A Gallery from *Quantoons*, Physics Art by Tomas Bunk

Feature

In 2005, the New York Hall of Science featured a collection of delightfully bizarre physics illustrations called *Quantoons* by artist Tomas Bunk. You see before you four examples of the 58 *Quantoons*. All 58 have been published in an anthology bearing the same title, “the perfect book for science and math buffs who crave both physics problems and freaky illustrations.”[1, 2]

In Tomas Bunk’s world, electrons that are bound prior to being set free in the photoelectric effect wear a despondent ball and chain. The Compton effect occurs when a drunken photon crashes its car into an electron in a wheeled hospital bed as a distinguished audience looks on, their skeletons revealed by X-rays, showing “that inside we all look alike.” Tomas reminds us that physics should be *fun*. His images are populated with Galileo and Newton and Einstein—as we might expect—but also with Dante and Marie Antoinette and Frank Zappa—which we do *not* expect, reminding us that physics is connected to the larger range of life. Would that our textbook illustrations and chalkboard drawings were even 10 percent as creative as *Quantoons*!

These merry but thought-provoking illustrations first appeared in *Quantum* magazine.[3] Tomas created them to accompany the Contest Problems that were a regular feature of the magazine during its 11-year history. These problems require only freshman physics for their solution, but graduate students and physics professors find them challenging! They captivate anyone who enjoys the intrigue of a well-designed multi-concept physics problem. With Tomas’s illustrations, the collection also offers a student-engaging resource, rich with opportunities for discussion in the introductory physics course.[4] Many of these problems were originally developed to select the strongest physics students in the 60 countries that participate in the International Physics Olympiad (IPhO). Two of them are stated for your pleasure at the end of this article.

Quantum came to the United States thanks to Arthur Eisenkraft. He was introduced to the Russian publication *Kvant* by his friend Sergey Krotov of the former Soviet Union, while both were Academic Directors for their respective national teams competing in the IPhO. Impressed by *Kvant*, Arthur saw that its easy-going style of articles, problems, and humor could be well adapted to a U.S. audience. Through the efforts of many people, *Quantum* began publication in 1990. Among those cru-

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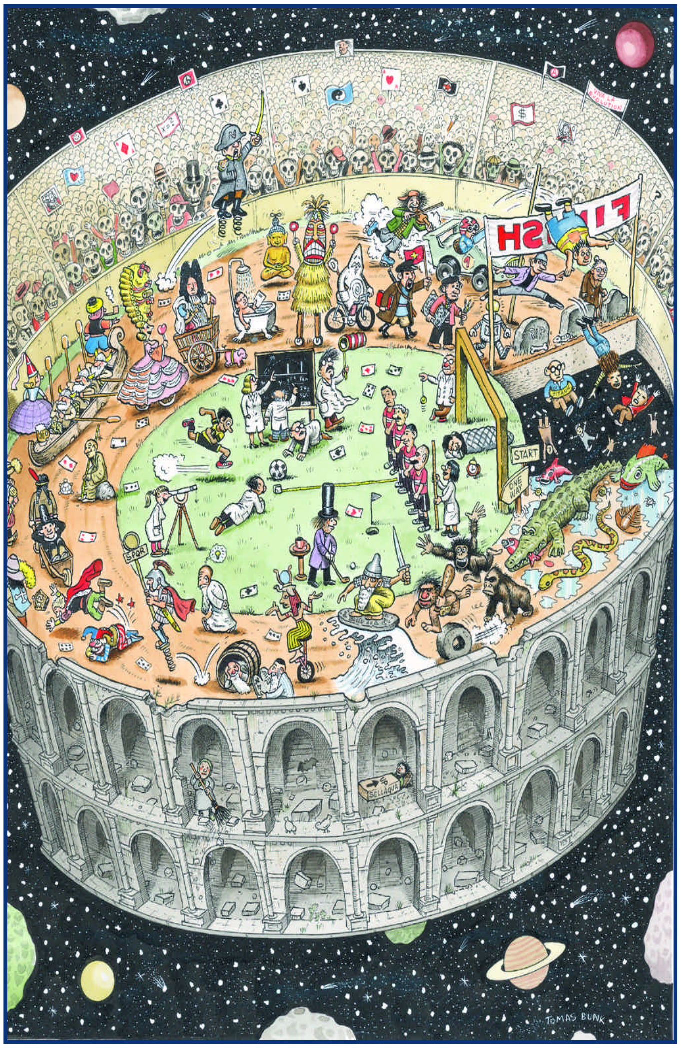
Cloud formulations

