafter referred to as *WPNP*), there is a consensus that many parts of the book can be classified as challenging or "tough sledding." Although Richardson had an appealing and relaxed style of discussing various issues pertinent to NWP, he could carry the reader far afield with extraneous material—one often lost direction in the turbulence of detailed discussion. On the demanding pathway through *WPNP*, Lynch serves as an experienced guide—a trusted leader and companion who possesses the macroscopic view of Richardson's work and adds detail from his pervasive knowledge of the subject. Beyond the knowledge, he has the gift of writing where hard mathematical fact is eloquently mixed with history and that occasional but welcome tincture of humor.

In chapters 3–6, Lynch sets the stage for the calculation/forecast by discussing the natural oscillations/temporal scales of the large-scale motion, limitations on initialization of the deterministic model, and algorithmic structure of the finite-difference integration. He breathes life into Richardson's construction of the forecast equations (a form of the primitive equations).

How did Richardson handle that irascible vertical velocity in the equations—how did he isolate it (i. e., derive a diagnostic equation for vertical motion of the air)? Lynch carefully leads us through the steps that end with "Richardson's Equation," so labeled by Arnt Eliassen.

Chapter 7 focuses on the forecast—"the twenty numbers that were calculated" (tendencies of momentum, pressure, humidity). As most of us know, the forecasted surface pressure tendency was unrealistic: 145.1 mb/6 h, off by a factor of 100. Lynch's exploration and examination of the source(s) of this error is a highlight of the book.

The final two chapters of the book (chapters 10 and 11) faithfully track NWP from Richardson's time to the present. This examination of NWP's evolution will serve as a valued supplement to our graduate courses in numerical prediction and data assimilation. Although the book is written at a level intended for first- or second-year graduate students in meteorology, it will be enjoyed by all who have an interest in weather. Especially valuable is the clear explanation of the elements required to make a dynamical weather forecast.

In style, Lynch's work bears a strong resemblance to Adrian Gill's book, *Atmosphere–Ocean Dynamics*. In their books, these authors give us the solid theory that is masterfully blended with history. The subjects come to life and inspire us. *The Emergence of Numerical Weather Prediction: Richardson's Dream* has a special place on my bookshelf. It is a treasure, and I will refer to it often.

—John M. Lewis

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FOR FURTHER READING

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Lynch, P. 1992: Richardson's barotropic forecast: A reappraisal. *Bull. Amer. Meteor. Soc.*, **73**, 35–47.

Platzman, G., 1967: A retrospective view of Richardson's book on weather prediction. *Bull. Amer. Meteor. Soc.*, **48**, 514–550.

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REANALYSIS

Looking back at "Shorter Contributions" in the Bulletin of February 1940:

A Trial Seasonal Forecast

Since a major departure in atmospheric pressure, and attendant weather, in one part of the earth must have compensation elsewhere, the atmosphere being composed of a definite quantity of air, and since major departures must have subsequent reactions, it is reasonable to use such departures for purposes of foreshadowing the general character of the seasonal weather wherever interconnections have been found. Sir Gilbert Walker has classified the major interconnected swings of the atmosphere into "oscillations," and has used them to improve the seasonal foreshadowing of the rainfall of India that has gone on under Government auspices in India for more than half a century. Some time ago, in extending his analysis of world weather, he found that a large area in the northern Rocky Mountains and plains region of the United States and the adjacent portion of Canada and another one embracing Florida and the neighboring portion of the West Indies displayed a delayed reaction to large departures of pressure in the Australasian region.

The nature of this reaction has been studied further by Irving I. Schell of the Blue Hill staff, first under Sir Gilbert, in London, and later here, and a numerical evaluation of the apparent relationship was made with respect to foreshadowing the winter precipitation of Montana. Test foreshadowings were attempted for each of the 44 years for which data were reduced, with encouraging results. It appears that when the weather in the Australasian region has a large departure from normal in the three months period September to November, a market departure in the winter precipitation of Montana may be expected to follow. When there has been no large departure in the East Indian region the precipitation of Montana in winter will rarely depart much from the normal.

This fall we thought we should try an actual foreshadowing, and so requested the weather services of the Philippines, India, Java, Australia, and New Zealand to cable us the September to November departures in pressure (first four) or temperature (last one). This they kindly did. Since, however, no large departure in the weather there had occurred Mr. Schell found no basis for expecting an important departure in Montana precipitation this winter. (December precipitation was 14% above and January's 26% below normal.)

—*Bull. Amer. Meteor. Soc.*, **21**, 76