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The Price of Gravity: Private Patronage and the Transformation of Gravitational Physics after World War II

ABSTRACT

This paper examines how various private patrons intervened to support research in gravitational physics from the late 1940s through the early 1960s. Our analysis centers primarily on two wealthy and eccentric businessmen, Roger Babson and Agnew Bahnson, and their efforts to galvanize the study of gravitation. Not only did these patrons provide generous funding at a time when the subject of gravitation received few other institutional sources of support; they also helped to knit together a research community. Moreover, we trace the evolution of their patronage efforts, as scientists and patrons revised their arrangements to address what came to seem weak or ineffective features of the original efforts. These unusual philanthropic efforts played an outsized role in spurring what has been called the renaissance of general relativity during the middle decades of the twentieth century.

KEY WORDS: general relativity, private patronage, Cold War, anti-gravity, Roger Babson, Agnew Bahnson, Gravity Research Foundation, Institute of Field Physics, John Wheeler, Bryce and Cécile DeWitt

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The following abbreviations and acronyms are used: BDW, Bryce DeWitt papers, University of Texas at Austin; CDWM, Cécile DeWitt-Morette papers, University of Texas at Austin; GRF, Gravity Research Foundation records, call number 14.20, Special Collections, Babson College, Wellesley, Massachusetts; NBL, Niels Bohr Library, Center for History of Physics, American Institute of Physics, College Park, Maryland; UNC, University Relations: University Development Program, Physics Department records, call number 40136, University Archives, Manuscripts Department, Wilson Library, the University of North Carolina at Chapel Hill.

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INTRODUCTION

In a remarkable burst of creativity, Stephen Hawking produced a string of new insights into gravitation and the structure of spacetime between the mid-1960s and the mid-1970s. During those years he (along with Roger Penrose) clarified the conditions that would lead, inexorably, to the collapse of matter into a black hole. He also demonstrated (in his words) that "black holes ain't so black": subtle quantum-mechanical effects should make black holes glow with what is now known as "Hawking radiation." Physicists often tout these results as products of the "renaissance of relativity": the resurgence of interest during the middle decades of the twentieth century in Albert Einstein's general theory of relativity, his elegant theory of gravitation.[1]

Before Hawking published his results in peer-reviewed journals—and long before he popularized them in his bestselling book, *A Brief History of Time* (1988)—he introduced many of them in brief essays. Between 1965 and 1974, Hawking received six prizes for his entries in an annual "Essays on Gravitation" competition. The competition, which began in 1949 and continues to this day, has been sponsored by the Gravity Research Foundation, a private foundation based in the suburbs near Boston, Massachusetts.[2]

The people who founded the Gravity Research Foundation soon after World War II aimed to catalyze research in gravitation. They were dissatisfied—at times dismayed—by the lack of effort they saw academic physicists or their government sponsors devoting to the subject. Before long, they were joined by other private donors and industrial partners, each of whom sought to build a steady infrastructure for research in gravitation.

As historians have documented, Einstein's general theory of relativity suffered a curious fate. Having catapulted to worldwide attention after the famous 1919 eclipse expedition—on the basis of which British astronomers, led by

1. Hawking described much of this research in his popular book, *A Brief History of Time* (New York: Bantam, 1988), chap. 7 of which is entitled, "Black holes ain't so black." See also, e.g., Clifford Will, *Was Einstein Right? Putting General Relativity to the Test* (New York: Basic Books, 1986), 11–12.

2. Hawking's prize-winning essays are available at http://www.gravityresearchfoundation.org (accessed 11 Sep 2017), and include Hawking, "The gravitational collapse of the universe" (2nd prize, 1965), "Singularities in space-time" (3rd prize, 1966), "On gravitational collapse and cosmology" (2nd prize, 1968), "The creation and annihilation of matter by a gravitational field" (5th prize, 1969), "Black holes" (1st prize, 1971), and "Black holes aren't black" (3rd prize, 1974). In most of these cases, the corresponding peer-reviewed articles were submitted to journals several months after the essays had been sent to the Gravity Research Foundation.

Arthur Eddington, announced that they had measured the bending of starlight's path near the sun, in accord with Einstein's prediction—the subject quickly faded from most physicists' attention. The allure of quantum theory and nuclear physics, combined with the Nazis' crushing displacement of the world's most active centers for gravitational research, kept general relativity out of most physicists' research articles and classroom lectures during the 1930s. Einstein noted plaintively in the foreword to a colleague's 1942 textbook, "I believe that more time and effort might well be devoted to the systematic teaching of the theory of relativity than is usual at present at most universities."[3]

The subject remained on the margins after the war. Few universities in the United States, for example, offered courses in the subject during the first decade after World War II, and none of the leading physics departments required their graduate students to study it.[4] By the mid-1960s, on the other hand—just as young researchers like Hawking were entering the field—several research groups devoted to the study of general relativity and gravitation were flourishing at elite universities throughout the United States and Europe. After "begging" for names of physicists specializing in general relativity in 1961, the Swiss-based International Society for General Relativity and Gravitation counted more than 220 members in 1974, while more than 800 participants crowded into the conference halls for the Ninth Texas Symposium on Relativistic Astrophysics, held in December 1978.[5]

3. Albert Einstein, "Foreword," in Peter G. Bergmann, *Introduction to the Theory of Relativity* (New York: Prentice-Hall, 1942), p. v. See also Jean Eisenstaedt, *The Curious History of Relativity: How Einstein's Theory of Gravity was Lost and Found Again* (Princeton, NJ: Princeton University Press, 2006); and Matthew Stanley, *Practical Mystic: Religion, Science, and A. S. Eddington* (Chicago: University of Chicago Press, 2007), chap. 3.

4. See W. C. Kelly, "Survey of Education in Physics in Universities of the United States," 1 Dec 1962, available in American Institute of Physics, Education and Manpower Division, Records, 1951–1973, Box 9, call number AR15, NBL; and David Kaiser, "A *psi* is just a *psi*? Pedagogy, practice, and the reconstitution of general relativity, 1942–1975," *Studies in History and Philosophy of Modern Physics* 29 (1998): 321–38.

5. André Mercier, form letter (Jan 1961), and Mercier, membership list, Apr 1974, in International Society for General Relativity and Gravitation, Records, 1961–1982, call number AR94, in NBL. On the Ninth Texas Symposium, see Will, *Was Einstein Right?* (ref. 1), 15. In Mercier's January 1961 form letter, which he addressed "To Scientists throughout the World active in the field of Theories of Relativity and Gravitation," he asked, "Would you please beg anybody whom we could not reach and of whom you know, that he is keen to be on our list," to send appropriate contact information. On the rapid growth of membership in the International Society for General Relativity and Gravitation, see also Roberto Lalli, *Building the General Relativity and Gravitation Community During the Cold War* (New York: Springer, 2017), 58–69.

Historians have pored over the formative years of general relativity, as Einstein and a circle of colleagues expanded upon and adapted Einstein's original work in the 1910s and 1920s. Much less is known about the dynamics of the later period: how and why a subject that had been neglected for decades became such a thriving topic of research.[6] As we document here, a significant part of the work that blossomed into the "renaissance of relativity" by the 1960s emerged from networks and institutions that were sustained primarily by private patronage.

Two wealthy, eccentric businessmen—Roger Babson and Agnew Bahnson—played outsized roles. Babson founded the Gravity Research Foundation in 1948; within a few years, Bahnson took up similar efforts, bankrolling the first dedicated research center for gravitation in the United States. When industrial firms and federal agencies like the U.S. Air Force turned their attention to gravitation during the 1950s and early 1960s, their efforts were often in conjunction with—and subsidiary to—those of the private patrons. These industrial and federal initiatives, in turn, had quite significant international effects, enabling, for example, young researchers to move between the then-small islands of activity in gravitational physics, and funding some research projects outside the United States.

