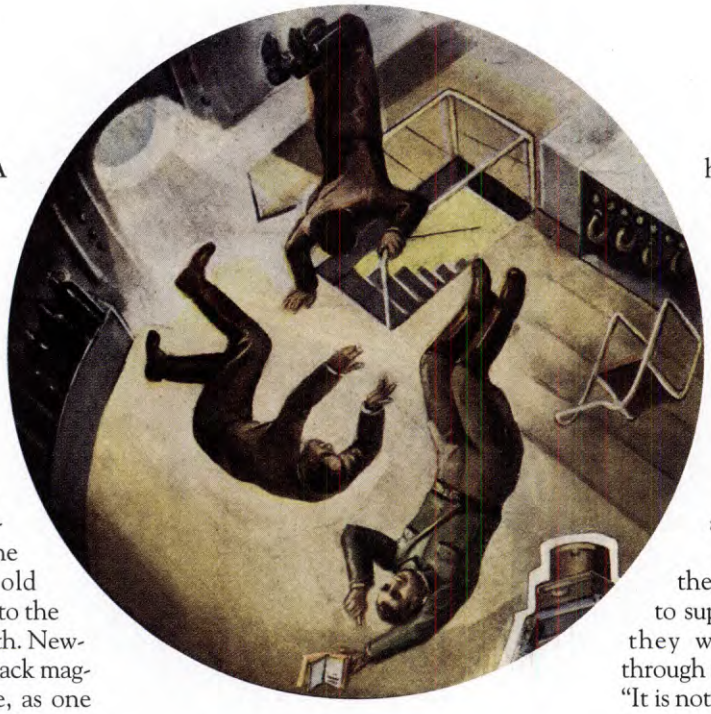
A CURIOUS ATTRACTION

On the quest for antigravity

By Jon Mooallem



1. SPOOKY ACTION AT A DISTANCE

Even Sir Isaac Newton recognized that the idea of gravity—that one object can instantaneously yank another through total nothingness and from extremely far away—was so counterintuitive, "so great an absurdity," that no intelligent person could be expected to stand for it. It lacked the elegant horse sense of the old ideas, such as the rock falling to the earth because it is made of earth. Newton was able to imagine this black magic moving the apple because, as one biographer admiringly writes, "he embraced invisible forces." And he did so more promiscuously than we choose to remember. The inventor of modern gravity was also a fanatical alchemist. It's just that, in the case of universal gravitation, the invisible force he embraced turned out to be real.

"Most of the fundamental ideas of science are essentially simple, and may, as a rule, be expressed in a language comprehensible to everyone," Albert Einstein once wrote. Yet in 1915, Einstein's theory of general relativity pulled gravity even further from the realm of common sense, entangling it in recondite mathematics and dreamlike geometry.[1] Initially, it didn't seem to matter whether Einstein was right; his masterpiece was attacked for not being *populist* enough. "A great and serious retrograde step," one Princetonian called it. "All previous physical theories have been thus intelligible . . . [to] the whole race of man." A flummoxed Columbia professor announced that general relativity smacked of Bolshevism and must be stopped.

In 1919 astronomers made the first significant observation to support general relativity when they watched starlight bending through space-time curved by the sun. "It is not possible to put Einstein's theory into really intelligible words," the *New York Times* noted in its coverage of the event. One scientist tried, but it was as though he'd had a conversion experience into a very small cult. What this new observation showed, he told the *Times*, was that parallel lines could eventually meet, that three angles of a triangle needn't add up to 180 degrees, and that "a circle is not really circular." The editors headlined the story, in part: "Stars Not Where They Seemed or Were Calculated to Be, but Nobody Need Worry."

As in Newton's time, a seemingly unbridgeable rift opened between the everyman's visceral experience of gravity and the specialist's explanation of it, and the laymen didn't always accept this estrangement

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[1] *The theory of general relativity conceived of empty space as actually being a fabric of space and time, with gravity caused by the imprints objects make in it. Imagine the depression a basketball would make if placed in the center of a taut sheet; when a less massive object, like a marble, travels close to the ball, it will be derailed off its course and begin circling in the curved depression made by the ball. In this way, the earth orbits the sun, and we are forever foundering in the deep space-time trench around the earth. Einstein's gravity is not so much a force as a circumstance: the very material of the cosmos has crumpled steeply around you until, almost conspiratorially, all of your possible paths have been narrowed to one.*

Space Travellers Will Have to Learn to Live in a Gravity-Free Environment, 1933 © Mary Evans Picture Library

with the wry dispassion of the *Times*. Somehow it just didn't seem right that this ubiquitous force affecting us all should be understood by only a select few. A man named George Francis Gillette published *Orthod Oxen of Science*, claiming that Einstein's "self created fairyland of 4th dimensional space" was "the funniest mental belly ache inflicted on science." It was also "utter tommyrot." Gillette offered a number of ideas in place of Einstein's hooey. Among them was "The All Cosmos Doughnut."[2]

Despite the initial resistance, however, physics rapidly fell in love with general relativity. More observations supported it, and its predictions seemed to operate on too astronomical a scale to check directly with any technologically feasible experiments. Einstein's gravity came to stand as a kind of untestable truth.

