

Science

Ecologist Marten Scheffer Recognises no Boundaries

At the National Science Quiz broadcast on Dutch television in December 2009 the ecologist Marten Scheffer (Amsterdam, 1958) walked away with the title '*homo universalis*'. He did not earn this epithet just by winning a television game. Crossing boundaries, between academic disciplines but also between knowledge and art, is the *leitmotiv* of his career. It is not for nothing that, along with five Nobel laureates, he is one of the founding fathers of the Para Limes Institute which is now in the process of being set up. The Institute's ambition is to become a European haven where scientists of every kind can work together on cross-disciplinary research.

Scheffer, currently head of the department of aquatic ecology and water quality control at the University of Wageningen, published his first trail-blazing article in 1993, a year after gaining his doctorate at the University of Utrecht. He showed that lakes have two stable states – clear or cloudy – with nothing in between. The change from the one state to the other does not happen gradually but all at once. And if the water which was once beautifully clear ever becomes overgrown with blue algae, there is no cure for it. Scheffer developed his ideas on this in his best-seller *Ecology of Shallow Lakes* (1998). His theory forms the basis of a shock therapy which is often put to practical use. By temporarily removing certain kinds of fish, such as bream, from a cloudy lake, the water can magically be restored to clear water supporting a large number of species.

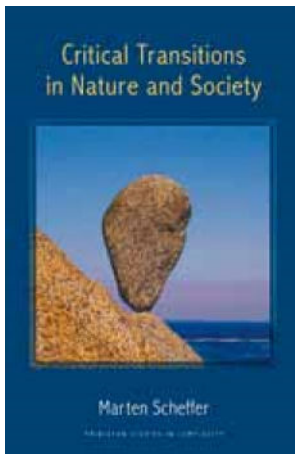
After his work on lakes Scheffer cast his net more widely. He arranged to co-operate with scientists from various branches of ecology. Together they demonstrated that very different ecosystems – from coral reefs to savannas – have tipping points that function in a similar way. This research was published in 2001 as 'Catastrophic Shifts in Ecosystems' in the prestigious journal *Nature*. This article, still his most frequently cited work, led to a radical change in thinking in his subject area.

In summer 2009 Princeton University Press published Scheffer's latest book, *Critical Transitions in*



Marten Scheffer (°1958 -).

Nature and Society. This scientific study, which due to the crystal clarity of his argument can easily be followed by the interested lay person, is the fruit of some fifteen years of scientific research into major changes. Anyone reading it will understand immediately why when Scheffer received the Spinoza Prize (the highest scientific distinction in the Netherlands) in 2009, the jury's report spoke of '*work that opens up new horizons*'. Scheffer jumps from the smallest scale of all – function differentiation in cells – to the very greatest – climate changes over hundreds of millions of years of history. He analyses the emergence of deserts as easily as the collapse of the stock market. The biologist with a penchant for mathematics demonstrates that in these two totally different systems the same warning lights go on on the eve of a major change. The patterns then displayed can be captured elegantly in



mathematical comparisons, but are more difficult to express in everyday language. 'Autocorrelation' is one of the red lights. It does not matter whether it is the brain just before an epileptic fit or a boat just before it capsizes - when a system is approaching a tipping point it is less able to cope with disturbances. Give a shove to a healthy system and it quickly recovers its balance. But if it is close to a tipping point it reacts more slowly, which means that today's situation is more like that of yesterday. And that is autocorrelation in a nutshell.

In *Critical Transitions* Scheffer relates vivid histories of dramatic changes in the climate. How hundreds of millions of years ago the earth was covered in snow and ice, only to change in a relatively short time into a greenhouse in which the oceans had a temperature of at least fifty degrees. As a biologist he fears that we are now rapidly pushing the climate to a tipping point by pumping greenhouse gases into the atmosphere on a massive scale. As a committed scientist he does not hesitate to air his concern about this in the media. In *Vrij Nederland* he declared that the climate is like a wild animal that had been dozing for ten thousand years. '*Civilisation as we know it, has developed in an exceptionally calm period. The beast was asleep. And now we're prodding it into action.*' In Scheffer's view too little attention is still being paid to the seriousness and speed of climate change.

With English and German colleagues he discovered a method for estimating positive feedback mechanisms in the climate. What they tell us is that for every ton of carbon dioxide that man puts into the atmosphere the warming earth adds another half-ton for

free. This reinforcing effect has not yet been taken into account in the scenarios of the United Nations' scientific panel on climate change (IPCC).

In an article in *Nature* in autumn 2009, he and a large group of other eminent scientists named ten planetary boundaries. These are thresholds that humanity must not exceed if we are to avoid that sudden shift that could have catastrophic consequences. According to the group that is putting itself forward as a new Club of Rome, we have already broken through three crucial barriers: the amount of nitrogen released into the environment by agriculture, the concentration of greenhouse gases in the atmosphere and the rate at which species are becoming extinct.

Not very cheerful views, but Scheffer is far from being a pessimist throwing in the towel. He is a member of the Resilience Alliance, an international group of academics from a wide range of disciplines who are designing strategies for sustainable interaction between society and nature. In addition to his busy scientific activities he also finds time to make music. Two totally different worlds, but with common ground. In Scheffer's view both science and art spring from something intuitive, from brainwaves and associations. Both of them also require great technical capability, the patience of a saint and serious hard work. And in both worlds improvisation, creating something new out of existing elements, plays a crucial role. In music as in science, Scheffer is someone who can turn his hand to anything, who refuses to be held back by the boundaries of any genre. He has played Vivaldi's Mandolin concerto, once had a group that played Dutch language folk music, and last year recorded the CD *Transitions*, containing compositions inspired by themes taken from music from all over the world. A '*homo universalis*' indeed.

Tomas Vanheste

Translated by Sheila M. Dale