

Invitation to

Oceanography

Web Enhanced Edition

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OceanLink



Paul R. Pinet

Oceanography

Web Enhanced Edition

Paul R. Pinet
COLGATE UNIVERSITY



JONES AND BARTLETT PUBLISHERS

Sudbury, Massachusetts

BOSTON

LONDON

SINGAPORE

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Editorial, Sales, and Customer Service Offices

Jones and Bartlett Publishers
40 Tall Pine Drive
Sudbury, MA 01776
978-443-5000
info@jbpub.com
http://www.jbpub.com

Jones and Bartlett Publishers International
Barb House, Barb Mews
London W6 7PA
UK

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Printed in the United States of America
02 01 00 99 98 10 9 8 7 6 5 4 3 2 1 0

Library of Congress Cataloguing-in-Publication Data

Pinet, Paul R.

Invitation to Oceanography/Paul R. Pinet—Web enhanced ed.
p. cm.

Includes bibliographical references and index.

ISBN 0-7637-0614-0

I. Oceanography. I. Title

GC11.P55 1998

551.46—dc21

98-35551

CIP



TEXT IS PRINTED ON 10% POST
CONSUMER RECYCLED PAPER



■ DEDICATION

Marita E. Hyman

A wise, passionate, caring partner who shares her life with me living on a special parcel of land on a large Earth in a vast universe.

■ PRODUCTION CREDITS

Copyediting: Maggie Jarpey

Typing, Word Processing and Proofreading:
Publication Support Services, Inc.

Interior Design & Composition: Seventeenth Street Studios

Artwork: Randy Miyake, Miyake Illustration;
Patti Isaacs, Parrot Graphics; Precision Graphics

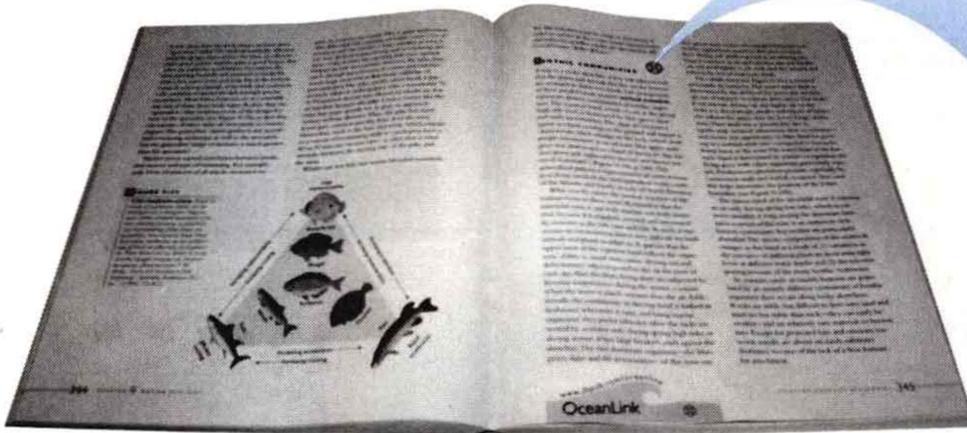
Cover Design: Artscribe

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- The Key Topic icon identifies key topic headings that are matched to WWW sites you can visit through OceanLink.
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Brief descriptions on Jones and Bartlett's OceanLink site place the links in context.

With a click of the mouse, OceanLink takes you to the best and most current sites on the Web.

OceanLink Key Topics
Chapter 9: Marine Ecology
Page 345: Benthic Communities

1. Vertical zonation is a universal characteristic of rocky shores that are affected by a significant tide. Also, they are readily accessible for viewing at low tide when this community is exposed to air. The Rocky Shores web site allows you to learn more about the principal inhabitants of rocky shore communities and their life habits, as well as the nature of the intense competition for living space in this intertidal zone.

Go to the [Rocky Shores web site](#).

