

HANDBOOK ANIMAL SCIENCE

Volume III E. C. Melby, Jr. N. H. Altman





Handbook

of Laboratory Animal Science

Volume III

Editors

Edward C. Melby, Jr.

Professor of Medicine and Dean of the Faculty New York State College of Veterinary Medicine Cornell University Ithaca, New York

Norman H. Altman

Senior Scientist
Papanicolaou Cancer Research Institute
Miami, Florida

Published by



CRC PRESS, Inc. 18901 Cranwood Parkway · Cleveland, Ohio 44128

Library of Congress Cataloguing in Publication Data

Main entry under title:

CRC handbook of laboratory animal sicence.

Includes bibliographies and index.

1. Laboratory animals. 2. Zoology, Experimental – Technique. 3. Medicine, Experimental – Technique. QL55.M45 636.08'85 74-19795

This book represents information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Every reasonable effort has been made to give reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

All rights reserved. This book, or any parts thereof, may not be reproduced in any form without written consent from the publisher.

© 1976 by CRC Press, Inc.

International Standard Book Number 0-87819-344-8 Volume III
International Standard Book Number 0-87819-343-X Series

Library of Congress Card Number 74-19795
Printed in the United States

Handbook of Laboratory Animal Science

Volume III

Editors

Edward C. Melby, Jr.

Professor of Medicine and Dean of the Faculty New York State College of Veterinary Medicine Cornell University Ithaca, New York

Norman H. Altman

Senior Scientist
Papanicolaou Cancer Research Institute
Miami, Florida

This is the third volume in the CRC Handbook of Laboratory Animal Science Series. Subjects covered in the two previous volumes are:

- Volume I Legislation, Housing Requirements, Parameters of Reproduction, Gnotobiotics, Teratogenic Techniques and Agents and Mutagenicity, Biohazard Control, Epidemiology, Surgery of Laboratory Animals, Radiobiology and Nuclear Medicine, Reptiles in Laboratory Animal Science, Veterinary Medical Specialization and Specialty Organizations, and Laboratory Animal Technician Training Programs.
- Volume II Viral Neoplasia, Blood Coagulation, Histology Techniques, Semen Examination, Animal Models, Comparative Aspects of Immunologic Diseases, Zoonoses Of Laboratory Animals, Diseases of Laboratory Animals, Clinical Pathology: Blood Chemistry, Clinical Microbiology, and Appendix: United States List of Endangered Fauna.

THE EDITORS

E. C. Melby, Jr., D.V.M., is Professor of Medicine and Dean of the Faculty of the New York State College of Veterinary Medicine, Cornell University, Ithaca, New York.

Dr. Melby was educated at the University of Pennsylvania, the University of Vermont, and received the D.V.M. degree from Cornell University. He subsequently entered private veterinary medical practice in Vermont. In 1962 he joined the faculty of the Johns Hopkins University School of Medicine, where he organized an academic program in laboratory animal science and comparative medicine which is today one of the most extensive of its kind in this country.

Dr. Melby is a Diplomate of the American College of Laboratory Animal Medicine and a member of numerous scientific societies. He has served on various committees of the National Institutes of Health and the National Research Council-National Academy of Sciences where he is the current chairman of the Institute of Laboratory Animal Resources.

Norman H. Altman, V.M.D., is a Senior Scientist at the Papanicolaou Cancer Research Institute and Associate Professor of Pathology, the University of Miami School of Medicine, Miami, Florida.

Dr. Altman received his B.S. degree from Penn State University and his V.M.D. degree from The University of Pennsylvania. He practiced veterinary medicine in Philadelphia, Pennsylvania before entering academic medicine. Dr. Altman was on the staff at Johns Hopkins University School of Medicine for 5 years before moving to Miami.

Dr. Altman is a member of numerous scientific organizations and a Diplomate of the American College of Laboratory Animal Medicine and the American College of Veterinary Pathologists. He has served as a consultant to the National Institute of Health, the National Research Council, National Academy of Sciences, and the American Association for Accreditation of Laboratory Animal Care. He has authored over 30 scientific publications.

