

## Do not try this at home

SIR — Scientific publication entails grave social responsibility. The reckless publication of "Laboratory simulation of cosmic string formation in the early Universe using superfluid  $^3\text{He}$ " (ref. 1) brought at least one physics PhD to perilous attacks of hysteria and threatens his marriage because his wife has to keep throwing cold water on him. I know. That unfortunate scientist is my husband.

After his first attack of giggles and tears, I, a mere ecologist, approached the triggering paper with due trepidation. As I understand it, the authors see a thimbleful of liquid helium as a literal microcosm, a model of the Universe at the moment of 'creation', and elaborate a mathematical model of the creation process, based on observations of the events in the dab of helium.

As a mere ecologist, I had questions about this paper. For example, ecologists grapple with problems of scale and magnitude; aren't there problems in physics jumping from a scale of about a couple millilitres in volume to gazillion cubic kilometres? Don't fundamentally different processes sometimes occur at these vastly different scales?

Another example: ecologists have an obsession about verifying their models. How

would this model be verified? Has a 'superstring' ever been seen at cosmological distances or is this concept applicable only to a particular species of helium in a particular microhabitat?

Each time I asked such a question, my spouse would relapse into hysterics. Our relationship changed. Now we look on each other with apprehension and dread, not good elements in a marriage<sup>2</sup>.

*Nature* needs a special edition similar to *Journal of Irreproducible Results*. In addition to *Nature Genetics*, *Nature Avant Garde* could be published for papers such as Bäuerle *et al.*<sup>1</sup> and the famous Benveniste lamentation of watery memories of *solutes perdus*. You could display a conspicuous warning on the cover about the 'nature' of the contents and thus fulfil your grave social responsibility.

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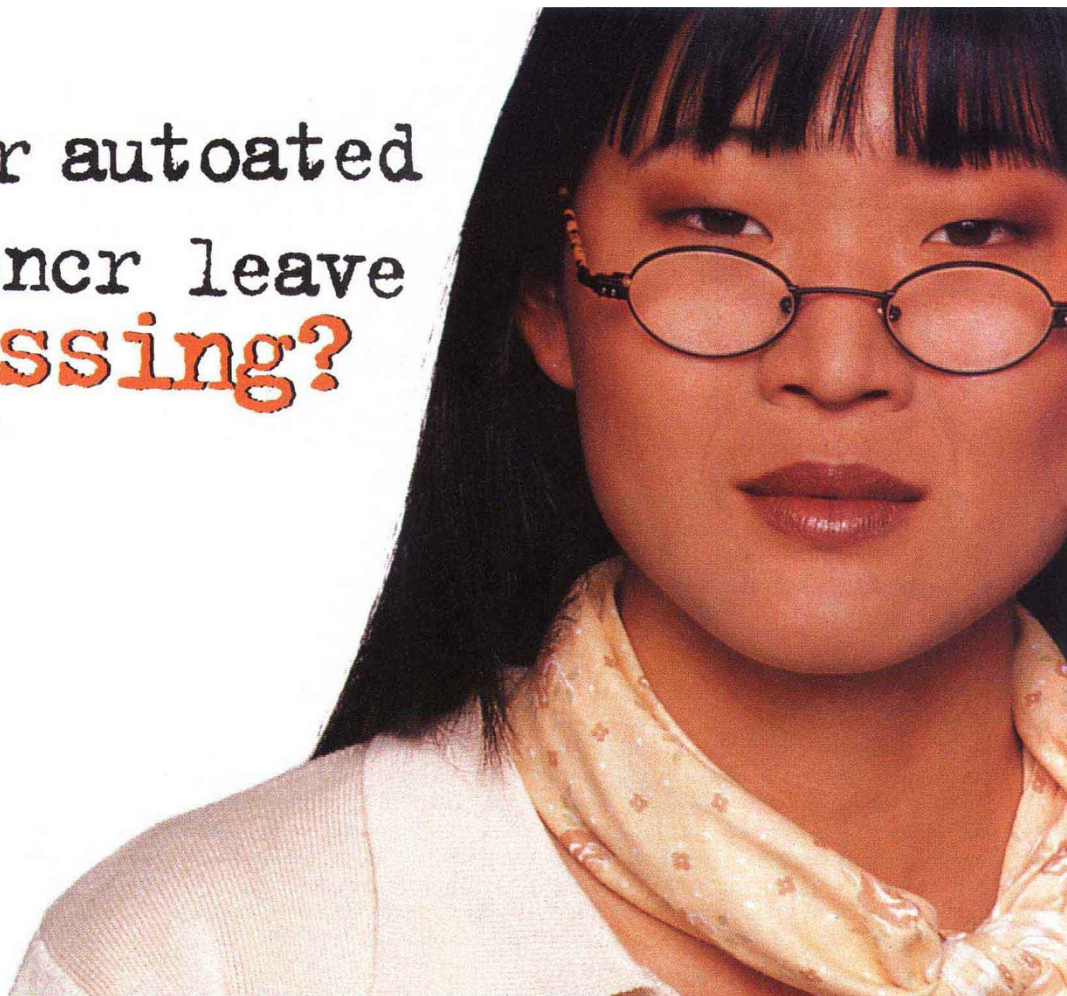
REPLY — To take your points in reverse order, the *Journal of Irreproducible Results* is ruled out because in cosmology there are no irreproducible results. There has only ever been one experiment, still running, and we are latecomers watching from the back.