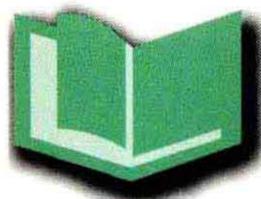
ROCKY SHORES

Photograph by Raymond Seed

In the study of community structure, larval recruitment, and physiology, rocky shores have proven to be the most versatile habitats, owing to their accessibility to observation and to the strong physiological gradient, ranging from fully marine to terrestrial habitats. The physiological gradient makes it relatively easy to see the interactions of physiological performance and interspecies interactions. Ecological processes such as competition and predation are strongly modulated by the time organisms are exposed to air and such effects cause vertical gradients in the importance of, for example, predation. Many carnivores can only move about and seize prey when covered with water, which limits the time that intense predation can occur in the high intertidal.

Our understanding of these environments has been informed especially by field experiments. Removal or addition of hypothetical predators and prey has been crucial in understanding ecological interactions. The experiments performed by Joseph Connell and Robert T. Paine and their followers set the standard for ecological field work both in the marine and other environments.

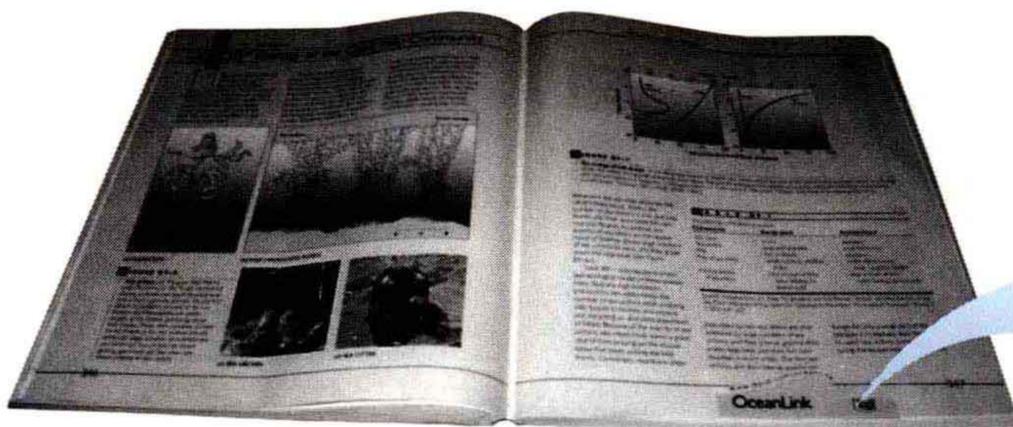
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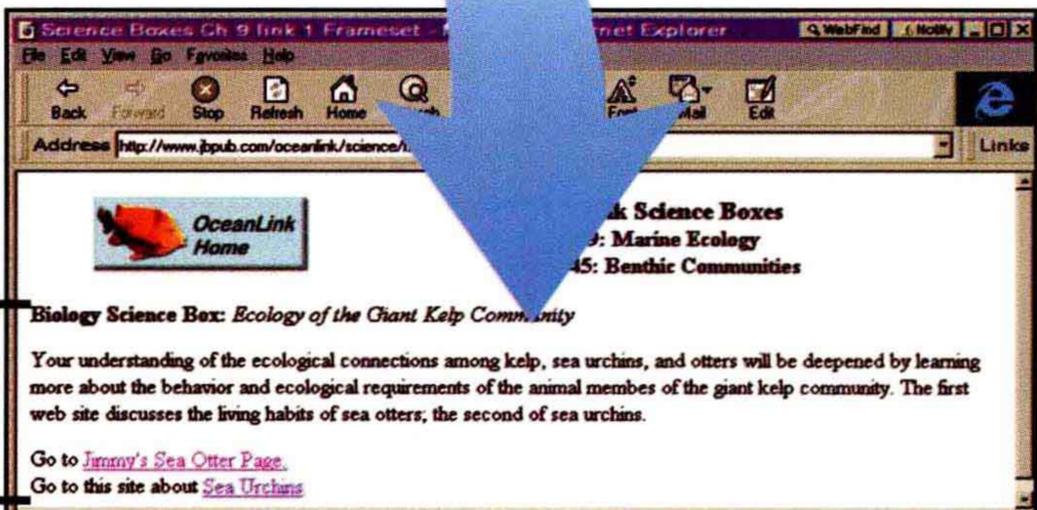
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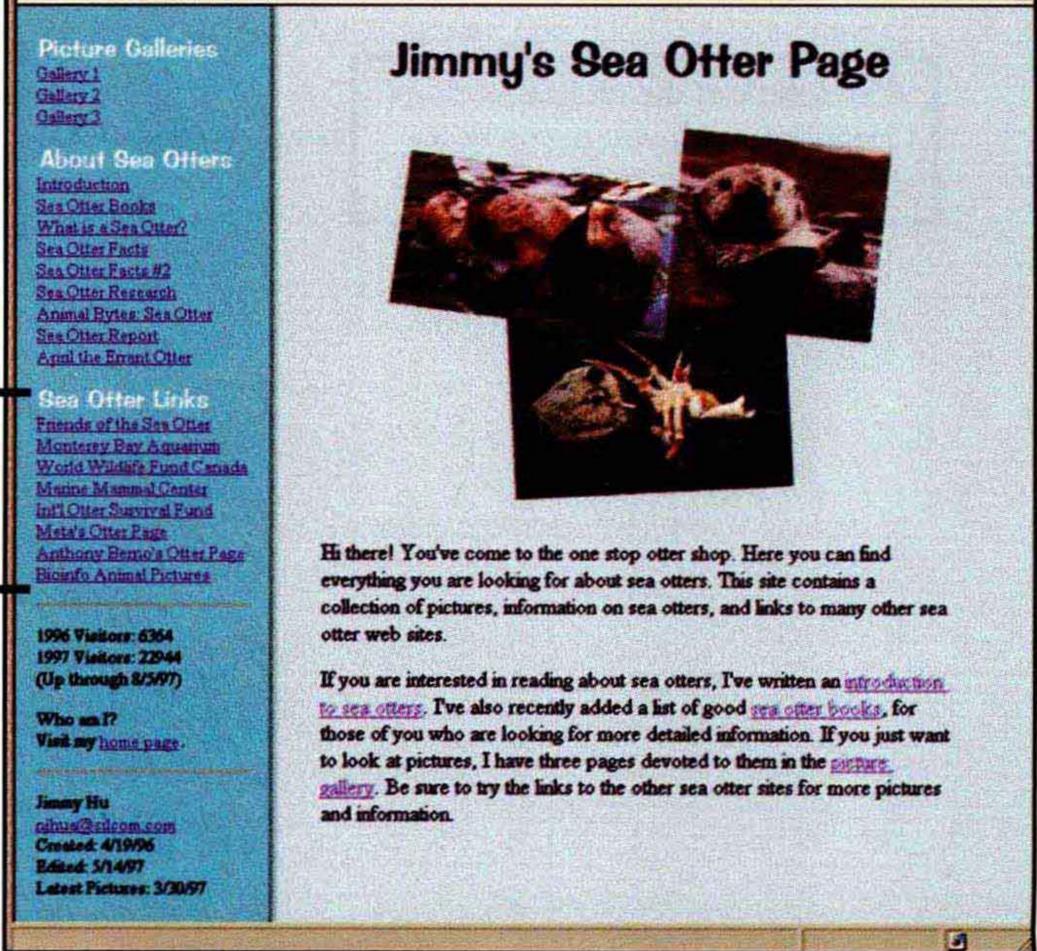


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OceanLink takes you to sites offering valuable extra information and/or the latest research news.