Efforts of philanthropists like Babson and Bahnson stand at odds with our usual understanding of physics after World War II. The story of postwar physics in the United States has often been told—and told well—as a narrative about a surge in federal spending on basic research, nearly all of which came from defense-related agencies. By 1953, as Paul Forman has shown, spending on

6. On the early history of general relativity, see esp. Jürgen Renn, ed., *The Genesis of General Relativity: Sources and Interpretations*, 4 vols. (New York: Springer, 2007); Michel Janssen, "'No success like failure': Einstein's quest for general relativity," in *The Cambridge Companion to Einstein*, ed. Michel Janssen and Christoph Lehner (New York: Cambridge University Press, 2014), 167–227; Hanoch Gutfreund and Jürgen Renn, *The Road to Relativity* (Princeton, NJ: Princeton University Press, 2015); and Hanoch Gutfreund and Jürgen Renn, *The Formative Years of Relativity* (Princeton, NJ: Princeton University Press, 2017). On the later resurgence of interest in the subject, see esp. Eisenstadt, *Curious History* (ref. 3); Kaiser, "A *psi*" (ref. 3); Daniel Kennefick, *Traveling at the Speed of Thought: Einstein and the Quest for Gravitational Waves* (Princeton, NJ: Princeton University Press, 2007); Benjamin Wilson and David Kaiser, "Calculating times: Radar, ballistic missiles, and Einstein's relativity," in *Science and Technology in the Global Cold War*, ed. Naomi Oreskes and John Krige (Cambridge, MA: MIT Press, 2014), 273–316; Dean Rickles, *A Brief History of String Theory* (Berlin: Springer, 2014); Alexander Blum, Roberto Lalli, and Jürgen Renn, "The reinvention of general relativity: A historiographical framework for assessing one hundred years of curved space-time," *Isis* 106 (Sep 2015): 598–620; and Lalli, *General Relativity and Gravitation Community* (ref. 5).

non-mission-oriented research in the physical sciences was twenty-five times greater than it had been in 1938 (in constant dollars). In 1949, 96 percent of those funds came from the Department of Defense and the Atomic Energy Commission. By 1954—four years after the establishment of the civilian U.S. National Science Foundation—the proportion of physical-science funding from defense-related agencies had risen to 98 percent.[7] The federal windfall drove a "big science" boom in particle accelerators and nuclear reactors, which in turn steered ever more researchers toward subfields like nuclear physics and solid-state physics—subjects that policymakers and scientific advisors deemed most relevant to the nation's needs during the Cold War.[8]

Gravitation remained a low priority for federal officials amid wartime mobilization and the exigencies of the early Cold War. Support from patrons like Babson and Bahnson thus proved critical. In addition to providing funds, Babson and Bahnson sought to mobilize their considerable personal networks in an effort to knit the nascent research community together.

On the other hand, neither Babson nor Bahnson had significant scientific training, and each enjoyed enthusiasms—such as dreams of anti-gravity machines or flying saucers—that often set them at odds with the physicists they sought to support. Although at times these different views lent levity to the search for levitation, the patrons' and scientists' competing ideas about gravity and about how best to foster its study sometimes led to friction. Leading physicists strove to apply lessons learned from some early ventures when crafting new institutional arrangements—akin to other efforts at that time to broach productive partnerships between amateur and professional researchers, such as astronomers' "Operation Moonwatch."[9]

7. Paul Forman, "Behind quantum electronics: National security as basis for physical research in the United States, 1940–1960," *Historical Studies in the Physical Sciences* 18 (1987): 149–229, on 152–53.

8. See esp. Forman, "Behind quantum electronics" (ref. 7); Daniel Kevles, "Cold war and hot physics: Science, security, and the American state, 1945–56," *Historical Studies in the Physical and Biological Sciences* 20 (1990): 239–64; James Capshew and Karen Rader, "Big science: Price to the present," *Osiris* 7 (1992): 3–25; Peter Galison and Bruce Hevly, eds., *Big Science: The Growth of Large-Scale Research* (Stanford, CA: Stanford University Press, 1992); David Kaiser, "Cold war requisitions, scientific manpower, and the production of American physicists after World War II," *Historical Studies in the Physical and Biological Sciences* 33 (2002): 131–59; and Audra Wolfe, *Competing with the Soviets: Science, Technology, and the State in Cold War America* (Baltimore: Johns Hopkins University Press, 2012).

9. Cf. Patrick McCray, *Keep Watching the Skies! The Story of Operation Moonwatch and the Dawn of the Space Age* (Princeton, NJ: Princeton University Press, 2008). See also David Kaiser, *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (New York: W. W. Norton, 2011), chap. 5.

Important elements of the renaissance of relativity—especially contributions rooted within the United States—were put into motion with funding and support that bore little relation to the typical "big science" endeavors that have dominated the historical literature on postwar physical sciences. We focus on a series of productive, if unexpected, interactions between experts in gravitation and their colorful, private patrons. The means of support that these groups forged hearkened back to interwar patterns of support, and presaged more recent philanthropic trends in the support of basic research in the United States and around the world since the end of the Cold War.[10]

THAT DRAGON GRAVITY: ROGER BABSON AND THE GRAVITY RESEARCH FOUNDATION

Just two years after he established the Gravity Research Foundation, Roger Babson recorded within his twice-revised autobiography his "disappoint[ment] with the attitude taken by many college professors and engineers in conjunction with" the study of gravitation. "The mention of gravity too often brings a smile as if the inquiry were not taken seriously," he added.[11] The Gravity Research Foundation aimed to change that.

The foundation's first task was to build a library that would contain the world's most comprehensive collection of gravity-related materials; Babson and foundation president George M. Rideout expected to gather hundreds of thousands of titles. Drawing liberally on Babson's funds, price seemed to be no object, as they sent orders far and wide to university presses and used-book dealers searching out titles. They also scoured the card catalogs at Harvard, the Massachusetts Institute of Technology, and the U.S. Library of Congress for references to order. The library would be free and open to all interested parties, students and laypeople as well as university professors.[12]

10. On interwar patronage relationships for scientific research in the United States, see esp. Robert Kohler, *Partners in Science: Foundations and Natural Scientists, 1900–1945* (Chicago: University of Chicago Press, 1991); and Roger Geiger, *The History of American Higher Education: Learning and Culture from the Founding to World War II* (Princeton, NJ: Princeton University Press, 2015), chap. 11.

11. Roger W. Babson, *Actions and Reactions: An Autobiography of Roger W. Babson*, 2nd rev. ed. (New York: Harper & Brothers, 1950 [1935]), p. 341.

12. See the correspondence in GRF, Box 1, Folders 1 and 3, and the Foundation's annual reports in GRF, Box 2, Folder 9.

Next, the foundation would operate as a "free clearing house" of information, working as a go-between by putting various researchers with common interests in touch with each other. Continuing with this goal, Babson soon instituted special annual conferences under the foundation's banner, held in New Hampshire each August, to stimulate student interest in gravity and to further increase discussion and contact among people pursuing the study of gravitation.[13]

Most famously, the Gravity Research Foundation inaugurated its annual essay contest in 1949. During the first decade, the foundation gave out an average of nearly $2,000 each year in prize money for award-winning essays. First prize alone carried the handsome sum of $1,000, about equal to a graduate student's annual stipend at the time. The foundation then printed copies of each year's first-prize essays and distributed them widely. Raymond Birge, while department chair of Berkeley's department of physics, wrote in for his department's copy of the essays in 1955.[14] In the mid-1950s, foundation president Rideout reported that collections for the gravity library were proceeding well. "More than half of this material [in the library] has been written in the last six years, largely due to the efforts of the Foundation."[15]

In 1958, Rideout could report with pride on the foundation's progress during its first decade. Whereas it had received an average of 25 letters per week during its first year of operation, the foundation was processing over one-hundred times as much correspondence by 1958. The twenty-two attendees at the foundation's first conference on gravity, in 1951, could hardly have imagined the crowd of 280 people attending the 1958 summer conference. The essay contest routinely drew over one hundred submissions each year, and within its first decade, winners included rising stars in the field as well as leading figures, such as Bryce DeWitt (1953), Stanley Deser and Richard Arnowitt (1954), Phillip Morrison and Thomas Gold (1957), and John Wheeler (1957)—even before Stephen Hawking and Roger Penrose joined the winners' roster in the 1960s.[16]

13. GRF annual reports, in GRF, Box 2, Folder 9.

14. Raymond Thayer Birge to the Gravity Research Foundation, 15 Apr 1955, in Raymond Thayer Birge papers, call number 73/79c, Bancroft Library, Berkeley, California. On stipend and salary rates for young physicists at the time, see Nathan Nichols, "Stipend: $1000," *Physics Today* 1 (July 1948): 16–17, 28.