Nevertheless, as physics has worked to refine its understanding of gravity, a sanguine subculture of amateurs and outsiders has continued to needle the accepted thinking for weaknesses, setting out not to better define this invisible force but to overcome it. Much of this recreational research asks whether we might finally be able to *do* something with this power and not simply suffer from it. Today, the website American Antigravity serves as a clearinghouse for this quasi-scientific uprising, and the mere copiousness of its holdings has a way of making the incredible feel almost inevitable. Surely a "cure" for gravity will arise from something here: the "Angelina VI" ball-lightning generator, the Beifeld-Brown Effect, the internal plasma expansion/contraction engine, the Impulse Gravity Generator based on a charged Y Ba2Cu3O7-y superconductor with composite-crystal structure, or the Quantum Vacuum Pathway Theory, which "describes a plausible mechanism" for "spooky action at a distance."[3]

We are suspenders of disbelief, easily enchanted by possibility, addicted to wonder. So whatever measure of faith we harbor in the fallibility of gravity may, like our faith in so many things, be sustained not by facts or lack of facts as much as by the sheer strength of our longing for it to be so. After all, what clearer vision of joyousness and freedom is there than a band of jumpsuited astronauts in zero gravity tumbling upward and over themselves like giddy pinwheels? "Of all the natural forces," wrote futurist Arthur C. Clarke, "gravity is the most mysterious and the most implacable." Yet Clarke also assumes that the high Himalayan peaks will one day be as saturated with tourists as the beaches of Cannes, once personal gravity control is perfected. "The Sherpas and Alpine guides will, of course, be indignant," he writes. "But progress is inexorable."

After a century of science fiction on the subject, a life unfettered by gravity may feel strangely like an entitlement. Indeed, there is mounting suspicion even in the most respectable spheres of physics that the force we call "law"—this fact evidenced by every dropped paper clip and sunset, as frank as a falling anvil—may not actually be settled at all.

2. GRAVITY RADIO

In 2002, at a Princeton physics symposium titled "Science and Ultimate Reality," Raymond Chiao announced his plans to turn gravity into both electricity and light and electricity and light into gravity. For more than twenty years, Chiao had been laboring over a revolutionary communications apparatus that would work by linking these disparate forces. He'd originally called the device a "gravitational radiation antenna," but his son-in-law eventually came up with a better name: gravity radio.

Chiao is sixty-six, an MIT alumnus, and a fellow of both the Optical Society of America and the American Physical Society. At the time of the Princeton symposium, he was still a celebrated professor of physics at the University of California, Berkeley. As Chiao spoke, he described his contraption in the drab and equation-encumbered language of physics. Yet the rattling wondrousness of gravity radio and the world into which it could deliver us was impossible to miss. What could gravity radio do? Gravity radio could beam unstoppable, information-rich gravity waves straight through the soil, crust, and core of the earth to be received—unattenuated and unscathed—by gravity radios on opposite ends of the planet. Relaying a flimsy signal between satellites might be a serviceable way to dial China, but here was a phone call of unwavering directness. Point gravity radio up, and gravity radio could send emails to Venus, or farther, at the speed of light. Gravity radio could broadcast *Fresh Air* to Alpha Centauri. Gravity radio could pick up gravity waves still emanating from the big bang; which is to say, gravity radio could be a baby monitor tuned to the infancy of time.

"It is hard to know whether the assembly was more astonished by the idea that this might be possible," one observer in attendance noted, "or by Chiao's lack of concern for his own reputation." No one has ever even seen a gravity wave. Einstein predicted that these ripples in space-time are sent coursing through the cosmos any time an object moves. Yet Einstein himself had trouble believing this at first; then, conveniently, he decided that if gravity waves did exist (we now know they almost certainly do), they would be such slight disturbances that we'd never be able to detect them. For half a century, in fact, no one bothered to try.

