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Marsupials as models for biomedical research

Recent discussion in *ANZCCART News* has focused on the use and validity of various model species for biomedical research. Michael Lardelli (2000) has discussed the advantages of a new model, the zebrafish, and pointed to its use in developmental genetics. Caroline McMillen (2001) discusses a longer established model, the sheep, and looks at its declining use; perhaps correlated with the increased use of more genetically defined, high throughput species like the mouse. The use of zebrafish and sheep, along with other "model" species such as fruit flies, chick and the rat, is largely accepted within the research community. They are long established: Nusslein-Volhard used congruent mutation strategies in *Drosophila* and Zebrafish in the early 1980's and sheep have been the major tool in developmental physiology, particularly among Australian and New Zealand groups, for over 40 years. These models perhaps serve different roles. Sheep-based research has translated readily from the animal house to the antenatal ward whereas zebrafish are used to address more basic questions in embryological development and their genetic basis. In this contribution we wish to discuss another group of animal models, more difficult to handle, more liable to attract emotional debate, but having unique characteristics that can be exploited to answer basic questions. Work on these animals is unashamedly doubly valuable; as animal models they must provide lateral advantages to other species including our own. However a spin-off is that we may gain information useful in management and conservation of native fauna.

Marsupials represent only six percent of extant mammalian species but dominate the mammalian fauna of Australia. Some of the early work on marsupials around 1903 centred on energetics and temperature regulation and suggested that their low metabolic intensity engendered "primitiveness". This was probably the beginning of what Hugh Tyndale-Biscoe has termed "eutherian chauvinism": animals of little use to explain how animals work but fulfilling a role in keeping the scientists of the antipodes generally amused. A more fruitful period of marsupial research began in the 1950's with Sharman's studies on reproduction and Moir and his colleagues defining the role of foregut fermentation in kangaroos and wallabies. A third phase of research on marsupials came in 1988 with the publication of a book edited by Tyndale-Biscoe and Peter Janssens, *The Developing Marsupial: Models for Biomedical Research.* This is a volume that anyone who works on marsupials delves into occasionally, however on looking back we were probably premature in our contributions. Most of the material is not heavily based on "…Models for Biomedical Research" but is more centred on what was then cutting edge research on marsupials. However the question had been raised: are marsupials useful models?

What are the real differences between marsupials and eutherian or placental mammals and can any underpin the establishment of a model ? The most obvious thing about large kangaroos and wallabies is that they hop, the only group of large animals ever to have adopted

ANZCCART's Financial Position

While ANZCCART has always operated on a tight budget, its continued operation beyond the end of 2001 is in doubt, due to the cessation of core funding by the NHMRC and the Royal Society of New Zealand.

The Board of ANZCCART is considering a number of other sources of funds and ways of reducing costs. One option is to charge for this newsletter on a cost-recovery basis. *ANZCCART News* is now in its fourteenth year and is recognized as the flagship of ANZCCART's operations.

The Board of ANZCCART would like to receive feedback from as many readers as possible on this point. Please email the ANZCCART office by 9 November on -

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and let us know if you agree or disagree with this proposal.

A Special General Meeting of ANZCCART Council will be held in Sydney on 15 November to consider ANZCCART's future and, if it is to continue, what type of services it should offer in the future.

this simplest of locomotory gaits. A second difference is that marsupials are born at an early stage of development and are adapted to completing much of their growth within the mother's pouch. In a functional sense this simply means that the ratio of the time spent in gestation compared to lactation is much less than in other mammals. In the case of wallabies for example, around 26 days of gestation is followed by 250 days inside the pouch. A third difference relates to the inactivation of one of the two X-chromosomes in the premeiotic germ and somatic cells of the female mammal. In eutherians it can be either the male or the female contribution, apparently randomly decided. In marsupials it is always the paternally derived chromosome that is inactivated, i.e. genes on the male X are lost. To further confuse the picture marsupial X-inactivation appears to be incomplete and in some cells is expressed, albeit not to the same degree as that derived from the female. Finally there are some major differences in the patterns of sexual differentiation between marsupials and eutherians. In some beautiful work, Marilyn Renfree's group at Melbourne University has shown that, in contrast to eutherians in which differentiation of scrotum and mammary glands is hormone driven, in some marsupials, at least, the determination is via an X-linked genetic mechanism. We will only discuss two of these differences in relation to our theme of models. However, Tyndale-Biscoe and Janssens (1988), Graves *et al.,* (1990) and Saunders and Hinds (1997) provide fuller accounts along this theme.

Hopping as a model gait

About 70 species of mammals and birds, including over a dozen marsupials, have been run on motor-driven treadmills and their metabolic rate, or rate of consumption of oxygen, recorded. A clear pattern has emerged. As running speed increases the rate of oxygen use increases linearly, however the rate of this increase is dependent on body mass. Smaller animals have a steeper slope to the line describing this relationship and a simple arithmetic calculation shows that the energy to move a given mass of animal a given distance (J/kg/km) is greater. Given that this is a straightforward measure of locomotory efficiency the simple conclusion is that larger animals move more efficiently than do smaller ones. This result spans all animals from elephants that have been walked behind a golf cart in the Atlanta Zoo wearing a "mask" " fashioned from a plastic bin, to ants and cockroaches running on small treadmills. The late Dick Taylor of Harvard and Roger Kram from Berkeley have shown that the feet of small animals spend a proportionately shorter period of time on the ground during a step cycle. This requires faster (twitch) muscle fibres which are more expensive in their energy use than the slower fibres afforded by larger animals. This is a very powerful derivation as, given the body mass and speed of an animal, an equation can be used to predict within attractive limits the cost of moving.

Kangaroos and wallabies are different. When they hop the rate of energy use does not increase in a linear fashion, rather it levels off with increased hopping speed. This means that the animals have effectively uncoupled oxygen use from hopping speed, an ability unique to large hopping macropods and not seen in small bipedal rodents for example. The hypothesis has been advanced that kangaroos and wallabies store elastic strain energy during the contact phase of the step and it is subsequently recovered from the recoil of spring-like elements in the body and trunk. We have worked with Andy Biewener of Harvard University on this problem and by attaching strain gauges to the tendons of hopping tammar wallabies we have shown that most of this energy storage occurs in the tendons of the hind limbs. Two corollaries to this finding have also arisen. The frequency of hopping in wallabies is always the same as the breathing frequency, a coupling driven by the viscera acting as an inertial piston and dragging down the diaphragm as the animal leaves the ground. This process has been termed "locomotory respiratory coupling". It is known from other mammals and from birds but many species have a "gear box" by which this ratio can be changed. Furthermore, few species use a piston arrangement to achieve this efficiency of coupling as central neural generators are responsible. The second corollary is that wallabies can carry their joeys at no cost in addition to that normally associated with hopping; again related to the advantages of the storage and recovery of elastic strain energy in the hindlimb tendons. Most other animals (arthropods are an exception) show an increase in metabolic rate which is proportional to the magnitude of the load.