15. George M. Rideout, undated annual report, ca. 1954–55, in GRF, Box 2, Folder 9.

16. George M. Rideout, annual report 1958, in GRF, Box 2, Folder 9.

Riding the excitement of their first-decade celebrations, the foundation made a number of gifts and grants to various colleges and universities, including a series of $5,000 donations and gifts of $12,000 in stocks (together worth about $140,000 in 2018 dollars). The physics department at Tufts University, for example, received one such grant from the foundation in 1961. As Rideout assured Babson and the other members of the foundation's Board of Trustees, gravity was by then taken seriously by some of the nation's top physicists, and the foundation could take pride in spurring the transition.[17]

The block grant to Tufts—which helped to establish the Tufts Institute of Cosmology, and which provides financial support for the Institute to this day—reveals much about Babson's eccentricities, as well as his goals in establishing the Gravity Research Foundation. Along with the grant came a literal block: a large, engraved stone monument, bearing the inscription that the monument 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." Until such a day, the sheer bulk of the stone was meant to inspire students and faculty to study gravitation, in hopes of discovering some anti-gravity effect that would make it simple to move such a massive object. (The foundation donated thirteen such monuments to various colleges and universities during the early 1960s.) Campus legend at Tufts has it that from time to time, groups of fraternity brothers band together at night to move the 2,000-pound monument to different locations on campus, working like anti-gravity's little elves. These days, the director of the Tufts Institute of Cosmology anoints new PhDs by dropping an apple on their heads beside the Babson stone (Fig. 1).[18]

17. GRF annual reports in GRF, Box 2, Folder 9. The grant to Tufts University is reported in Jay Chrepta, "Antigravity: Without gravity, planes would never crash," *Tufts Criterion* (Alumni Magazine), Winter 1991, p. 10, a copy of which may be found in GRF, Box 2, Folder 9. Ms. Sherri Kelley of the Tufts University Archives confirmed the university's receipt of the funds: personal communication to David Kaiser, 25 Jun 1999. The foundation made a similar donation in 1961 to Hobart and William Smith College, in Geneva, New York. Perhaps coincidentally, the head of the chemistry department at Hobart and Smith was the son of one of the foundation's board of directors.

18. Photographs and press releases related to the grants and monuments available in GRF, Box 3, Folder 2. On the Tufts stone, see also Joseph Lanza, *Gravity: Tilted Perspectives on Rocket Ships, Roller Coasters, Earthquakes, and Angel Food* (New York: Picador, 1997), 95; and Alexander Vilenkin, *Many Worlds in One: The Search for Other Universes* (New York: Hill and Wang, 2007), 73–76. On other foundation monuments, see also Austin Wright, "A visionary's dreams of antigravity never got off the ground," *Chronicle of Higher Education* (20 Jul 2009).

FIGURE 1. Three students at Tufts University pose in 1973 with the stone monument given to the university by the Gravity Research Foundation. *Source:* Digital Collections and Archives, Tufts University.

Babson's obsession with gravitation—and his hopeful quest for anti-gravity—had deep roots. Born in Gloucester, Massachusetts, in 1875, he grew up among merchants and sailors in the coastal town. His older sister drowned in 1893, when Babson was a teenager. He later recounted the episode in one of the first pamphlets published by the Gravity Research Foundation, entitled, "Gravity: Our Enemy Number One." "Yes, they say she was 'drowned,'" he wrote, "but the fact is that, through temporary paralysis, or some other cause (she was a good swimmer) she was unable to fight Gravity which came up and seized her like a dragon and brought her to the bottom." A half century later—just one year before he established the Gravity Research Foundation—Babson's grandson also drowned: "that 'dragon' Gravity came up and snatched Michael!," he lamented in the same pamphlet.[19]

Soon after his sister's death, Babson enrolled in the Massachusetts Institute of Technology (MIT) as an undergraduate. He became fascinated with turn-of-the-century technological transitions, such as electrification and artificial

19. Babson, *Actions and Reactions* (ref. 11), 14–15; Babson, "Gravity: Our Enemy Number One," 4-page pamphlet produced by the Gravity Research Foundation, n.d. (ca. 1948), in GRF, Box 2, Folder 3.

illumination. After his studies he began investing in railway companies and electric and water utilities, building what became a successful stock-market brokerage firm. By the 1920s, thousands of clients received Babson's monthly stock-tip reports, which were filled with statistical measures of market trends—though economist John Kenneth Galbraith later dismissed Babson's approach as so much "hocus-pocus of lines and areas on a chart."[20]

Babson had learned more than statistical methods at MIT; he had also become fascinated with Isaac Newton. Indeed, Babson came to see Newton's laws of motion—especially his third law, relating every action to an equal-and-opposite reaction—as a template for understanding everything from business trends to the care of one's soul. (He titled his autobiography, *Actions and Reactions*, and considered Newton's third law to be a formal restatement of the Christian "golden rule" about doing unto others.) For the stock market, Babson read Newton's law literally: what goes up must come down. His firm tracked various stocks' selling prices, confidently informing investors that unusual upswings would be counterbalanced quickly by downward corrections, and vice versa.[21]

Babson's most famous application of Newtonian theory (at least as he considered it) came in the autumn of 1929. Purportedly using Newton's third law, Babson predicted that the U.S. stock market would suffer a dramatic crash the following month. By the time Black Tuesday arrived on October 29, 1929—right on Babson's schedule—he had diversified his own funds and went on to sail through the Great Depression as one of the wealthiest individuals in the United States. His physics-inspired acumen became legendary; newspapers across the country carried his weekly syndicated business column. (When

20. Babson, *Actions and Reactions* (ref. 11), 63–115; John Kenneth Galbraith, *The Great Crash, 1929* (Boston: Houghton Mifflin, 1955), 85. For a more sympathetic assessment of Babson's statistical stock market forecasting methods (compared to other efforts at the time), see Walter Friedman, "Roger W. Babson: The rule of past patterns," in Friedman, *Fortune Tellers: The Story of America's First Economic Forecasters* (Princeton, NJ: Princeton University Press, 2014), 12–50. DK thanks Caley Horan for bringing Friedman's book to his attention.

21. Babson explains that he designed his firm's "Babsonchart" method for predicting stock price variations based on Newton's third law. The Babsonchart tracked more than simple time series for stock prices. Rather, Babson crafted an "equal area law" (akin to Keplerian astronomy), such that the area of a given stock's price above some average line when plotted over time would be balanced by an equal area below the line. (Babson, *Actions and Reactions* [ref. 11], 108–12.) Henry Macomber, the librarian of the Gravity Research Foundation's special library, explained to a correspondent that "one of the reasons for Mr. Babson's early interest in Newton was the fact that Newton was a deeply religious man and found nothing in philosophy and science to contradict his religious belief." Macomber to Edith Oakley, 11 Oct 1950, in GRF, Box 1, Folder 3.

composing his autobiography years later, Babson omitted the many other predictions he had made, with equal confidence, that Newton's third law implied that the crash of 1929 would quickly be offset by major market rebounds.) Ever a tee-totaling, church-going man, Babson ran for U.S. President in 1940 on the "New Prohibition" ticket. He came in fourth place, with 0.12 percent of the popular vote, sandwiched between Socialist candidate Norman Thomas and Communist candidate Earl Browder. (Franklin Roosevelt, the incumbent, won the election with nearly 55 precent of the popular vote.)[22]

During the 1930s, buoyed by what he considered a Newtonian key to his financial success, Babson and his wife Grace began to collect rare books and manuscripts that Newton himself had owned and annotated. Their collection of Newtoniana quickly grew to be the third-largest in the world, surpassed only by the collections of Cambridge University and the Royal Society. The Babsons also purchased what was purported to be a sapling from the apple tree in Woolsthorpe, England, under which young Newton had pondered universal gravitation; and they purchased the living room from Newton's London apartment—wooden wall boards and all—and had it shipped to the business college that Babson had founded, adjacent to the grounds of his market analysis company, in Wellesley, Massachusetts.[23]

After the war, Babson's interest (even obsession) with Newton and gravitation took on additional, Cold War shadings. He began to speak in grand terms of his dream of "harnessing gravity." A partial insulator of gravity, he reasoned, would enable engineers to mass-produce highly efficient power generators, offering free and limitless electrical power. "Such power," early pamphlets from the Gravity Research Foundation noted, "would probably be the greatest single factor in bringing about world peace by eliminating the strongest cause of rivalry between nations." They would also be a boon to

22. Babson, *Actions and Reactions* (ref. 11), chaps. 29, 32. On his repeated predictions for a speedy recovery after the 1929 stock market crash, see, e.g. Roger Babson, *Cheer Up! Better Things Ahead!* (New York: Revell, 1932); Babson, *A Revival is Coming* (New York: Revell, 1936). On the presidential campaign, see Babson, *Our Campaign for the Presidency in 1940: America and the Churches* (Chicago: New Prohibitionist, 1941). On the 1940 election results, see data available at http://uselectionatlas.org (accessed 12 Sep 2017). Galbraith was convinced that Babson had made a lucky guess about the stock market crash of October 1929, being "right for the wrong reasons." Galbraith, *Great Crash* (ref. 20), 85.