PREFACE

This book represents the completion of 6 years of work by the editors and many contributors toward establishing a broad-based series covering laboratory animal science. The Preface in Volumes I and II outlined our general intentions for this series. Our basic concepts and objectives have not changed, and we respectfully suggest reading the Preface which appears in both books.

We gratefully acknowledge the efforts and thank each contributor who has taken time out of his busy schedule to participate in this project. Our effects to develop this series have had their rewards and frustrations. The initial chapter sequence had to be altered and unfortunately some important material had to be omitted.

We believe it important not to further delay the publication of the subjects contained in Volume III. At the same time, being the dynamic field that it is, laboratory animal science continues to rapidly change. We recognize the need to correct inadequacies that may be found in the current series, as well as to introduce other subject areas. With this in mind, a second edition of the entire series will soon be underway. New areas will be added, and some may be deleted or undergo significant change in an effort to keep abreast with changes as they occur or to correct inadequacies found in the original contributions. Your comments and suggestions are welcomed.

ADVISORY BOARD

Dr. Eugene Arnold

Department of Pathology The Johns Hopkins University Baltimore, Maryland 21205

Dr. James Corbin

College of Veterinary Medicine University of Illinois, Urbana Urbana, Illinois 61801

Dr. Joseph H. Gans

Department of Pharmacology University of Vermont School of Medicine Burlington, Vermont 05401

Dr. William Gay

National Institutes of Health Bethesda, Maryland 20014

Dr. Chester A. Gleiser

Department of Veterinary Pathology College of Veterinary Medicine Texas A & M University College Station, Texas 77843

Dr. Richard A. Griesemer

Box Y Oak Ridge National Laboratory Oak Ridge, Tennessee 37830

Dr. E. S. E. Hafez

Department of Gynecology—Obstetrics Wayne State University School of Medicine Detroit, Michigan 48201

Dr. Carl Hansen

National Institutes of Health Bethesda, Maryland 20014

Dr. T. C. Jones

New England Regional Primate Research Center 1 Pine Hill Drive Southborough, Massachusetts 01772

Dr. S. S. Kalter

Southwest Foundation for Research 7480 West Commerce Street San Antonio, Texas 78228

Dr. Robert W. Leader

Department of Pathobiology University of Connecticut Storrs, Connecticut 06268

Dr. Norman D. Levine

Agricultural Experiment Station Department of Zoology College of Veterinary Medicine University of Illinois, Urbana Urbana, Illinois 61801

Dr. Walter Loeb

Bionetics Research Laboratories 5516 Nicholson Lane Kensington, Maryland 20795

Dr. William Medway

School of Veterinary Medicine The University of Pennsylvania Philadelphia, Pennsylvania 19104

Dr. Luis V. Melendez

Department of Human and Animal Health Pan American Health Organization Washington, D.C. 20037

Dr. Alvin F. Moreland

Division of Comparative Medicine University of Florida—Gainesville College of Medicine Gainesville, Florida 32601

Dr. Kenneth D. Quist

Center for Disease Control Bureau of Laboratories Veterinary Services Branch Atlanta, Georgia 30333

Dr. R. D. Radeleff

College of Veterinary Medicine Texas A & M University College Station, Texas 77843

Dr. Harry C. Rowsell

Department of Pathology
The Faculty of Medicine
University of Ottawa
Ottawa, Ontario, Canada K1N 6N5

CONTRIBUTORS

Edwin J. Andrews, V.M.D., Ph.D.

Associate Professor of Laboratory Animal
Medicine
Department of Pathology
Director, Laboratory Animal Diagnostic
Resources
New York State College of Veterinary Medicine
Cornell University
Ithaca, New York 14853

Leonard H. Billups, D.V.M.

Major, VC, U.S. Army Armed Forces Institute of Pathology Washington, D.C. 20306

John M. Bowen, D.V.M., Ph.D.

Department of Physiology and Pharmacology College of Veterinary Medicine University of Georgia Athens, Georgia 30602

Robert W. Bull, D.V.M.

Department of Medicine Michigan State University East Lansing, Michigan 98823

James M. Buttram, Ph.D.