Kangaroos and wallabies are examples of an extreme case used to explain a fundamental property of many tissues, the ability to store strain energy. We have now gained simultaneous recordings from electromyograms, from sonomicrometry electrodes in muscle and from tendon strain gauges and have established hopping macropods as a model system for investigations of locomotory physiology.

Marsupials as a model foetus

The basic difference between eutherians and marsupials lies in the differing ratio of time spent during lactation to that for gestation. The result is a "foetus" which is accessible in a pouch for up to 250 days. Blood and milk samples are readily taken and the young can be sampled without surgical intervention. In short, marsupial young permit researchers to buy time on the X-axis. Development is prolonged and during this time the young is accessible. This has been exploited in investigations of many organ systems. The composition of pulmonary surfactant, a complex mixture of lipids, proteins and carbohydrates, was described in the air-sac stage of the neonatal tammar wallaby in 1989. This was followed by a morphometric analysis of postnatal lung development by Sue Runciman at Flinders University which showed that alveoli development occurred in the middle stage of pouch life up to 180 days (Runciman *et al.*, 1999). A mature capillary organisation developed after this time and correlated with the onset of endothermy. Central cardiac shunts also differ in marsupials with separation of systemic and pulmonary circuits occurring due to tissue growth across a fenestrated septum rather than the flap-like arrangement seen in most eutherians. The other marked difference in cardiovascular function between marsupials and eutherians lies in haemoglobin function in the young. The eutherian foetus has hemoglobin (or several) which have stronger binding characteristics for oxygen than does the mother. This permits oxygen exchange across the placenta. In marsupials the pouch oxygen levels are well above the 100 torr characteristic of the placenta and the haemoglobin has a lower affinity for oxygen, accompanied by increased levels of the organic phosphate which facilitates unloading at the tissues. All these differences are modifications on the typical mammalian pattern; they occur slowly and in an environment external to the mother.

Other uses of marsupials

Two recent developments of marsupial models have used the nervous system. Norman Saunders and Kate Dziegielewska from the University of Tasmania have established a colony of the South American marsupial opossum *Monodelphis domestica*. They exploit the fact that marsupials are born at a stage of central nervous system development equivalent to an early foetal stage of eutherians and study development and repair of the spinal

cord. Richard Mark's group at ANU was the pioneer in using marsupial neonates to understand the retinal-cortical relationship in mammals. Mark argues that eutherian-marsupial similarities are striking but the latter occurs in an accessible free-living fetus rather than in the inaccessible uterus. The tissues of the immune system are underdeveloped at birth and the timing of final immunocompetence is still ill defined. This provides another example where a prolonged chronology may assist definition of a process that occurs much more quickly in eutherians. There are many other examples of marsupial models which take advantage of accessibility and extended chronological sequences; many of them summarised in Saunders and Hinds (1997).

Marsupials in the laboratory

The establishment of a laboratory species is a form of domestication and obviously takes time. There are very few marsupial species which will ever acquire this status-nor should we want them to. The exception is the South American opossum, or "laboratory opossum". Captive breeding began in 1978 from wild populations and thousands of animals have now been bred in rodent cages using commercially pelleted food. They are as close to a standard laboratory marsupial as we will ever get. The opossum is susceptible to ultra violet - induced melanoma and has found use in work on this condition; cell lines cloned from affected lymph node cells are available. The species' susceptibility to ultra violet radiation is also manifest in opacification of the cornea and neovascularisation in other regions of the eye. The animal is also a promising model for hyperlipidaemia. Details of this use can be found in the edited volume by Saunders and Hinds (1997). The only marsupials approaching this level of utility are the dunnarts of the genus *Sminthopsis*. Several colonies exist in Australian universities where they have been mainly used for genetic and developmental studies.

There are no other marsupials which can be treated as mice, rats and rabbits. Tammar wallabies, *Macropus eugenii*, have fueled most of the recent work on reproductive biology as well as studies in biomechanics discussed above. Colonies exist in Canberra, Melbourne and Adelaide, all derived from wild stock captured on Kangaroo Island SA. The animals weigh about 6 kg, readily breed in captivity and adapt well to large pens. However, some specialist care is required but the colonies are largely sustaining. Brush-tailed possums, *Trichosurus vulpecula*, have been used as models for gastric function, particularly related to the sphincter of Oddi. However, short-term housing from field populations rather than colony formation is common.

The ethics of marsupial use

Provided that natural populations are not affected marsupial use in research should be treated the same as for any other mammal species. However this view is optimistic: when native animals are established in captivity for research purposes additional ethical considerations are inevitable and understandable. One of us (RVB) gave a keynote address to a national conference of anaesthetists recently: the topic was "marsupials as biomedical models". The response included 10 media interviews, a discussion on breakfast radio and a long dialogue with a Reuter's representative! A congruent discussion on the white mouse would have engaged less discussion. If marsupial models are to be accepted, albeit in a limited way, the public has to be reassured that the work has the validity, and the ethical underpinning, of any other animal-based research. One problem with this lies in the provision of animal care. Experienced animal care technicians familiar with the requirements of marsupials are uncommon and generally have to be trained under the auspices of research grants. On the other hand, housing requirements are better understood and standard veterinary practice in matters such as anesthesia is now better established. If the excellent ANZCCART publication, *The use of wildlife for research* is revised some of this newer material should be included (Mellor and Monamy, 1999).

Summary

The use of marsupials in research has many drivers: among them work such as cross fostering which has immediate conservation benefit, and studies which aid the comparative approach in which insights to a common function may be defined. However we argue that marsupials have validity as a novel biomedical model where accessibility of a fetus is required, where slow growth and development is an advantage and where the simplest of gaits can assist in the elucidation of neuromuscular-energetic paradigms. Such extremes provide good examples from which structural-functional relationships can be determined. The person who first prompted marsupial adoption, Hugh Tyndale-Biscoe, once wrote that "..marsupials do things differently rather than less well". A belief in this statement may mean that marsupials can increasingly lead to research advances. An attractive spin-off is that conservation and veterinary issues may be amplified.

