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which were commonly dismissed as reworking, were primary features of volcanic flow.

Fisher generously acknowledges that the credit for seeing the link between the atomic base surges and volcanic phenomena belongs to Adrian Richards, who briefly noted the similarities in 1959, and to Jim Moore of the US Geological Survey, who developed the insight in detail. However, it was principally Fisher who pioneered the systematic documentation and interpretation of the deposits of base surges with colleagues and students such as Aaron Waters, Hans Schminche and Grant Heiken. This exciting and important period in volcanic geology is described with the insights into the twists and turns of original discovery that are usually missing from scientific papers.

Later in the book, Fisher also describes in characteristically modest fashion his important discoveries and ideas about pyroclastic processes such as ash-cloud surges, flow transformations and the expanded character of some pyroclastic flows.

Volcanology can be a dangerous profession. The most poignant part of the book concerns the deaths of two outstanding young American scientists by volcanoes just as their careers were blossoming. When Mount St Helens started to erupt in 1980, Harry Glicken was stationed at the Coldwater II observation post, six miles north of the volcano. Glicken had a meeting with Fisher on 18 May to discuss his career and so David Johnston took over his duty. The catastrophic eruption of that day killed Johnston. Eleven years later, Glicken was killed by a pyroclastic flow on Mount Unzen in Japan along with the film-makers Katia and Maurice Kraft and many journalists.

Pyroclastic density currents are the most lethal of volcanic phenomena. As this book reminds the reader, advances in understanding the geology of these deposits (in which Fisher himself has played a leading role) have established the criteria for identifying them — which is an essential part of volcanic hazard and mitigation work.

Fisher is a good writer and mixes tales of his travels, science and personal anecdotes well. The book is entertaining and an easy read. Geologists will enjoy the book because they will be reminded of their own escapades. Young people contemplating a geological career will surely also be seduced by the idea of a slightly anarchic life in remote and beautiful parts of the world. Fisher has clearly been motivated by the wonder of nature and the fundamental desire to understand its mysteries that drives many successful natural scientists. Perhaps the only regret is that the book is not a bit longer. □

Steve Sparks is at the Chiron Corporation, D-207Q, Emeryville, California 94608, USA.

Speaking in tongues

The Neurolinguistics of Bilingualism: An Introduction
by Franco Fabbro
Taylor & Francis: 1999. 255 pp. £39.95

Risto Näätänen and Teija Kujala

The past few decades have seen our exposure to multiple languages continuously increasing. In this sense, Franco Fabbro's *Neurolinguistics of Bilingualism*, dealing with the representation and processing of multiple languages in the brain, meets an urgent need. Another major factor underlining the importance of this research field is that bilingualism is by no means unusual. If we define it in the broad sense — to include not only people who from an early age have spoken two or more languages, but also those who master a foreign language to a certain extent or a language in more than one dialect — then bilingualism covers more than half of the world's population.

The main message of the book is how lesions in various parts of the brain affect the comprehension and production of languages. Important questions are addressed, such as what happens to the native language compared with those acquired later in life when certain parts of the brain are damaged, or, if these languages are lost, which of them recovers first or to the greatest extent. The cases described elucidate not only bilingualism, but also, more generally, the fascinating complexity of human cognitive brain functions.

A great strength of the book is that it is organized in an extremely reader-friendly way. It starts with a general introduction on what language is and how the acoustical analysis and production of speech take place. This is followed by an introduction to the functional anatomy of the brain. The reader is also briefly introduced to technologies and means of studying cognitive brain functions and assessing language-related dysfunctions. This introductory part makes the rest of the book comprehensible to readers who do not have a solid knowledge of the brain's functional neuroanatomy. Without such an introduction, the main part of the book, which attempts to explain bilingualism from observations on patients with brain lesions causing various forms of aphasia and dysphasia, might be hard for readers outside the field of neuroscience to understand.

The case reports — describing how language functions can be affected by a brain lesion, and how these functions are recovered — are interesting and very helpful for understanding how multiple languages are represented in the brain. But this emphasis on brain lesions makes the book somewhat one-sided and is problematic for several reasons.

For example, if a region of the brain is damaged, causing loss of certain functions, it is hard to tell whether these functions are represented in that specific area or whether the loss is caused by a disconnection of two areas whose interaction is required.

Very recently, brain-activity measurements have shed new light on language representation and learning in the healthy human brain. For example, by using a cortical brain response termed 'mismatch negativity', it is possible to study the long-term memory representations of speech sounds of an individual's native language. Subsequent studies have shown how these native-language representations develop in early childhood, and what plastic changes accompany the development of the new phonetic categories of a foreign language learned in adulthood. Since this is a fairly recent development in neurolinguistics, however, it is understandable that it is not covered in the book.

In conclusion, this interesting and very clearly written book provides a good introduction to the way in which multiple languages are represented in the brain based on what we know from brain-lesioned patients. After reading it, an enthusiastic neurolinguist or neuroscientist will look forward to the next volume, elucidating bilingualism from studies on the healthy human brain. □

Risto Näätänen and Teija Kujala are at the Cognitive Brain Research Unit, Department of Psychology, PO Box 13, FIN-00014 University of Helsinki, Helsinki, Finland.

