Ultimately, this diverse and truly international collection of articles does succeed in informing the reader about important global issues, trends and challenges in animal welfare, and in my view, achieves the stated objective of this publication to "communicate the international leadership role of the OIE in animal welfare issues".

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International Zoo Yearbook, Volume 40

Edited by FA Fisken, B Holst, M Hutchins, C Lees, A Rübel, M Stevenson and C West (2006). Published by Blackwell Publishing, UK on behalf of The Zoological Society of London, Regent's Park, London NW1 4RY, UK. 528 pp Paperback (ISSN: 0074-9664). Price £96.

The *International Zoo Yearbook* has been a major source of information and communication for zoos internationally for several decades. Although its role is not as crucial as it was in the days when it was practically the only source of reliable information, there remains no better book or publication at combining theoretical and practical articles with valuable reference information about zoos, zoo associations, and studbooks. The theme of this 40th issue and the totality of section 1 is elephants and rhinos, in both captivity and the wild; covering their conservation, management, reproduction, care and behaviour. It is the first time they have been featured in the yearbook, surprisingly enough, considering their popularity with visitors as captive animals in zoos and as subjects of research and conservation by scientists and managers, both *in situ* and *ex situ*.

A wide array of topics are presented, including very welcome overview conservation articles reviewing the status, distribution and biology of Asian elephants by renowned expert R Sukumar and the conservation status and threats to African and Asian rhinos by a whole collection of rhino experts. There is a good representation of topics for both taxa, ranging from reproductive physiology, behaviour, feeding and captive care, population biology and management, welfare, training, human-elephant interactions, and a report on the EAZA rhino campaign. Almost half of the articles deal with topics which contribute to the animals' short-term welfare, such as research in operant conditioning, feeding, veterinary care and welfare, etc.

The second part of the *Yearbook* deals traditionally with a variety of taxon groups and topics pertinent to zoos. Design, nutrition, breeding, behaviour, design and exhibitry, hand-rearing and programmes for a diverse array of species originating primarily throughout the non-western world make up Section 2. Articles cover nearly all major groups: fish, amphibians, birds, and mammals. It is particularly satisfying to find peer-reviewed articles on such practical topics as hand-rearing, nutrition and design

Finally, the reference section includes its usual very useful lists of zoos, zoo associations and studbooks, an appendix listing taxonomic authorities consulted for the *Yearbook*, indices to *Yearbook 40* authors and subjects and instructions for authors. The entire reference section has been downloaded to a CD which is invaluable to store in a convenient space in one's office or even computer. Updated yearly, this quick guide to some basic stats of the world of zoos, is invaluable.

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Seeing red: A study in consciousness

N Humphrey (2006). Published by The Belknap Press of Harvard University Press, Cambridge, Massachusetts, USA. 151 pp Hardback (ISBN 0-674-02179-7). Price £12.95.

Everyone concerned about animal welfare should be interested in the problem of consciousness because the ability of non-human animals to consciously experience positive and negative mental states is both a driver, and a key assumption, underlying these concerns. Even if we accept this assumption, there are others who do not, and the question of how widely the assumption can be spread — just to primates, to all mammals, to all vertebrates — undoubtedly impacts on how we view, treat and legislate for different species.

On the other hand, what can we ever really know about the conscious experiences, the thoughts and emotions, of other people, let alone other species? Doesn't the private subjective nature of consciousness make it fruitless to endlessly speculate and theorise on what it is, what it's for, and how it relates to the wet material stuff of the brain? Indeed, isn't the psychologist Stuart Sutherland's assertion, quoted by Nick Humphrey at the start of his book, absolutely spot on? "Consciousness is a fascinating but elusive phenomenon; it is impossible to specify what it is, what it does, or why it evolved. Nothing worth reading has been written about it".

Humphrey has been thinking and writing about consciousness for three decades, and might justifiably take some offence from this quote, but instead he uses it as a jumping-off point for his book which is a succinct and updated summary of a theory he developed in the early 1990s, and based on guest lectures given at Harvard University in 2004. He sets out to address the issues raised in the quote: what is consciousness, what does it do, why did it evolve, and to propose a new approach to answering them. He also hints tantalisingly at the start of the book that the quote itself may unexpectedly provide a clue as to why consciousness matters and why it has evolved.