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Sustainability and animal welfare with reference to developments in poultry welfare

Introduction

The view that sustainability should be taken into account in relation to human activities is widespread and increasing. Whole industries are under review and the agriculture industry is no exception. A system or procedure is sustainable if it is acceptable now and if its effects will be acceptable in future, in particular in relation to resource availability, consequences of functioning and morality of action (Broom, 2001c). There are several possible reasons why an animal production system, or other system which uses animals, might not be sustainable. However, the earliest reason is often that something impinges upon the general public's values in a way which the members of the public find unacceptable. Frequently considered reasons for unsustainability are that a resource becomes depleted so much that it will become unavailable to the system, or that a product of the system accumulates to a degree which prevents the functioning of the system. Widely known examples are the exhaustion of rare resources or the accumulation of pollutants. Where there is depletion of a resource or accumulation of a product, the level at which this is unacceptable, and hence the point at which the system is unsustainable, is usually considerably lower than that at which the production system itself fails. That which is unacceptable is sometimes the action itself, sometimes an immediate effect and sometimes effects on other systems.

One major reason why animal usage systems may be regarded by the public as unacceptable, and hence become unsustainable without some modification, is that the product adversely affects human health. Another reason is that they have an effect on the welfare of animals which are used in the system. There is a point at which the welfare of the animals is so poor that the majority of the public consider the system to be unacceptable. Hence animal welfare and public attitudes to it must be considered wherever the sustainability of an animal production or other animal use system is evaluated.

No system or procedure is sustainable if a substantial proportion of people find aspects of it now, or of its consequences in the future, morally unacceptable. The people referred to here may be in a local community, in a nation or in the world as a whole. Hence each of the following is unsustainable, not just the first two: a manufacturing process which rapidly and irreversibly uses up all of the world supply of a rare metal; a pharmaceutical synthetic process whose by-product kills all fish in a river; a wild animal pest control programme which causes severe pain or other poor welfare to the animal; an organic farming system in which the incidence of a debilitating disease condition is higher than on conventional farms so that the welfare of the animals is worse overall. Public concern about animal welfare has increased rapidly in recent years (Broom, 1994, Ryan 1997, Ouedraogo and Le Neindre 1999) and, as a result of public awareness of the impact of human actions on the welfare of animals, more practices have become unacceptable.

In most countries, the areas where certain aspects of the poultry industry, as it functions now, might be considered unsustainable are, in order of importance: the welfare of the birds, risks to human health resulting largely from *Campylobacter* and *Salmonella*, and pollution problems. The remainder of this paper concerns animal welfare issues. Human disease resulting from poultry products is not often serious but is a major problem because careful human hygiene is needed to avoid significant *Campylobacter*, or sometimes *Salmonella*, infection. In Sweden, a substantial campaign by government agencies and by the industry has largely eradicated *Salmonella* as a problem. It is likely that the industry in other countries will have to deal with this problem and that increased use of antibiotics will not be acceptable. Pollution of waterways by poultry effluent can be avoided at a certain cost and in most countries the emission of ammonia into the air is not a major issue. Odours from poultry farms may be a local problem.

Developments in views of welfare and related concepts

Scientists who write about welfare and its assessment are generally agreed that welfare refers to animals, including humans, but not to other organisms or inanimate objects. Also, the study of the welfare of individuals is a scientific discipline in which various measurements can be used as indicators and welfare varies over a range (Curtis 1986, Duncan 1987, Broom 1988). Hence welfare can be poorer as well as better. An essential criterion for a useful definition of animal welfare is that it must refer to a characteristic of the individual animal rather than something given to the animal by man. The welfare of an individual may well improve as a result of something given to it but the thing given is not itself welfare. There is also wide-ranging agreement that, when assessing welfare, efforts should be made to assess degrees of suffering or happiness and the extent of any pathology and its consequences. Some authors accentuate feelings largely or exclusively (Duncan 1993, 1996) when referring to welfare whilst others concentrate most on health aspects. Dawkins (1993) and Fraser *et al.*, (1997) emphasise that both must be included. If, at some particular time, an individual has no problems to deal with, that individual is likely to be in a good state including good feelings as indicated by body physiology, brain state and behaviour. Another individual may face problems in life which are such that the individual is unable to cope with them. Coping implies having control of mental and bodily stability and prolonged failure to cope results in failure to grow, failure to reproduce or death. A third individual might face problems but using an array of coping mechanisms, be able to cope but only with difficulty. The second and third individuals are likely to show some direct signs of their potential failure to cope or difficulty in coping and they are also likely to have had bad feelings associated with their situations. Feelings have evolved to help individuals to cope, as have other coping mechanisms (Broom, 1998). My definition of welfare: "the state of the individual as regards its attempts to cope with its environment" includes feelings and health (Broom 1986, 1996, 2001d). 'Environment' may refer to that which is outside an individual or outside a particular response system. Welfare concerns how well the individual fares, or goes through life, and can be assessed scientifically (Broom and Johnson 1993).

Health, like welfare, can be qualified as good or poor and varies over a range. It refers to body systems, including those in the brain, which combat pathogens, tissue damage, or physiological disorder. All of this is encom-

passed within the broader term welfare so health is a part of welfare. Whenever there is disease welfare is poorer than when there is none. It is therefore incorrect to write about "health and welfare" and better to refer to "welfare, including health".

Stress is a term which has often been used in an imprecise and confusing way by scientists. It is of little use if it just means pertaining to the activity of the hypothalamic-pituitary-adrenocortical system or if it means any taxing stimulation. For most people, stress implies the effects of some challenge to the individual which disrupts homeostasis, rather than just activating simple, energetically cheap control mechanisms. A further area of general agreement amongst scientists studying the attempts of individuals to cope with challenge is that there are many coping systems. Hence it is incorrect to speak of "the stress response" if this means that there is only one. There are many different responses which are used by individuals in challenging and potentially adverse situations.

If stress implies some degree of adversity for the individual, the key question is how much adversity? The definition of stress which I find most useful is: "stress is an environmental effect on an individual which overtaxes its control systems and results in adverse consequences, eventually reduced fitness". The environmental variable which has the effect on the individual can be called a stressor. Using this definition, stress may or may not involve the activation of the HPA axis but stress is never good for an individual. Stimulation, some of which may be initially unpleasant, is necessary for the development of many aspects of systems for coping with challenge and individuals which are prevented from having adequately varied experience may prove unable to cope with certain problems. However, such ultimately beneficial stimulatory effects are not stress. Stress always involves poor welfare. However, welfare can also be poor where the individual is having difficulty in coping, for example during pain or depression, but where there is no likelihood of fitness reduction.

In order to understand the needs of animals, the range of functional systems e.g. controlling body temperature, nutritional state etc., must be understood. A need is a requirement, which is part of the basic biology of an animal, to obtain a particular resource or respond to a particular environmental or bodily stimulus. The need is in the brain and there are needs to carry out actions as well as those for particular resources. Needs can be identified by studies of motivation and by assessing the welfare of deprived individuals (Hughes and Duncan 1988; Toates and Jensen 1991).

