phy and meets a high standard of scholarship. Not everyone will agree with Mills, however, regarding the congruency of plankton dynamics with biological oceanography or the composition of his list of heroes. The predominance of chemists on this list is striking. Some might wish for a more economic treatment of the plankton story and more room for other aspects of biological oceanography, including benthic processes and fisheries research. Also, one might question whether Riley deserves such exclusive prominence as he is given among U.S. researchers in this field (perhaps he does). The non-specialist reader should start with the conclusion of the book for introduction: the single paragraph on controls on plankton productivity at the beginning is insufficient background for understanding the arguments that follow. Perhaps that is Mills's intention: to let the reader run the same maze as the pioneers.

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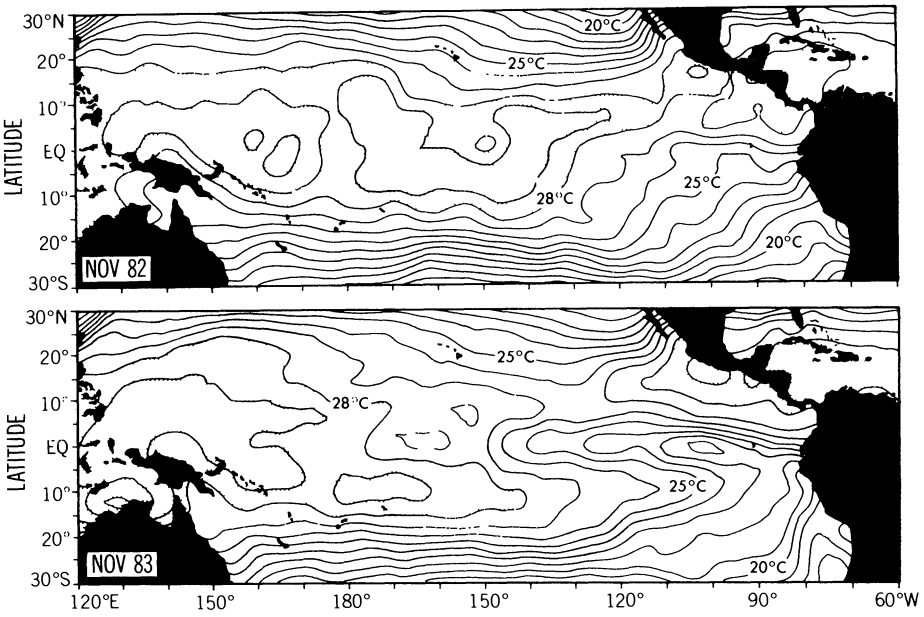
Geophysical Interplays

El Niño, La Niña, and the Southern Oscillation. S. GEORGE PHILANDER. Academic Press, San Diego, CA, 1989. x, 293 pp., illus. $59.50. International Geophysics Series, vol. 46.

El Niño is a phenomenon of the coasts of Peru and Ecuador that in recent years has come to be understood as one element of a grand and dramatic shift of the climatic state of the ocean circulation and the atmosphere. It is a prototype of the sort of coupling between the ocean and atmosphere that oceanographers, meteorologists, and climatologists have been pointing to as probably crucial to understanding both weather and climate change.

Parts of El Niño and its associated atmospheric partners are very conspicuous elements of the weather and climate of the tropical Pacific Ocean. Indeed, the phenomena were well known to Spanish explorers of Latin America as early as the days of Pizzaro. One of the more sobering aspects of the struggle to understand climate is that it took over 400 years (until the middle of the 20th century) before these elements were recognized as part of a global system, leading to droughts in some regions, torrential rains in others, disturbed biological cycles throughout the tropical Pacific Ocean, and many more manifestations. With hindsight, El Niño is not very subtle; the signals are large and conspicuous when one knows to look for them. Which slightly smaller signals in the ocean-atmosphere system now go unremarked because we do not know what to look for?



