Against the Grain

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Collectiing to the Core -- Physics

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Collecting to the Core — Physics

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Column Editor's Note: *The "Collecting to the Core" column highlights monographic works that are essential to the academic library within a particular discipline, inspired by the* ***Resources for College Libraries*** *bibliography (online at* ***http://www.rclweb.net****). In each essay, subject specialists introduce and explain the classic titles and topics that continue to remain relevant to the undergraduate curriculum and library collection. Disciplinary trends may shift, but some classics never go out of style. — **AD***

As academic librarians who select monographs in physics, we understand that much of the physics professional literature is written at a level incomprehensible to the undergraduate student. It's not necessarily that the content is beyond the motivated student, but even the notation in most scholarly works is not the same as that taught in beginning coursework. As a result, when determining what books to include in the *Resources for College Libraries (RCL)* core bibliography, a selector must also consider what will be accessible to an undergraduate studying physics. In addition to introductory textbooks and more advanced theoretical works, a solid collection should also include monographs that highlight the interesting concepts driving physicists' research. The *RCL* physics section includes not only essential scholarly titles but also popularizations, biographies, and select content intended to kindle the imagination of next-generation physicists and launch them into careers investigating the fundamental nature of the universe.

One author helped motivate an entire generation of scientists through his popularizations of physics, as well as various other branches of science and mathematics. **George Gamow** was a renowned physicist who made seminal contributions to atomic and nuclear physics, cosmology (his work contributed to the Big Bang theory *before* it was known as a popular sitcom), and even to decoding the structure of DNA. He is also known for creating the fictional character Mr. Tompkins. First appearing in serialized form in *Discovery* magazine in 1938, Tompkins is a mild-mannered bank clerk by day who attends physics lectures and dreams of fantastic worlds by night. **Gamow** wrote three monographs featuring the character: *Mr. Tompkins in Wonderland*, *Mr. Tompkins Explores the Atom*, and *Mr. Tompkins Learns the Facts of Life*.[1-3] The first two books were updated and revised in 1999 by **Russell Stannard** and published as *The New World of Mr. Tompkins*, although very little needed to be either revised or updated.[4] In addition to the influential Tompkins series, **Gamow** also authored several popular nonfiction science books, most notably *One, Two, Three…Infinity*; *Matter, Earth, and Sky*; and *The Atom and Its Nucleus*.[5-7] In 2006, *Mr. Tompkins Gets Serious*, with a foreword by **Gamow's** son **Igor**, provided a "best of" compilation of the latter two books, although without even a cameo appearance from Mr. Tompkins himself.[8] For the interested reader, **George Gamow's** autobiography *My World Line* offers a fascinating look into his eventful and influential life.[9] This essay will focus on two of the best-known works — *Mr. Tompkins in Wonderland* and *One, Two, Three…Infinity* — as illustrative examples of **Gamow's** popular books.

In *Mr. Tompkins in Wonderland*, Mr. c.G.h. Tompkins' initials refer to three fundamental constants of nature: the speed of light, the gravitational constant, and Planck's constant. As Mr. Tompkins drowses off during physics lectures at the local university, his subconscious creates a fantastical world where the values of those constants are very different than they are in our world. In a world where the speed of light is much slower than ours, he finds that riding a bike doesn't cause the town to go by faster, but rather to get scrunched up, buildings becoming narrow slits. When he gets off his bike and looks at the town hall clock, half an hour has passed, while it seems to him that only a moment has gone by. Then he meets a young travelling salesman along with his elderly great-granddaughter due to the time dilation caused by general relativity. When faced with a quantum constant (h) much larger than that in our own universe, in a game of "quantum snooker," hitting a cue ball causes it to spread out and become diffuse, eventually covering most of the pool table with "probability." Trying to corral the cue ball in a triangle, Tompkins causes it to bounce around quite quickly, due to the uncertainty relationship between position and velocity, until eventually the ball "leaks" out and rolls across the table, just like neutrons or alpha particles tunnel out of atomic nuclei in the process of fission. A trip to the "quantum jungle" similarly results in Mr. Tompkins being attacked by one wild tiger that appears as a pack surrounding Tompkins from all sides, analogous to the motion of electrons around a nucleus. Then, he encounters a herd of gazelles running in formation, caused by a single gazelle running through a regular bamboo patch. By exaggerating the values of the fundamental physical constants to bring the quantum and relativistic principles to a scale where they are easily observable, **Gamow** uses imagery to both instruct and inspire readers. Between the fantastical dream scenes, **Gamow** provides brief introductory-level overviews explaining the theories that led to those dreams, so an interested reader can immediately find supplementary academic information.

One, Two, Three…Infinity: Facts and Speculations of Science, originally written in 1947, "plays it straight." Rather than offering a fictionalized account, **Gamow** showcases amazing factual stories that require no exaggeration, taking the reader on a tour of mathematics, physics, and biology. The book opens with a section called "Playing with Numbers." The first example describes **Grand Vizier Sissa Ben Dahir**, a skilled mathematician, asking for his reward from **King Shirham of India** for having invented the game of chess. The clever **Vizier** asks for one grain of wheat for the first square of the chessboard, two

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or we can adjust to the economic times in ways that are innovative and creative, preserving the best about what we do but letting go those things that may not be necessary or have been overtaken by change.