Unsatisfied needs are often, but not always, associated with bad feelings whilst satisfied needs may be associated with good feelings. When needs are not satisfied, welfare will be poorer than when they are satisfied.

Hens need to:

* obtain adequate nutrients and water;
* grow and maintain themselves in such a way that their bodies can function properly;
* avoid damaging environmental conditions, injury or disease; and
* be able to minimise the occurrence of pain, fear and frustration (Broom, 1992).

In order to achieve these ends, hens carry out a variety of activities, respond to certain stimuli and maintain certain physiological states.

Hence they have other needs such as to:

* show certain foraging and investigatory movements;
* have sufficient exercise;
* show preening and dust-bathing behaviour;
* explore and respond to signs of potential danger;
* interact socially with other hens; and
* search for, or create by building, a suitable nest-site.

Important results from research on poultry welfare in relation to housing

Within the European Union food retailers have been pressurised by public opinion to set up standards for egg and poultry meat production. These standards have resulted in substantial changes in farm practice (Broom 1999). In relation to egg production, farmers have been helped towards uniformity in certain aspects of systems by the Directive (1999/74/EC) *Laying down minimum standards for the production of laying hens.* This legislation (Broom 2001b), which will phase out the use of battery cages, was based on information from a report from the E.U. Scientific Veterinary Committee. A further report on broiler welfare is likely to lead to future legislation. Some of the welfare research data are summarised here. The details of the publications can be found in the E.U. reports or in Broom (2001a).

Stocking density

If hens need to carry out a range of normal movements how much space is required for these? Measurements of the space occupied by a hen when carrying out such movements have been made. An average hen uses 1044 cm^2 for preening, 1096 cm^2 for turning and 1420 cm^2 for wing-flapping. If there are five hens in a cage, these will not show all of the different movements simultaneously and some hens might be relatively inactive whilst one bird uses more space. If hens crowded together occupy 325 cm^2 each, four hens crowded plus one wing flapping would need 2720 cm^2, more than the 2250 cm^2 cage for five hens allowed 450 cm^2 each. Similarly, four hens standing but not crowded and one preening occupy 3074 cm^2, two hens standing, two turning and one wing stretching occupy 4050 cm^2 so the stocking density severely inhibits normal movements. Wing-flapping is not possible with commonly used cage heights of 50 cm or less.

If hens are allowed more space than 450 cm^2 per bird the amount of disturbed behaviour shown is decreased. Hens will work for a larger space allowance of up to 1125 cm^2 per bird and they continue to space themselves out in cages of 1410 cm^2 per bird but in much larger space allowances of 5630 cm^2 per hen, they cluster. The effects of space allowance on the extent of injurious behaviour do not have linear relationship in battery cages but depend upon the complexity of the environment. In order to provide opportunities to escape and to hide from birds which tend to feather-peck or cause tissue damage by pecking, more space allowance than that normally provided in a battery cage is needed. Such escape possibilities are important in order to minimise injuries caused by other birds. As long as they are available, injurious behaviour can be low at various space allowances.

The space requirements of broilers in normal housing conditions, are sufficient to allow normal movements, exploration and social interactions. At least enough space to exercise, maintain leg condition and have access to resources is needed. The problem arises in the latter stages of growth when birds are crowded together. Increasing stocking density above 25 kgm^{-2} increases mortality, reduces locomotion, reduces litter quality, increases leg disorders and dermatitis, reduces calm behaviour and nesting and makes the finding of sick and injured birds more difficult.

Weak bones and exercise

The diet of hens is adequate for bone development, with calcium and vitamin D being key factors, but the bones of hens from battery cages break easily. In a series of studies, 25-40% of end-of-lay hens from battery cages were

found to have at least one broken bone following handling prior to stunning and 98% of carcasses had a broken bone. The numbers of broken bones from percheries and aviaries were much lower although hens from poorly designed or over-crowded percheries sometimes broke bones in the living conditions. The strength of the bones in wings and legs were reduced if there was insufficient opportunity for exercise. Birds which lived in cages in which they could not flap their wings had wing bones which were only half as strong as those of birds in a perchery which could and did flap (Knowles and Broom, 1990; Nørgaard-Nielsen ,1990).

Needs for pecking and dust bathing

Chickens strongly prefer litter floors to wire floors. The opportunity to peck at objects on the floor, scratch on the floor and dust bathe in a suitable substratum reduces the likelihood that injurious behaviour will be shown by hens and broiler breeders. Studies of the development and motivational basis of feather-pecking behaviour indicates links with deprivation of ground-pecking and dust-bathing opportunities.

Needs for nest boxes

An appropriate nest box is used by almost all hens if it is readily accessible and behaviour is clearly disturbed if none is available. The abnormal behaviour most frequently observed when no suitable nest site is present is stereotyped pacing. This stereotypy is a sign of long-term, intense frustration.

Needs for perches

Perches are preferred resting places for all but the youngest chickens. The design should be right and early experience of perches facilitates effective use. The presence of perches can increase leg strength. Where cloaca-pecking is a possibility, the perch should not be sited at such a height that the heads of some birds are level with the vents of others. This has been an important reason for the failure of some "getaway" cages because of injurious pecking. Young broilers use platforms and straw bales more than perches but appropriate perching facilities could improve welfare in general and leg strength in particular.

Problems of low light levels

If hens, broilers or broiler breeders are kept in low light levels they are not able to show normal exploratory behaviour. At the lowest levels eye development is impaired and clear welfare problems are indicated at light levels lower than 20 lux.

Beak-trimming

Mutilations which involve tissue damage are painful at the time of the operation and can sometimes cause neuromas which result in lasting pain. Beak-trimming also seriously impairs sensory input and pecking behaviour. The effect on welfare of beak-trimming is substantial but is much greater if neuromas are present.

Problems of leg disorders and ascites

The major causes of poor welfare in modern strains of broilers are leg disorders and ascites. The clinical conditions which impair walking include femoral head necrosis, dyschondroplasia, valgus-varus deformity, rickets and, in older birds, degenerative disorders. These conditions have become much commoner as growth rates have increased. The conditions must be painful as walking ability of birds with moderate lameness was improved after administration of the analgesic and anti-inflammatory drug carprofen.

Ascites is another pathological condition associated with fast growth in broiler chickens. It is also known as pulmonary hypertension syndrome and results in fluid from the blood leaking into abdominal cavities. It affects 5% of young broilers and 15-20% of the larger birds and whilst it can kill, it certainly weakens the birds and results in carcass condemnation. The main cause of ascites is failure of heart function associated with lack of oxygen supply to tissues. It is extremely rare in old strains of broilers and results from failure of the cardiovascular and pulmonary systems to grow fast enough to keep pace with the demands from the muscles and gut.