As it happens, while Chiao delivered his paper, science's best hope of pinning down gravity waves was being readied to switch on after thirty years of development. The experiment is called LIGO, the Laser Interferometer Gravitational-Wave Observatory, and involves multimillion-dollar arrays of

[2] *Gillette envisioned the universe as being composed of little masses that zipped around and collided.* "In all the Cosmos there is naught but straight flying, bumping, caroming and again straight flying. . . . A mass unit's career is but lumping, jumping, bumping, rejumping, rebumping, and finally unlumping. . . . *Gravitation," he concluded, "and backscrewing are synonymous."*

[3] *Stray too far into the site's labyrinth of links and you could end up, as I did, listening to an interview with "a man who saw somebody dear to him suddenly transform into a strange, reptilian creature." But with gravity most of us are ill equipped to distinguish between the hokum and the shreds of austere physics on which it is imaginatively based; "spooky action at a distance," for instance, is Einstein's phrase and describes a genuine conundrum of quantum physics.*

lasers streaking through sets of two-and-a-half-mile-long stainless-steel tubes in Washington State and the Louisiana woods. Still, even with these massive antennae, LIGO might barely be able to detect the universe's most robust gravity waves, such as those emitted from violent supernovas. Gravity radio would practically fit on a tabletop.

"This is the too-good-to-be-true argument," a colleague of Chiao's told me. "It threatens everyone else's intuition." When a reporter for the magazine *New Scientist* visited Chiao at Berkeley in 2003, he found gravity radio on the floor. It was a slab of superconducting ceramic, a couple of empty paint cans for insulation, some polystyrene cups, and bits of wood, all disassembled and piled into a cardboard box. It looked like trash. Chiao was funding gravity radio himself, ordering materials from high school suppliers. A peer-reviewed journal, he said, had rejected one of his gravity-radio papers without explanation.

When I called Chiao two years later, he seemed understandably ambivalent about explaining the promise and controversies of gravity radio to a novice. He still hadn't performed any experiments; he was refining his theories. "Let me put it this way," he said. "It's a long shot. But I think it's worth continued research."

Several weeks later, seeming more confident about gravity radio than ever, Chiao suddenly left his job at Berkeley to build it. I was welcome to visit his new lab, he said, if I was willing to make the drive.

3. OUR ENEMY NUMBER ONE

I'd first learned about gravity radio while tracing the loose ends of a figure whose life I was coming to see as both a cautionary tale and a catalyst for just this kind of questioning. Roger Babson was an obdurate entrepreneur so giddy with the possibilities of the twentieth century that he saw even in gravity's downward tug an opportunity waiting to be leveraged. Born in 1875 in Gloucester, Massachusetts, Babson rejected the values of the town's "codfish aristocracy," instead holding fast the good Protestant value of self-reliance. He turned his small investment newsletter into a trusted empire called Babson's Reports; founded Babson College near Wellesley, Massachusetts; and became both wealthy and famous when, it is said, he predicted the Great Crash of 1929 with his signature "Babsonchart."

Babson went barking into the post–World War II years with a beautiful idea: namely, that gravity, the most immutable law of the Enlightenment, was unacceptable and should be changed. "It seems as if there must be discovered some partial insulator of Gravity which could be used to save millions of lives and prevent accidents," he reasoned in his treatise "Gravity—Our Enemy Number One." His antipathy was steeped in grief. In the summer of 1893, Babson's three-year-old sister, Edith, drowned in the Annisquam River near their house. "Yes they say she was 'drowned,'" Babson wrote, but Edith was a fine swimmer. He blamed "Gravity which came up and seized her like a dragon and brought her to the bottom." In 1947 his teenage grandson also drowned, after diving off a motorboat to rescue a friend. Less than eighteen months later, Babson had formed the Gravity Research Foundation.

The foundation's underlying imperative was to learn all it could about gravity and defeat it. It rose to meet the gravity problem with seemingly unlimited funds and a fervor that suggests a near-total unawareness of its Sisyphean nature. Frozen-food magnate Clarence Birdseye, a Gravity Research Foundation trustee, suspected that a gravity insulator might be discovered by accident, through unrelated research. So twenty-five hundred labs were contacted and asked to keep their eyes peeled. Three men were kept on permanent watch at the patent office. Thomas Edison once wondered aloud to Babson how it was that birds could fly—maybe there was something there. Thus, a lavish collection of stuffed birds, from five thousand different species, was amassed to be studied, just in case.

George Rideout—foundation president and Babson's longtime right-hand man—devised an annual essay contest with a thousand-dollar purse to inspire research on "the possibilities of discovering some partial insulator, reflector or absorber" of gravity. Babson and Rideout purchased a twenty-five-year run of *Time* magazine to use as an almanac, searching for correlations between international incidents and the phases of the moon. They wondered if gravity's pull on the body affected temperament, and mailed an exploratory survey to subscribers of Babson's investment bulletin. And so straitlaced industrialists were asked to fill in their weight and to agree or disagree with such statements as "I love physical comfort," "I am an unimpressive talker," and "Ladies like me."