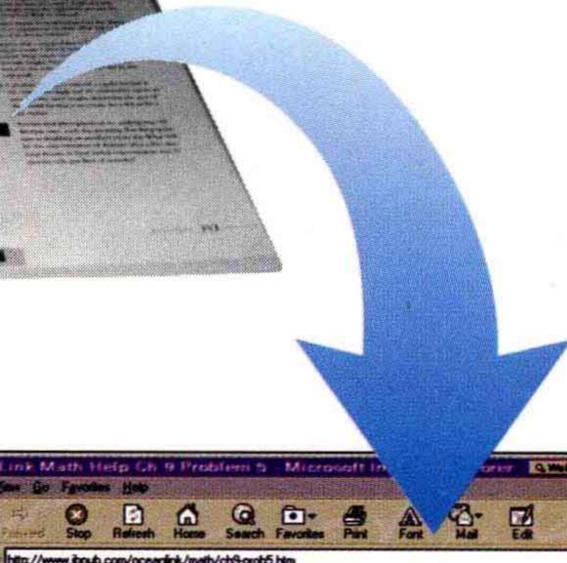
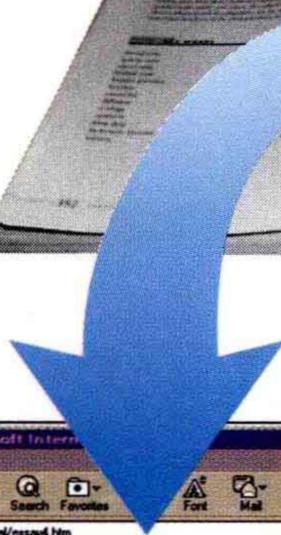
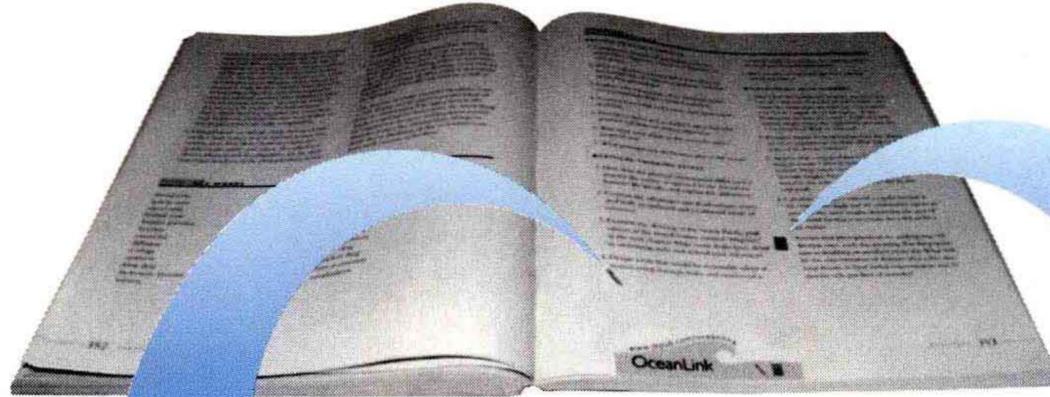




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CRITICAL THINKING & MATH TUTOR ICONS

The Critical Thinking and Math Tutor icons identify selected end-of-chapter “Critical Thinking Essays” and “Discovering with Numbers” exercises for which additional resources and assistance are available on the Web. Your text author, Paul Pinet, encourages you to take your critical thinking a step further, and he patiently guides you through the mathematical problem solving process.



Topic is placed in clearer context; direct links and a search engine facilitate **Doing the Research**; and clear guidance is offered for **Constructing Your Answer**.

Math Tutor gently guides you through mathematical problem solving process with clues, but no answers.



Preface

This book deals with the workings of the ocean, the dynamic processes that affect its water, sea floor, and abundant life forms. The approach used is a broad one, relying on basic concepts to explain the ocean's many mysteries. Anybody—whether sailor, surfer, beachcomber, or student—can learn about the processes and creatures of the oceans by reading this visually exciting book. No background in science is required to grasp the many important ideas that are relevant to the working of the oceans. Wherever appropriate, the underlying science is first explained clearly, and only then is it used to account for ocean processes. These overarching scientific concepts are summarized conveniently as “Key Concepts” at the end of every chapter. In order to help those unfamiliar with the practice of science, Chapter 1 provides an explanation of how scientists reason and draw conclusions about the natural world. In the glossary, important words are clearly defined and are accompanied by page numbers which refer you to the critical section of the book where the term in question was first introduced.