Problems resulting from selection by breeding companies

Farm animals have been selected for breeding on the basis of a range of criteria but by far the most important has been efficiency of production per animal. Fast growth, good feed conversion efficiency and high egg production have been selected for and this has had various consequences.

Broiler chickens have been selected, and their nutrition and management have been designed, so that they grow to market weight quickly and convert food to muscle efficiently. Thirty years ago chickens reached market weight at 12 weeks of age. Now the weight is often reached in 35 days and the age has been reduced by one day per year. The change in the bird has been that muscle and gut grow very fast but problems can arise because the bones and cardiovascular system do not grow as fast.

As a consequence, the birds may suffer from leg problems even when the diet is ideal. Some broiler chickens have leg damage and leg pain especially in the last week before slaughter, one consequence being that their ability to walk is impaired. In one study 90% of broiler chickens had some walking ability impairment in the last week before slaughter and 26% had a severe impairment. In another using a broiler strain used in many countries 30% of birds on commercial farms had severe walking difficulties by market age. It is widely known that birds with weak legs sit on litter and when the litter quality is not good many chickens, as a consequence, have contact dermatitis visible on carcasses as breast or hock burn. A comparison of 1957 and 1991 strains of broilers showed that growth rates and, hence, leg problems have an origin which is much more a consequence of genetics than of food quality.

The poor welfare which occurs in broiler chickens as they near the age of slaughter affects a very large number of individuals and may well be the most serious animal welfare problem in the world today. However, the problems can be solved. Birds can be bred for stronger legs but some slowing of growth, by genetic selection or management, is essential for a real solution. Leg problems can be reduced if food intake is limited for a period during growth. Some problems are exacerbated by high stocking density so this should be limited to a maximum of 25 kg m^{-2}.

For broiler breeders, the major welfare problem is probably hunger. Selection for fast growth means that the breeding birds would eat too much if fed *ad libitum*. However, the level of feeding normally used means that broiler breeders are hungry for most of their lives.

The selection of hens has taken insufficient account of the need to minimise injurious pecking and other welfare problems. Successful genetic lines in future will have to be those for which good welfare, as well as egg-production, has been a major factor in selection procedures.

Conclusions

Animal welfare is a factor in the sustainability of systems and procedures. Welfare includes feelings and health and studies of stress and welfare help us to understand needs. There are very serious problems for hens in battery cages which result in poor welfare. In order to solve these, the basic needs of hens, including those to show certain behaviours must be met. This is not possible unless the space available and design allows the provision of: a nesting place, a perch, possibilities for dust-bathing and

investigatory pecking, and room for walking and wing-flapping. No small cage can provide this. Design of hen accommodation and genetic selection of birds should be such that injurious pecking is minimised.

Broiler chickens must be genetically selected for stronger legs and slower growth. Stocking density must be limited and methods of enriching the environment in adequately illuminated conditions should be used.

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ANZCCART Workshops on the welfare of transgenic animals

ANZCCART will be holding workshops on this very topical subject in Sydney and Melbourne on 28 and 30 November, 2001.

The Sydney workshop will be held at the University of New South Wales and the Melbourne workshop at the Parkville Campus of Monash University. Each will commence at 9.30 am and finish at 3.30 pm and will cover the following topics:

* ethical issues;
* welfare issues;
* how to measure welfare of transgenic animals; and
* legislative issues.

Speakers will include scientists and representatives of animal rights groups. All are welcome.

Notes will be produced for participants and will also be posted on ANZCCART's website.

For further information, including the program and registration, contact ANZCCART's website –

www.adelaide.edu.au /ANZCCART/

or email ANZCCART at-

anzccart@adelaide.edu.au

New Zealand Royal Commission on genetic modification

A Royal Commission is regarded as having greater prestige than any other type of inquiry. Thus, it is a measure of the perceived importance of the subject that such a Commission was appointed to report on the strategic options for New Zealand, with regard to genetic modification.

The Commissioners consisted of Dr. Jacqueline Allan(Maori and Medical Issues), Dr. Jean Fleming (scientific research, reproductive biology), Rt. Rev. Richard Randerson (Anglican Bishop) and the commission was chaired by The Rt. Hon. Sir Thomas Eichelbaum(former Chief Justice). The Commissioners faced the formidable task of forming opinions on a highly complex field with a total experience that did not always cover completely, that which was reviewed.

Information was collected from oral and written submissions, from public opinion surveys and with specific input from Maori, on the grounds that New Zealand has a shared culture, which is underpinned by the Treaty of Waitangi (1840). Although the aim was not to conduct a referendum, it was predictable that the median of the wide range of views would be the accepted final view of the report.

The Commissioners took great care not to accept uncritically that which surrounds (and frequently confounds) any debate, and could be termed biotech-mythology (e.g., Kaatz's bees, GMO toxicity, perceived risks etc.). The important principle of clearly separating discussion of the product from the consideration of the process was mostly maintained. Readers may be a little surprised however, at the suggestion that synthetic genes or mammalian homologues be used wherever possible, to avoid the use of genes derived directly from humans (Rec. 7.6).

This short review concentrates mainly on the comments and conclusions involving the aspects of the report that cover ethical processes and the use of animals in research and teaching.

The main recommendation was that New Zealand could not be free of all genetically modified material BUT there should not be unrestricted use of such material. The basis for this overall conclusion are well discussed.

General impact

Currently, the production, containment and use of GMOs is regulated by The Hazardous Substances and New Organisms Act (1996), the HSNO Act. Briefly, manipulations that are regarded as 'risky' are controlled by a central assessment body, the Environmental Risk Management Authority (ERMA), which is set up under that Act. Other manipulations are covered and monitored by Institutional Biological Safety Committees (IBSCs) which are audited from time to time by ERMA .

Of the 47 recommendations, approximately seven will require amendments, and at least four will require changes to the Act. Three or more need more consultation and debate before being considered. The implementation of the current HSNO Act has been controversial and costly, but there is no recommendation that it should be recast. Legislation like HSNO, is analogous to a 'regulatory net'. Simple alterations to single components may cause the whole net to become distorted.

There are three main additional recommendations.

Field Trials

There was obviously a large amount of discussion on this topic ,particularly in relation to organic, conventional agriculture and integrated pest management. Many will consider it unfortunate that final decisions could be political. If a Minister is able to veto situations in which he/she regards risks are not acceptable, this might be contrary to balanced scientific judgment. With the current MMP system in NZ, coalitions are likely to persist. It is hoped, at least, that the selection processes for appointing Ministers will favor persons who can access informed advice without relying on doctrinaire views.

