

## Sound stuff

David Pye

**The Sonar of Dolphins.** By Whitlow W. L. Au. Springer-Verlag: 1993. Pp. 277. DM 148, £58.50.

How must the world appear to other species, whose senses differ in varying degrees from our own? It is hard to imagine what it must be like to use natural echolocation, at which dolphins and bats excel. Although we now have a thorough understanding of echo principles and can



Fathoming the mystery.

produce excellent sonars for use in water and radars for air and space, there are still many problems in understanding the sonar of animals.

Sonar study itself has never been cohesive. Quite apart from the obvious differences between the size and needs of dolphins and bats, there are fundamental differences in the way they operate. These are probably associated less with their separate evolution than with differences between air and water as acoustic media, which also demand different techniques in their study. So there have always been 'bat people' and 'dolphin people', who only meet at the splendid but infrequent joint conferences run as NATO Advanced Study Institutes. Even the literature on dolphins often seems (to a bat person) to be in quite obscure publications, so the conferences were occasions of delight as everyone discovered what the 'other side' had achieved. Now at last there is a

comprehensive review of the dolphin story, and a 'batty' equivalent is devoutly to be desired.

For Whitlow Au has written a splendid book, which is likely to become a classic in its field, and of considerable interest well outside it. This is not only an authoritative reference work but it also contains a clear historical perspective and a treatment of all the fundamentals for a reader new to the subject. There is no excuse afterwards for thinking a decibel is a unit of sound intensity or for confusing peak-to-peak with root mean square amplitudes. (But is it merely an unfortunate slip to say, contradicting the adjacent equation, that sound pressure level, rather than intensity, decreases with square range?) The succinct accounts of time versus frequency domains, Fourier transformation, near and far fields, psychophysical methods and detection theory should all do much good.

There follows a detailed and systematic survey of dolphin ears, hearing and acoustic discrimination. Sound production, emission and directionality lead into analysis of the signals themselves and a comparative account of the pulses of 21 species (although echolocation has not actually been demonstrated in all of these) out of a possible 65. Inevitably parts of this will be seen by some as contentious, for matters lacking firm evidence have often given rise to heated dispute, some of which cannot yet be resolved — even the source of sound within the dolphin's head is still a mystery. But the author deals fairly and confidently with the confusion and conflict, presenting evidence and opinion in an admirably even-handed way that is both stimulating and reassuring.

Eventually the stage is set for reviewing the very impressive capability of dolphin echolocation, followed by its interpretation by acoustic theory and speculations on the neural processing involved. Again, some of this may be contentious but that is not the point — its stimulus will be justified if it leads to more than verbal dispute. At least this is a new starting point.

Finally Au takes a careful look at bat systems for comparison and concludes with a brief, moderate consideration of outstanding problems, deficiencies of past approaches and indications of future potential. The whole is beautifully produced and copiously illustrated with admirable clarity. □

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## Thinking in circles

Susan Greenfield

**The Creative Loop: How the Brain Makes a Mind.** By Erich Harth. Addison-Wesley: 1993. Pp. 196. \$21.

SCIENTISTS are finally waking up to the question of consciousness. The nature of the mind, for so long regarded as the terrain of philosophers, psychiatrists and cognitive psychologists, has become a growth industry among those with a detailed knowledge of physics and biology. Like most scientists who have produced books on the subject, Harth is not a neuroscientist; he is a physicist who nonetheless succeeds in keeping his background well under control. The chapters follow each other effortlessly in a witty yet authoritative style that should immediately capture the imagination of the general reader.

Harth starts with a refreshing departure from other forays into the mind-brain problem by reflecting on the frequently neglected question of the actual nature of life itself, and hence of the divergent development of animate, purposeful organisms away from inanimate objects. This approach brings a new perspective on the hoary issue of the physical versus the mental: the author focuses attention on the difference in objective time and space, where there is only local causality and isolated entities in a perpetual present, in contrast to the vast spans in time and space by which we bond together a subjective universe. In attempting to relate the objective to the subjective, Harth espouses a 'physicalist' standpoint: this approach, which has already been broached by such diverse authorities as the mathematician Roger Penrose and the philosopher Thomas Nagel, is that science may ultimately account for the talent of our brains to translate the physical into the phenomenological. But the current laws and relations that might be thought adequate by the 'materialist' to explain the mind will need to be supplemented by as yet unknown principles and laws.

The central question around which this book is written is basically that already publicized by Dennett as the 'Cartesian Theatre', the fallacious anatomical locus of consciousness. Like most who have contemplated this issue, Harth rejects the idea of a hierarchical pyramid of neurons leading to a final set of 'gnostic neurons' as a centre of consciousness. By contrast, he is reluctant to embrace the only apparent alternative, parallel processing. He rejects the idea of transiently salient 'multiple drafts' or 'bundles' of consciousness as ducking the issue of the undeniable cohesion and continuity of our individual awareness. If we 'demystify the brain' by

claiming it is like an anthill, then surely we have only 'mystified the anthill'.

Harth's solution is inspired by the observation that neurons are always relaying signals, never merely receiving them. The centrepiece of his theory is thus that reverberating loops of neurons are responsible for mental phenomena. In particular he makes much of the back projection from the visual cortex to the lateral geniculate nucleus (LGN) of the thalamus, an area that neuroscience neophytes normally view as a simple stepping stone in a one-way path up into the cortex. The obsession with this particular thalamo-cortico-thalamic loop inevitably makes Harth focus much of his contemplations on consciousness in terms of eidetic visual awareness, 'pictures in the head'. He accounts for the subjective quality of our vision as being at the behest of the signals bombarding the LGN from the 'higher' regions of the brain where memories, prejudices and the like will be generated. The more dominant this 'higher' input to the LGN, and hence the more unfettered from the sobering input of our retina, the more we will be at the mercy of our dreams, fantasies and delusions.