23. Grace Babson, "Sir Isaac Newton's parlour brought to American: Taken from his house occupied 1710–1725," 8-page pamphlet printed by the Babson Institute, 1939, available in Special Collections, Babson College, Wellesley, MA.

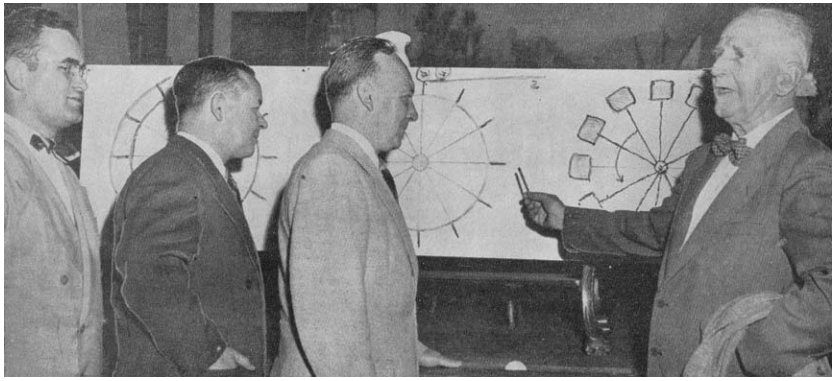

FIGURE 2. Roger Babson (right) describing how a gravitational insulator could be used to create a power-generating perpetual-motion machine, 1949. *Source:* New Boston, New Hampshire Historical Society.

investors, Babson reasoned: power companies would operate with such low costs that dividends to stockholders would jump (Fig. 2).[24]

He became so concerned about the next war that he located the headquarters for his new Gravity Research Foundation in the tiny town of New Boston, New Hampshire. Babson had consulted with experts at MIT about the likely zone of destruction, should a nuclear bomb be detonated over Boston. They suggested that a distance of sixty miles from ground-zero should be safe. So Babson consulted a map and noticed that New Boston lay almost exactly sixty miles north of Boston—and proceeded to purchase several office buildings and two hundred acres of land in the small New Hampshire town. Sensing another good business opportunity, Babson began to offer document storage in New Boston for other corporations' critical paperwork, to aid in maintaining operations following a nuclear attack. One more reason to encourage scientists to search for anti-gravity: in the nuclear age, the threat of things falling from the sky grew more menacing than ever (Fig. 3).[25]

Babson's quest for an insulator of gravity shared some keywords in common with professional physicists' leading-edge ideas, though Babson tended to short-circuit their complicated arguments. Early in January 1950, for example,

24. See, e.g., the pamphlets produced by the Gravity Research Foundation: Roger Babson, "Is 'free power' possible?," 3-page pamphlet (n.d., ca. 1948); Babson, "Is 'free power' coming?," 5-page pamphlet (n.d., ca. 1948); both available in GRF, Box 2, Folder 3.

25. Babson, *Actions and Reactions* (ref. 11), 340–41. See also David Brooks, "Gravity exercise: What starts up in N.H. must go down to Mass.," *The Nashua Telegraph* (20 Jun 2001), available at http://www.newbostonnh.gov (accessed 17 Sep 2017).

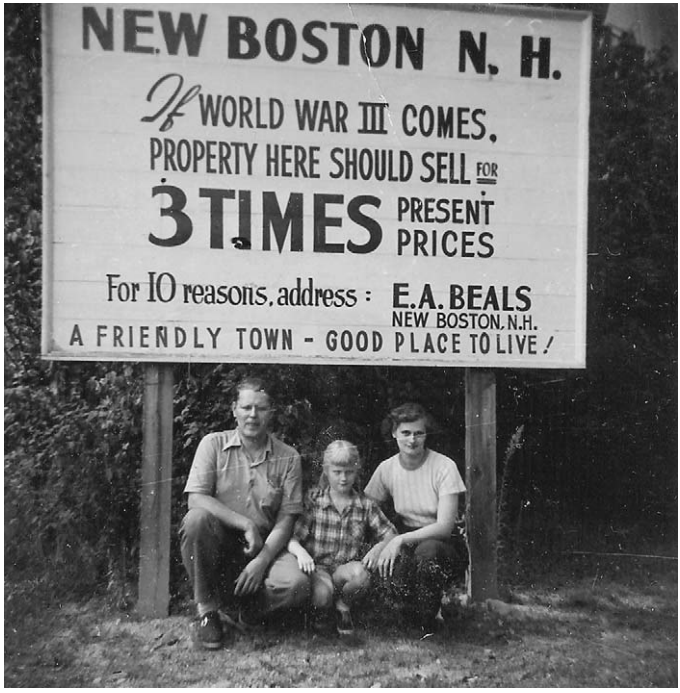

FIGURE 3. The Wilke family poses in front of a billboard in New Boston, New Hampshire, 1950. *Source:* New Boston, New Hampshire Historical Society.

Time magazine ran a profile of Babson and the foundation's new essay contest. On that same page, the magazine published a separate news item about Albert Einstein's latest attempt to craft a "generalized theory of gravitation"—part of his decades-long effort to find some unified field theory—that would reveal intimate connections between gravitation and electromagnetism. "Since both electromagnetism and gravitation are properties of matter," the *Time* reporter noted in the story about Einstein's latest work, "scientists are sure that they must be connected somehow." As physicists like Einstein, Hermann Weyl, and Peter Bergmann pondered analogies and possible mathematical relationships between gravity and electromagnetism, Babson simply closed the loop: in his mind, gravitation must simply be a form of magnetic attraction. And, the MIT alumnus reasoned, if gravity is simply magnetism, then perhaps it could be shielded.[26]

26. Anon., "Super-relativity," *Time* 55, no. 1 (2 Jan 1950): 56 ("Since both electromagnetism and gravitation," on Einstein and unified field theories); anon., "The trouble with gravity," *Time* 55, no. 1 (2 Jan 1950): 56 (on Babson and the foundation). On Einstein's approach to unified field

The hunt for anti-gravity shaped all of the Gravity Research Foundation's early endeavors. If Babson's goal remained clear, however, the best route to achieve it was not. In the early years, the Gravity Research Foundation efforts were rather scattershot and amateurish. In setting up the new gravity library, for example, foundation officials made little effort to distinguish between works treating the theory of gravitation from nineteenth-century analyses by the U.S. Coast and Geodetic Survey of specific features of the Earth's gravitational field. Showmanship seemed at least as important as scholarship. At one point, for example, Babson instructed the foundation's librarian to make sure a copy of Newton's *Principia* was on display in the gravity library:

> We should have now at New Boston an English translation—any edition—the latest is probably the most accurate—of that book by Newton in which he gives his Laws of Gravity. Reporters and others who come to New Boston want to see it! I care not for the physical condition of the book. The older it looks, the more it will appeal to any curious visitors. Please get me such a copy and send it to New Boston and notify me when you send it.[27]

Likewise, Babson built a "Thomas Edison Bird Museum" near the foundation headquarters in New Boston—with 5,000 specimens—after his friend, Edison, suggested that birds' wings likely contained some sort of gravitational absorber; for how else could one account for birds' remarkable aerodynamic lift?[28]

Babson also aimed to conquer gravity through teamwork and networking. Foundation board member Charles Birdseye (of frozen-food fame) informed the other board members that he had found his own invention for freezing foods serendipitously. Birdseye predicted that if gravity-absorbing materials were ever found, it may be by accident. So the foundation undertook an

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theories, see esp. Jeroen van Dongen, *Einstein's Unification* (New York: Cambridge University Press, 2010). See also Hermann Weyl, *Space, Time, Matter*, trans. Henry Brose (New York: Methuen, 1922); and Bergmann, *Introduction to the Theory of Relativity* (ref. 3), Part III.

27. Handwritten letter from Roger Babson to Henry Macomber, [date illegible], 1950, in GRF, Box 1, Folder 3. On the library's collection, see also the foundation annual reports in GRF, Box 2, Folder 9.