An extra category of ERMA approval is recommended. Not only can GMOs be approved for field release, but an additionally, approval may have conditions attached.

A new Bioethics Council

Although the Commissioners state that they approve of the current system of ethical review in NZ, there are sections where their understanding of that system seems inconsistent. Currently there are, a national HRC ethics committee and a National Animal Ethics Advisory Committee both set up under statutes. The Minister of Health may set up an additional advisory committee. The Gene Technology Advisory Committee advises the Director-General of Health on scientific and technical aspects of gene therapy and xenotransplantation before ethical review by Institutional ethics committees. Committees function well only if they are set up with members appropriate for filling a definite prescribed role. Tech-nical and ethical functions are quite different, albeit connected. ERMA and GTAC have no ethical advisory role except they could draw attention to matters that an ethical committee should consider.

If the Commissioner of Patents and plant biologists require ethical and/or cultural advice it seems costly, and unnecessary to set up an all embracing Council to cover them and areas already well served. The recommendations do not indicate whether the proposed Council will duplicate or even replace the expertise already in place.

Parliamentary commissioner on Biotechnology

Administratively, to set up a position analogous to the Commissioner of the Environment would appear tidy. Unfortunately the two fields are not comparable. Biotech-nology is highly complex and includes the environment. To cover an auditing, monitoring and consultative role in all areas requires a rather special person(s). If such a Commissioner addressed some of the points raised in the Report, he/she would have to predict future trends, inform or establish public perceptions of Biotech-nology, follow international trends and follow what is being done (or not) in NZ and probably by their overseas associates.

The Report does deal with some aspects of confidentiality and Intellectual property but not in relation to

the proposed commissioner. To complete that task envisaged, the parliamentary commissioner would need to have the trust and respect of the biotechnology workers or even the authority to insist on being informed of projected work. In addition, it suggested that the commissioner would audit and presumably report on five Ministries, ERMA, the Australian and New Zealand Food Authority, the Bioethics Council and maybe the biotechnology companies. An Ombudsman is another model on which the commissioner's role is based. It should be noted that complaints procedures and processes for second opinions are already insisted upon in human and animal ethics systems.

Several submissions to the Royal Commission requested that bureaucracy should be pruned rather than increased. Readers of the Report may well wonder whether accepting the recommendations will achieve that end.

The author would like to thank David Bayvel (Biosecurity, MAF) for his assistance in the preparation of this article.

John Marbrook
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National Animal Ethics Advisory Committee
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New Zealand

Book Review

The brushtail possum: biology, impact and management of an introduced marsupial

T.L. Montague (Ed)
Manaaki Whenua Press.
Lincoln, Canterbury, New Zealand. 2000

ISBN 0 478 09336 5
Price: $NZ59.95

Acclimatisation, the redistribution of animals and plants across the world, is one of the more arrogant ideas ever to be adopted by "biologists" and politicians. The first meeting of an acclimatisation society was probably held in Paris in 1854. However the movement was world-wide in its impact and soon gained hold in Australia in the early 1860's. The acclimatisation societies in New Zealand were real enthusiasts as here was an environment largely free of native mammals and birds. Into this scene were introduced stoats, moose, various deer, many avian and fish species and medicinal leeches. However the major introductions were from Australia; for example several marsupial species were imported to relieve the country of its faunal deficiencies.

Among the introductions from Australia was the brushtail possum (*Trichosurus vulpecula*); initially imported by private individuals in 1837 but later given legitimacy by acclimatisation societies. One of the side benefits was to supply the profitable Russian and American fur trades. The introductions have been successful: 60 to 70 million of the animals occupy more than 90% of the country and occur in densities of up to 25 individuals per hectare. They damage native forests and agriculture, act as a vector for bovine tuberculosis and are a significant predator on small birds. They reach population densities up to 20 times higher than those recorded in Australia, relishing the lack of competition from other arboreal mammals, a lack of parasites and a forest ecosystem less chemically defensive than the sclerophyllous habitats of Australia. In the 1930s the emerging conservation movement clashed with the acclimatisation societies, the latter having benefited from possum pelt sales. Not until the early 1950s did the government introduce possum control: this initiative now expends about NZ$50 million each year.

Tom Montague's edited volume, "The Brushtail Possum", is a significant publication which documents many aspects of the possum and its control in New Zealand. The book has four major sections which detail possum biology and the history of introductions and subsequent controls, the relation of possums to the spread of tuberculosis, economic damage to agricultural crops, and damage to native forests and predation on native species, particularly birds. For a volume boasting 41 authors the treatment is relatively uniform. Nigel Barlow treats us to an introduction of epidemiological modelling, there is a chapter on public perceptions of possum control, Tom Montague and Bruce Warburton write euphemistically about "non toxic" control and Phil Cowan discusses the prospects of biological control of the species. There is also a chapter by Terry Fletcher and Lynne Selwood which can serve as a good introduction to marsupial reproduction and some effective tables on population densities since the early 1970's assembled by Murray Efford. The standard of this hardback production is excellent, with good figures and a pleasing layout and type style. At NZ$59.95 the book is good value.

Where is the relevance to ANZCCART and its theme of humane science? It primarily lies in the book's concluding chapters on biological control and on decision systems for management of the species. Phil Cowan discusses the approaches to biological control through parasites, diseases and physiological control and the scope of available vectors. Much of this work is laboratory based and highly experimental. Cowan is intrigued with the possibility of inserting genes for contraceptive antigens, as well as those for protection against bovine tuberculosis into the same vector. Dr Cowan concludes his chapter with a discussion on the social and political issues involved in the biological control of possums. To conclude the book, David Choquenot and John Parkes discuss decision support systems for possum management. Decision systems such as this are full of "what-if" scenarios, again begging comment from those concerned with ethical welfare and pest management.

There are few books which attempt treatment of this breadth: perhaps it may offer a better format with which to address significant problems rather than the usual diffuse papers scattered in journals which are becoming increasingly difficult to access. It is a valuable compendium of a problem with enormous ethical consequences if we get it wrong.

Russell Baudinette
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Adelaide University
SA 5005

Letters

The use of neuro-muscular blocking agents without anaesthesia

I write to describe an instance in which wise guidelines were deemed not to apply in rather unusual experimental circumstances.

At the core of this communication is the non-noxious use of neuromuscular blocking agents without anaesthesia, a technique that could not be avoided if the scientific questions were to be answered. The guidelines were those of the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (1997). The interaction between the domains of the science, the procedure and animal welfare is of interest.