A tower of Babel-shaped rock rises high above the sea with a winding road leading to the top. One side is warm and summery, the other cold and icy. The balloon on the warm side, fully inflated, joyfully floats up into the sky while the same balloon on the frosty side decreases in volume and sadly drops down with its three scholarly passengers reacting accordingly. Up the winding road we follow a procession of evolutionary development, from the sea creature leaving the ocean and pushing a balloon full of promise all the way up to the modern humans, who are leaving the earth to ride the lofty skies toward heaven. Some, though, end up on the cool side, and with their balloons they plummet into the icy waters of the dead. They should have learned their physics.
— Tomas Bunk

Image credit: Quantoons, used with permission cially placed to get *Quantum* going were Bill Aldridge, then Executive Director of the National Science Teachers Association (NSTA), and Yuri Ossipyan, vice-president of the USSR Academy of Science. The National Science Foundation (NSF) provided initial funding. Additional support came from the American Association of Physics Teachers (AAPT) and the National Council of Teachers of Mathematics (NCTM). *Quantum* was proudly published by NSTA throughout the magazine's 11-year existence.

From the beginning of *Quantum*, Arthur Eisenkraft and Larry Kirkpatrick collaborated in creating the Contest Problems feature. They are uniquely qualified to collect and edit physics problems that are challenging, fascinating, yet doable with introductory methods. Larry followed Arthur as Academic Director of the U.S. Physics Team; co-authored (with Gerald Wheeler, current NSTA Executive Director) the excellent text *Physics: A World View*, served as a President of AAPT; and is today Professor Emeritus of physics at Montana State University. Arthur taught high school physics for many years in New York; serves as Project Director of the *Active Physics* curriculum that puts hands-on, inquiry-based "physics for all" into the ninth-grade classrooms of many of the nation's largest school districts; and holds the chair of Distinguished Professor of Science Education and Director of COSMIC (Center of Science and Math in Context) at the University of Massachusetts-Boston.

From the beginning, their column offered readers more than just great physics problems. Literary quotes accompanying the problems gave the column an extra touch of class. But Arthur and Larry also wanted more creative illustrations. So one day Arthur approached Tomas Bunk.



Sportin' life

Circus Maximus, lots of play, history is made of mistakes, but looks OK. Our story starts some years back, when some fish decided to crawl out of the water and live on dry land, initiating a chain of evolutionary developments. After we quickly arrive at Homo erectus, we already see the caveman inventing the wheel to get ahead faster. He is followed by the surfing Babylonian, the biking Egyptian, the rolling-in-a-barrel Greek, the hopping Roman, and so forth. The human comedy moves on and on and around, seemingly without a goal: at the finish line we slip back into the universe, where we originally came from. In the middle of the circus the soccer player is running to kick the ball into the goal. In the halls we see Dante's Belacqua sleeping—he doesn't seem to be very interested in taking part in this whole circus. — Tomas Bunk

Image credit: Quantoons, used with permission

A native of Croatia, Tomas left West Berlin for New York City in the 1980s to work for the Topps Company. A professional illustrator, Tomas regularly contributes to *Mad* magazine. He is also one of the creators of the *Garbage Pail Kids* trading cards, and illustrates children's books. His work has also been published in numerous European magazines. After joining *Quantum*, Tomas became the illustrator for *Active Physics* as well. Tomas's first reaction to Arthur's inquiry was, "But I don't know physics." Arthur responded, "Well, that might be an asset." Tomas learned the physics he needed to illustrate the Contest Problems. Coming from a different background, Tomas helps us see physics from a refreshing perspective.

As the Contest Problems evolved, so did Tomas's illustrations. They began to include political commentary, historical themes, and philosophical issues. But always, Tomas's colorful images were densely populated with quirky characters who found themselves in settings both hilarious and thought-provoking. With boundless humor, a philosophical mind, and keen insight to match his artistic talents, Tomas gently reminds us that physics is connected to all of life, too important to be taken too seriously.

After *Quantum* ceased publication in 2001, the 58 Contest Problems were collected into *Quantoons*, with the subtitle *Metaphysical*

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Illustrations and Physical Explanations. The collection comes complete with Tomas's cartoons, literary quotes, and discussions by Arthur and Larry of the problems' backgrounds and solutions. This anthology also carries a feature not originally available in *Quantum*: accompanying each illustration we find a brief commentary written by Tomas. As Arthur and Larry write in the Introduction, "This peek at the creative mind of a visual artist not only provides insight into how Tomas views the world, but also how people who are not trained in physics can appreciate the world of science and make it their own."

There's more to see here than meets the casual eye. One finds allegories to scenes and characters from great literature, philosophy, and art, as well as physics. For example, see if you can find Tomas's use of the motif from the 1793 painting by Jacques-Louis David, "*Marat Assassinated*."

Prepare to be intellectually stimulated and visually delighted! Enjoy *Quantoons*!

