



DIVING MEDICINE

RICHARD H. STRAUSS, M.D.
EDITOR

WITHDRAWN
UNIVERSITY
FROM THE
OF YORK
UNIVERSITY
LIBRARY
OF YORK
LIBRARY

Y 6.98022 STR



Alexander's Dive. This illumination is from an early fourteenth century French manuscript entitled *Histoire d'Alexandre*. It depicts Alexander the Great (356-323 B.C.) in what is supposed to be a diving bell, although the vehicle resembles a transparent submarine. Various creatures are shown, some of which are not generally found underwater. (Courtesy of Staatliche Museen Preussischer Kulturbesitz Kupferstich kabinet Berlin-Dahlem, Hs. 78 C 1, fol. 67 r.)

DIVING MEDICINE

Edited by

RICHARD H. STRAUSS, M.D.

Department of Medicine,
Peter Bent Brigham Hospital
and Harvard Medical School,
Boston, Massachusetts;
Department of Physiology,
University of Hawaii School of Medicine,
Honolulu, Hawaii



Grune & Stratton

A Subsidiary of Harcourt Brace Jovanovich, Publishers
New York San Francisco London



1976

Library of Congress Cataloging in Publication Data
Main entry under title:

Diving medicine.

Includes bibliographical references and index.

1. Submarine medicine. 2. Diving, Submarine
—Physiological aspects. I. Strauss, Richard H.
II. Title. [DNLM: 1. Diving. 2. Submarine
medicine. WD650 D618]
RC1005.D58 616.9'8022 76-10474
ISBN 0-8089-0699-2

CO16 0959 00 91

©1976 by Grune & Stratton, Inc.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the publisher.

Grune & Stratton, Inc.
111 Fifth Avenue
New York, New York 10003

Library of Congress Catalog Number 76-10474
International Standard Book Number 0-8089-0699-2
Printed in the United States of America

UNIVERSITY

CONTENTS

Foreword	vii
Preface	ix
Contributors	xi
1 A Short History of Diving and Diving Medicine <i>Eric P. Kindwall, M.D.</i>	1
2 The Physics of Gases <i>Richard H. Strauss, M.D.</i>	13
3 Diving Equipment <i>Glen H. Egstrom, Ph.D.</i>	23
4 Respiratory System in Diving <i>Nicholas R. Anthonisen, M.D.</i>	35
5 Barotrauma <i>Carl Edmonds, M.D.</i>	49
6 Decompression Sickness <i>Richard H. Strauss, M.D.</i>	63
7 Hyperbaric and Ancillary Treatment of Decompression Sickness, Air Embolism, and Related Disorders <i>Eric P. Kindwall, M.D.</i>	83
8 Aseptic Necrosis of Bone <i>D.N. Walder M.D.</i>	97
9 Ear and Sinus Problems in Diving <i>Joseph C. Farmer, Jr., M.D. and William G. Thomas, Ph.D.</i>	109
10 Eyes, Vision, and Diving <i>Robert B. Cook, M.D.</i>	135
11 Unearthly Atmospheres: Some Dangerous Aspects of Diving Gases <i>David A. Youngblood, M.D. and Walter G. Wolfe, M.D.</i>	145
12 The Physiology of Nitrogen Narcosis and the High Pressure Nervous Syndrome <i>Peter B. Bennett, Ph.D.</i>	157
13 Human Performance Underwater <i>Arthur J. Bachrach, Ph.D. and Glen H. Egstrom, Ph.D.</i>	183

14	Drugs and Diving	<i>J. Michael Walsh, Ph.D.</i>	197
15	Hypothermia	<i>K.E. Cooper, M.B., B.S.</i>	211
16	Hazardous Marine Life	<i>Bruce W. Halstead, M.D.</i>	227
17	Diving Adaptations in Marine Mammals	<i>Robert Elsner, Ph.D.</i>	257
18	The Physiology of Breath-hold Diving	<i>Suk Ki Hong, M.D., Ph.D.</i>	269
19	Saturation Diving	<i>James Vorosmarti, Jr., M.D.</i>	287
20	Diving Accidents	<i>Glen H. Egstrom, Ph.D.</i>	303
21	First Aid and Emergency Medical Treatment	<i>Carl Edmonds, M.D.</i>	309
22	Near-drowning: Pathophysiology and Treatment	<i>Mark E. Bradley, M.D.</i>	317
23	Investigation of Diving Accidents	<i>Carl Edmonds, M.D.</i>	329
24	Medical Examination of the Diver	<i>Eric P. Kindwall, M.D.</i>	341
Appendix			
1	Pressure Conversion Table		348
2	U.S. Navy Standard Air Decompression Tables and Treatment Tables		351
3	Decompression Tables for Diving at Altitude		361
4	Medical Examination Forms		372
5	Case Histories	<i>Edward L. Beckman, M.D.</i>	375
6	Answers to Study Questions		398
Index			409

FOREWORD

Albert R. Behnke, M.D.

A relatively new and intriguing challenge to physicians is the need to understand the complexities associated with current widespread diving activity, notably with recreational, scientific, and commercial aspects of scuba diving. During the past 25 years along littoral sea and inland waters hundreds of thousand individuals of both sexes, with varying degrees of aptitude and training, have gone diving. Such persons are in imminent danger of drowning should any mishap occur with equipment or as a result of inclement diving conditions. Too often the scuba diver, in contrast to the professional, is a relatively inexperienced, non-acclimatized amateur. On any particular day he may be in poor physical condition, under the influence of prescribed or other medication, and occasionally on narcotic drugs. Underwater spatial orientation may be greatly impaired by lack of adequate information from visual, proprioceptive, and vestibular systems. As pointed out by Edmonds, the diver's visual cues are virtually abolished in murky water or at night. Proprioceptive information is seriously distorted by zero gravity of neutral buoyancy. Extraordinary significance may be placed on vestibular responses greatly in excess of those customary during terrestrial activity. Impairment of judgment induced by the narcotic effect of hyperbaric nitrogen thwarts the diver confronted by the stresses of an unaccustomed and potentially hostile environment. Confronted with the need for heavy exertion, the scuba diver may be unaware of respiratory inadequacy and hypercarbia. Inexplicably, consciousness may be lost because of blunted recognition underwater of the danger signals which are monitory to protect individuals in a normal environment. Too rapid ascent may precipitate air embolism as a result of general or regional over-expansion of pulmonary tissues. Overstay at depth predisposes to intravascular embolization and gives rise to random symptomatology, remarkable in diversity and intensity.

The practice of breath-hold diving preceded by hyperventilation is conducive to hypoxic brain and cardiac injury and collapse. Despite the classic investigations of Craig and Scholander and their admonitory repercussion,