"Gravity Aids for Weak Hearts," one of many pamphlets the foundation published, recommends lessening gravity's strain on the body by moving into a bungalow-style house or using a cane. "Gravity and Posture" states, "It behooves us therefore to give the body all possible aid in maintaining the proper gravity pull by wearing the right corset." Digging through what's left of the foundation's early affairs in the Babson College archives, I found an entire folder of these instructional guides, with such titles as "Gravity and the Weather" and "Gravity and Your Feet." They linked gravity to the common cold, house fires, insomnia, poor crop conditions, tilted uteruses, the firing of General Douglas MacArthur, the shrinking of the elderly, tuberculosis, "worries," varicose veins, and hemorrhoids—which, one article asserts, "are merely varicose veins of the rectum."

"It was a time when amateurs could still hope and dream about being contributors," David Kaiser, a professor of physics and the history of science at MIT, told me. Kaiser has been fascinated with the Gravity Research Foundation since he wrote part of his doctoral thesis about it at Harvard. Babson's men were not experts, Kaiser explained, but their hearts were in the right place. "Babson thought, 'I'll just get all my buddies together and we'll fix it.'"

In some ways, undoing gravity seemed to be just another entrepreneurial project Babson felt compelled to get off the ground. (It was not, incidentally, his oddest venture: he also envisaged chocolate-covered fish, to bail out Gloucester's economy; asbestos-lined pants pockets, to prevent men from igniting their crotches when putting away their pipes; and,

to right America's moral compass, the creation of a federal "Department of Character Training," to be headed by the "Secretary of Character.") As a dedicated businessman, he couldn't allow gravity to go on wasting itself, pulling things in the same old direction for its own purposes and not ours. Electricity, light, magnetism—if all these things could be insulated and controlled, he argued, surely gravity could. It seemed only reasonable.

"World peace will come only as the Spirit of Jesus grows in the hearts of man and as the principles of birth control are taught to overcrowded nations and the latent power of gravity is used as freely as air, water and sunlight," Babson wrote in his autobiography, *Actions and Reactions*. He didn't know what caused gravity, and he didn't care. All he knew was that the damn stuff was everywhere, and only a sap would go on accepting its reprimand.

4. INFLATION

"How did you get onto it?" Rainer Weiss, professor emeritus at MIT, wanted to know when I brought up the Gravity Research Foundation. "You got onto Mr. Chiao, so that's a bad sign," he joked. "And now you got onto this—which is an even worse sign!"

Weiss, a short, charismatic man of seventy-three, had returned from Louisiana late the previous night after visiting LIGO—the grand experiment he'd dreamed up thirty years earlier. "Observatory" is the key concept of the Laser Interferometer Gravitational-Wave Observatory. Ultimately, LIGO aims to diagram the universe by charting gravity waves emitted by moving bodies, just as we now see things by the light they emit. Mapping the "gravity sky" will open a new field of astronomy, Weiss said—one theoretically capable of assembling a picture of the big bang.

I'd hoped to find out more about LIGO in order to gauge just how far-fetched Chiao's gravity-radio scheme actually is. Weiss resented my even comparing the two endeavors. He was a colleague of Chiao's at MIT for a time and still periodically writes Chiao to point out what he considers gravity radio's many unsolvable problems. "He says, 'Yeah, yeah. I'll get to it.'" Weiss said of Chiao. "I like him. He's a fine man. But he's not a doer. He likes to think about things."

On the phone, Weiss had urged me to stop writing about gravity waves altogether and cover "the real revolution" in physics—something called "Inflation," which, he said, "is probably the most shocking discovery in my lifetime." Now that I'd flown across the country to meet Weiss, my first question was about Roger Babson. He squinted at me from behind his desk. "I'm worried about you," he said. Babson was a businessman, Weiss went on, who went loopy over gravity because his relative got killed in an airplane. I corrected him, relaying the fates of Babson's grandson and poor Edith. "And so gravity did the job on her too, eh?" Weiss said. He sounded sympathetic. Then his voice rose. "Well, there wouldn't have been any water there for her to swim around in if there was no gravity!"

I pointed to his office door in my defense. Weiss had taped up a flyer announcing the Gravity Research Foundation's 2006 Awards for Essays on Gravitation, the fifty-seventh annual competition. The foundation has endured, its mission having matured from conquering gravity to understanding it. The essay contest, David Kaiser told me, is where graduate students now "look to see the coolest, hottest stuff." In his doctoral thesis, Kaiser argues that the contest helped return physicists to the study of gravity. Generations of graduate students had been told that there was no more work to do in the field after Einstein; one could merely plug numbers into his equations and futz around in the abstract. Rainer Weiss said that when he attended MIT in the Fifties, general relativity was taught only in the math department. Gravity, in short, had lost its place in the physical world.