28. See Carl Welty's 4-page pamphlet, "Birds as Flying Machines," produced by the Gravity Research Foundation, which noted in large print across the top, "Among the remarkable adaptations birds have made to life in the air are high power and light weight. Thomas A. Edison always believed that the birds could teach us much as to future flying, and our Babson Bird Exhibit was started at Mr. Edison's suggestion." Welty's pamphlet drew liberally upon John Storer, "Bird aerodynamics," *Scientific American* 186 (Apr 1952): 24–29. Welty's undated pamphlet may be found in GRF, Box 2, Folder 9.

annual letter-writing campaign to several thousand industrial laboratories across the United States, asking if anything new had been discovered that year that might impact the search for anti-gravity. Babson also purchased control of a Washington, D.C.-based firm, Invention Incorporated, which maintained staff in the U.S. Patent Office scanning newly issued patents. Under Babson's control, the firm kept special watch for gravity-related developments. Meanwhile, Babson also dabbled in patent medicines, pushing a remedy called Priscolene—which he nicknamed "gravity pills"—that were purported to help ease the aches of sore legs.[29] *Time* reported in 1950 that a leading shoe manufacturer had offered Babson $100,000—more than $1 million in 2018 dollars—for "something that can be put into the sole of a shoe to insulate against gravity," while rug manufacturers purportedly sought clues from Babson for how to produce "flying carpets."[30]

The instructions for the annual essay contest likewise kept the focus squarely on anti-gravity in the early years, stipulating that prizes would go to the best 1500-word essays

> (a) on the possibilities of discovering some partial insulator, reflector, or absorber of gravity, or (b) on the possibilities of discovering some alloy, the atoms of which can be agitated or re-arranged by gravity tension to throw off heat, or (c) on the possibilities of discovering some alloy the temperature of which can be affected by gravity waves.[31]

Babson was delighted with the first year's entries—"it was just like opening Christmas presents," he enthused to the *Time* reporter—but soon the foundation needed to remind entrants of the rules. Foundation president George Rideout complained within his second annual report that "we will not accept any essays simply on the subject of Gravity. Some of them sound just like a textbook. We are insisting on adherence to the subject, namely, the objective of discovering some partial insulator, reflector, or absorber of gravity."[32]

Only after the first set of essays had been submitted did Babson acknowledge that the foundation would need some sort of review panel to select

29. See foundation annual reports in GRF, Box 1, Folder 5; see also Babson, *Actions and Reactions* (ref. 11), 342–43; and Martin Gardner, "Sir Isaac Babson," in Gardner, *Fads and Fallacies in the Name of Science* (New York: Dover, 1957), 92–100, on 95.

30. Anon., "The trouble with gravity" (ref. 26).

31. Essay contest announcements, ca. 1950–65, available in GRF, Box 1, Folder 5.

32. Anon., "The trouble with gravity" (ref. 26) ("Christmas presents"); George M. Rideout, Second annual report, 1 Aug 1950 ("sound just like a textbook"), in GRF, Box 1, Folder 5.

winners. *Time* reported that one of Babson's business partners had advised Babson to "get a professor to look them over. That will take the smell off it." Babson proceeded to do just that, leaning on his instincts as a New England entrepreneur. First he tapped his neighbor, a medical physicist who lived near Babson in Wellesley, Massachusetts, and taught at Simmons College in downtown Boston (and who had no particular expertise in gravitation). Next Babson expanded the reviewing to a trio of local contacts, including a physics professor at the University of New Hampshire, the head of the science department at Keene Teachers College, and a physicist and executive secretary of the State Teachers Association in Concord, New Hampshire. Though none had ever published research on gravitation, their scholarly affiliations and close proximity to the foundation's headquarters in New Boston likely appealed to Babson.[33]

Foundation president Rideout concluded his 1952 annual report with pride, writing that the "foundation is now accepted as a dignified organization performing a service sorely needed since the days of Sir Isaac Newton." That same year, however, popular science writer Martin Gardner published a stinging parody of Babson and the Gravity Research Foundation, lumping the foundation together with parapsychologists and dowsing enthusiasts in his bestselling book, *In the Name of Science*.[34]

Despite Gardner's critique, the allure of the large prize money for the annual essay contests convinced some budding young experts to play along. Stanley Deser and Richard Arnowitt, for example, submitted an essay on "The new high-energy nuclear particles and gravitational energy," which received first prize in 1954. Deser and Arnowitt would each soon emerge as renowned leaders in the study of classical general relativity and its potential quantization. At the time, they were postdocs at the prestigious Institute for Advanced Study in

33. Anon., "The trouble with gravity" (ref. 26) ("get a professor"). The essay contest judges are listed in Rideout's annual reports for 1952 and 1953, in GRF, Box 2, Folder 9. The original contest judge, Howard O. Stearns, lived in Wellesley Hills, near Babson; see his entry in Jaques Cattell et al., *American Men of Science*, 10th ed. (Lancaster, PA: Cattell Press, 1961).

34. George Rideout, annual report dated 18 Aug 1952, in GRF, Box 2, Folder 9, quotation on p. 8. Gardner's scathing account of the Gravity Research Foundation was first published in Gardner, *In the Name of Science* (New York: Putnam, 1952), chap. 9, later revised and expanded as Gardner, *Fads and Fallacies* (ref. 29). Babson's foundation members, eager to publicize the foundation's activities, had cooperated with Gardner, sharing documents and correspondence and granting interviews. See George Rideout to Martin Gardner, 5 Feb 1952, and Henry Macomber to Marion Boulter, 11 Feb 1952, in GRF, Box 1, Folder 1.

Princeton, New Jersey—Einstein's home institution—having recently completed their doctorates under Julian Schwinger's tutelage at Harvard.

As Deser later recalled, "being a postdoc at the Institute put a lot of pressure" on people. He and Arnowitt "need[ed] something to break it up. So we thought it would be funny to write a paper" for the Gravity Research Foundation contest—as a fun diversion, "a lark," never expecting to win.[35] When their essay *did* win, it became headline news. The *New York Herald-Tribune* ran a front-page story about Deser's and Arnowitt's prize-winning essay, playing up the young physicists' affiliation with the Institute for Advanced Study. The director of the Institute, J. Robert Oppenheimer, was not happy about the sudden associations with Babson's group. Deser was quick to apologize to Oppenheimer, writing that "the sin of the entry was to win, when it was only meant to entertain; and the acceptance of the prize was motivated partly through need, and partly because there seemed no harm in accepting it from Babson on the publicly stated terms of the contest."[36]

Deser suggested to Oppenheimer that he and Arnowitt could write a letter to the *Herald-Tribune* to clarify that the essay had nothing to do with their work at the Institute; but Deser figured such a course of action would only backfire, generating more unwanted publicity:

> Such little experience as I have had with publicity inclines me to the view that it might be wisest, since there has apparently been little echo of the articles, to forget the whole thing; scientists would either laugh at the joke (as people at Princeton did when they heard we had won with that essay) or dismiss it as another example of garbled science reporting. The non-scientific public, I would imagine, skim all rocket-to-the-moon stuff and then forget it.[37]

35. Stanley Deser, interview with Donald Salisbury and Dean Rickles, 12 Mar 2011 ("being a postdoc," "something to break it up," "a lark"). On Deser's and Arnowitt's training at Harvard and the pressures of postdoc life at the Institute for Advanced Study at the time, see David Kaiser, *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics* (Chicago: University of Chicago Press, 2005), 87–93, 106–08.

36. Stanley Deser to J. Robert Oppenheimer, 13 Dec 1955, in Oppenheimer papers, Box 30, Folder "Deser, Stanley," held in the Manuscripts Division of the U.S. Library of Congress. DK thanks Sam Schweber for bringing the Deser-Oppenheimer correspondence to his attention. See also Ansel E. Talbert, "Conquest of gravity aim of top scientists in U.S.," *New York Herald-Tribune* (20 Nov 1955), 1, 36. A copy of Deser's and Arnowitt's 1954 essay is available in GRF, Box 2, Folder 9, as well as at http://www.gravityresearchfoundation.org.

37. Deser to Oppenheimer, 13 Dec 1955. Ansel Talbert wrote a series of articles on antigravity for the *New York Herald-Tribune*; in addition to "Conquest of gravity" (ref. 36), see also Talbert, "Spaceship marvel seen if gravity is outwitted," *New York Herald-Tribune* (21 Nov 1955), 1, 6; and Talbert, "New air dream: Planes flying outside gravity," *New York Herald-Tribune* (22 Nov 1955), 6, 10.

Still, the episode stuck with Oppenheimer, who had recently experienced his own strong dose of unwanted publicity. Just a few months earlier, the Atomic Energy Commission had leaked the 1,300-page transcript of the personnel security board review of Oppenheimer's fitness to maintain top-secret security clearance and to advise on nuclear weapons projects; Oppenheimer knew, as the young postdocs perhaps did not, the power of unwelcome associations. Writing to recommend Deser for a faculty position two years later, Oppenheimer noted that "[h]e and Arnowitt competed for and won a prize from the Babson Institute with an essay on gravitation which I should charitably characterize as a hoax, and they accepted the prize money. This has bothered me, though many colleagues regard it as a good joke."[38]

While Deser and Arnowitt's essay was generating news, Martin Gardner published an updated edition of his book. His criticism of Babson and the Gravity Research Foundation was unflinching, writing that the foundation was "perhaps the most useless scientific project of the twentieth century." The problem, in Gardner's diagnosis, stemmed from letting Babson—generous and well-intentioned, to be sure, but scientifically naive—call the shots. "There is surely a touch of pride in [Babson's] refusal to accept advice from competent physicists on how money could best be spent for the good of science and humanity."[39] Others quickly came to share that view, which shaped their next efforts to forge a productive relationship between experts in gravitation and private patrons.