The figures and their accompanying captions do not merely illustrate, but also supplement the written text. The drawings have been beautifully and accurately rendered by a team of talented artists and illustrators in order to present in visual form ideas that are at times necessarily abstract. They should be studied carefully before advancing to the next section of the chapter, because they help provide concreteness to the ideas discussed. It has been the author's experience that those students who truly understand the “ins and outs” of the illustrations tend to have a solid

grasp of the chapters' main concepts. This will take a bit of time, but it is time well invested.

Web Enhancement

Invitation to Oceanography: Web Enhanced Edition provides you with web-integrated activities and direct links to World Wide Web resources. The starting point is *OceanLink*, Jones and Bartlett's own extensive oceanography home page. Students reach the *OceanLink* home page by entering the URL <http://www.jbpub.com/oceanlink> into a World Wide Web browser such as Netscape Navigator or Microsoft Internet Explorer.

The distinctive *OceanLink* Key Topics icon in the text identifies topics that are matched to useful WWW sites you can visit through *OceanLink*. Brief introductions place the link in context *before* you connect to the site. Jones and Bartlett constantly monitors the links to ensure that there will always be a working and appropriate site on-line.

The Science Boxes icon appears in the featured boxes. *OceanLink* is connected to web sites that provide additional coverage of the topic in the box and examples of science in use.

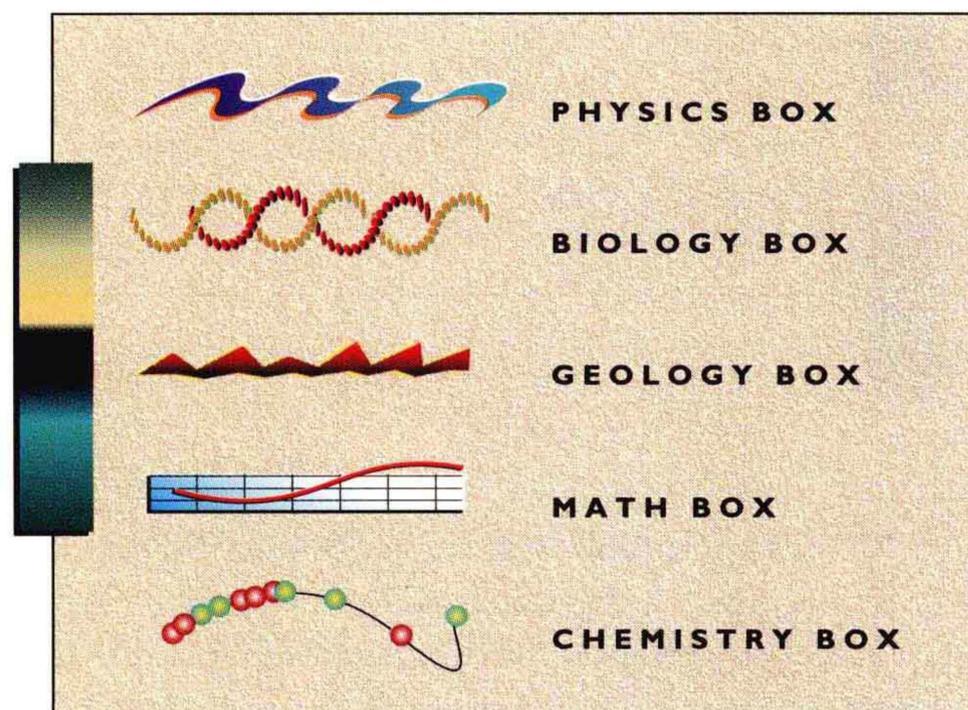
The *OceanLink* Critical Thinking icon next to selected end-of-chapter “Critical Thinking Essays” directs you to *OceanLink*, where useful links and additional help, including tips for researching your essay on the web, are available. The same is true for the “Discovering with Numbers” activities in the book. When you see a Math Tutor icon, it means that *OceanLink's* Math Tutor can help you work through the problem with clues, but it will not

provide answers. In addition, *OceanLink* has an on-line glossary with key figures from the book.

