

gramme. Skilled though they are in this field, the Brazilians had very little that the Chinese had not already developed or at least fully understood. It is difficult to see the agreement as anything other than a political investment, with perhaps the longer term goal of access to a launch site in the Southern Hemisphere.

Second, it would have been interesting for Harvey to have explored the telecommunications sector, the very slow break-up of the state monopoly, and the acceptance of foreign commercial investments to exploit satellite communication technology. This is probably the sector that will bring about the greatest visible change to life in China over the next few years. Ericsson, Motorola and their rivals worldwide all have a presence in China, and the once staid Ministry of Telecommunications is now on familiar terms with Iridium, Globestar and other global satellite networks.

Finally, I would have liked Harvey to have devoted a few pages to the opening up of space-related joint ventures, and to have examined the changes in Chinese internal organization and policy which these necessitated. Joint ventures range from the high-profile EuroSpace (a collaboration between Deutsche Aerospace and the China Aerospace Corporation) and Chinese government participation in the commercial satellite company Asia Pacific Mobile Telecommunications to more modest companies, such as the Canadian ComDev's joint venture with the Xi'an Institute of Space Radio Technology and the Shanghai Rockwell Collins company. Despite considerable bureaucracy at regional and national levels, the Chinese have been sufficiently flexible to put together business deals significantly more sophisticated than the usual agreements between space agencies.

By the same token, Harvey might have examined more closely the prospects for the commercial future of China's launcher industry. Despite setbacks, Chinese launcher services (now able to provide insurance and re-launch deals) are likely to acquire and retain about 10–15 per cent of the world market. The days of US-imposed launch limits are gone, thanks not least to US satellite-system investors eager to have reliable and cheaper launches, and the Chinese have a contract to launch some of the Iridium satellites.

Space will not escape the new government measures to spruce up the 370,000 state-run enterprises that this year's nomination of Zhu Rongji as prime minister will bring. A new super-ministry, the National Ministry of Defence Industries, will be created to take over the numerous factories working for the electronic, space and defence sectors. This may not seem to be a promising step towards reducing bureaucratic interference, but even local sceptics admit that it will

probably result in the delegation of more authority to the regions and challenge individual factories to make a profit or be absorbed. This will almost certainly lead to more joint ventures and more investment from overseas. Unfortunately, these recent events came too late for inclusion in Harvey's book.

All of this is some way removed from the historical detail of Harvey's book, but it is essential to an understanding of China's multi-pronged approach to space. As Harvey suggests in his final chapter, its future should be judged not on the successful achievement of manned space flight, but on progress in all of the space-related sectors that China has opened up. The pace in each sector will be different, reflecting the areas in which China sees the balance of advantage in any particular period. The basic objective — and an entirely realistic one — is for China to be a well-established and important space power early in the next century, with programmes in science, commercial applications, manned space flight... and defence. □

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Lost for words

Why Our Children Can't Read and What We Can Do About It

by Diane McGuinness
Free Press/Penguin: 1997/1998. Pp. 396.
\$25 (hbk), £8.99 (pbk)

Philip T. Smith

Diane McGuinness's two-year-old son used to tip over furniture "to see if it would break". There is no doubt from which parent he inherited this trait. In an impassioned book, McGuinness seeks to tip over the educational establishment that she holds responsible for the poor standards of literacy in the United States and Britain.

Few are exempt from criticism, from those responsible for government policy dating back to the nineteenth century that downgraded the status of teachers, to child-development experts who have no children of their own. The chief culprits are the advocates of teaching schemes ('look-and-say', 'phonics' and 'real books') that do not work (Kenneth Goodman, who said that reading is a "psycholinguistic guessing game", comes in for particular criticism), and also the vested interests in the educational establishment, particularly in government departments and teacher training colleges. Both groups are failing, according to McGuinness, because the methods they favour are based on inadequate research, and important research findings are ignored.

The crucial research can easily be summarized. Speech can be described as a sequence of segments called phonemes,

together with suprasegmental features responsible for such things as stress and intonation. Phonemes are difficult to define rigorously, but correspond to units that listeners perceive as having an invariant sound (so speakers of English perceive that the words 'pit', 'spit' and 'tip' each contain the phoneme /p/). An alphabet is a system for transcribing speech using letters to represent phonemes (so the letter 'p' often represents the phoneme /p/ in English).

We might think it should be easy to teach people to write with an alphabetic system: all they have to do is to listen to the phonemes in a word and transcribe them; reading should be the equally simple reverse process. But having sufficient awareness of the phonemes in a word to carry out this transcription process is a skill that does not come easily and needs to be carefully taught. Research in the past 30 years, principally by psychologists in Belgium, Britain, Sweden and the United States, has shown that fluency in manipulating phonemes goes hand in hand with mastering an alphabetic writing system: those who lack this 'phonemic awareness' will be severely limited in how far they can progress in learning to read, as they will lack the skills to handle unfamiliar words.