The scientific questions

Our laboratory in a teaching hospital/medical school uses rats for two models of a form of human epilepsy - convulsants are administered intravenously in a chronically prepared animal (operated on two to four weeks before, pentobarbitone anaesthesia 60mg/kg intraperitoneally). We use sophisticated methods of analysis of the electroencephalogram (EEG) to reveal processes occurring as the convulsive state develops. In normal circumstances it is possible to measure EEG rhythms between one and 100 Hz. Until now, there has been no method suitable for examining higher frequency rhythms because, as animals move, chew and have convulsions, electrical activity from muscles is also present in the recordings, confounding the measurement of higher frequency rhythms. Similarly, gross movements of the animal disturb the cabling, which, even though electrically shielded, produces low frequency shifts in electrical signal. No-one, as far as we are aware, has been able to examine the role of high or very low frequency EEG rhythms in epileptogenesis and from our own work, we could see that we were not 'seeing' everything by measuring between one and 100 Hz. The reason this proves to be important is that epilepsy may turn out to be due to excessive strength of endogenous rhythms and if there are rhythms below one or above 100 Hz normally they may be critical in the generation of seizures.

I should point out that humans having generalised seizures are unconscious and one expects that non-human animals would be as well. If so, the experiments in which seizures are induced are not noxious in the sense of causing pain. Furthermore, anaesthetic agents block seizures, so that the experiments cannot be performed with the use of any anaesthetic agent.

Non-noxious artificial respiration via the nose

Rat experimentalists perform recovery surgical procedures under a variety of anaesthetic agents, some of which provide better analgesia than others. Those using pentobarbitone are aware that deep anaesthesia is required because at low doses, pentobarbitone does not block responses to noxious stimuli. More than deep anaesthetic doses of pentobarbitone cause cardio-respiratory suppression, usually resulting in death of the animal. After several hours of painstaking surgery, the impending death of the animal is dismaying from many points of view in addition to the unwanted loss of an animal. Under such circumstances, we have been used to performing 'mouth-to-snout' resuscitation, that is to say, applying a 1.5 cm diameter plastic tube to the rat's snout and puffing gently on the other end. By watching the rat's abdomen, it is possible to mimic the movement one expects to see in a spontaneously breathing rat. This simple procedure regularly resurrects what previously was regarded as a terminal experiment. From 5-60 minutes of artificial respiration are easily survived.

It is important to remember that humans are unique in having a low larynx, so that the analogous approach in humans requires that a face-mask covering the mouth be used. In all other animals, as far as I am aware, the larynx lies above the soft palate at the level of the nasopharynx so that inflation of the lungs occurs if one applies air under pressure via the nose.

In view of our experience with artificial respiration in over-anaesthetised animals, it was clear that we could apply non-noxious artificial respiration successfully in animals in which we induced neuromuscular blockade. The latter would then allow us to record frequencies below and above our usual range in animals having seizures. Clearly, endotracheal intubation without anaesthesia would be unacceptable.

The Animal Ethics Committee (AEC)

Our initial application to undertake preliminary studies of seizures in neuromuscular-blocked animals was rejected because the Australian Code of Practice states that 'immobilisation of an animal solely with a neuromuscular blocking agent is not acceptable (3.3.39)', a guideline all scientists would support.

Because in our experiments, unlike nearly any other experiment for which anaesthesia would be required, animals were not being subjected to any surgical procedure or any other procedure causing pain, it therefore seemed that anaesthesia should not be required. To make progress on this matter, I approached our University's AEC. I was advised that if it was the Code of Practice that was at issue, I should discuss the matter with the NHMRC Animal Welfare Liaison Officer. Her advice was that the Code, while it constitutes a powerful guide to practice, is to be considered in relationship to specific experiments and scientific outcomes, and that the Code of Practice is not meant to be automatically applied without consideration of specific situations.

Our group reapplied for animal ethics approval with the advice from the NHMRC included in a covering letter. The application was received by the University's AEC and given serious deliberation. We received permission for several preliminary studies using neuromuscular blockade without anaesthesia with the requirement that members of the AEC attend to observe proceedings. Subsequent to the completion of the few preliminary experiments, a report on the outcome of the experiments would be expected.

Our preliminary experiments revealed that we could maintain normal oxygen and carbon dioxide pressures using the snout mask coupled to a small animal ventilator. The tube is held to the snout by hooking a small side-hole in the tube over the animal's incisor teeth. The method is simple and effective and, to my mind, might be applicable in many experimental situations where artificial respiration is required and which is usually given by endotracheal intubation or by tracheostomy.

We received approval for our NHMRC application and our preliminary studies have been revealing in regard to epilepsy pathophysiology.

John Willoughby
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Flinders University and Flinders Medical Centre
Adelaide, SA

Reply to hot topic

Congratulations on the Hot Topic, *How can an AEC assess the scientific validity of a project?*, chosen for the June 2001 issue of *ANZCCART News.*

I consider it to be essential that all proposals involving the use of animals be subject to scientific peer-review, and now that private sources of funds are becoming ever more important if medical and biological research is to continue, it is time to set standards for the independent scientific peer-review of protocols which cannot be guaranteed to have undergone such a process before the proposals reach the AEC.

It is important to note that in addition to the sources of funds you mention protocols may also be funded by groups of medical specialists and, more and more, by charitable groups with a special focus on health. In South Australia the Flinders Medical Centre Foundation is an obvious example, but there are several others as well, such as the Arthritis Association. The lists of funds distributed to investigators, as shown in the magazines of such organisations, make it look as if the money is usually used to top up a University or NHMRC grant, but this may well not always be the case. There seems to be no indication of how protocols are accepted for funding, and there is no reference to ethical clearances.

The starting-point in deciding how to deal with the AEC's problem has to be that all protocols involving animals must be subject to scientific peer-review. This must be non-negotiable. So the question you pose, "What if the proposed work involves invasive experimentation on a large number of animals?" is dealt with as it would be in respect of applications to the University, the NHMRC or the ARC.

The real difficulty is how the AEC does a scientific peer-review. When I served on an AEC, we did our best by questioning the applicants, taking advice from outside experts when we could get it, and putting a heavy burden on our veterinary and scientific members and the Animal House staff. As we did not have many such applications involving finance from non-standard sources, I believe we managed to avoid making mistakes; but this ad hoc method is not adequate now that funds are being sought more often from sources which cannot be assumed to have a system of independent peer-reviews.

My suggestion is that a scientific peer-review should be undertaken on behalf of the AEC and that all expenses should be paid by the company, group or charity funding the protocol.