BAHNSON, THE DEWITTS, AND THE INSTITUTE OF FIELD PHYSICS, INC

Physicist Bryce DeWitt received first place in the Gravity Research Foundation essay contest in 1953, one year before Deser and Arnowitt won. DeWitt had shared some of the same steps along the way; like Deser and Arnowitt, he had

38. J. Robert Oppenheimer to David Falkoff, 25 Feb 1957, in Oppenheimer papers, Box 30, Folder "Deser, Stanley." On Oppenheimer's 1954 hearing, see esp. Richard Polenberg, ed., *In the Matter of J. Robert Oppenheimer: The Security Clearance Hearing* (Ithaca, NY: Cornell University Press, 2002); Kai Bird and Martin Sherwin, *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (New York: Knopf, 2005), part 5; Priscilla McMillan, *The Ruin of J. Robert Oppenheimer and the Birth of the Modern Arms Race* (New York: Viking, 2005); and Charles Thorpe, *Oppenheimer: Tragic Intellect* (Chicago: University of Chicago Press, 2006), chap. 7.

39. Gardner, *Fads and Fallacies* (ref. 29), 93 ("most useless scientific project"), 100 ("touch of pride").

recently completed his PhD at Harvard under Julian Schwinger, and followed his graduate studies with a postdoctoral fellowship at the Institute for Advanced Study in Princeton. There, however, the similarities came to a temporary halt.[40]

Deser and Arnowitt had each specialized in quantum electrodynamics and related techniques for theoretical high-energy particle physics during their graduate training, and only later came to make their marks in the field of gravitation. Following their postdoctoral study, they quickly proceeded to faculty positions at elite universities in the northeastern United States, Oppenheimer's concerns about their dabbling with the Gravity Research Foundation notwithstanding.[41] DeWitt, on the other hand, struggled to find a comparable position.

DeWitt had focused his 1949 dissertation on efforts to quantize the gravitational field—in effect, to try to find a quantum-mechanical version of Einstein's general relativity—at a time when such topics fell far outside the physics mainstream. DeWitt's chosen research topic did not help his prospects on physicists' academic job market. After his brief stay at the Institute in Princeton, he accepted a fellowship to study at the then-new Tata Institute for Fundamental Research in Mumbai, India—taking him further from the mainstream of American physics at the time—and quickly grew disheartened about his career prospects. In the fall of 1951, he wrote to various physics departments in the United States that might be looking to hire a young theoretical physicist:

> Owing to the difficult and tedious nature of research in gravitational theory, and also owing to the apparent complete lack of any immediate practical application of its results, I was, until recently, strongly resolved to discontinue further work along these lines and to turn my attention elsewhere. A conversation I had with F. J. Dyson this summer, however, has left me with somewhat altered views. He stressed to me the urgent need for workers in field theory who have a thorough understanding of gravitational theory and its problems.[42]

40. Bryce DeWitt and Cécile DeWitt-Morette, oral history interview with Kenneth Ford, 28 Feb 1995, transcript available at http://www.aip.org/history/ohilist/23199.html; Steven Weinberg, "Bryce Seligman DeWitt, 1923–2004: A biographical memoir," in National Academies of Sciences, Engineering, Medicine, *Biographical Memoirs* 90 (2009), on 5–6.

41. Kaiser, *Drawing Theories Apart* (ref. 35), 106–08.

42. Bryce DeWitt to Raymond Birge, 11 Nov 1951, in University of California, Berkeley, Department of Physics Records, Box 5, Folder 31, call number CU-68, Bancroft Library, Berkeley, CA. DeWitt's dissertation was entitled, *The Theory of Gravitational Interactions, and the Interaction of Gravitation with Light* (PhD dissertation, Harvard University, 1949). On his travel to

Dyson's advice had buoyed DeWitt, convincing him to stick with the topic of gravitation, though still no job offers materialized. Finally, in desperation, DeWitt accepted a position at the Livermore Laboratory in California. The laboratory had just opened in 1952, having been founded, at physicist Edward Teller's urging, to accelerate the nation's efforts to develop hydrogen bombs.[43]

One year into his position at Livermore, DeWitt spotted an announcement for the annual essay contest organized by the Gravity Research Foundation, and decided to give it a try. As he later recalled, he noticed the contest announcement just before the deadline to submit, so he stayed up all night, writing out his 1,500-word essay by hand—since the contest rules did not yet stipulate that entries needed to be typed!—and managed to get his essay to the post office just in time. His entry won first prize in 1953; he later cooed that it had been "the easiest $1000 I ever made."[44]

In his essay on "New directions for research in the theory of gravitation," DeWitt flatly rejected any possibility of finding insulators, absorbers, or reflectors of gravity in the context of general relativity, because Einstein's field equations are inherently nonlinear (unlike the linear equations that govern electromagnetism). But he went on to consider some of the features that might be found in an extended theory. Once gravity had been quantized successfully, DeWitt argued that it would be "welded into a single entity along with electromagnetic and meson fields." Within such a new theory, "in which one field cannot be distinguished from another, and a broadening of the term 'gravity' becomes inevitable," he wrote, then "one may well anticipate being able to 'harness gravity.'" The carrot for old Roger Babson was a clever workaround, and it worked.[45]

Mumbai and limited job prospects ca. 1950–52, see Weinberg, "Bryce Seligman DeWitt" (ref. 40), 5–6. DeWitt's was likely only the second dissertation on the subject of quantum gravity, and was completed independently of the pioneering work from the mid-1930s by Matvei Petrovich Bronstein; see Gennady Gorelik and Victor Ya. Frenkel, *Matvei Petrovich Bronstein and Soviet Theoretical Physics in the Thirties* (New York: Springer, 1994).

43. Weinberg, "Bryce Seligman DeWitt" (ref. 40), 6–7. On the founding of Livermore Laboratory, see Richard Hewlett and Francis Duncan, *A History of the United States Atomic Energy Commission*, Vol. 2, *Atomic Shield, 1947–1952* (University Park: Pennsylvania State University Press, 1969), 581–84.

44. Bryce DeWitt, interview with David Kaiser, 9 Jul 1999.

45. Bryce DeWitt, "New directions for research in the theory of gravitation" (1953), available in GRF Box 2, Folder 8, and at http://www.gravityresearchfoundation.org. DeWitt's essay is also reprinted in Cécile DeWitt-Morette, *The Pursuit of Quantum Gravity: Memoirs of Bryce DeWitt from 1946 to 2004* (New York: Springer, 2011), 61–68.

DeWitt's send-up of anti-gravity devices shared the same irreverence as Deser and Arnowitt's winning essay. In his conclusion, however, DeWitt struck a more serious tone. Echoing his 1951 letter to department heads, DeWitt warned that young physicists would likely lose interest in the subject of gravitation unless the prospects for such research could be improved. "External stimuli will be urgently needed in the near future to encourage young physicists to embark upon gravitational research in spite of the odds."[46]

That last part, about the need for "external stimuli," caught the attention of George Rideout, president of Babson's Gravity Research Foundation. Rideout, in turn, had been in touch for a few years with another wealthy businessman, Agnew Bahnson, Jr., who, like Babson, was eager to help support the study of gravitation. Bahnson, who was based in Winston-Salem, North Carolina, began attending the annual Gravity Research Foundation "Gravity Day" conferences in New Hampshire, and often compared notes with Rideout about promising prospects. After DeWitt won the 1953 essay contest, Rideout suggested that Bahnson contact him.[47]

In May 1955, Bahnson sent DeWitt a long, unsolicited letter. After noting that he had been in correspondence with Rideout for several years, Bahnson reported that the Burlington Mills Company in Greensboro, North Carolina, had recently donated $200,000 to the State College of the University of North Carolina, in Rayleigh—more than $1.8 million in 2018 dollars—to underwrite construction of a nuclear reactor. Since both DeWitt's and Deser and Arnowitt's prize-winning essays for the Gravity Research Foundation had made vague allusions to possible connections between gravitation and recent research in nuclear physics, Bahnson wondered if perhaps a facility like the new reactor could be helpful in advancing "the thing that has been of interest to me for over twenty years," namely, "practical application of an anti-gravity aircraft."[48]

Whereas Babson came to support the study of gravitation late in life, Bahnson began his efforts before his fortieth birthday. Born into a wealthy family in 1915, Bahnson had studied at the University of North Carolina (earning Phi Beta Kappa honors), then spent a year at Harvard studying industrial management before joining the family business. A decade later, in 1947, he became president of Bahnson Company, a firm specializing in

46. DeWitt, "New directions" (ref. 45).

47. Agnew Bahnson, Jr., to Bryce DeWitt, 30 May 1955, reproduced in DeWitt-Morette, *Pursuit of Quantum Gravity* (ref. 45), 71–73.