At that time, when a physics professor might earn only five thousand dollars a year, Babson's foundation was offering one thousand dollars for a brief theoretical essay on gravity. In 1953 a brilliant but down-on-his-luck postdoc named Bryce DeWitt submitted a paper and won. (DeWitt, with the backing of a southern financier Babson had introduced him to, went on to

found an esteemed gravity-research institute at the University of North Carolina, Chapel Hill.) Two Princetonians took home the prize in 1954, and in 1957 it was a team from Cornell and Harvard. As the contest rules softened over time—it now solicits papers "on the subject of gravitation"—icons like Roger Penrose and Stephen Hawking won, too. In 1981 a young Berkeley professor named Raymond Chiao took second place for an essay on "Gravitational Radiation Antenna." It was among Chiao's first staggering steps toward gravity radio—an idea, Chiao later told me, that initially leaped out at him from one of Bryce DeWitt's equations.

"Despite himself," Kaiser says, "Babson and his foundation—this band of misfits and amateurs—actually played a role in bringing great minds back to gravity. Fifty years ago no one was doing this work. Now it's what gets government funding. There are fancy conferences and big expensive equipment. It's what you make *NOVA* specials about."

The day before my meeting with Rainer Weiss, I tracked down a monument on the campus of Tufts University. I found the four-foot block of granite beside a chapel overlooking the Boston skyline.

THIS MONUMENT HAS BEEN
ERECTED BY THE
GRAVITY RESEARCH FOUNDATION
ROGER W. BABSON FOUNDER
IT IS TO REMIND STUDENTS OF
THE BLESSINGS FORTHCOMING
WHEN A SEMI-INSULATOR IS
DISCOVERED IN ORDER TO HARNESS
GRAVITY AS A FREE POWER
AND REDUCE AIRPLANE ACCIDENTS

Babson issued at least thirteen such monuments to various colleges, accompanying them in most cases with sizable gifts of stock. The endowments were to be held for a certain number of years and then dedicated to research in the fight against gravity. By the time the Tufts stock was freed up in 1989, it had appreciated to roughly half a million dollars. Absolved by the foundation's lawyers from its original antigravitational obligations, Tufts used this windfall to found its Institute of Cosmology, which is now a prestigious training ground for theoretical physicists. The institute's director, Alex Vilenkin, told me that new graduates are led to the monument and ordered to kneel so that an apple may be ceremoniously dropped on their heads.

I was beginning to see Babson's misdirected burst of energy as having loosed a ripple effect not unlike a gravity wave itself—nearly imperceptible but warping the fabric of legitimate physics ever so slightly wherever it reached. Still, I was unprepared for the epilogue to Vilenkin's story. "The funny thing is," he said, "we actually do work on antigravity."

He was referring to the theory of inflationary cosmology, the theoretical-physics revolution Weiss had urged me toward. The theory seeks to explain why the universe's expansion, once thought to be powered by momentum from the big bang, is, in fact, speeding up. Its answer is "dark energy," a power aggressively pushing everything in the cosmos away from everything else. It is, by definition, antigravity. Cosmologists now suspect that dark energy accounts for as much as 75 percent of the energy in existence; that is, our universe is mostly this thing we only just discovered. As Weiss put it, "It turns out there is no vacuum. The vacuum is full of stuff!"

Perhaps not since general relativity has a theory produced such maddeningly counterintuitive corollaries, calling into question fundamental presumptions of physics, even relativity itself. "A dark mystery is burbling up," Weiss told me, "and it says: We don't have a working knowledge of the universe."

Inflation happens to be David Kaiser's field. He was surprised but pleased that a scientist of Vilenkin's stature would refer to dark energy as "antigravity." "Repulsive gravity," instead, has emerged as the term of art. Nothing about dark energy suggests it can be harnessed, generated, or, say, spread on the bottom of your shoe to facilitate expeditious slam-dunking. But physicists may worry that borrowing a shibboleth like "antigravity" would open them up to discussions with the wrong crowd.

I asked Kaiser how he'd respond to some earnest, pseudo-scientific hobbyist pointing to the relatively late discovery of dark energy to argue that the more fantastical antigravitational aspirations of laymen—of us all—should never be deemed impossible.

"I would grant that," he said. Though, he added, he wouldn't feel this same equanimity if he hadn't become so enamored of "our wacky friend Babson." When Kaiser does get mail like this, he chooses to be heartened by it. "Usually my reaction is, 'Isn't it great that people are interested in what we do all day?'" Besides, he told me, "crazy ideas are sometimes right."