— *Editor*

Acknowledgments
Many thanks to Tomas Bunk, Arthur Eisenkraft, Larry Kirkpatrick, and, from NSTA, David Beacom and Catherine Lorrain, for their gracious assistance in preparing this article and gallery of *Quantoons.*

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[1] Quotes and historical comments are taken from the Introduction and back cover of *Quantoons*.

[2] *Quantoons: Metaphysical Illustrations* by Tomas Bunk, with physical explanations by Arthur Eisenkraft and Larry Kirkpatrick, © 2006 by the National Science Teachers Association.

[3] Problems and artwork originally published in different forms in *Quantum* magazine, Vol. 2, No. 1 (September/October 1991) through Vol. 11, No. 6 (July/August 2001). They and many others now appear in the book *Quantoons* © 2006 by the National Science Teachers Association (NSTA). All rights reserved. Illustrations and text excerpts used by permission of NSTA.

[4] To order *Quantoons*, potential purchasers may: Phone 800-277-5300 (U.S. and Canada only) or 301-638-0200, 9a.m. to 5p.m., Monday-Friday; Fax: 888-433-0526 (U.S. and Canada only); Online: http://store.nsta.org/; Mail: NSTA, P.O. Box 90214, Washington, DC 20090-0214.

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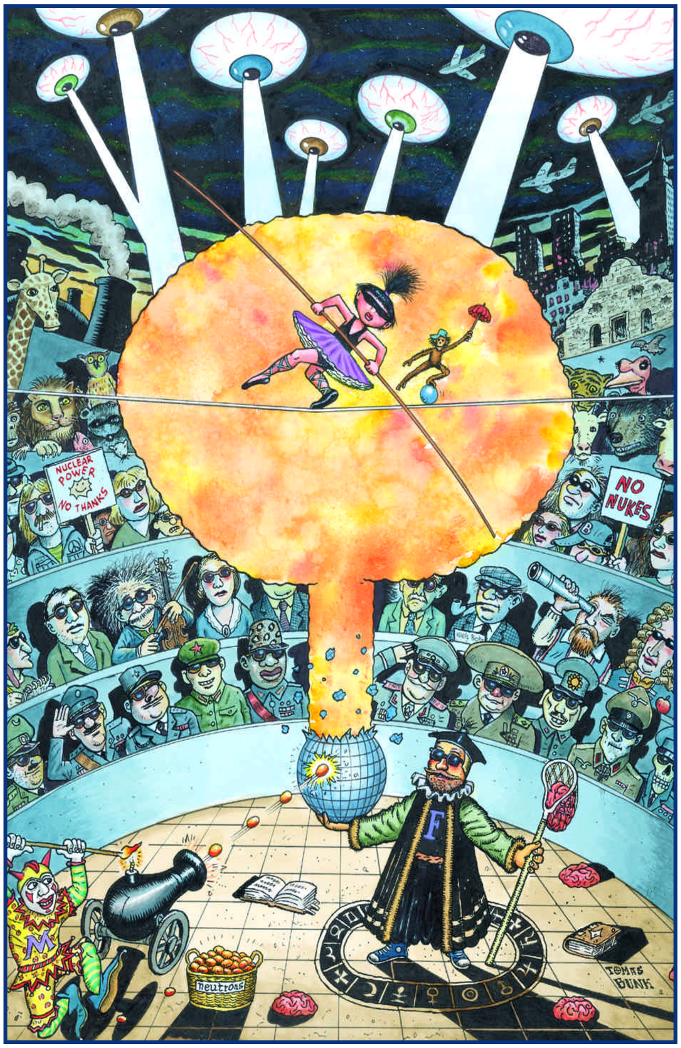

Breaking up is hard to do

Western man (and woman) wants to know everything that can be known and make anything that can be imagined. Unfortunately, this is a difficult balancing act. One can improve life, but one can also destroy it. Faust has sold his soul to the devil for divine knowledge and now plays with nuclear power. The military in the front row is pleased to get their toys of destruction, while the scientists behind them are more concerned. Even Einstein forgets to play the violin for a moment, and Dante, seeing what's coming, is already writing his Inferno. The regular people are afraid of nuclear power but uncertain what to do, and the animals behind them worry about their own extinction. Beyond the theater we see pollution and destruction—and while impartial eyes watch from space, they do not interfere. It all may be just a dream, a delicate dance on a blue ball without any purpose except to keep everybody on her toes.

— Tomas Bunk

Image credit: Quantoons, used with permission

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TWO SAMPLE PROBLEMS

"Boing, Boing, Boing" (begins on p. 120 of *Quantoons*)

"A ball is dropped vertically, falls a distance h, and strikes a ramp inclined at 45° to the horizontal. The ball undergoes a perfectly elastic collision [neglect air resistance]...." The solution to the first bounce is then described, using conservation of energy for the fall from release to first impact, becoming a projectile problem after the first impact. The ball leaves the first bounce horizontally, then hits the ramp for the second time at some distance L_1 down the ramp. "...[W]hen we looked at the second bounce, something very interesting emerged that prompted us to look at the third bounce, and the fourth...