48. Bahnson to DeWitt, 30 May 1955 (ref. 47).

FIGURE 4. Agnew H. Bahnson, Jr., ca. 1957. *Source*: Hunter Bahnson.

industrial air-conditioning manufacturing. An amateur composer, he had already become a generous patron of the arts in the Winston-Salem area before turning his sights on scientific research (Fig. 4).[49]

Bahnson had been a licensed small-craft pilot since his mid-twenties, and remained fascinated by air travel. Yet what had long been a youthful preoccupation for him had recently taken on ominous overtones, as he explained to DeWitt. Not only would anti-gravity technology "change our whole concept of transportation, even more radically than the development of the automobile or airplane itself":

> It will probably also have broad repercussions in international relations and the entire concept of both trade and political associations between men all over the earth. One fearful note is seen in the accelerated development of weapons both in the nations of the free world and in the Communist

49. Anon., "A. H. Bahnson Jr. Killed," *Winston-Salem Journal* clipping (ca. 4 Jun 1964), in CDWM.

> dominated areas in that we are undoubtedly not alone in dreaming of such a mechanism and I believe it is a foregone conclusion that the Communist scientists are working along these lines already.[50]

Bahnson believed it was time to act.

Bahnson had read DeWitt's essay for the Gravity Research Foundation with care, and acknowledged DeWitt's caution that (as Bahnson paraphrased), "a great deal of theoretical background must be given to the study of gravity before anything practical can be developed." But in the hope that DeWitt was not too reticent about conceiving a future step "from the theoretical into the practical"—and at Rideout's suggestion—Bahnson wanted "to lay a few hopes at your threshold for consideration." In particular, Bahnson wondered if DeWitt might consider taking a five-year, soft-money position (funded by Bahnson) at the new nuclear physics laboratory at Rayleigh, to concentrate on gravitational theory. Bahnson assured DeWitt that both Bahnson and the director of the Rayleigh laboratory (with whom Bahnson had already been in contact) agreed that "basic research must be done [on gravitational theory] before we can turn our specific attention to the anti-gravitational aircraft project."[51]

As DeWitt later recalled, he and his wife Cécile DeWitt did not know what to make of Bahnson's letter. (Cécile DeWitt, *née* Morette, was an accomplished mathematical physicist whom Bryce had met and courted when they were both postdocs at the Institute for Advanced Study. At the time, Cécile was better known in the field than Bryce. Indeed, in the early days of their marriage, Wolfgang Pauli referred to Bryce as "Mr. Morette.") Though Bryce DeWitt was eager to leave the weapons laboratory at Livermore and begin an academic career, Bahnson's letter seemed too strange to take seriously. He ignored Bahnson's letter for several weeks (Fig. 5).[52]

50. Bahnson to DeWitt, 30 May 1955 (ref. 47). The obituary for Bahnson in 1964 noted that he had been a pilot for 25 years at the time of his death, at age 48: anon., "A. H. Bahnson Jr. Killed" (ref. 49).

51. Bahnson to DeWitt, 30 May 1955 (ref. 47).

52. DeWitt and DeWitt-Morette oral history interview with Kenneth Ford (ref. 40); see also Weinberg, "Bryce Seligman DeWitt" (ref. 40), 5, on the DeWitts' engagement while at the Institute for Advanced Study. Cécile DeWitt-Morette often used the last name DeWitt in the 1950s and 1960s, and began including her original (maiden) name in the 1970s. See, e.g., Cécile DeWitt and Roland Omnès, eds., *Relations de dispersion et paricules élémentaires* (New York: Wiley, 1960); Cécile DeWitt and John Wheeler, eds., *Lectures in Mathematics and Physics* (New York: Benjamin, 1968); and Cécile DeWitt-Morette, ed., *Gravitational Radiation and*

FIGURE 5. Bryce and Cécile DeWitt, ca. 1960, holding a medal commemorating the centennial of when the Savoy region of the Alps became part of France (1860–1960). Cécile DeWitt founded and organized an influential summer school for theoretical physicists in Les Houches, within the Savoy region, which began meeting annually in 1951. *Source*: Chris DeWitt.

In the meantime, Bahnson consulted with the influential physicist John Wheeler, who was just then turning his interests to the topic of gravitation. Wheeler had begun his career as a young nuclear physicist at the University of North Carolina before moving to Princeton, and he had remained in contact with colleagues throughout the state; the director of the new nuclear reactor laboratory at Rayleigh suggested to Bahnson that he reach out to Wheeler. Bahnson asked Wheeler who might be a good physicist to recruit for the Rayleigh reactor project on anti-gravity, and Wheeler (like Rideout) suggested DeWitt. Bahnson then sent another inquiry to DeWitt and followed up with a telephone call—"it was just a torrent of words from him," DeWitt later recalled, "and essentially after half an hour I was not the least bit interested." But Wheeler sent DeWitt a telegram, urging him not to decline Bahnson's offer prematurely. Wheeler, "an opportunist" (in DeWitt's description), who himself had only recently turned to the topic of general relativity, sensed that

Gravitational Collapse (Boston: Reidel, 1974). For the Pauli anecdote, see Toni Feder, "Snapshots from the life of Cécile DeWitt-Morette," *Physics Today* (10 Oct 2017).

Bahnson was eager to devote considerable resources to support research in gravitation.[53]

With Wheeler's encouragement, DeWitt responded to Bahnson with a long, handwritten note one week later, and agreed to Bahnson's request that DeWitt visit North Carolina in person in early July. (Bahnson offered to have his friend, Earl Slick of Slick Airways, personally fly DeWitt from California in Slick's private plane, though as it happened, DeWitt would be on the East Coast for other meetings anyway.) DeWitt and Bahnson quickly hit it off, and soon they were trading excited letters and telephone calls throughout the summer of 1955, full of plans for a new venture in gravitation. Bahnson visited the DeWitts in California that September to continue their planning.[54]

Among the first items to be settled, DeWitt convinced Bahnson that there would not be any fruitful connection between gravitational research and the nuclear-reactor facility at Rayleigh, and more generally, that the new project should focus on theoretical research rather than experiments. Such activities, DeWitt continued, seemed more suited to the University of North Carolina at Chapel Hill than the reactor facility at Rayleigh. Both Cécile and Bryce DeWitt also recommended a series of popular books to Bahnson—including *Matter and Light* and *Physics and Microphysics* by Louis de Broglie, and a charming introduction to general relativity in cartoon form, *The Einstein Theory of Relativity*, by Lillian and Hugh Lieber—so that their new patron could learn more about modern physics.[55]

One challenge concerned what to name their new venture. Early in the process, while he was still hoping to locate the project at the Rayleigh nuclear facility, Bahnson proposed that they establish a new "foundation for advanced research in nuclear physics which would not disclose the primary interest in

53. DeWitt and DeWitt-Morette oral history interview with Kenneth Ford (ref. 40), ("torrent of words," "opportunist"). See also Agnew Bahnson, Jr., to Bryce DeWitt, 14 Jun 1955, in CDWM. On Wheeler's turn to focus on gravitation, see John Wheeler with Kenneth Ford, *Geons, Black Holes, and Quantum Foam: A Life in Physics* (New York: W. W. Norton, 1998), esp. chap. 10; and Aaron S. Wright, *More Than Nothing: Histories of the Vacuum in Theoretical Physics, 1927–1981* (PhD dissertation, University of Toronto, 2014), chap. 4.

54. Bryce DeWitt to Agnew Bahnson, Jr., 22 Jun 1955; Bahnson to DeWitt, 14 Jun 1955 (ref. 53); Bahnson to DeWitt, 27 Jun 1955; DeWitt to Bahnson, 3 Aug 1955; and Agnew Bahnson, Jr., memo to members of the Institute of Field Physics, 17 May 1956; all in CDWM.