The device that Humphrey uses is to consider the experience of seeing the colour red. He starts by dissecting what happens when a subject sees a red screen, and he suggests that there are two types of thing going on — one *phenomenal* and the other *propositional*. The phenomenal component is the subjective sensation of seeing red – the raw feel or *qualia* of redness. The propositional component is the "ideas — beliefs, opinions, feelings" about how things are in the world (eg the screen is red) and about the sensation itself (eg I am having a *visual* sensation). The use of the word "feelings" here is slightly confusing and I will return to this later. Humphrey goes on to argue that a subject seeing red also gets to "experience himself as an experiencer". By this he means that the act of consciously experi-

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encing a sensation somehow confirms the existence of the person or 'self'.

Having sketched a framework of what happens when one sees red, Humphrey then asks why the different components exist and how they relate to each other. His particular interest is in the phenomenal component, the raw feel or qualia of redness, which he equates with *sensation*, as opposed to the more symbolic, logical, processed information of the propositional component which he equates with *perception*. He considers and dismisses the idea that there is a serial chain process leading from sensation to perception, and instead suggests that there are parallel processes, one that generates sensation and the other that generates perceptual information. He draws on several lines of evidence to support his argument, including the well-known phenomenon of blindsight wherein patients can carry out perceptual tasks (eg guessing the location or shape of an object) without reporting any conscious visual sensation. He also movingly recounts his experiences with the apparently blind monkey, Helen, that played a part in the discovery of this phenomenon.

Humphrey acknowledges and addresses objections to the dissociation of sensation and perception, one of which being "if sensations are not involved directly in perception, then what *are* they involved in? What's the *point* of them?" In answer to this, he cites information from blindsight patients suggesting that an absence of conscious sensation somehow diminishes the person's sense of engagement with the world, and their sense of self. Hence, maybe sensation plays a role in establishing one's own identity, a theme that is returned to at the end of the book.

A key part of Humphrey's thesis involves the construction of a possible evolutionary pathway explaining the separate evolution of sensation and perception processes. He suggests that primitive single cell organisms evolved specific and adaptive active responses, or what he calls "wriggles", to incoming stimuli such as pH or saltiness or red light. Over evolutionary time, as life for the organism became more complex, it would have benefited from "a mental representation" of stimuli at its body surface which could then be used for more sophisticated decision-making. Humphrey argues that rather than evolving such a system from scratch, it would be most parsimonious to tap into active responses, or "wriggles", that the organism was making to these stimuli because these already carried information about the nature of a stimulus, its location and how it should be dealt with. The organism should thus "monitor what it itself is doing" in order to produce a "qualitative, present-tense, transient and subjective" picture of what was happening locally to it — the prototype of sensation as we know it today. On the other hand, Humphrey suggests that a different sort of information would have been needed to evaluate what was happening beyond the borders of the organism, "out there in the world", and that the local information encapsulated "wriggles" would not have been sufficient to provide this. Instead he proposes that a separate "quantitative, analytical, permanent and objective" processing channel evolved, independent of the primitive one and became the prototype of perception.

A final step in the argument is the suggestion that, as the organism increased in complexity and became more independent from its environment, it ceased to need to respond directly to surface stimuli. But rather than losing this "wriggle" response system entirely, Humphrey suggests that it still had value in informing the organism about what was happening to it, and so the system became "privatized", still issuing response commands to stimuli but not actually executing these. Instead, these were transmitted through "short-circuited" internal loop structures somewhere in the brain and became the basis for phenomenal consciousness and sensations. Interestingly, it follows from this hypothesis that sensations are something to do with the effector or production side of the mind rather than the reception side, and Humphrey suggests that this might fit with recent ideas about empathy, which view the imitation of others' bodily *actions* as important mediators of shared experience. Perhaps of more direct relevance, and indirectly alluded to be Humphrey, it also has echoes of the James-Lange theory of emotion which posits that felt emotions result from sensing or monitoring the body's response to events in the outside world. It is worth noting that although this theory remains influential, its relevance is debated in contemporary emotion research (Lang 1994).

