

does not address the specific situation in the United States, where (unlike many European countries) dissection of animals is common practice in biological science instruction and presumably accounts for the largest numbers of animals used in education (accurate numbers are not available). This use of animals in the United States is unregulated, and has been a topic of contentious discussion within the teaching profession at times in the past, but now seems generally ignored. A reader might wonder after perusing this book: why do teachers use the non-alternative resources, or how did this practice get established? The book does not attempt to present the perspectives of teachers involved in using conventional resources of animal cadavers and tissues. The question of why dissection continues as such a widespread practice is not addressed.

This book is the strongest document to date charting a path away from consumptive uses of animals. It calls for proactively embracing humaneness, not simply avoiding methods involving harm to animals. The authors call for a full curricular transformation and further investment in life science education to facilitate students' acquisition of knowledge and skills with improved teaching tools. Their book is now the essential handbook presenting a comprehensive overview of the literature and resources available in the area of animal alternatives for teaching. While it clearly establishes that many resources are already available, it also points the way towards a need for systematic development of additional outstanding teaching resources.

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**Handbook of Laboratory Animal Science, 2nd Edition — Volume 1: Essential Principles and Practices, and Volume 2: Animal Models**

Edited by J Hau and GL van Hoosier Jr (2003). Published by CRC Press LLC, 2000 NW Corporate Boulevard, Boca Raton, Florida 33431, USA; <http://www.crcpress.com>. Volume 1: 556 pp. Hardback (ISBN 0849310865). Price £93.00. Volume 2: 269 pp. Hardback (ISBN 0849310849). Price £66.99.

The first edition of this handbook was published in 1994, edited by Per Svendsen and Jann Hau. Hau has now joined forces with Gerald Van Hoosier to produce this completely revised and updated new edition. Each chapter focuses on an important sub-discipline of laboratory animal science and contributors are experts from Europe and North America. Like the latest edition of the UFAW Handbook, this comprises two volumes, each of which is available separately. Volume 1, 'Essential Principles and Practices', is a substantial treatise comprising 22 chapters and over 500 pages. The first chapter briefly surveys the contribution of laboratory animals to medical knowledge and progress but fails to make reference to the controversy that has surrounded this area. Chapter 2 comprises a much more in-depth review, exploring the human benefits of animal experimentation

and the cost to the animals, and then looking at the ethical dilemma. The authors conclude that researchers are better equipped to account for their methods when they understand both the ethical issues raised and the theories that lie behind them. The aim of the chapter is to set out this theoretical framework to help those interested acquire this understanding.

The book then proceeds to develop a global view of the controls and legislative framework that different countries have implemented to regulate animal experimentation, and explores the activities of care and use programs, and education and training. For example, Chapter 3 outlines the evolution of the Directive for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (86/609/EEC) and then explains its scope and describes how these provisions constitute the minimum for national regulation. There follows a rather more weighty consideration of North American legislation, which deals principally with the United States, and then much briefer accounts of the legal frameworks in Asia, Australia and New Zealand. The next chapter compares the three commonly used quality assurance systems and their backgrounds — the GxP regulations, AAALAC International and ISO Accreditation, and the authors stress the ethical and legislative imperative for adopting best practice in animal care and use programs. The chapter on education and training appears somewhat unbalanced to the European reader, devoting rather less than two pages to trends in Europe, (principally the FELASA training accreditation scheme) and eight describing the AALAS scheme in the United States; there is no consideration of training practices elsewhere. The authors do not include a web address for FELASA or Lab Animals, which would have been the easiest way to offer the reader access to the various training guidelines developed outside the USA. This section concludes with a useful chapter listing many of the laboratory animal science associations worldwide, related professional organisations and some animal care and welfare organisations (UFAW is included here).