Fourth, and final, for the last three decades librarians have complained mightily about the rising costs of library materials, mainly journals, but we have not been able to effect any long-lasting solution. The end result has been journal and aggregate databases that range in price from a small diamond ring, to a fully-equipped yacht. Again, with these flushed economic times, no one is willing to pay for that any more. When solutions are offered, hysteria reigns supreme from outright resistance, to half-hearted implementation. Don't believe me? Look at our response to possible solutions via **ebrary**, **iPads**, e-readers, demand-driven acquisitions, or even **SkyRiver**. We can either make the hard changes, or suffer harder changes made by others. Neither will be pretty, mind you, but the changes we make are certain to be better than those made by others.

It's easy to protest change, especially the one going on at **Harvard** (and you know as well as I do it isn't just there). Furthermore, change, when it disrupts, reassigns, or remakes people and their livelihoods, always appears severe and even insensitive. But, unless we as a profession are willing to offer thoughtful, tenable, solutions — even ones that run contrary to what we've done for the past fifty years — to these very pressing problems, we will continue to feel the earth move under out feet and the sky come tumbling down, tumbling down.

Or, in other words, we'll see our own *mene, mene, tekel upharsin* written right there in plain letters.

And mostly likely LED ones, too, with that absurd braying, to boot.

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grains for the second square, four for the third, eight grains to put on the fourth, and so on. The King thought the reward seemed very modest, but he quickly becomes a victim of the power of geometrically increasing numbers and soon it becomes evident that to deliver the reward would require the world's total wheat production for a period of two thousand years! After explaining elementary number concepts, **Gamow** goes on to explore space, time, and **Einstein's** theories. The second portion of the book covers topology, **Euler**, the map coloring problem, **Mobius** strips, and **Klein** bottles. Four dimensions are explored with rhetorical prompting: "And what would a four-dimensional cube or sphere look like?" These questions draw the reader into **Gamow's** imaginative world and help to concretize spatial and theoretical constructs.

The third part of the book, which covers the microcosmos, presents an explanation of the atom and atomic structure. Cell biology also gets significant treatment, with illustrations depicting cell division and the heredity of color blindness. One of the major strengths of *One, Two, Three….Infinity* is the delightful illustrations incorporated throughout, ranging from an automatic printing press producing a line from **Shakespeare** to an illustrated argument against the spherical shape of the Earth. Drawing the accompanying cartoons himself, **Gamow** illustrates difficult concepts with simple but effective visual images to help the reader achieve deeper understanding. A longtime university professor, **Gamow** teaches the reader through understandable analogies, such as "If the sun were a large pumpkin, the Earth would be a pea, the moon a poppy seed, and the Empire State Building in New York about as small as the smallest bacteria we can see through the microscope," and through equations that are accessible even to a high school student.[10] **Gamow** also includes several classic physics limericks. For example:

There was a young girl named Miss Bright,
Who could travel much faster than light.
She departed one day,
In an Einsteinian way,
And came back on the previous night.[11]

In addition to featuring dynamic descriptive language, visual representations, and instructional examples, this book provides an excellent snapshot of scientific thought during the mid-twentieth century and yet continues to serve as an authoritative and engaging introduction to the fundamental mathematical and scientific principles that are still taught today. **Gamow's** elegant, illustrative, and accurate portrayal of the sometimes counterintuitive physical world ensures that his works will always belong on the shelves of academic libraries, as well as public and school libraries, inspiring new physicists' work and expanding the minds of anyone interested in the wonders of science.

Endnotes

1. **Gamow, George**. *Mr. Tompkins in Wonderland: or, Stories of c, G, and h.* New York: The Macmillan Company, 1940.
2. **Gamow, George**. *Mr. Tompkins Explores the Atom.* New York: The Macmillan Company, 1945.
3. **Gamow, George**. *Mr. Tompkins Learns the Facts of Life.* Cambridge: Cambridge University Press, 1953.
4. **Gamow, George** and **Russell Stannard**. *The New World of Mr. Tompkins.* New York: Cambridge University Press, 1999.*
5. **Gamow, George**. *One, Two, Three ... Infinity: Facts and Speculations of Science.* New York: Viking Press, 1947.*
6. **Gamow, George**. *Matter, Earth, and Sky.* Englewood Cliffs, N.J.: Prentice-Hall, 1958.
7. **Gamow, George**. *The Atom and Its Nucleus.* Englewood Cliffs, N.J.: Prentice-Hall, 1961.
8. **Gamow, George** and **Robert Oerter**. *Mr. Tompkins Gets Serious: The Essential George Gamow.* New York: Pi Press, 2006.
9. **Gamow, George**. *My World Line: An Informal Autobiography.* New York: Viking Press, 1970.*
10. Ibid. 5, p. 277.
11. Ibid. 5, p. 102.

*Editor's note: An asterisk (*) denotes a title selected for *Resources for College Libraries*.