State of Alabama
Department of Toxicology and Criminal
Investigation
P.O. Box 231
Auburn, Alabama 36830

Jim Corbin, Ph.D.

Department of Animal Science College of Agriculture University of Illinois at Urbana-Champaign Urbana, Illinois 61801

D. W. Frank, D.V.M., Ph.D.

Pathology and Toxicology Research The Upjohn Company Kalamazoo, Michigan 49001

Gary W. Gill, A.B., CT(ASCP), CT(IAC)

Division of Cytopathology Department of Pathology The Johns Hopkins University School of Medicine Baltimore, Maryland 21205

Richard A. Griesemer, D.V.M., Ph.D.

Box Y Oak Ridge National Laboratory Oak Ridge, Tennessee 37830

Alfred H. Handler, Ph.D.

Bio-Research Institute Cambridge, Massachusetts 02141 University School of Medicine and School of Graduate Dentistry Boston, Massachusetts 02215

John C. Harshbarger, Ph.D.

Director, Registry of Tumors in Lower Animals National Museum of Natural History Room W216-A Smithsonian Institution Washington, D.C. 20560

Eleanor D. Hart, B.S., M.T., C.T.(ASCP)

Medical Technologist Smith Kline & French Laboratories 1500 Spring Garden Street Philadelphia, Pennsylvania 19101

C. F. Helmboldt, D.V.M., Ph.D.

Professor Emeritus
Department of Pathobiology
University of Connecticut
Storrs, Connecticut 06268

Paul Heltne, D.V.M., Ph.D.

Assistant Professor The Johns Hopkins School of Medicine Division of Laboratory Animal Medicine Baltimore, Maryland 21205

Chao-Kuang Hsu, D.V.M., Ph.D., M.P.H.

Division of Laboratory Animal Medicine The Johns Hopkins University School of Medicine Baltimore, Maryland 21205

Howard C. Hughes, Jr., V.M.D., M.S.

Department of Comparative Medicine The Milton S. Hershey Medical Center The Pennsylvania State University Hershey, Pennsylvania 17033

R. M. Jakowski, D.V.M., Ph.D.

Department of Pathobiology University of Connecticut Storrs, Connecticut 06268

S. R. Jones, D.V.M., M.S.

Lt. Col., VC, U.S. Air Force Armed Forces Institute of Pathology Washington, D.C. 20306

S. S. Kalter, D.V.M., Ph.D.

Director, Division of Microbiology Southwest Foundation for Research and Education P.O. Box 28147 San Antonio, Texas 78228

Richard H. Latt, D.V.M.

Laboratory Animal Resources Program Centralized Biological Laboratory Pennsylvania State University University Park, Pennsylvania 16802

H. B. Lewis, B.V.M.S., M.R.C.V.S.

Willowdale Veterinary Centre Route 82 Kennett Square, Pennsylvania 19348

George Migaki, D.V.M.

Registry of Comparative Pathology Armed Forces Institute of Pathology Washington, D.C. 20306

T. E. Murchison, D.V.M., M.Sc., Ph.D.

President and Scientific Director Dawson Research Corporation P.O. Box 8272 114 West Grant Avenue Orlando, Florida 32806

S. W. Nielsen, D.V.M., Ph.D.

Department of Pathology University of Connecticut Storrs, Connecticut 06268

B. J. Payne, D.V.M., Ph.D.

Associate Director of Pathology/Toxicology Smith Kline & French Laboratories 1500 Spring Garden Street Philadelphia, Pennsylvania 19101

F. R. Robinson, D.V.M., Ph.D.

Lt. Col., VC, U.S. Air Force Chief, Veterinary Pathology Division Armed Forces Institute of Pathology Washington, D.C. 20306

Ruth Saison

Assistant Professor Department of Biomedical Sciences Ontario Veterinary College University of Guelph Guelph, Ontario, N1G 2W1, Canada

Michael A. Stedham, D.V.M., M.S.

LTC, VC, U.S. Army Armed Forces Institute of Pathology Washington, D.C. 20306

Robert B. Wilson, D.V.M., Ph.D.

Department of Veterinary Pathology College of Veterinary Medicine University of Missouri-Columbia Columbia, Missouri 65201