Introduction
Animal welfare: focusing on the future

In focusing on the future of animal welfare this issue of the *Scientific and Technical Review* seeks to develop and illustrate two important themes.

The first is that animal welfare is a complex, multifaceted, international and domestic public policy issue with scientific, ethical, economic, religious and cultural dimensions plus important trade policy implications (1, 2). This theme is addressed directly in the seven papers in Section 1 – 'Drivers for global animal welfare policies'. In various ways, this section illustrates the interactive nature of the numerous drivers, and highlights the dominant drivers in different regions of the world. The theme also receives further detailed treatment in other papers that deal with working animals (Section 7) and canine rabies control (Section 11) in different regions.

The second theme, apparent in all subsequent papers, is the importance of having secure scientific foundations as a basis for management practices that aim to maintain animal welfare at acceptable levels. Such scientific foundations are emphasised in Chapter 7.1. of the OIE *Terrestrial Animal Health Code* (3) under the headings of 'Guiding principles for animal welfare' (7.1.2.) and 'Scientific basis for recommendations' (7.1.3.). Also outlined are 'General principles for the welfare of animals in livestock production systems' (7.1.4.). These principles, which highlight specific practices that support animal welfare, are demonstrably underpinned by at least 50 years of scientific research (4, 5) that covers:
– the effect of genetic selection on animal health, behaviour and temperament
– the influence of the environment on the risk of injury and transmission of diseases and parasites
– the effect of the environment on resting, movement and the performance of natural behaviour
– the management of animal groups to minimise conflict and allow positive social contact
– the effects of air quality, temperature and humidity on animal health and comfort
– the provision of feed and water suited to the animals' needs and adaptations
– the prevention and control of diseases and parasites, plus humane euthanasia
– the prevention and management of pain
– the creation of positive human–animal relationships
– the provision of training for animal handlers to ensure that they have adequate skill and knowledge.

Most papers in this issue draw on this understanding of the scientific bases for animal welfare practices, and some extensions to the underlying principles are directly addressed by several of the papers. Also, the papers are not primarily concerned with the status quo. Rather, they seek to consider the current understanding of particular aspects of animal welfare and the potential future implications for its management.

Section 2 firmly establishes this theme with three papers that explore *i)* the current status and future implications of new ideas about the interactions between emotion and cognition in animals, *ii)* the use of ethological and health indicators of welfare, and *iii)* how these and other factors help to provide validated scientific foundations for animal welfare standards. The pivotal importance of stockperson attitudes and skills in securing the welfare and productivity of farm livestock and working animals is then outlined in the paper in Section 3. This paper

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represents an appropriate introduction to the two papers in Section 4, which deal with the management of intensive livestock production systems. This is an important topic, because the role of veterinarians and stockpersons is likely to assume greater significance in the future in view of the anticipated worldwide expansion of such production systems. These papers deal with the future application of lessons learned in the past and with science-based management of livestock welfare in intensive systems.

The next four papers are relevant to both intensive production systems and pastoral/rangeland environments. The first two, in Section 5, deal with ways of improving the genetic 'fit' of animals with their environments. Thus, they consider key animal–environment compatibilities and incompatibilities that may guide the genetic selection of animals and/or the choice or manipulation of environments that may promote animal welfare. The two papers in Section 6 consider how technology may be used to enhance welfare monitoring and management. Thus, they outline current and anticipated technological applications that will improve the welfare management of rangeland livestock over long distances and facilitate multifaceted monitoring in intensive husbandry systems.

The remaining papers consider the welfare of particular classes of animals.

The first paper in Section 7 deals with the welfare of working animals in Africa and Asia, and seeks to identify problems, consider solutions and anticipate future developments. The second paper focuses on working equines in South America and emphasises strategies that are currently being deployed to improve their welfare.

Companion animal welfare is considered in two papers in Section 8. The first explores the impacts of breeding, behaviour and householder lifestyle on cat and dog welfare. The second analyses welfare-related issues that may arise with non-traditional pets and, based on that analysis, provides a checklist for evaluating whether the welfare of such animals can be secured in home environments and, thus, whether or not they are suitable to be kept as pets.

The welfare of farmed fish is explored in Section 9, which includes three papers. The first introduces the concept of fish welfare and outlines how it may be assessed and promoted; the second discusses pain perception and the causes and consequences of stress in fish; and the third outlines key elements of the humane harvesting and slaughter of fish. Taken together, these papers introduce this relatively new area of welfare evaluation, the significance of which will continue to increase as the anticipated rise in aquaculture to provide protein for the growing human population gains momentum.

Laboratory animal welfare is the focus of Section 10. The first of two papers presents the wide range of factors that should be considered when assessing the justification for particular laboratory studies by conducting harm–benefit analyses, and strongly emphasises the minimisation of harm. The second paper provides support for the proposition that the scientific validity of laboratory animal studies is improved, rather than undermined, by the increased biological variability that may be introduced by welfare-enhancing environment enrichment initiatives.

Section 11 includes four papers on the management and disposal of pest and diseased animals. The first outlines an approach to ranking the humaneness of vertebrate pest control and culling

methods; the second explores how humane slaughterhouse practices may be applied to large-scale culling; the third evaluates humane killing of large numbers of animals for disease control purposes; and the fourth considers initiatives to control canine rabies in developing countries and some animal welfare implications of the methods used. A common theme in these papers is recognition of the potential for these activities to elicit negative emotional responses in those who undertake them, those whose animals are killed, and others who witness the events at a distance. A further theme is that the urgency of some mass killing events may justify the use of less humane techniques than might otherwise be chosen, but that, nevertheless, those responsible for slaughter must use the most humane methods practicable in the circumstances.

Finally, the single paper in Section 12 considers some possible future developments in the global context of animal welfare.

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