Deficits in reading ability, in McGuinness's view, are almost all due to inadequate teaching: "Everyone... can be taught to read unless they have such deficient mental and/or linguistic skills they can't carry on a normal conversation." An adequate teaching programme should consist of developing phonemic awareness, followed by a carefully phased introduction of the alphabetic system, with emphasis on letters being pictures of phonemes, and delaying exposure to some of the more complex idiosyncrasies of English spelling until the basic code is mastered.

She says that children who fail at reading do not have some deep-seated biological deficit (dyslexia) but have developed inadequate strategies as the result of poor teaching: children taught by the look-and-say or real books methods do not understand the alphabetic code because they are concentrating on units that are too large; children taught by 'phonics' stand a better chance of cracking the code, but the emphasis on sounding out letters ('letter→sound') can obscure the essential insight that an alphabet transcribes sounds ('sound→letter').

I applaud what McGuinness is trying to do, and consider, from a practical point of view, that she is correct. If a child (or adult) has reading difficulties, our first hypothesis, once gross sensory impairments have been discounted, is that reading instruction has been inadequate, and that a proper remedial scheme, based on developing phonemic awareness, is likely to succeed. But I think she is too hasty in discounting visual and biological contributions to reading difficulties: only three pages are devoted to vision and I

am surprised she makes no reference to the work of William Lovegrove, whose research suggests that subtle interactions between the magnocellular and parvocellular systems in vision can lead to reading difficulties.

Also, despite her references to the work of Paula Tallal, McGuinness does not see a weakness in the processing of rapidly changing stimuli (possibly in both the auditory and visual modalities) as a barrier to reading for all but a small minority of children. As in many areas of biology and psychology, nature–nurture interactions are probably more complex than we think.

The book is long, which may put off some parents; it lacks an index; and it is not always easy to match up claims in the text with references at the end of the book, which will put off some academics. But it is a very important book, and should be read by every member of the educational establishment. If McGuinness's ideas were fully implemented in schools, we would see substantial reductions in the number of children experiencing reading difficulty, with all its concomitant miseries. □

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Some like it hot

Life on the Edge: Amazing Creatures Thriving in Extreme Environments

by Michael Gross

Plenum: 1998. Pp. 200. \$25.95, £15.75

Andrew R. Cossins

Extremists of all kinds tend to challenge firmly held concepts and ideas. This is particularly true with the discovery in the past two or three decades of microorganisms that inhabit conditions previously thought to be totally incompatible with life. The first such organisms were isolated from hot springs in Yellowstone National Park by Thomas Brock. The surprise was not just that they live at temperatures of up to 95 °C, but that they cannot be cultured at lower temperatures; they have become thermal specialists *par excellence*, unable to cope with change.

This finding encouraged microbiologists to expand their travel budgets and explore a wide range of very uncomfortable environments, including boiling mud-holes, volcanoes, solfatara fields and even 'black smokers' on the ocean floor, all of which are home to microorganisms. Microbial communities have since been found in the extreme cold of the Antarctic, in the hypersaline Dead Sea in Israel, under the very high hydrostatic pressures of ocean trenches, and even in rock drillings from 1,500 metres beneath the US state of Washington. These astonishing discoveries extended the microbiological lexicon to include such terms as



Water colours

Jellyfish are "among the most beautiful animals of the sea" and are composed of 95% or more water, write David Wrobel and Claudia Mills in *Pacific Coast Pelagic Invertebrates* (Sea Challengers/Monterey Bay Aquarium, \$16.95 (pbk)).



extremophile, hyperthermophile and chemolithoautotroph. Michael Gross has written a highly readable account of these organisms and the excitement surrounding their discovery. His overview is masterfully broad, linking their discovery with a number of recent developments in molecular biology, biotechnology, pollution control, biogeochemistry and the origin of life.

Perhaps the most fascinating aspects of these microorganisms is how they thrive in conditions that would rapidly kill more familiar organisms. The proteins of hyperthermophiles must be particularly resistant to denaturing at high temperatures, although Gross shows that there is no simple or consistent set of structural features that account for this. He describes heat-shock proteins and their role in refolding heat-damaged proteins, although their specific

role in extremophiles is uncertain because they are found in virtually all living organisms, including those inhabiting polar habitats. Similarly, he discusses the antifreeze glycoproteins of polar fish, even though they have no role in microbial adaptation.

Yet Gross virtually ignores the issue of membrane adaptation through the modification of lipid structures, an important feature of adaptation to extremes of both temperature and pressure in a wide variety of animals, plants and microbes. Hyperthermophiles in particular possess very unusual membrane lipids, some of which appear to suppress the excessive molecular motion that high temperatures might otherwise cause.

Gross is on safer ground in showing that extremophiles are more than just a scientific curiosity. Their discovery has underpinned