5. UNWANTED DEGREES OF FREEDOM

A low charcoal-colored storm readied to break as I drove toward Yosemite to meet Raymond Chiao. In 2005, Chiao abandoned the flagship school of the University of California system—Berkeley—for its fledgling start-up, the University of California, Merced. The college was exactly three months old. It had eight hundred students. For the low-profile venture three hours' drive southeast of San Francisco, Chiao's appointment was "a major recruiting triumph." Merced's press release touted his research in gravitational radiation and listed his prize from the Gravity Research Foundation first among his many honors.

Chiao's laboratory is several miles from the unfinished campus, set back from Highway 99—past several cow yards, some sheep, and acres of blossoming almond orchards. The university had erected a lone building there, on the decommissioned Castle Air Force Base. Nearby, mid-century dogfighters and transporters were set out to make an air museum. They crowded together on the flat, featureless land, a reliquary of ancient propeller planes in khaki and chrome.

Chiao had just finished lunch when I arrived. I asked after the gravity-radio prototype I'd read about—the paint cans, the wood. It was boxed up in a closet and forgotten, he said, fluttering his hands in front of him as though to exonerate himself. He had now arrived at a "much clearer and much simpler" concept. "I have reached a point of conclusion that is, I think, incontrovertible," he announced. "Unless I've made a mistake."

Gravity radio is essentially a transducer, Chiao explained. He would beam waves of electromagnetism—like those broadcast by a radio station—into two drops of helium, and they would bounce off the helium as gravity waves. The gravity waves would then be sent, however far and through whatever obstacles, to a second gravity radio, a receiver. There they would hit other drops of helium and be converted back to usable radio waves. Chiao's calculations led him to believe that nothing would be lost in these conversions. He could, in physics parlance, "freeze out" all the helium's "unwanted degrees of freedom." That is, if he cooled the helium, it would reflect one form of incoming energy by radiating it back as the other, and not in a disorganized array of other forms, such as sound or heat.

Chiao was trying to pick up exceedingly weak gravity waves through the disturbances they made in two exceedingly small drops of helium—as opposed to picking up very powerful waves, like those from exploding stars, through the disturbances they made in LIGO's two-and-a-half-mile lasers. This, Chiao explained, looks impossible, given much of the field's thinking since Einstein. But to compensate for his antenna's infinitesimal size, Chiao was banking on triggering an elusive phenomenon of quantum mechanics. The helium, he believed, would act as a "superfluid": every atom would shudder under the gravity wave as one coherent object, amplifying the effect.[4]

"I don't care what people say," Chiao told me. "I really don't care. I think most people like Rai Weiss will say I'm a crackpot. But I know that I'm not—especially after writing this paper." Chiao had recently delivered a new paper on gravity radio to a colloquium in Snowbird, Utah, where he was awarded the prestigious Lamb Medal for unrelated work in optics. To celebrate, some former students had organized a series of laudatory panels called Chiaofest.

He was eager to walk me through the paper and printed off an even more recent version than the one he'd previously emailed. In this latest refinement, he'd linked his hypothesis to an ironclad constant in physics called Planck's mass. Although this maneuver did little to convince two other physicists I spoke to, it clearly put gravity radio on inviolable ground as far as Chiao was concerned. He underlined the paragraph in red, read it aloud slowly, then flipped the paper across his desk to me as if it were an unbeatable poker hand.

At Merced I'd expected to find a bitter man in exile. But Chiao seemed disarmingly content—relieved, even—to be there. He'd already put his start-up funds toward the sophisticated low-temperature lab that gravity radio would require, having ordered two European-built dilution refrigerators at a cost of half a million dollars. He was building from the ground up and would be ready to perform his experiment in five years. Maybe it wouldn't work. But the most important thing was to build his device and, through gravity radio, let the universe speak for itself. "In the end," Chiao said, "the truth will prevail. Especially in physics."

I'd heard, from more than one physicist, the real-life allegory of Joseph Weber, another accomplished Gravity Research Foundation honoree. In the late Sixties, Weber announced he'd made the world's first successful detection of a gravity wave using a stubby pair of aluminum bars in his University of Maryland lab. "It was a very unfortunate event for him," Rainer Weiss had explained, "because up to that time he'd been perfectly dispassionate about this." Physicists around the country, spurred to think seriously about gravity-wave experiments for the first time, eagerly built their own "Weber bars," trying to confirm his work and push it further. No one saw anything. But Weber clung to his story, stubbornly, for years. He traveled the country, announcing his findings at conferences. Another physicist shadowed and heckled him to safeguard the integrity of the field. The two men had to be separated on-

[4] *For nearly a century, physics has lived with a kind of acute schizophrenia: general relativity and quantum mechanics, both useful predictors of the way things work in and of themselves, can't be made to fit together into a single "Theory of Everything." Quantum mechanics is used to understand phenomena on the atomic level and smaller, and relativity applies to those on much larger scales. The real significance of gravity radio, if it works, is that Chiao will have teased out an interface between the two.*

stage at MIT after raising their fists. Demoralized but still adamant, Weber kept bars running until he died in 2000.

