

cultures from Tibet to the Kalahari (via New Guinea and Venezuela) "tempos in musical performance change by low-order integral ratios". Both the biological and the aesthetic significance of the observation remain opaque. Siegfried analyses the space-time structure of the grasshopper dance performed by !ko-Bushman. The pulse beat (indexed by the deepest flexion of the knees) is remarkably stable across extremely complex movement patterns but the author's interpretation is sloppy: "The rules provide a framework within which the dancer can cause shivers by trying new exciting movement combinations". You should see me do the tango!

The visual arts suffer much the same fate. Zollinger provides a good introduction to colour perception and naming, while Baumgartner writes lucidly on form perception. But neither explicitly relates the modular character of the visual system to the pictorial effects that can be manipulated in drawing and painting. The sole chapter that does make an effort to do so is by Rentschler, Caelli and Maffei. They demonstrate how reducing image information by band-pass and orientation-

selective filtering can simulate the look of a Monet or a Feininger, or soften a Duccio into a Leonardo.

We now have a general model of the psychophysiology of the visual system: separate pathways for colour, different aspects of static form perception, and movement and depth, that are integrated into a unified percept. But why should (some ways of) de-unifying that percept by selectively enhancing, attenuating or distorting components of the *gestalt* produce interest, insight and pure pleasure? The editors of *Beauty and the Brain* did not invite "a recognized specialist in the field of art history or aesthetics" to their symposium. Future meetings may need to include contributions from those areas if neuroaesthetics is ever to replace the theory of the nine Muses. When actually listening to Mozart it is difficult not to feel that God decided to amuse herself by dictating a few piano concertos. And that choosing Amadeus as amanuensis was the best joke of all. □

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## On the road to Montreal

Philippa Lloyd

**Ozone Crisis: The 15-Year Evolution of a Sudden Global Emergency.** By Sharon L. Roan. Wiley: 1989. Pp. 270. \$18.95, £12.95.

ONCE thought of as 'dream' compounds because of their chemical stability and lack of toxicity, chlorofluorocarbons (CFCs) first came under suspicion in 1974. In a paper published that year, Mario Molina and Sherwood Rowland of the University of California, Irvine, looked at what happened to them after they had been released into the atmosphere.

Because of their stability, CFCs reach the stratosphere unaltered but there they are broken up by short-wavelength ultraviolet radiation. Molina and Rowland deduced that this photodissociation would allow the release of free chlorine atoms which would then react with and ultimately destroy the ozone layer, the filter that protects the Earth from that same ultraviolet radiation. The worldwide production of CFCs at that time was almost a million tons a year, for use as refrigerants and in air-conditioning systems, as well as in spray cans, and the implications for the ozone layer were appalling.

Sharon Roan sets out to give a behind-the-scenes account of the controversy that

ensued in the United States over the environmental safety, or otherwise, of CFCs. Writing very much from the viewpoint of Molina and Rowland, she vividly portrays the frustrations they faced in trying to alert the government and the chemical industry to their fears. But industrialists did not want theories, they wanted proof before they would be persuaded to take any kind of regulatory action.

The fight between industry and the atmospheric scientists was long and bitter, but in 1976 the Food and Drug Administration and the Environmental Protection Agency announced plans to phase out the use of CFCs in spray cans. The political climate was changing, however, and regulations to ban the use of non-aerosol CFCs failed to reach the statute book. In 1980, the new Reagan administration was reluctant to intervene in environmental issues — and in this case there was still a great deal of uncertainty over the extent to which CFCs were damaging the ozone layer. With science unable to resolve matters, lobbyists for industry were able to convince the legislators that any further regulations would be premature.

More evidence was needed to support Molina and Rowland's claims. In 1984 it arrived from an unexpected source. Joe Farman and his team at the British Antarctic Survey had for several years been monitoring ozone levels in the Antarctic stratosphere from their station at Halley Bay, and their data for 1977–1984 showed that a dramatic decline in ozone levels occurred in the southern spring. Farman's

paper initially met with some scepticism, particularly as satellite data over the same area had not indicated any such loss of ozone. But it transpired that because the satellite instruments sometimes gave erroneous results, any readings below a certain value were flagged as 'bad' and thrown out. On reassessing the satellite data, the ozone depletion and its extent could easily be seen.

The reaction among the atmospheric science community was one of bafflement; although it had been predicted that CFCs might destroy ozone, nothing on the scale of the Antarctic 'ozone hole' had been forecast by any of the atmospheric models. The next step was to identify the cause, and in August 1986 13 scientists journeyed to the South Pole to take measurements in order to see what was going on. Uncertainties remained — there were both chemical and dynamical theories for the ozone hole — yet the following September delegates from around the world met in Montreal to sign a protocol proposing a 50 per cent cutback in the production of CFCs. A further expedition in August 1987 confirmed that CFCs were indeed the culprits and that November, after publication of the results, there were calls to strengthen the Montreal Protocol.

Since then, the Ozone Trends Panel has reported (in March 1988) that small ozone losses were occurring in the Northern Hemisphere, and in February of this year an international expedition to the Arctic announced that the chemical preconditioning necessary for ozone depletion had been found there too. NASA has just reported that this year the ozone hole over the Antarctic is as deep as that previously recorded (in 1987); it may turn out to be even deeper.

Just under half of Sharon Roan's text is devoted to events before 1984, the remainder to the discovery of the ozone hole and its ramifications — scientific, political and for industry. As a science writer on the *Orange County Register* in California, the author was well placed to cover the issues as they have developed over the past two decades. Her journalistic background betrays itself in the rather breathless prose, and the book is stronger on the politics and some of the personalities behind the ozone-CFC debate, rather than the science. But this is nonetheless a highly readable and informed account of its subject. □

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### Erratum

In the review of the Elsevier journal *Geomorphology* (*Nature* 341, 362; 1989) price and frequency of publication should have been given as Dfl.298 and 4/yr, respectively. In the same issue (p.352) the price outside North America of *Chinese Journal of Biochemistry and Biophysics*, published by Allerton, should have read \$280.