Humphrey closes the book by considering what he refers to as "the *hard* problem, the X factor" of consciousness. This is earlier defined as "the extra feature that somehow lifts ordinary sensory experience into the realm of phenomenally rich conscious sensory experience" (implying that 'ordinary sensory experience' is not conscious?). He suggests that a candidate for the X factor is the perceived depth of passing time — our conscious experience of 'now' is temporally thick and not just of a fleeting moment — and proposes that his theory could account for this consciousness phenomenon. He argues that the internalised loops of his hypothesised sensation system may have evolved and interacted with incoming sensory inputs to produce self sustaining recursive or 're-entrant' circuits. Researches and theorists have indeed postulated that such circuits may play a role in the special qualities of consciousness, and Humphrey suggests that they might be neural correlates of the experience of temporal thickening. Further, he posits that temporal thickness is a key feature of phenomenal consciousness because it gives substantiality to the experience of being to the 'self' — and this experience is so mysterious and special that it itself may hold the reason for why consciousness has evolved. "The more mysterious and unworldly the qualities of consciousness, the more seriously significant the Self. And the more significant the Self, the greater the boost to human self confidence and self importance-and the greater the value that individuals place on their own and others' lives". So, as illustrated by Sutherland's quote at the start of the book, consciousness is mysterious, and Humphrey argues that the very mystery of consciousness may be the reason it has been so successful in human evolution;

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conscious beings strive for success to preserve and continue the 'specialness' of their conscious selves.

Humphrey has written an interesting and absorbing book. It provides a concise and highly readable overview of a very personal view of the consciousness problem. Of course, as with any work in this area, it has received criticism and scepticism from other researchers, and some of these are summarised by Humphrey himself and in a special volume of the *Journal of Consciousness Studies* (vol 7, pp 5-112, 2000). I also had problems with some of the arguments presented. I felt the critical distinction between phenomenal (sensation) and propositional (perceptual) components of experience and their relationship to conscious experience could have been made more clearly. Humphrey appears to be arguing that raw feels or qualia are the preserve of the phenomenal system and yet, confusingly, uses the word "feelings" (about how things are in the outside world) in his definition of the propositional system. Indeed, when we think logical, rational (propositional) thoughts, we usually experience accompanying subjective states and perhaps these are the qualia of propositional experience? If so, the phenomenal/propositional distinction becomes muddied, hence undermining the structure of Humphrey's argument.

I also found the limited reference to neuroscientific evidence surprising, given Humphrey's undoubted knowledge of this field. The book is a philosophical work but it does make assumptions and predictions about the design of the visual system, and some discussion of how these match with the well-researched neurobiology of vision, in particular when using the phenomenon of blindsight to exemplify the sensation/perception distinction, would have been illuminating. For example, there appear to be several different neural pathways involved in visual processing (eg Danckert and Rosetti 2005), rather than two clearly distinct 'sensation' and 'perception' systems — how does this fit with the hypothesis? Residual 'perceptual' abilities remain in the absence of one of the pathways (to primary visual cortex, V1) that seems to be needed for conscious visual sensation. Apparent limitations to these abilities would suggest that V1 plays a 'perceptual' role too. If so, is this a problem for Humphrey's ideas? Providing testable hypotheses for the evolution of consciousness is a tall order, and it has to be remembered that such hypotheses are fashioned in relation to the knowledge of the time. Hence, one would expect them to generate ('just-so') predictions that match current understanding (eg Humphrey's hypothetical feedback loop system nicely matches current knowledge about recursive neural circuits that may play a role in conscious experience). Nevertheless, some more discussion of the matches and mis-matches between hypothesis and knowledge from cognitive neuroscience (of blindsight and other visual phenomena) would have been nice to see.

Does Humphrey's book have implications for our understanding of animal consciousness and hence animal welfare? This partly depends on the extent to which a hypothesis based on analysis of visual consciousness can be extended to sensory systems that are more heavily used by other species (eg olfactory or auditory systems in other mammals). In principle, however, the general evolutionary process that Humphrey proposes could, if it happened at all, have happened in other species. If it did, and if it was accompanied by the emergence of value for self and others that Humphrey intriguingly proposes result from wonder at the mystery of conscious experience, then that would certainly alter our view of the species in which it occurred. Currently, however, the only way to decide whether this is likely to have happened, and one which I would urge you to try, is to read this thought-provoking book and judge for yourself.

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