When I asked Chiao how he knew he wasn't turning into another Joseph Weber, he characterized Weber's work as wishful thinking. "Allowing wishful thinking to dominate your assessment of reality is a sin," he said.

6. A BASEMENT IN WELLESLEY HILLS

The Gravity Research Foundation is currently headquartered a mile from Babson College, in the suburb of Wellesley Hills. George Rideout Jr., the son of Babson's right-hand man, inherited the Gravity Research Foundation in 1988, six years before his father's death, and now administers its sole remaining activity—the essay contest—from a cluttered back room of his basement. Rideout, a subdued man with a long patrician chin, explained that the job is largely administrative. He xeroxes contest submissions and mails them to an anonymous panel of judges every winter. Rideout minored in physics in college, he said, but cannot read the essays with any great understanding.

In preparation for our meeting, Rideout had set up a card table in the center of the basement headquarters, with glasses of water on coasters resting in front of each of our seats. His setting also included a yellow legal pad, on top of which was written my name, followed by the date and a list of points he intended to cover. A battery of filing cabinets holding the complete archive of essay submissions lined one wall; nearby, hung among some crayon-drawn birthday cards, was a handwritten note from Abraham Lincoln to his surgeon general. Something Mr. Babson had collected, Rideout told me when I happened to notice it.

I had spent the previous day rifling through the Gravity Research Foundation's scant archives at Babson College, watching in those pages a man toil earnestly toward his own hamfisted theory of everything—a man imagining a universe in which gravity was the greatest asset and the most pervasive menace. But I also detected in those papers the foundation's rising prestige as the years wore on. Then, following the minutes from Gravity Day 1958, the paper trail ran out.

Babson had sponsored Gravity Day every summer as part of a conference on "Investments and Gravity" at the foundation's headquarters in New Hampshire. Attendees were largely from the business world. Thus, a presentation on "Eliminating Weight" might dovetail with a talk like "Who Should Buy Mutual Funds?" Conventioneers were invited to see Isaac Newton's bed, view the stuffed-bird collection, or sit in special Japanese-made "Gravity Chairs"—undulating wooden recliners that alleviated gravity's strain on the legs. "Remember," exclaimed the brochures, "that gravity is Enemy Number One for middle aged and older people."

Eventually some airline executives began attending, as did Igor Sikorsky, the inventor of the first successful helicopter. By 1958, the minutes depict a serious-minded crowd of 278 discussing general relativity and joking about various quack entrants in that year's essay contest. According to one attendee, many of the essayists had devised their arguments simply by reinventing gravity "from scratch, with a mind uncluttered by knowledge." None of the conventioneers pointed out that they were gathered there because, ten years earlier, Roger Babson had done precisely that.

Babson, then an eighty-three-year-old man, was relegated to a brief paragraph at the end of the minutes. "Before the close of the session," the record concludes, "Mr. Babson reported on the question of the physical reality of the examples of levitation mentioned in the Bible." He'd polled Christian Scientists, Roman Catholics, and Protestant clergy and asked that the foundation convene every Easter to discuss the matter further.

George Rideout Jr. wasn't sure he had ever attended a Gravity Day. Much of what Rideout knew about Babson, he admitted, came from his father and the autobiography, *Actions and Reactions*. But he had enjoyed romping around the New Hampshire compound as a child. He liked the Japanese Gravity Chairs; they were comfortable. "It's too bad," Rideout said from across the card table. "They sold that place, and I don't think they kept any of the chairs." He then pointed to what remained of the foundation's stuffed-bird collection. A long-necked specimen sat upright on the filing cabinets to my left, and another squatter bird perched by the opposite wall. "It's some kind of duck up here," Rideout said, noting the webbed feet.

When I relayed what I'd learned at the Cosmology Institute at Tufts, Rideout reached behind him for a photo of the gravity monument. But his arm swept into his still-full glass of water. The glass—having no choice—toppled over. Ice cubes skirted across the card table. There was suddenly a puddle. "Let me go get a towel," Rideout said.