Chapter 7 provides a useful review of the effects, causes and control of Laboratory Animal Allergy from a refreshingly practical point of view. The following chapter devotes 45 pages to laboratory animal facilities and equipment for different management systems; although there is very brief consideration of the requirements of different species, the emphasis is mainly on facility design and plant and equipment needed for contemporary biomedical research. Chapter 9, by Michael Festing, addresses the genetics of laboratory animals and in particular the importance of selecting the most appropriate genetic background for investigations. It provides a good introduction to the major classes of genetic animal and particularly the value of isogenic strains in research. Although Festing briefly reviews genetic monitoring of isogenic strains, the following chapter deals at greater length with the phenotypic characterisation of genetically engineered mice, although it is equally relevant to mutant strains. It deals only briefly with transgenic technology and for the greater part focuses

on methods for the accurate phenotypic characterisation of such mice, progressing from whole colony observation, through modern imaging and pathology techniques to neurological and special sensory assessment.

The next four chapters examine factors that can have a confounding effect on research programs. For example, Chapter 11, by Axel Hansen, is very well referenced and addresses the issue from a point of view of animal health status and monitoring; he systematically reviews a selection of bacterial, viral and metazoan parasitic agents that affect rodents and rabbits. Hansen stresses that the absence of symptoms should not be taken to indicate absence of infection and then describes how the presence of these agents can interfere with the interpretation of results obtained from animal experiments. He then outlines eradication and control measures before reviewing the problems inherent in health monitoring, which he considers in relation to the FELASA guidelines. Chapter 12, by Ritskes-Hoitinga and Chwalibog, explores nutrient requirements and their influence on experimental results, animal health and welfare. The authors consider the pitfalls of experimentally manipulating dietary composition, and observe that although *ad libitum* feeding is recognised to adversely affect the health of many species, it is still commonly practiced with rodents. In view of the impact of this regime on rodent longevity and general health, they argue for moderate food restriction to become the new standard in laboratory rodent facilities. They also suggest that foraging for food could be used as a way of enrichment provided that the basic needs of the species are considered.

The next chapter explores the influence of the biotic and abiotic environment on animal experiments. The inter-relationship between bias and population variability in animal experiments is explored in relation to implementing best animal welfare practice and minimising the number of animals used. The authors argue that refinement and reduction are inter-dependent and that an appreciation of their inter-play is crucial when designing an investigation. They initially examine biotic factors and re-emphasise the serious potential impact of sub-clinical infections; consideration of abiotic factors is directed principally to factors that lie inside the cage or pen: bedding, enrichment, cage material and micro-environmental factors. They review arguments for and against the provision of environmental enrichment, and emphasise that provision needs careful management if it is not to increase population variance during a study. Like several chapters in this book, the text is comparatively short (9 pages), but well referenced — there are 137 references at the end of the text!

This section on experimental planning concludes with a chapter on study design and statistical analysis by Festing and Weigler. They urge scientists to improve their approach to experimental design, examine the robustness of some of the more common strategies, for which they urge researchers to work with persons knowledgeable in this area, and they stress the benefits to be obtained from a good computer statistics and graphing package.

The book then moves on to examine the principles of experimental technique. Chapter 15 describes common non-surgical techniques and procedures. Starting with handling and physical restraint, the authors demonstrate that safe, firm and gentle handling is the key to humane technique. The chapter then considers a number of simple procedures including techniques for identification, administration of substances by injection, oral dosing and blood sampling; species covered are rats, mice, guinea pigs, rabbits and pigs, and the chapter is well illustrated. There follows a chapter on the production of polyclonal and monoclonal antibodies. This sadly contains two pages on the production of monoclonal antibodies by the ascites method in the mouse; only after detailed description of this method do the authors acknowledge that several European countries have issued regulations restricting ascites production and that the NIH has declared that *in vitro* production should be the method of first choice.

