animals during catastrophic events, such as outbreaks of fire. Preventative medicine is extremely well presented, recognizing its importance as a key element in successful zoo animal medicine. In view of mounting antagonism to zoos, the chapter on 'Ethical and welfare issues associated with keeping wild animals in captivity' is of special value. The critical appraisal of reintroduction programmes (in part 4) - analysing long-term effects and failures – is also a particularly important contribution.

In part 2, dietary recommendations are well based on the morphophysiological specializations and adaptions of animals under natural conditions. The section first establishes rules for evaluating the nutritional status of the species and considers mammalian nutrient requirements as a whole, before devoting separate chapters to the diets of herbivores, carnivores and omnivores.

In part 5 ('Behaviour'), respecting the evolutionary and ontogenetic adaptation of animals' behaviours is accorded a priority similar to that of maintaining genetic diversity in zoos. This is a most important attitude, if zoos are to take their role in conservation efforts seriously. Discussing appropriate aspects of behaviour in other sections, however, makes the book a really practical guide-cum-handbook. Unfortunately, there is no mention of disturbed or pathological behaviour, even though this is well documented in the central European literature, and these behaviours and often heavily criticized by the public. Reproduction (part 6) is particularly well treated in a series of chapters by competent authors, be they discussing its physiological aspects, or regulatory measures such as contraception. By highlighting the extreme differences between mammal species, this section also emphasizes the need for much more basic research on reproduction.

Our overall impression of the book is very positive. Since it will become the key volume in the field - with updated editions to follow, we hope - the present restriction to Anglo-American authorship and literature sources has to be criticized. In many of the fields covered by the book, there are impressive results from scientifically guided zoo breeding programmes elsewhere in the world. In the future, more European and Asian authors should be involved - which could only benefit the treatment of such an important and special aspect of mammalian conservation. The book is, however, a pioneer effort of high quality, and hence a 'must' for the entire zoo community and beyond.

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Animal Alternatives, Welfare and Ethics

Proceedings of the 2nd World Congress on Alternatives and Animal Use in the Life Sciences, held in Utrecht, The Netherlands, 20-24 October 1996. Edited by L F M van Zutphen and M Balls (1997). Elsevier Science: Amsterdam. 1260pp. Hardback. Obtainable from the publishers, 1000 AE Amsterdam, The Netherlands; or, in the USA/Canada, from Elsevier Science Inc, PO Box 945, Madison Square Station, New York, NY 10160, USA (ISBN 0444824243). Price NLG 545.00 or US$340.75.

Improved understanding of behavioural science and developments in the new genetics draw us to agree with Darwin's own view that human morality is the extension of the social instincts of the higher animals. Physiological, anatomical and other similarities between man

and animals have been exploited in science to the benefit of both animals and ourselves. Surely, at the end of the 20th century, there are few in our society who still think that man has an unlimited right to intentionally inflict pain on animals.

In the main, animal welfare law provides a code of behaviour and sets limits intended to safeguard the well-being of animals. But laws that regulate the use of animals in research actually permit suitably qualified people to inflict pain and suffering on animals quite deliberately. Animals, particularly those we refer to as higher animals, share a remarkably similar genetic make-up with us and have similar behaviour patterns to ourselves; and for that very reason, we want to use them for experiments which will inevitably cause a degree of pain. The relevant laws in different countries all adopt a utilitarian approach, accepting the need to use animals and setting limits as to why, how, by whom and where they should be used - the end justifies the means. Public concern - indeed outrage - is not, therefore, surprising. We share genetic links and form emotional bonds with animals and yet, for some purposes, the law allows us to inflict pain and suffering on them.

Finding alternatives to the use of live animals in research is one of the most important challenges facing those working in the life sciences. Reading this book, one cannot help but be impressed by the commitment of so many scientists around the world and the scale and quality of their work in searching for alternatives. The first world congress on the subject was held in Baltimore, USA in 1993 and a third is planned for Bologna, Italy in 1999. The proceedings of the second congress in Utrecht, will prove to be an essential source of reference, not only for those actively engaged in the science but also for the wider non-scientific community. We must understand how and why we have reached the position we find ourselves in now - and the philosophical and political landmarks that have been encountered on that journey.

The first stated aim of the 1996 Utrecht congress was to provide an overview of the present status of *replacement* alternatives, *reduction* alternatives and *refinement* alternatives, thus highlighting the 3Rs of Russell and Burch who published their seminal work in 1959[1]. Indeed, this book of the proceedings is dedicated to the memory of Rex Burch (who died earlier in 1996) and is a celebration of his major contribution to the welfare of experimental animals. It can be seen from the text that the guiding principle of the 3Rs must have resonated throughout the Utrecht congress and is picked up nicely by Bill Russell's lecture (as the 3Vs in the Dutch translation). In his paper, Michael Balls acknowledged the role played by Charles Hume in the mid 1950s: he decided that UFAW should undertake the study of humane techniques in laboratory animal and appointed Russell and Burch to do the work. It has taken far too long but at last the 3Rs have become established as a guiding principle that should never be far from the mind of anyone who has any responsibility for research involving animals anywhere in the world.

The congress was opened by Erica Terpstra, State Secretary for Health, Welfare and Sport in the Netherlands, who stressed the balance governments have to make in order to protect public health on the one hand and responsible stewardship of animals on the other. HRH Prince Laurent of Belgium, in an enlightened address on the obligation to study animal

[1] *The Principles of Humane Experimental Technique*. W Russell and R Burch (1959). UFAW: South Mimms, UK

welfare, posed key questions for delegates to bear in mind during the congress. Professor Bill Russell sketched in the historical picture from Homer's description of Odysseus' old dog, through Voltaire's observations on the similarities between canine and human behaviour on finding something that has been lost, to Darwin and the founders of modern ethology - Lorenz, Tinbergen and Diebschlag.

