deficient and in addition to their topographical impairment, patients can bump into objects quite violently. Others can see parts of objects but cannot see the relationship between the parts. The authors suggest that another patient was impaired because she could not manipulate enough information at a time to plan a route or to keep track of it once embarked upon. Because it is obvious that all these abilities must enter into route finding, the neuropsychological findings do not seem to be telling us anything more than that each ability can be selectively impaired by lesions.

I have touched on only one of the many defects dealt with in this book. Others include unilateral neglect, in which a lesion to one hemisphere can cause the patient to be unaware of half of his visual field: he may eat the food that is on the same side of the plate as the damaged hemisphere while leaving that on the other side untouched; when asked to describe a scene from memory, he may describe only that part of it lying on the same side as the lesion. Another strange phenomenon is palinopia: the image of something seen may persist so that when a hat is seen, the same hat subsequently appears on different people's heads.

J. W. Brown has edited a useful collection of papers that will for some time form a standard work of reference for anyone interested in the field. But, despite the fascination of the bizarre defects described, they have so far failed to illuminate the workings of the visual system. They remain more of a challenge to explanation than a contribution to it, for like Zangwill's patient, they raise more problems than they solve. □

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Model behaviour

Grant R. Bigg

El Niño, La Niña, and the Southern Oscillation. By S. George Philander. *Academic: 1990. Pp.289. £42.50, $59.50.*

THE trade winds in the central equatorial Pacific weakened considerably last year. Convective activity along the Equator near the dateline strengthened as 1989 passed into 1990, while sea surface temperatures were 0.5 to 1 °C above average along the Equator between 160 °E and 150 °W during January. Nevertheless, forecasts supplied to the Climate Analysis Center in Washington, DC, suggest that climatic conditions during 1990 will not be unusual, and specifically that El Niño is not about to disrupt the Pacific basin once again.

How have we arrived at the situation where dynamical models of the atmosphere and oceans can be used with moderate confidence to infer interannual climatic changes over a significant portion of the globe? George Philander in his new book captures the story behind the present embryonic science of forecasting climate variability, and comprehensively explores the coupled physics of the atmosphere and oceans that forms the basis of this science. Much knowledge has been gained recently. A major El Niño event occurred in 1982, causing great economic and climatic hardship in the Pacific basin and elsewhere. There were droughts in Australia, India and southern Africa; floods or typhoons soaked Ecuador, California and Tahiti; and the anchovy-fishing industry off Peru was practically destroyed. This quasi-periodic, large-scale alteration to the distribution of heat and momentum in the ocean and atmosphere of the tropics, particularly of the Pacific, took the scientific community by surprise because of its timing and intensity. Such clear evidence of a lack of understanding of a phenomenon that semi-periodically affects a quarter of the globe led to a focusing of research efforts onto the physics of the coupling of the atmosphere and ocean.

Philander leads the reader on a voyage of discovery through the known climatology and variability of the atmosphere and oceans of the tropics. He demonstrates clearly the complexity of the system that needs to be understood, exploring the mathematical and physical models that have been constructed to explain the ocean and atmosphere systems in isolation. Finally, he presents the recent advances in the understanding of the coupling of these two systems, through the use of simple models.

The dominating message of these descriptions, whether of the ocean, the atmosphere or the coupled system, is the ubiquity of waves. Whether one is considering the response of the ocean to an applied wind stress, the atmospheric heating from a sea surface temperature anomaly or the interaction of the two media over entire ocean basins, wave processes are vital to physical understanding. Particularly in trying to unravel the coupling of the ocean and atmosphere, we are shown clearly how the theoretical exploration of different modes of climatic oscillation, begun only in the past few years, has opened up possibilities of forecasting interannual climatic variability. These possibilities are currently being investigated through the development of coupled general circulation models of the ocean and atmosphere.

This book is not for the casual reader and should be approached only by those with solid physical and mathematical skills. But it illuminates a field that has intrigued many since Sir Gilbert Walker, director-general of observatories in India in the early part of the century, demonstrated strong trans-Pacific correlations in climate. Philander has had considerable personal experience in the search for explanations of tropical climate variability. The synthesis of this experience shows that much still needs to be understood but also demonstrates the knowledge gained since 1982 and the hope that future El Niños will not catch the world unprepared. □

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Long in the tooth — the walrus is one of the marine mammals described in *The Pinnipeds* by M. Riedman. Published by University of California Press, price $29.95, £18.70.