A photocopy of "Black Holes Aren't Black," an essay by Stephen Hawking, had gotten the worst of the spill. I must not have noticed Rideout sliding it into position on the table as we spoke. He'd been bringing out various relevant artifacts as he steered our conversation down the talking points on his pad. Much of his presentation dwelled on the stature of the foundation today. I assumed he was saving the Hawking paper as a robust finale. It included hand-drawn diagrams, and I took its brusquely paradigm-shattering title as a sign of its significance in the history of physics. The Gravity Research Foundation awarded it third place in 1974.

Soon Rideout returned with a yellow hand towel that he spread carefully across a dry section of the floor. He brought over the first few pages of the Hawking paper and arranged them on the towel. Then, with a kind of aloof but patient dignity, he knelt to pat them dry.

7. THE MYSTERY SPOT

After returning home from New England, my wife and I took a drive to the California redwood forest one Sunday afternoon. Our destination was the Mystery Spot, a small plot of land where "the laws of physics do not apply." "Within the Mystery Spot," a bright-yellow brochure claims, "it appears as though every law of gravitation has gone haywire, turned topsy-turvy and just doesn't make sense." Grainy photos show a ball rolling uphill, someone leaning so far back he seems to hover, and an old man standing on a wall. According to the promotional materials, a

number of theories have been worked up to try to explain this aberration: an excess of carbon dioxide or radiation, a "magma vortex," underground metal cones implanted by aliens.

A guide in a ranger-style uniform led a group of us up a hillside into a cabin he described as "the grandfather of all American funhouses." The wooden floor sloped in one direction and the walls skewed off in others. The guide announced that we were in an epicenter of mystery, where unknowable forces abound and the power of gravity frays. Then he began, slowly, to bend backward from the waist. He kept on bending—more, further, *Matrix*-like—until his hands touched down on the floor behind him. Emboldened, a boy there with his mother and older brother dove into a kind of handstand, corkscrewing his pubescent torso like a marlin snagged on an invisible line. It was stunning. I'd read about a psychology professor at UC Santa Cruz who brings his classes here to demonstrate how optical illusions operate. But I found myself ignoring any rational explanations of the Mystery Spot's mysteriousness, instead losing myself in a kind of simple glee. Even my wife, who had threatened to wait in the car, now seemed delighted by the strange push and mild nausea neither of us could deny feeling.

In 1940 a certain Mr. Prather first claimed to have discovered "puzzling variations in gravity" on this land and promptly opened the Mystery Spot as a kitschy "mind-boggling" amusement. It was an era of amusements and, not unconnectedly, of war. Science was moving in its one perfunctory direction: forward. Physics would build the bomb that gravity lowered on Japan with quiet and characteristic indifference, thirty-two feet per second, per second. Who then could fault Roger Babson for believing, with a faint and tender measure of desperation, that other trajectories were possible? "The harnessing of Gravity today is at the stage where the harnessing of electricity was when Ben Franklin flew his kite during a thunderstorm," Babson wrote in 1950. Free power from gravity "is the next thing on the scientists' agenda. It has been delayed by the Army's atomic craze to kill people; but it is coming," he insisted. "Be patient."

When I called Rainer Weiss a few weeks later to tell him about Chiao's move to Merced, he became suddenly optimistic. "I bet you something good will come of it," he said. Although he had no hope for gravity radio, he felt that a physicist of Chiao's caliber, given this new opportunity to do well-funded experiments, would end up making some important contribution to the field. Ideas are nice, Weiss explained, but they need to be checked and honed through actual experiments. In science, progress means industriously refining one's vision of the world until it reflects reality. This is to say that in science, progress means the exact opposite of what it meant for Roger Babson.

Babson assumed he could will the universe's most elemental mechanism into a more agreeable shape, that he could keep hammering away at it until it gave. In the closing chapter of *Actions and Reactions*, he wrote, "Perhaps the foremost lesson I have learned is that emotions rule the world, rather than statistics, information, or anything else." This may be his stoic confession, a recognition of the blinding force of his own impracticable idealism. He concedes that the longing for what should be possible does not easily give way in the implacable face of what actually is.

In the redwoods that afternoon, as gravity suddenly seemed to slacken its grip, I realized we'd been lured to the Mystery Spot by the promise of finding longing and reality finally, if only fleetingly, aligned. It felt like a celebration, a homecoming into our own imaginations. We were chattering, pointing, laughing. Suddenly a woman climbed onto a table, leaned startlingly far over the edge, and balanced there for a friend's camera. "This should be in a commercial," someone else yelled, overtaken by wonder.

I watched a little girl dressed entirely in pink—with pink sandals, pink fur trim on her coat, and pink-sequined fringe on her skirt—stretch out her arms and start to twirl on a curious axis. Then the tour guide cupped a hand to his mouth and hollered, "If anyone wants to walk up the walls, come with me!" And we followed him into the adjoining room, drifting uphill. ■