How would the reviewers be selected? I believe the responsibility for suggesting panels of reviewers could best be discharged by the NHMRC for medical research and the ARC for non-medical research. There may of course be other, more appropriate, bodies with which I am not familiar. It is simply not possible for an individual AEC to guarantee to find the most appropriate people, and moreover I do not think it would be satisfactory for AECs to create their own list: the panels should be selected by a national body to ensure as much impartiality as possible.

The policy of inviting applicants to discuss their protocol with the AEC is one with which I am in total agreement, and I would continue to advocate it whatever the proposed source of funding.

Elizabeth Close
Past Chairperson of Flinders University Animal Welfare Committee
and Former Chairperson of ANZCCART
Adelaide, SA

New Publication by ANZCCART

Farm Animals in Research – can we meet the demands of ethics, welfare, science and industry?

This 128 page monograph contains the Proceedings of the very successful conference held at the University of Adelaide on Thursday, 30 November and Friday, 1 December 2000. The Proceedings have been edited by Dr Robert Baker, Dr Mark Fisher and Professor Paul Hemsworth and contain six sections and 21 contributed papers.

This conference addressed basic and applied research using farm animals and considered how this is driven by science and industry and what are the ethical and welfare issues associated with such research. Farm animals are used widely for agricultural and veterinary research, as well as being used as models for basic biomedical research.

Issues covered by the speakers include:

* farm animals as experimental models for research;
* environmental enrichment of farm animals;
* xenotransplantation;
* cloning and transgenic animal production;
* aquaculture;
* cattle feedlot research;
* crocodile farming;
* views from a philosopher, a scientist and an animal rights representative.

Copies are available for $A44, including postage in Australia and New Zealand, and an order form is enclosed with this issue.

Coming up

Alternativas 2001

First Caribbean and Latin American Workshop on Alternative methods

Santiago de Cuba
4-5 December, 2001

Contact: Dr Ulpiano Perez
email:
uperez@toxi.scu.sld.cu

Australian and New Zealand Society for Comparative Physiology and Biochemistry

18 Annual Meeting
6-9 December, 2001
Adelaide

Convenor: Dr Sandra Orgeig
Tel: 08-8303-6127
Fax: 08 8303 4364
email:
sandra.orgeig@adelaide.edu.au

IACUCS and Research Animal Welfare Conference

10-11 December, 2001
San Antonio, USA
Scientists Center for Animal Welfare

Fax: 1-301-345-3503
email: info@scaw.com
website: www.scaw.com

Australian Veterinary Association Annual Conference
Adelaide
6-10 May, 2002

Includes two day program by AVERT on animal ethics issues.

For further information, contact:
avacos@ava.com.au

Tel: 02-6273-8855
Fax: 02-6273-8899

Fourth World Congress on alternatives and animal use in the life sciences
New Orleans, USA
11-15 August, 2002

email: dpease@hsus.org

website: www.worldcongress.net/

News

International course on Laboratory Animal Science

May 27 – June 7, 2002

A two week intensive course on laboratory animal science will be held at the Department of Laboratory Animal Science of the University of Utrecht, The Netherlands in May/June 2002. The objective of this course is to present basic facts and principles that are essential for the humane use and care of animals and for the quality of research.

The contents of the course are in line with recommendations of the Federation of European Laboratory Animal Science Associations (FELASA) regarding the training of the young scientists whose research involves the use of vertebrate animals.

The course may also be of interest for those who intend to set up a similar course at their location. For this purpose, during the course the acquisition of teaching materials can be discussed with the course committee. For more in-depth information on specific topics there is an option for participating in one of the following modules:

* Genetic monitoring
* Nutrition
* Anesthesiology
* Microsurgery
* Primatology

Each of these modules will take two days (microsurgery three days). The modules will be organized directly after the two week course (Monday – Tuesday, June 10 – 11).

For information and application forms please contact:

Prof. Dr. L.F.M. van Zutphen
Department of Laboratory Animal Science
University of Utrecht
PO Box 80.166, Utrecht
The Netherlands
Fax: 31-30 2537997

Email: pdk@las.vet.uu.nl

ANZCCART's Housing Monograph well received

The publication of this 150 page monograph, *Housing for rats, mice, guinea pigs and rabbits* by Dr Ann Hargreaves, late last year has seen very pleasing reviews and a very good response from scientists, animal technicians and institutions.

Copies are available from ANZCCART's Adelaide office for $A55.00 (including postage in Australia and New Zealand).

An order form is posted on our website – www.adelaide.edu.au/ANZCCART/

Planning for the Fourth World Congress

The program for this major conference, to be held in New Orleans from 11-15 August, 2002 is now being prepared. The overall theme of the conference will again be alternatives and animal use in the life sciences. The conference website is : www.worldcongress.net./

Professor David Mellor from Massey University, New Zealand is acting as coordinator for the Australian and New Zealand input to the program.

For further information, contact Professor Mellor on Email: D.J.Mellor@massey.ac.nz or Donna Pease at the Humane Society of the United States on dpease@hsus.org

Grants for work towards the reduction of animal use in research, education and product testing

The Humane Society International (HSI) is offering a number of small grants to community organisations, of between $500 and $1000, as a contribution towards local, regional and national activities, aimed at reducing animal use.

The types of activities which will be funded include development of interest groups within universities where students may support the use of alternatives in their education; development of education resources; general public education; computer modeling; conference presentations or papers; other publications and other carefully targeted advocacy activities. The HSI's main interest is in how the proposals' outcomes will affect the use of animals in research, education and product testing.

Proposals, including a descriptive title, should be not more than two pages, highlighting the project's expected outcomes and how these outcomes will be evaluated. A brief profile of your organisation/group should also be included. This grant program is open to all not-for-profit organisations, associations and university groups.

The closing date for this first round of grant applications is October 31, 2001. Applications should be addressed to
The Director,
Humane Society International,
PO Box 439, Avalon,
NSW 2107
and marked "Small Grants Program".
E-mail applications are accepted: admin@hsi.org.au

HSUS Pain and Distress Report

This new quarterly publication from the Humane Society of the United States is a four page newsletter available free-of-charge electronically. It aims to provide animal ethics committees and others with up-to-date information on issues regarding pain and distress in laboratory animals.

It includes short news items, helpful websites, including the resources of services available from the HSUS, recent publications and technical notes.

To receive electronic versions of the reports, contact the HSUS at ari@hsus.org

ANZCCART News is published quarterly by the Australian and New Zealand Council for the Care of Animals in Research and Teaching Limited.

It is a publication for researchers and teachers; members of animal ethics committees; staff of organisations concerned with research, teaching and funding; and parliamentarians and members of the public with interests in the conduct of animal-based research and teaching and the welfare of animals so used.

Contributions to ANZCCART News are welcomed and should be sent to:

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