End of Chapter Features

Each chapter concludes with a series of questions arranged into three groupings. The first set, the **Review Questions**, are just that. They address the main notions developed in the chapter. The second set, the **Critical Thinking Essays**, require more thought, because you must synthesize ideas, sometimes drawing from concepts developed in previous chapters. In other words, verbatim answers might not be found anywhere in the book. However, you can develop an answer by thinking deeply about the question posed and applying common sense and logic to the information provided in the book. The final set of questions, **Discovering with Numbers**, deals with making straightforward calculations about ocean processes. They rely on basic mathematics, the kind that any high-school graduate has mastered. In order to assist you, math boxes that teach the art of computation are included in each chapter. Each box deals with a basic mathematical concept and provides a step-by-step solution to a specific problem. The trick to answering math questions is to understand conceptually what it is you are trying to solve. These math boxes will help you upgrade your math skills and develop self-assurance about reasoning with numbers. With the proper learning attitude, the math problems actually become fun to solve and provide special kinds of insights into ocean processes that only numerical calculations reveal.

Featured boxes abound in all of the chapters. They consist of four types, based on the principal subfields of oceanography: biology, chemistry, geology, and physics. Each is identified as such by a colorful and distinctive logo placed near the title of the box. The featured boxes serve several purposes. Some review common research techniques employed by oceanographers to investigate the seas. A number of them flesh out a concept merely outlined in the text. Others spotlight case histories whereby the oceanog-



raphy of a specific place is presented in concrete terms from the standpoint of an idea introduced in the text. Finally, a few featured boxes review a concept that is simply interesting in and of itself, and that otherwise could not be integrated easily into the main text of the chapter. They are like eating dessert after finishing the main course of a meal. Enjoy them! Here is a list of each box in the book and where they appear in their respective chapters.

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Two chapters—“Coastal Processes” (Chapter 8) and “The Human Presence in the Ocean” (Chapter 12)—are particularly noteworthy. They deal with the

despoilment of the Earth’s precious marine environments. We are just beginning to sense the gravity of our collective impact on the oceans in general and on the shorelines in particular. Many of these coastal ecosystems—beaches, dunes, estuaries, salt marshes, mangrove swamps, lagoons, coral reefs—are being stressed well beyond their resiliency to absorb the damaging effect of our careless and abusive habits. However, the future looks promising, since more and more people are becoming ardent environmentalists, wanting to reverse the polluted and damaged state of the ocean’s many habitats. In fact, there is a great deal that you can personally do. Some of these activities are discussed in the final chapter of the book. Our collective individual actions have caused these massive, far-reaching problems; our collective individual actions can undo them as well.

Chapter 5—“Ocean Circulation” begins with a compact summary of climate processes and their effect on the movement of water in the ocean. Then, after describing ocean circulation, the chapter concludes with an up-to-date assessment of the likelihood of global warming in the future. This chapter is particularly important because it shows how interconnected the flow of air in the atmosphere and the flow of water in the oceans are, and how susceptible each is to human-induced activity.

A **reading list** is provided at the end of each chapter that includes both classical, but still relevant, references and more recent writings on the ocean’s dynamic processes and diverse habitats. Some are books; most are articles. They should prove valuable for delving deeper into an area of oceanography that intrigues you and for writing term papers. Also, the **appendices** at the end of the book provide important ancillary material, including conversion factors, a geologic time chart, and map-reading techniques.

It is the author’s hope that this book conveys his deep respect for Earth, especially its watery realm, and inspires the same in its readers. Perhaps a few, like the author, will even devote their lives to studying, protecting, and teaching about the oceans, increasingly enamored of their beauty, fragility, and complexity.