"A. Complete the analysis of the first bounce [to the second] by showing that the time t_1 in the air equals $2t_0$ [$t_0 = \sqrt{(2h/g)}$ = time for the ball to fall from the point of the release to the ramp, g denotes the gravitational field], the speed of impact is $\sqrt{(5)}v_0$ [where $v_0 = \sqrt{(2gh)}$ = speed going into first bounce], and the angle Θ_1 that the ball makes with the vertical is given by tan Θ = ½.

"B. For the second and third bounces, find the distance the ball travels down the ramp (in terms of L_1), the time in the air (in terms of t_1), the speed at impact (in terms of v_o), and the tangent Θ of the angle with the vertical at impact.

"C. Generalize your answers to the nth bounce and give physical reasons for the existence of the observed patterns."

"Focusing Fields" (p. 108 of *Quantoons*)

"Ions of mass m, charge q, and speed v diverge from a point P [visualize P at $x = 0$]. A uniform magnetic field B perpendicular to the plane of the page focuses them to a point R located at a distance $PR = 2a$ away from P [R is at $x = 2a$]. Their trajectories have to be symmetrical to the axis that is the perpendicular bisector of PR. Determine the boundaries of the magnetic field [its boundaries in the xy plane above the x-axis; the B field itself points parallel to the z-axis]."

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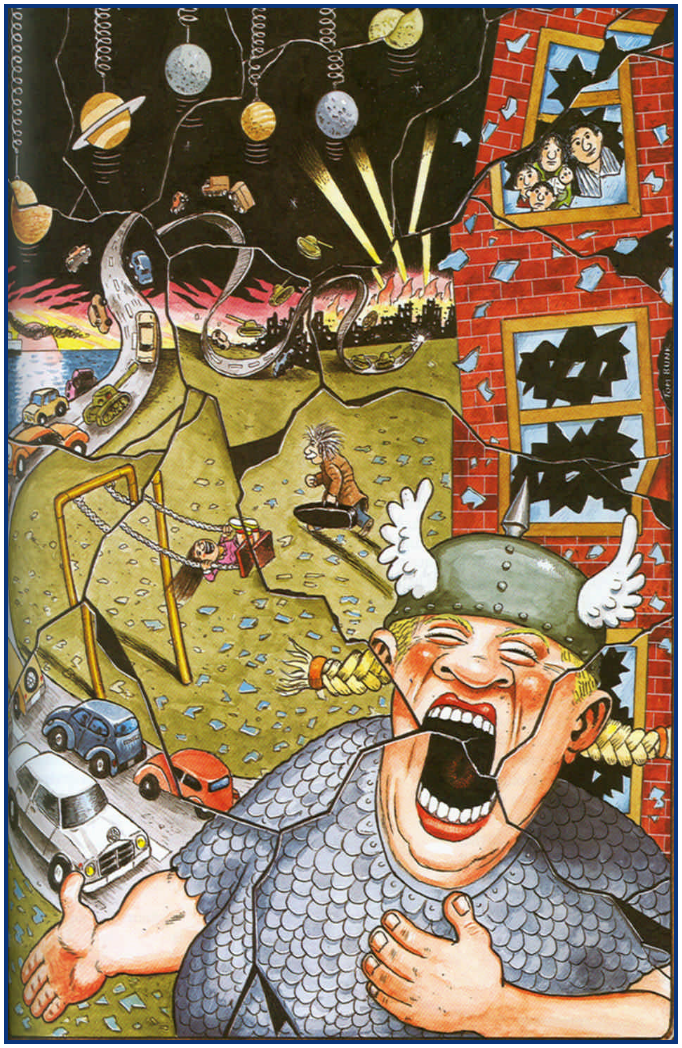

Cool vibrations

Within the frame of this broken mirror we find ourselves in the Germany of the late 1930s. A voluminous singer of Wagnerian proportions is blasting her high-pitched voice into her surroundings, creating vibrations that cause crystal goblets to shatter. In this case the image hints at the so-called Kristallnacht, when Jews were beaten and killed by organized thugs all over Germany. Shortly after this incident, Hitler's Autobahn was convulsed by marching boots rumbling through the earth leading straight into the hell of World War II, the destruction of cities and millions of lives. Some, like Einstein, managed to escape in time to reach the boat of safety. The innocent little girl is swinging happily to new heights, creating good vibrations, but they could not compete with the poisonous ones that ruled the times.

— Tomas Bunk

Image credit: Quantoons, used with permission