The following seven plenary lectures set the tone for the rest of the book. Referring to the 3Rs, Michael Balls draws an enticing analogy identifying the 1930s with a renaissance, darkness in the 1960s, reason in the 1970s, reformation in 1980s and an alarming age of revolution in the 1990s. Although there is still room for considerable improvement and a change in attitude, he points out that the revolution must be non-violent. Andrew Brennan draws on his experience as a philosopher, while presenting an Australian view of ethics and codes of animal research. The key to success of any ethical review process is the two-way trust with the community on one hand and the scientists on the other.

Expectations and limitations of alternatives are reviewed by Silvio Garattini from Milan. Knowledge of kinetics in the live animal is the starting point for many in vitro studies. He bases his argument on examples from pharmacology and models of animal disease to point out some of the discrepancies between in vitro and in vivo findings. Robert Gartner, a political scientist, discusses British and American political response to the animal protection movements seeking further restrictions on the use of animals in laboratories. Hansruedie Glatt and colleagues from Germany discuss the use of cell lines genetically engineered for human xenobiotic-metabolizing enzymes. These extend the possibility of detecting adverse signs of chemicals without using animals or could provide data to refine experimental design and reduce animal experiments.

The case for transgenic technology as an alternative to animal experimentation is put by Jon Gordon from the USA. The emphasis is on the mouse – but his conclusions apply to all species when he challenges the aim of eliminating all animal research. He believes that the intimate interaction between scientist and animal leads to a better understanding and greater respect for the animal, and concludes that the research subject is the most precious and irreplaceable resource of the animal researcher. Albert Osterhaus from Rotterdam uses the example of vaccine production to discuss progress in biotechnology and the use of laboratory animals. Novel approaches to vaccine production have led to fewer animals being used for each dose of vaccine produced. However, he sees an urgent need for new vaccines and, consequently, an increase in research and development, which will still require animals to be used.

There are also more than 150 additional congress papers under sections covering: national and regional developments; welfare and refinements; education; databases and communications; alternatives in toxicology; pharmacology; testing medical devices; antibody production; and the validation and acceptance of alternatives. It is interesting to read the outcome of workshops covering humane end points for procedures, ethics committees, editorial policy, polyclonal and monoclonal antibodies, and the validation and acceptance of alternatives. Sessions were set up to debate contentious issues including: 'Transgenic animals – an alternative?'; 'Acceptance of the benchmark approach to toxicity testing'; and 'In vitro toxicology – a recognized new scientific discipline?' In each case the volume reproduces statements from the proponent and opponent and comments from the moderator.

With over 1200 pages, this is a book to dip into. Any scientist working in the subject will want to have a copy on the shelf, because it will provide an essential reference source. Others following this particular story, however, will find a wealth of new material, good science, well-argued points, and food for further thought when they grapple with the important ethical dilemmas. The format of a well-informed debate, which emerges from the 2nd World Congress, will lead to improvements in laboratory animal welfare by providing replacement alternatives, reduction alternatives and refinement alternatives.

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Living Biology in Schools

Edited by Michael Reiss (1996). Institute of Biology: London. 120pp. Paperback. Obtainable from the publishers, 20-22 Queensbury Place, London SW7 2DZ, UK (ISBN 0900490322). Price £12.50.

Overall, I found this to be a very useful guide to dealing with living organisms in school laboratory/classroom situations throughout the country. In fact it should find itself on the shelf of every secondary school prep room. I feel it is unlikely to be read by every science teacher, but as long as the Head of Science reads it from cover to cover, then valuable information can be passed on to colleagues and included in schemes of work.

The 'Introduction' makes the valuable point that probably the biggest constraint upon using living organisms as educational tools is the duty of care involved both during the school term and, most importantly, over holiday periods. Few teachers or technicians have the time for good husbandry, and many who have inherited animals from a previous teacher will not even have the inclination. Keeping living things in school requires some form of ongoing commitment built into work schedules.

The second chapter, on microbiology, is probably the most original and useful chapter for a teacher. Micro-organisms, their uses and dangers are an integral part of the *Life Processes and Living Things Attainment Target 2* of the Science National Curriculum. If understood properly, and used safely, microbes can play a part in a number of interesting and low-resource-demand experiments. Because this branch of biology is little understood, particularly by non-biologists, great care must be taken to give adequate safety instructions but not to scare people away from otherwise simple procedures. Box 2.4 - level 2 explains that body surfaces must not be used as an environment from which to supply microbes due to potential danger from human pathogens. Should this be read as including making thumbprints in an agar medium, a simple and often-used experiment? If not, it may be creating unnecessary worry. Similarly, possibilities for practical investigation into the production of food and drink should be encouraged, as in this book, but must also be accompanied by a warning not to allow tasting of the product. Box 2.5 provides an excellent summary of simple precautions. If it was all on one page it could easily be photocopied, enlarged and stuck up on the wall of the laboratory or prep room.

The interesting chapter on plants unfortunately emphasizes outdoor gardens which makes its suggestions unfeasible for most inner-city schools. These ideas will only be possible in a school with excess space, committed and cooperative pupils and excellent site security. Does such a school exist? Surprisingly, in the present conservation-minded environment, there is no mention of the value of maintaining an uncultivated 'wild' area. The areas of the