Acknowledgments

West Publishing Company published the first edition of this book. The valuable work and vision of the entire West staff is duly noted in the acknowledgments of the first edition. Since then, Jones and Bartlett Publishers have worked tirelessly to produce this new edition, the Web-enhanced version of *Invitation To Oceanography*. Brian McKean, the senior biology editor, has overseen the preparation of this edition. He is responsible for convincing me about the value of incorporating the internet idea into the book. His guidance, patience and energy, as well as his strong sense of aesthetics, are largely responsible for the successful and surprisingly painless completion of this project. Also, Judy Hauck, senior managing editor, Mary Hill, senior production editor, Dean DeChambeau, senior developmental editor, and Kathryn Twombly, project editor worked with me as a team in the truest professional manner. The final rendering of the book is the direct result of their combined efforts and clear-cut vision of how much more the book could be. I am indebted to all of them. Finally, there are the “nuts-and-bolts” people, Mike Campbell, director of internet technology and Andrea Wasik, web designer. Both are indispensable, knowledgeable professionals who endured my vast ignorance of computers and who held me firmly by the hand as they offered me a glimpse of the vast educational potential of this new technology. I have learned a great deal from the entire staff of Jones and Bartlett Publishers; I am privileged to be an author of one of their books.

Many colleagues at numerous institutions reviewed and constructively criticized various chapter drafts of the first edition. Those who were particularly helpful and generous with their time and expertise include:

Marsha Bollinger
Winthrop University

Chuck Breitsprecher
American River College

William Chaisson
University of Massachusetts—Amherst

Karl M. Chauffe
St. Louis University

Charles M. Drake
Dartmouth College

Walter C. Dudley
University of Hawaii at Hilo

John Ehleiter
West Chester University

William Frazier
Columbus College

Tom Garrison
Orange Coast College

Jack C. Hall
University of North Carolina—Wilmington



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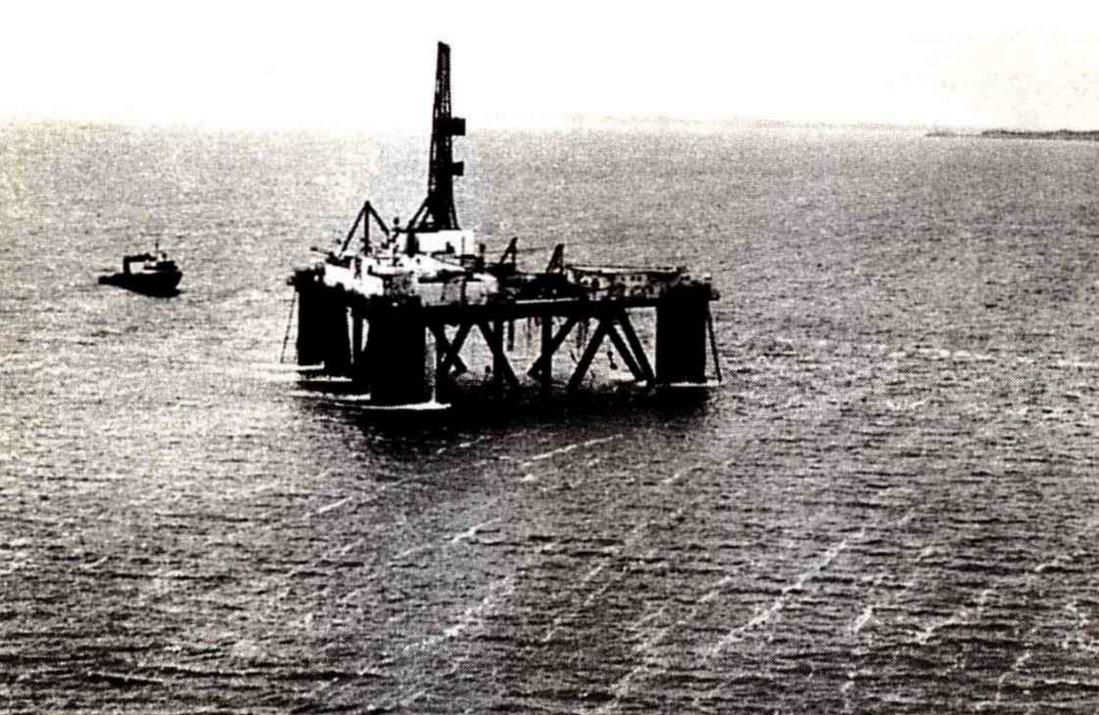
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