believes we can make the Kuiper Belt habitable, then surely an incremental temperature change here at home should be easy.

The possible development in science that I think he misses is the gradual incursion of true science – evolutionary reasoning and neurophysiological reality, for example – into the field of human behaviour. Most generally, I perceive in this book an absence of any "sense of danger" with regard to the totally unexpected new directions that science (or society, for that matter) can take over the course of 100 years.

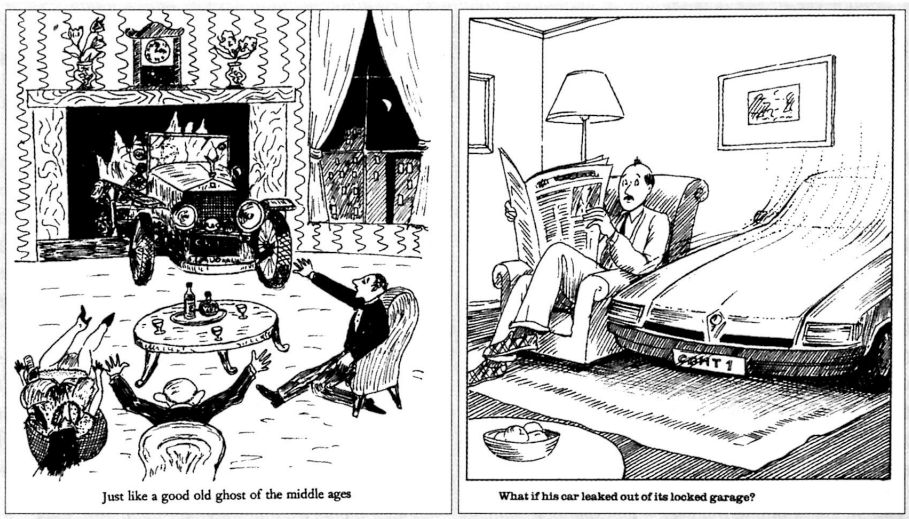
All that being said, this is a book I can heartily recommend, if not for what it can tell us about the 21st century, then at least for what we can learn about what goes on in our own.

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Mr Tompkins makes a comeback

The New World of Mr Tompkins
George Gamow and Russell Stannard
1999 Cambridge University Press 260pp
£14.95hb/£7.95pb



Before and after – quantum tunnelling as illustrated in the old (left) and new (right) versions of Mr Tompkins

When I was asked to review what is an "updated" version of George Gamow's *Mr Tompkins in Paperback*, I was sceptical about what the book was going to be like. For updating a classic is no easy job. Imagine updating the Sherlock Holmes stories, with the hansom-cabs replaced by minicabs, country houses by high-rise apartments, and with the master sleuth surfing the Internet to trace the murky past of some suspect. It just wouldn't be classic any more. However, as I read on, I warmed to Russell Stannard's attempts to tackle the difficult job ahead of him. As he confesses in the foreword, he is aware that his approach might not please everyone.

Physics and astronomy have advanced rapidly since Gamow's paperback first appeared in 1965. The question facing Stannard – an emeritus professor of physics at the Open University in the UK – was how to incorporate recent ideas in big-bang cosmology and particle physics into the new version, without "spoiling" the earlier parts. Instead of making patchwork attempts to revise the original, Stannard has completely reworked the description in several such cases, and written four entirely new chapters. And just as Holmes would solve crimes by imagining himself to be the criminal, Stannard has tried to put himself in Gamow's shoes to imagine how he would have described the topics. So here is a version that Stannard believes Gamow himself might have written, had he been at work today.

Physics took a giant leap at the junction of the 19th and 20th centuries. The largely intuitive Newtonian approach, with firm ties to the macroscopic world, gave way to counter-intuitive concepts such as observer-dependent space–time measurements, the twin paradox, curved space and non-Euclidean geometry, the absolute speed limit on physical interactions, the uncertainty principle and probabilistic approach to physical events, and the discreteness of nature. Not only were non-scientists – whom Mr Tompkins represents – sceptical about what was being suggested with relativity and quantum mechanics, so were the physicists themselves.

Gamow therefore used the book to explain these concepts through the experiences of Mr Tompkins, partly through his listening to erudite lectures by a professor (who later becomes his father-in-law) and partly through dream sequences as he dozes off during those pedagogic exercises. By imagining new values of physical constants, Gamow – in those dream sequences – brought the effects of special relativity and quantum mechanics closer to everyday life. These remarkable effects were designed to help the reader relate to the actual behaviour of the microscopic world, rapidly moving particles, and the very large universe. It was a very successful and novel exercise, and Stannard has adopted the same approach in his extensions and additions.

There is one difference, though, between explaining the counter-intuitive results of special relativity, general relativity and quantum mechanics on the one hand, and the sweeping extrapolations of the very early universe and grand unified theories on the other. The difference is that the former are based on well conducted experiments, but the latter are not. So when "inflationists" say that there was a period of extremely rapid expansion in the early universe, which was caused by a "phase transition" when the universe was a billion, billion, billionth part of a second old, what demonstrable proof do they have for that assertion? And when the Standard Model of particle physics is extrapolated across more than 12 orders of magnitude in energy, there is no laboratory experiment to assure us that the extrapolations are correct. This is why particle physicists look towards big-bang cosmologists to provide them with a scenario where these extrapolations can be tried. And this is also why big-bang cosmologists look to those extrapolations from particle physics to provide them with the physics for the very early universe.

But two intermeshed speculations do not make for a healthy scientific combination of theory plus experiment. At best one may claim an overall self-consistency, at worst rely on articles of faith. I therefore wish that Tompkins, in his characteristically naïve but honest way, had raised this issue. I would also like to have read how the persuasive professor or his aggressive daughter Maud would answer his doubts, since, to the best of my knowledge, this issue is always evaded.

The problem is that big-bang cosmologists assume that the particle theorists – when considering the very early period of the universe when only one grand unified force existed – rest their theory on solid ground, while the particle theorists assume the big bang to be a well proven fact. Here is a great opportunity for raising this issue. But

in the controversy over whether the universe evolved from a big bang or whether it has always existed in a steady state, Tompkins is told that while he might consider the steady-state ideas attractive, they had to be abandoned because of experimental evidence. Why not use the same yardstick while assessing the ideas on the very early universe?

This criticism apart, the book deals very well with the more recent developments, and Mr Tompkins' visit to a particle accelerator is well described. Stannard has also updated the language, where appropriate. One example of this evolution is where he replaces the adjective "gay" with "merry" to describe an assembly of electrons.

However, it is inevitable that one makes a comparison with the original. I, for example, would have retained more of the original Gamow than Stannard has done. Nevertheless, the author has generally succeeded in putting himself in Gamow's place, and the reader does not notice any significant change of style. However, as far as illustrations are concerned, I wish the originals had been retained. They carried the Gamow stamp and were more "reader-friendly".

All in all, this has been a successful exercise that Gamow – figures apart, I think – would have liked. I can recommend the book both for general readers, and for specialists who may like to check how their subject is being presented to Mr Tompkins today.

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