Hallo capitalism, goodbye science

What Have We Learned about Science and Technology from the Russian Experience?
by Loren R. Graham
Stanford University Press: 1998. 165 pp. $14.95, £10.95 (pbk).

Zhores A. Medvedev

The early history of Soviet science was very tragic indeed. Thousands of scientists, both prominent and unknown, perished in the Gulag. Biologists were forced to follow the pseudoscientific theories of Lysenko and other charlatans. The best aeroplane designers had their engineering facilities attached to special prisons. Promotion to a senior position, even in universities or institutes engaged in fundamental research, required membership of the Communist Party. Foreign travel was impossible. In libraries, even *Nature* fell prey to the censor's scissors.

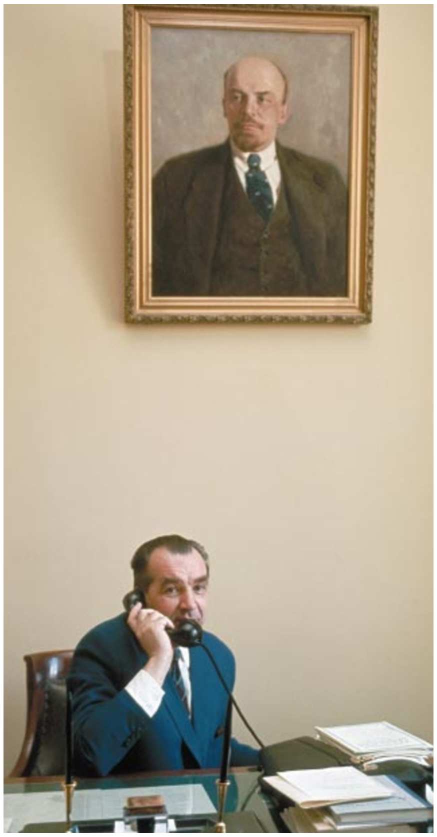
But despite all this, Soviet science behind the Iron Curtain did reasonably well. It gave Stalin atomic and thermonuclear bombs much more quickly than did the scientists working for the democratic governments of Britain and France, and it made antibiotics available for free health care throughout the USSR. The volume of research, basic and applied, and the number of research institutes grew rapidly. With Sputnik a few years later Soviet science and technology started to receive great respect and attention. In 1960, when Loren R. Graham arrived at Moscow University to study the history of the Academy of Sciences of the USSR, the Soviet Union had more researchers and engineers than the United States, and there were many areas of excellence, innovation and technological breakthroughs. Soviet scientists were world leaders in several fields.

In later years, Soviet science and technology continued to grow rapidly, but its efficiency did not keep pace with its size. This was mainly due to poor cooperation among the main sectors of research activity (universities, academies and ministries) and the vast military complex that consumed so much of the research and development budget.

Why, in new and democratic Russia, were science and technology treated so differently and deprived of financial support? Why did the transition from totalitarianism to democracy, from socialism to capitalism, harm the research capabilities much more than the infrastructure of science itself?

Graham, a leading historian of Soviet science and technology, tries his best to avoid political analysis and to link the developments in science with the general reform process. In his earlier books, Graham, like many other American historians, did not predict that science would collapse together with communism. It was believed that the development of science and technology in communist countries had a 'westernizing' influence, and that "science and technology have helped to make Soviet society more like the rest of the world, eroding the revolutionary and exceptional ethos in which the USSR was born" (*Science and the Soviet Social Order*, Harvard University Press, 1990). Among Soviet scientists, there was a general expectation that being free to exchange information, choose their collaborators and travel would aid their research, increase productivity and promote their integration into the world of science.

There was nothing wrong with this theory, or its expectations. The failure was with the transition itself. It was initiated as a step-by-step process by Mikhail Gorbachev, but was accelerated into the collapse of the USSR by Boris Yeltsin. As a result, a much smaller and poorer Russia was left with a research infrastructure that was too large and expensive, and most of the problems of 'big science' and military-industrial development became entirely irrelevant. With the largest external debt in the world, not only science and technology, but all state-dependent services — health, education, security and police — have been forced onto a survival regime with a subsistence level of government support. The current Russian budget is approximately the same as Denmark's.



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Picture of health: Nikolai Blokhin, president of the USSR Academy of Medical Sciences, in 1964.

Graham describes how some famous Russian research institutes have responded to poverty. They have usually reduced research expenses while trying hard to avoid redundancies. When resources get too low, they reduce salaries, often to levels of destitution, but try to keep staff, even if scientists cannot do much, or anything. They let parts of their — fortunately large — buildings to foreign companies or commercial firms and transform their fenced territories into paid parking lots for the expensive cars of the new elite.

This is not only a survival technique, but humanitarian as well. There are no redundancy payments, early retirement schemes or even unemployment benefits in Russia for scientists who lose their jobs. Some other state services, such as health, do the same. People continue to work even when they are not paid for months. They know that if they stop the situation will get worse, not better. But if we really want to take something from the Russian experience, it is that Russia is doing much better than the other republics of the former Soviet Union. Scientists in the Ukraine have started to wonder, half-jokingly, if their government will introduce entrance fees for their institutes. □

Zhores A. Medvedev is at the National Institute for Medical Research, The Ridgeway, London NW7 1AA, UK.