As it stands, this vision is not completely persuasive. Harth admits that the physicalist standpoint cannot yet account for the phenomenon of the feel of consciousness. Although this is a completely respectable and acceptable limitation, we might have expected, nonetheless, a richer account of the actual physical-chemical events in the brain itself, beyond the simple game of shuttlecock between relatively extensive regions of cortex and thalamus. Once he strays from this particular path, however, Harth becomes rather lost. He mentions the brainstem, yet does not elaborate on the way in which arousal might play a part in his scheme: he admits that beyond our vivid awareness of raw pictures, we would need to retreat into the 'neural jungle of the cortex': but then he leaves us there in uncharted territory, without any clue as to how more abstracted awareness might be subserved. He points to drugs and anaesthesia in support of the physicalist standpoint, yet he does not incorporate the actions of, say, LSD or morphine, let alone the powerful intricacies of neuro-modulation, into what remains in consequence a factually thin, impoverished viewpoint.

Even when we look beyond the machinations of actual neurons, it would have been helpful for the description of awareness of 'pictures in the head' to be placed in the context of other candidates for the seat of consciousness, not least the highly popular circuit linking another region of thalamus (the nucleus reticularis) and the cortex, which has been previously proposed to provide the all-important ingredient for making us conscious of the

otherwise unconscious. Another disquieting whitewash is that Harth dismisses the degree to which our consciousness is kept in touch with external reality by glibly referring to 'an internal logician'. This is surely tantamount to stretching out in the front stalls of the Cartesian Theatre, and certainly offers no new insight. But then again, Harth makes no claim to be a neuroscientist and cannot therefore be expected to produce an embroidered account of the intricate workings of cortical circuits in literal, physiological terms. The onus is surely on neuroscientists to develop a scheme free of metaphor and extending beyond one or two pathways, be they linear or looped.

Freeman Dyson is quoted at the beginning of a chapter as claiming that, "In dealing with the problem of consciousness, physicists have had courage but no competence, biologists have had competence but no courage". The book frames questions that really only neuroscientists can answer: it is high time they proved their worth. In the meantime, Harth transmits an infectious concern for the 'fuzzy' edges that surround the beginning of life, a contempt for the potential of the plodding analogues of computation and a plea that we are not changing into automata bereft of original ideas. The strength of this book lies not in its detail, but in its breadth and its humanity. □

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## Spreading information

*Jonathan M. Mann*

**The Slow Plague: A Geography of the AIDS Pandemic.** By Peter Gould. *Blackwell: 1993. Pp. 228. £35 (hbk), £12.99 (pbk).*

PETER Gould takes the readers of his book on a voyage, proposing to offer a new look at AIDS, with new vistas and horizons but, unfortunately, he leaves us disappointed and dispirited. He starts with an attractive thesis — that geographical perspectives on the human immunodeficiency virus (HIV) pandemic may offer a new insight — but simply fails to deliver on his promise. This is particularly frustrating as he is addressing the critical question of how to give shape (and therefore meaning) to a complex phenomenon, the global epidemic of HIV and AIDS.

It is true that existing 'pictures' of the pandemic are generally simplistic, failing to capture the diversity, differential in-

tensity and velocity, and unstable nature of HIV/AIDS in the world today. As a relatively new historical occurrence, the HIV pandemic is still highly dynamic, which includes its continued spread in all affected areas (in the United States, 40,000–80,000 new HIV infections are projected this year, along with about 75,000 new infections in Europe), its spread to previously little-affected places (such as rural areas or South-East Asia) and its highly differentiated and evolving nature within single urban areas such as Miami, New York, Paris or Nairobi. For all these reasons, the promise of a new approach to structuring our understanding of the pandemic, based on an emphasis on the 'space' of the geographer, is appealing.

The book is indeed initially stimulating, with sharp and pungent writing. The author's wide-ranging observations and speculations are full of energy and passion. He shines when criticizing others, which, at least at the beginning of the book, heightens our expectations.

The first disappointment is Gould's curious weakness for minor inaccuracies and a lack of precision. For example, he is mistaken when he labels the US Centers for Disease Control (CDC) "the international center for reporting the outbreak of diseases all over the world"; states that Sweden proposes that most people with AIDS should be put on an island; and reports that "tens of millions of WHO and CDC research dollars" were spent in Zaïre.

Second, the reader becomes impatient wondering when geography's critical insight will finally be articulated. For example, the chapter on Thailand, although entertaining, could have been written by any number of authors uninformed beyond general literacy about the science of geography. There are some excellent and interesting maps of cumulative AIDS cases in the United States (particularly in the Bronx in New York) and brief discussions of spatially contagious and hierarchical diffusion, yet these do not add enough geography to satisfy the reader.

But let us come to the central point. Having promised and failed to demonstrate how geography will make a critical difference, the author's real agenda emerges. He informs us that there has apparently been a conspiracy against geographers; every time they have tried to clear up the confusion about AIDS, they have been rebuffed. The following is typical of the tone of his discussion: "I want to . . . look at a few . . . aspects of the way bureaucratic power, combined with a deadly combination of Establishment ignorance and arrogance, suppressed any consideration of the spatial dimensions of the epidemic, denying both the scientific community and the general