the 'origin'. An agnostic scientist talks about the way in which science reclaims land for a little island of knowledge from a huge sea of ignorance. A biologist talks of evolution, natural selection and the possibility Darwin affords us of God being *in* life, being immanent as well as transcendent.

Serious issues raised include the idea of interplay between chance and natural law, of evolution as helpful in the development of new creative things, rather than acting against religion; Will Provine's controversial idea of reprogramming people; the Human Genome Project as the Mount Everest of scientific enquiry; Jung's belief that Christianity has distanced spirit and matter, and the importance of integrating matter into the spiritual world; the ability of science to resolve what is meant by consciousness and to solve 'everything'; Stephen Hawking's reasoning that without time or space before the Big Bang, God could not have existed — refuted by Augustinian thought showing God to be not just in space-time, but also in and beyond; Hell as the absence of God; religion as a virus that spreads; science as God; science as a path to God; and the importance of combining science and religion in education.

It is a rich assortment of essentials all touched upon: varied and interesting points of view are brought up as quickly as they are passed over. Stannard does not make a strong case for the dialogue he wants between the opposing disciplines; he could for instance have made his achievement more emphatic by stressing in his own debate William Blake's maxim: "Without contraries is no progression".

He has put the evidence before us, with only polite indignations showing us what offends. But without a central thread, he leaves himself open to the accusations of those who feel that because science and theology are separate disciplines anyway, providing meaning through different channels, there is really no argument in the first place.

Stannard's passion may not always be apparent to the reader: his is a difficult task of incorporating everyone's views into a cohesive whole, and the result is frustratingly broad rather than deep; there is nothing for us to get our teeth into. Yet he cannot be wrong in advocating that science and theology should be approached with 'wonder'. He can only be too safe. Where is the wonder for science or belief when it is a word used at the end rather than at the beginning of the book? If Stannard is not clear about the exact connection between science and belief, he has at least established a dialogue and shown that it is entering society's consciousness. □

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Yesterday's weather

Peter Lynch

Calculating the Weather: Meteorology in the 20th Century. By Frederik Nebeker. Academic: 1995. Pp. 255. £44, \$64.95.

How did meteorology join the ranks of the exact sciences, and how is weather prediction done today? With few general accounts of computer forecasting available, the appearance of Frederik Nebeker's book aroused hopes that here at last was a comprehensive discussion of these questions. But disappointment awaits the reader seeking an understanding of modern weather forecasting. Nebeker looks at the ever-increasing role of calculation in meteorology but fails to provide a satisfactory picture of the state of play.

The central theme of the book is that computational methods have brought about a unification of meteorology. In 1900, three main strands were clearly discernible: climatology, dynamical theory and practical forecasting. Over the course of this century, these three strands have become more quantitative and computational and a greater unity has become apparent. To the unifying forces acting in the three areas, Nebeker gives the self-explanatory if prosaic names 'data-push', 'theory-pull' and 'science-not-art'.

Nebeker starts by reviewing the three strands as they were in 1900. The then status of climatology is captured in a quotation from Joseph Henry: "There is perhaps no branch of science relative to which so many observations have been made and so many records accumulated, and yet from which so few general principles have been deduced." The theoretical tradition is reviewed but the treatment is patchy. The dynamical studies of Ferrel, Hann and Exner are outlined and there is a minireview on Sir Napier Shaw, but one is left without any overall picture of the status of theoretical meteorology in 1900. Things improve with the chapter on practical prediction. The synoptic method is well described, giving a good feeling for the plight of the hapless forecaster.

In the second part, Nebeker deals with developments up to 1945. Bjerknes's programme to make forecasting a science is described, although the crucial 1904 reference to his plan is missing. The graphical solution method is well illustrated by an example of calculating vertical velocity near the ground. Richardson's method and forecast are the subject of a long and interesting chapter. Nebeker states that Richardson's work was highly regarded, but he does not adequately explain why no-one followed it up, even though Richardson had pointed to smoothing as

the solution to his problems.

The growth of meteorology between the two world wars is considered next, especially the dramatic influence of frontal theory on practical forecasting. Nebeker makes the dubious claim that the Bergen school methods were "probably more subjective than earlier procedures". There is a brief but interesting biographical sketch of Rossby. The remainder of this part concerns calculating aids used before and during the Second World War. The extensive treatment of punched-card equipment is rather dull, but the descriptions of the D-day forecasts and of the wartime importance of meteorology are good.

In the third part, Nebeker considers the emergence of computer forecasting, providing excellent coverage of the Princeton project of von Neumann and the crucial role played by Jule Charney. The subsequent introduction of computational methods into general operations and the greater cohesiveness that has resulted are then discussed, but with virtually no information on work since 1970. For example, the European Centre for Medium-Range Weather Forecasts is not even mentioned.

The final chapter looks at Lorenz's discovery of chaos, which has brought about a scientific revolution and has profound implications for predictability of weather. A major thrust of recent research has been to estimate the probability of different weather scenarios using ensembles of forecasts. This springs directly from Lorenz's work on sensitivity to initial conditions. Yet ensemble forecasting, which is inextricably intertwined with supercomputing, is not mentioned; such an omission in a book of this nature is extraordinary.

The book is well written and pleasant to read and includes about 450 references and a good index, although the end-notes beloved of publishers are a nuisance for readers. There are several errors in the few equations displayed and even the list of equations on p. 51 is wrong. But my main complaint is that the book might have been written 30 years ago. Readers interested in the early history of numerical forecasting will find it a useful summary. Given the title, most scientists will be unhappy with the absence of a description of modern forecasting methods. □

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New in paperback

The Second Creation: Makers of the Revolution in Twentieth-Century Physics by Robert P. Crease and Charles C. Mann. Rutgers University Press, \$21.95. "...a satisfying popularization of what may be the most glamorous and philosophically nourishing part of this century's physics", said Laurie M. Brown in his review of the original edition (*Nature* **323**, 119; 1986).