"Sea surface temperatures in November 1982 during El Niño and one year later during La Niña." [From *El Niño, La Niña, and the Southern Oscillation*]

Following the work of the meteorologist J. Bjerknes in the 1960s, the existence of El Niño as a component of an oscillation known in its atmospheric manifestation as the Southern Oscillation (the two together are often known as ENSO) has come to involve a large and growing number of meteorologists and oceanographers in attempts to understand this system. Ever more obvious climatological, economic, and even political implications have emerged. Such has been the intensity of interest that the subject has become nearly a specialty in its own right, with a growing and very technical literature.

George Philander, one of the pioneers of the study of ENSO, has written a monograph that will be of great importance to anyone attempting to enter this field, to understand its theoretical underpinnings and the degree to which mysteries remain. The focus of the book is on the ocean—on how the ocean responds to various forcing functions imposed by a changing atmosphere—and only secondarily on the atmospheric response to oceanic changes. This emphasis is appropriate, given the much greater maturity of meteorological science. As a story of the need to understand ocean-atmosphere coupling, the book is compelling.

Philander first guides the reader through a primarily verbal portrayal of the seesawing of atmospheric pressure and winds, coupled to a rapid and highly interesting oceanic motion that in turn reacts back onto the atmosphere. He depicts the ocean as existing in one of two extreme states, one being called El Niño, with the eastern Pacific Ocean warmer than normal and with certain specific accompanying atmospheric values. The opposite state produces an eastern Pacific colder than normal with a very different meteorology. "El Niño," meaning "The Child," and specifically "The Christ Child," was the name given by natives of the west coast of South America to the warm state because of its tendency to set in shortly before Christmas. Philander christens the cold state "La Niña" for "The Girl"; whether the opposite of "The Christ Child" is "The Girl" is presumably more a question for theologians or feminists than for scientists. I suspect the name will stick.

With this qualitative background, the book begins the construction of a more quantitative picture, beginning with description of mean and time-variable states and going on to write equations for important dynamical elements that are then invoked to explain many of these observations.

The book will be indispensable to anyone attempting to penetrate the large and confusing literature; Philander has made a good story of it. In many ways, he has produced the theoretician's view in that, presumably in the interest of brevity, much of the complexity of the observational problems has been slighted. For example, the windfield over the Pacific Ocean is presented as "the" windfield in the form of a two-dimensional vector plot without any comment about possible uncertainties. A novice would not

know of the controversy over the accuracy of estimates of the windfield there, or of the many different methods used to estimate it. With the observational messiness minimized it does make a better story.

I suspect that workers already somewhat familiar with oceanography and meteorology will be the most appreciative of this book. Philander is sparing of references and has pared the explanatory material to the barest of minima in many places. Critical layers, for example, are defined in one sentence as energy absorbers and then employed as a *deus ex machina* to explain the failure of energy to propagate through the ocean. A few references to the literature on critical layers would have been helpful to anyone attempting to understand what is in fact a complex set of physical processes that can reflect and amplify as well as absorb. As it is, the book would make a good accompaniment to a more general textbook such as Gill's *Atmosphere-Ocean Dynamics* (Academic Press, 1976) and will surely remain both the beginner's bible and the expert's companion for many years.

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A Deep-Sea Quest

Gorda Ridge. A Seafloor Spreading Center in the United States' Exclusive Economic Zone. GREGORY R. MCMURRAY, Ed. Springer-Verlag, New York, 1990. xvi, 311 pp., illus. $89. From a symposium, Portland, OR, May 1987.

In 1983 the suggestion was made by the United States Geological Survey that the Gorda Ridge, located just off the shore of northern California, contained mineral resources of great value and near-term exploitability. There thus began a broadly based investigation of the ridge involving the collaboration of a large number of government and university agencies and individuals.

Quite early, the government, inspired by excessive optimism (and with some naiveté regarding the realities of deep-sea mining), floated the suggestion that lease bids would soon be requested. The expected response from industry never materialized, except in the form of free lectures about economic realities, lectures that still echo in the closing section of this book. One may thus ask at the outset what this book, three years after the symposium it derives from, has to say on this matter. The answer is that it is long on scientific discussion but very short on quantitative definition of the resources of the area. Nor does it attempt a reasonable analysis of the problems associated with the exploration and exploitation of deep-sea hydrothermal mineral deposits. Instead, the final chapter, while presenting many recommendations for further research, carefully dodges the issue of the real economic prospects of the area.