By the irreproachable standards of ecology, there is very little that we can test. Nor do we need large scales to see that. The Earth is tied to the Sun by gravity, we suppose. That has not been 'tested' in the laboratory sense, say by moving the Earth and checking the force/distance relation. Gravity simply fits the facts better than any other speculation.

Although there is as yet virtually no solid evidence for cosmic strings, if (and that's a real if) the Universe did in fact undergo the phase transitions currently thought possible, then the nucleation process would have created grain boundaries in the structure of space which should have survived as cosmic strings. Their large mass would certainly help to explain the present uneven distribution of the galaxies. We clearly cannot perform experiments that reproduce the Big Bang. But, outside the pages of the above journal, if we are to subscribe to scientific method then we have to believe that similar conditions lead to similar results, and make the best of what we can do. Yes, in superfluid helium-3 we do have a model microcosm, the most complex system simple enough for us already to have a 'theory of everything'. If we force it through the appropriate transition then, via the same process mathematically by which cosmic

1. Bäuerle, C., Bunkov, Yu. M., Fisher, S. N., Godfrin, H. & Pickett, G. R. *Nature* **382**, 332–334 (1996)
2. Wallace, D. J. *Irrepro. Results* **41**(3), 10–12 (1996).

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strings are thought to form, we get the helium analogy — vortices. Bingo.

Meanwhile, your domestic equilibrium has been upset by contemplating our temerity in extrapolating a few millilitres of superfluid to the scale of the Universe. It seems only our duty to put minds at rest and restore conjugal bliss. Right, point out to him — very gently — that when the Universe underwent this transition, it was probably no bigger than a golfball.

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## Costing the Earth

SIR — Caldeira<sup>1</sup> criticizes the Economic-Damage Index<sup>2</sup> for using discounting to compare the monetary value of damages incurred at different times. Although discounting can appear easy to ridicule, one must account for the opportunity cost of resources<sup>3</sup>.

When investment opportunities exist, society can reallocate social costs over time. Consider Caldeira's second example: if, as implicitly assumed in the example, the value of an extinction  $V$  (the maximum value of resources society would willingly sacrifice to prevent it) is independent of the date, number and identity of species lost, and additional investments yield 3% per year social return, the time path of social costs associated with losing 10 species in 78 years can be exchanged for a path where a cost of  $10V(1.03)^{-78} = 0.997V$  is incurred today for investment, with the proceeds used to offset the value of the species loss in 78 years. In these conditions, losing 10 species in 78 years is not worse than losing one today, as the timing and magnitude of social costs of the former can be made equal to those of the latter if desired.

Conversely, if one refuses to save one species today because the resources so used could be invested to save 10 species 78 years later, should not one subsequently refuse to save the 10 species because the resources could then be reinvested to allow 100 species to be saved in another 78 years?<sup>4</sup>

Discounting is properly applied to the monetary value of changes<sup>5</sup> and is not applicable when tradeoffs cannot be made between environmental damages and other resources. One might choose to put biodiversity outside the bounds of economic analysis, setting constraints on species loss

that may not be violated regardless of the cost in other resources, but such an approach leaves open the question of how to set the constraints.

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1. Caldeira, K. *Nature* **383**, 214 (1996)
2. Hammitt, J. K., Jain, A. K., Adams, J. L. & Wuebbles, D. J. *Nature* **381**, 301–303 (1996).
3. Arrow, K. J. et al. in *Climate Change 1995: Economic and Social Dimensions of Climate Change* (eds. Bruce, J. P., Lee, H. & Haites, E. F.) 125–144 (Cambridge Univ. Press, 1996).
4. Keeler, E. B. & Cretin, S. *Management Science* **29**, 300–306 (1983).
5. Hammitt, J. K. *J. Health Econ.* **12**, 117–120 (1993).

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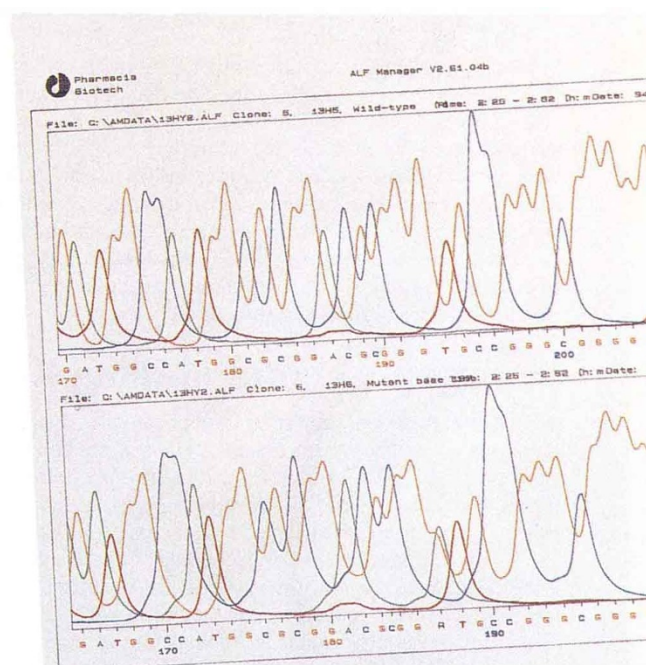
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The p53 gene from 316 breast cancer patients was sequenced using ALF automated sequencing technology. (Bergh J., Norberg, T., Sjögren, S., Lindgren A., Holmberg, L. "Complete Sequencing of the p53 Gene..." *Nature Medicine* 1995; 10:1029-1034.)