This is followed by chapters on anaesthesia and surgical techniques. The chapter on analgesia, anaesthesia and euthanasia, assembles current thinking on these topics and includes useful tables recommending doses of analgesic and anaesthetic agents; it is supported by a long and current list of references. As well as mammals, the authors make recommendations for birds, reptiles, amphibia and fish. There are two fairly short chapters devoted to surgical techniques: one addressing basic principles and procedures, the other dealing specifically with microsurgical procedures. Both are clearly written and illustrated and consider the instruments and accessories needed for surgery and then describe selected procedures. Chapter 19 also has a section on care of the animal before and after surgery.

Chapter 18 by Morton and Hau, called 'Welfare Assessment and Humane Endpoints', provides a much-needed welfare viewpoint to a book that doesn't always take the opportunity to develop this theme. The authors urge investigators to routinely assess welfare as an integral component of their research projects, and this chapter includes much practical advice as to how this can be achieved. They discuss the difficulty of objectively assessing pain, distress and suffering, and recommend that an initial approach should be to ask what a human in that condition would be experiencing. They adopt a broad definition of suffering which covers all feelings an animal might experience which humans would in any way find unpleasant or aversive, such as pain, mental distress, fear or boredom. The physiological mechanisms of pain, fear and mental distress are reviewed and a long table of indicative clinical signs and possible courses of action is provided. Practical guidance is also given on questions to ask when setting early humane end-points, and on the use of score sheets to monitor animals during experimental procedures, and there is brief consideration of welfare problems that may be peculiar to transgenic animals.

The next chapter, on necropsy procedures, is well illustrated and provides guidance on techniques applicable to rodents and rabbits, including the taking of samples for subsequent morphological examination and/or microbiology.

The final chapter on the 3Rs (Chapter 22) comprises only five pages plus references. It defines its subject, and then explores the concept of humaneness on the basis of the five needs identified by UFAW (identified here as the United Federation for Animal Welfare!). The authors observe that in the US, there is adequate information for risk assessment for only one fifth of chemicals in use by the public; a European Union paper released in 2000 revealed a similar problem and the authors acknowledge that it would be impracticable to attempt to address this concern by current methods involving whole-animal testing. There is a disappointingly short and incomplete list of information sources on alternatives and in general I felt that this chapter was a missed opportunity.

Volume 2 is available separately and addresses the characteristics and use of animal models. This is an interesting approach in that it draws together a great deal of information that is not readily accessible except in the form of a few subject-specialist monographs. It could be of particular use to new researchers who are often equipped with an understanding of the experimental protocols that they will use, but less frequently consider why they are using a particular model in the first place. It could also help people who are required to select and justify an animal model for deployment within a scientific project.

The opening chapter examines the concept of an animal model and shows how the ability to extrapolate results to the human depends upon the selection of an appropriate model. The chapter then reviews the different types of animal model available and discusses in more detail their validity. There then follow chapters addressing model selection in 11 different branches of biomedical research:

- Pharmacology and toxicology
- Foetal growth and development
- Nephrological disorders

- Xenotransplantation
- Neuroscience
- Psychological disorders
- Mycology
- Diabetes
- Skeletal disease
- Cancer research
- Oral health sciences

Each chapter assesses the features of models currently available in its respective area, which animals are used and why, how the various clinical conditions can be simulated and the fidelity of such models. Several authors provide useful advice on minimising the severity of simulated illness, but this was neither consistently present nor always carefully argued. Some authors also touched on ethical considerations and assessed the likely pattern of future developments. It seems somewhat paradoxical that genetically manipulated models do not feature here, although the principles underlying these were addressed at some length in Volume 1.

Both volumes of this book are well written, user friendly and complement the standard reference work on husbandry and care — the UFAW Handbook. Although the pace of scientific discovery will cause this book to date relatively quickly, it fills a current void by collecting together current practices in the scientific use of animals. Each chapter is well referenced and the book would be a valuable addition to the reference collections of animal facilities and research establishments. Just how useful is shown by the fact that during preparation of this review a researcher borrowed Volume 1 in order to look something up about antibody production.

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