Once this bitter but expected pill has been swallowed, it must be said that the Gorda Ridge is of considerable scientific interest and that some of the contributions in this volume add a good deal to our understanding of the region itself and of slow-spreading mid-ocean ridges in general. In particular the chapter by Hart, Hoefs, and Pyle on multistage hydrothermal systems in the Blanco fracture zone, the discussion by Morton, Koski, Normark, and Ross of the massive sulfide deposits of the Escanaba trough and their distribution, and Koski's comparison of the Gorda sulfides with Beshi-type deposits in Japan are contributions of real value. On the other hand, Zierenberg's discussion of Red Sea brine deposits not only is out of place here but is little more than a term-paper–like summary, as is the chapter by Fisk and Howard on the geophysics of the Gorda Ridge.

Five chapters discuss technological aspects of deep-sea exploration for mineral resources: hydrographic and geochemical techniques for plume prospecting, acoustic imaging, various other standard geophysical methods, and an electric drill. They offer little that is not already widely known and are far too short to assist the uninitiated in evaluating the techniques dealt with. A sixth chapter on deep-sea mining by Cruickshank misses its mark; its level of treatment would have been marginal in a popular magazine.

Perhaps ironically, this reviewer, hardly competent to judge their quality, especially enjoyed the six chapters on benthic ecology, which seem to me to be among the most substantial contributions to knowledge of hydrothermal regions and associated deep-sea environments made by this volume. The first two, by Carey, Taghon, Stein, and Rona and by Carey alone, deal with the distribution of the benthic megafauna in hydrothermal areas and compare it to the epifauna of the adjacent abyssal plain. Especially interesting is a comparative paper by Juniper, Tunnicliffe, and Desbruyères on the biological features of the hot-spring complexes of the Northeast Pacific, East Pacific Rise, and Gulf of Aden, and another one by Van Dover and Hessler that compares the spatial variation in composition of the East Pacific Rise and Galàpagos areas. Two final papers in this section deal with the Gorda vent faunas themselves but are too short to satisfy. Alas, in this volume these six papers will hardly attract the attention they deserve.

If there is thus a good deal to be enjoyed in this volume, and enjoyed across a rather broad interdisciplinary range, a fair portion is either hardly more than a summary or of such low quality that it would not have been accepted by any reputable scientific journal. It is not unknown, of course, that such work finds a refuge in symposium volumes, but it is a pity that libraries must pay for them.

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The San Historicized

Land Filled with Flies. A Political Economy of the Kalahari. EDWIN N. WILMSEN. University of Chicago Press, Chicago, 1989. xviii, 402 pp., illus. $60; paper, $17.95.

In the *New York Times* for 27 March 1990, a front-page story was headed "Gold Miners Routed in Effort to Save Stone-Age People." The subjects are the Yanomamo, described by the *Times* as "the last major isolated tribe in the Americas" and by the anthropologist Napoleon Chagnon as "our contemporary ancestors." In the film *The Gods Must Be Crazy*, the Kalahari "Bushmen" are portrayed as only just emerging from isolation, bewildered and vulnerable before a modern world of complex technologies of aeroplanes and Coca-Cola bottles. The image of a pristine isolation has been almost as common in research on foragers as in the popular media. *Land Filled with Flies* is a sustained argument against such views. Wilmsen marshals an enormous quantity of historical, archival, archeological, ethnographic, and survey data on the Kalahari Zhu to show how far from the reality these images are, how they have their own historical provenance, how conventional perspectives on Kalahari foragers have been analytically distorting, and how they have proven politically pernicious for living groups like the Zhu.

Wilmsen mounts a convincing critique of approaches that have made the San, in the words of John Yellen, "a kind of narrow and opaque window to the Pleistocene." He reminds the reader that Richard Lee and Irven DeVore chose the Kalahari for the