55. DeWitt to Bahnson, 3 Aug 1955 (ref. 54); Bryce DeWitt to Agnew Bahnson, Jr., n.d., fall 1955, in CDWM. See also Louis de Broglie, *Matter and Light* (New York: W. W. Norton, 1939); de Broglie, *Physics and Microphysics* (New York: Pantheon, 1955); and L. R. Lieber and H. G. Lieber, *The Einstein Theory of Relativity* (New York: Holt, Rinehart, 1945).

gravity," reasoning "from the standpoint of security and to avoid publicity." Ironically, Bahnson seemed to think that emphasizing nuclear physics would cause fewer security concerns than gravitation, presumably because he still hoped the project would focus on practical applications of anti-gravity.[56]

After surveying colleagues in California, Bryce DeWitt responded with other suggestions. His favorite title was "Research Institute of the University of North Carolina"—a name, he wrote, "which has a great deal of dignity, without being pretentious in the slightest degree, and which implies a certain permanence and honored tradition (which, of course, we hope to develop)." The word "foundation," meanwhile, had "met with universally strong disfavor," he reported, "as being too grandiose—implying something like the 'Ford Foundation,' 'Rockefeller Foundation,' 'Foundation for Infantile Paralysis,', etc."[57]

Like Bahnson, DeWitt suggested leaving the word "gravity" out of the title, though not for security concerns. Rather, DeWitt suggested that the new institute should project a wide outlook, and avoid the appearance of "a certain lack of open-mindedness." They should make clear in the institute's charter that the primary motivation was "the desire to increase men's understanding of the phenomenon of gravitation and its relation to the main body of theoretical and applied physics," rather than use the word "gravity" in the institute's name. In the end, they settled on DeWitt's somewhat innocuous suggestion: "Institute of Field Physics."[58]

Next came the challenge of how to represent the new project to university administrators, fellow scientists, and potential donors. Bahnson sent a draft of an exuberant statement to the DeWitts and John Wheeler, entitled, "The Glorious Quest," hoping to use it to announce the new project. The brief essay sprang from Bahnson's anti-gravity enthusiasms, tinged with his Cold War concerns:

> Consider the impact on world trade, on international relations, on transportation, in fact, on our very way of life, if it should be found possible to react against the lines of force of the earth in a controlled manner like the manner in which we now control an electromagnetic repulsion. We may never find an "insulator" for gravity. But some day we may learn to react *against* the force of gravity. That possibility alone provides us with a Glorious

56. Bahnson to DeWitt, 14 Jun 1955, in CDWM.
57. DeWitt to Bahnson, 3 Aug 1955, in CDWM.
58. DeWitt to Bahnson, 3 Aug 1955, in CDWM.

> Quest, particularly in this time of ideological impasses and threats of economic deterioration.[59]

Bryce DeWitt marked up the essay, his marginal comments alternating between patient clarifications of distinctions between gravity and electromagnetism and outbursts like, "Nothing to do with the price of beans." Where Bahnson had written, "As long as the problem of gravity remains an unpenetrated frontier we can hope that man will one day climb the 'ladder' that binds the earth to the sun," DeWitt had inserted, "for no damn good reason" after Bahnson's "hope."[60]

The draft clearly alarmed both DeWitt and Wheeler, each of whom responded gingerly. DeWitt wrote that he "enjoyed reading 'The Glorious Quest.' I just hope you will forgive me for pointing out a couple of errors in it which probably should be corrected before it is shown to too many people."[61] Wheeler—more experienced in interacting with influential nonscientists—was even more diplomatic:

> Your own statement, "The Glorious Quest," I found very interesting, and a stimulating expression of your own deep interest. However, I hope you will not mind if I question the appropriateness of some of the presentation for the purposes you have in mind. Ebullient as you and I are, I suspect sober going may go further when it comes to getting money from a foundation.[62]

DeWitt drafted a more "sober" statement, to be used in place of Bahnson's "Glorious Quest," entitled, "A presently neglected area of physical research, and its potentialities." He began by announcing, "The modern theory of gravitation, as formulated by Einstein in 1915, represents the high point of a profound revolution in human ideas as to the nature of the physical universe." Yet several factors had hampered physicists' efforts to explore the full implications of Einstein's work:

1. Past failures to extend the general theory of relativity.
2. The bad company of present research in the field.
3. The lack of experimental guide-posts.
4. The difficulty of the mathematics.

59. Agnew Bahnson, Jr., "The Glorious Quest," n.d., ca. Aug 1955, in CDWM.

60. See DeWitt's marginal notes on his copy of the draft of Bahnson, "Glorious Quest," in CDWM.

61. DeWitt to Bahnson, 3 Aug 1955, in CDWM.

62. John A. Wheeler to Agnew Bahnson, Jr., 29 Aug 1955, in CDWM.

5. The loneliness and the absence of rewards, both financial and in the esteem of colleagues, for those who work in the field.[63]

Wheeler also stepped in to help, writing his own testimonial on the importance of a new center devoted to the study of gravitation, and offering to gather comparable letters of endorsement from other leading physicists. He succeeded in collecting letters from such luminaries as Robert Oppenheimer, Edward Teller, Richard Feymnan, Freeman Dyson, and several others.[64]

DeWitt's goal for the new institute was to "provide a place where a number of physicists can work quietly, in financial and professional security, in a presently neglected field."[65] Wheeler's colleagues agreed that the subject of gravitation had been neglected for too long. DeWitt's former boss at Livermore, Edward Teller, for example, observed in his supporting letter for the new institute that "general relativity has been neglected by almost every theoretical physicist," while Oppenheimer underscored that "I share with most physicists the impression that this field [gravitation] has been rather neglected by us."[66]

Although they agreed that the topic deserved concerted attention, several raised concerns about how best to structure the new efforts. Dyson cautioned that success would only come if the institute were incorporated into "normal university life," rather than cordoned off or isolated. Feynman agreed, writing to Wheeler that "to solve a problem creating new fundamental knowledge a great flexibility of thought is required. Such problems have in the past been solved by men in Universities who can change their attention from one problem to another." MIT's Victor Weisskopf declined to endorse the new endeavor—as Dyson reported to Bahnson—because he believed that "the only effective way to support such research is by grants to individuals who will work in places of their own choice." Yet most of Wheeler's colleagues were won over once Wheeler and Bahnson clarified that the institute would be incorporated as a free-standing "money raising corporation" for the purposes of soliciting donations, but would otherwise be set up within the university. At the same time, Bahnson couldn't resist writing to Oppenheimer to reiterate his "secret

63. Bryce DeWitt, handwritten memorandum on "A presently neglected area of physical research, and its potentialities," n.d., ca. Aug 1955, in CDWM.

64. Wheeler to Bahnson, 29 Aug 1955, in CDWM. See also DeWitt to Bahnson, 3 Aug 1955, in *CDWM*, and John A. Wheeler memorandum, 28 Nov 1955, in BDW.

65. DeWitt, "A presently neglected area of physical research," in CDWM.

66. Edward Teller to John A. Wheeler, 23 Sep 1955; and J. Robert Oppenheimer to John A. Wheeler, 21 Oct 1955; both in CDWM.

hope" that the institute might one day "point a finger toward a practical utilization of gravity."[67]

As the DeWitts and Wheeler were hard at work in the fall of 1955 crafting careful statements and corralling support, news broke of the new venture. The *New York Herald-Tribune* ran a front-page story, trumpeting, "Conquest of gravity aim of top scientists in U.S." The piece opened dramatically:

> The initial steps of an almost incredible program to solve the secret of gravity and universal gravitation are being taken today in many of America's top scientific laboratories and research centres. . . . [T]here are increasing numbers who feel that there must be a physical mechanism for its propagation which can be discovered and controlled.[68]

Echoing Babson's and Bahnson's own claims, the reporter continued, "Should this mystery be solved it would bring about a greater revolution in power, transportation and many other fields than even the discovery of atomic power." The article quoted from the prize-winning essay by Deser and Arnowitt, touting their affiliation with the Institute for Advanced Study (which had raised Oppenheimer's hackles), and lauded the annual "Gravity Day" conferences at the New Boston headquarters of the Gravity Research Foundation. It also revealed the new proposal to establish an "Institute of Pure [*sic*] Physics" at the University of North Carolina, to be funded by Bahnson and led by Bryce DeWitt—identified as "the author of a Roger Babson prize-winning scientific study."[69]

The article caught Wheeler by surprise, and he quickly went into damage-control mode. "To keep clear of all these crazy anti-gravity stories is a real problem," he wrote to the various colleagues who had endorsed the new institute. Within a week, he had drafted a statement, together with Bahnson

67. Freeman J. Dyson, "Statement concerning the proposed Institute of Field Physics," 22 Oct 1955, in CDWM ("normal university life"); Richard P. Feynman to John A. Wheeler, 18 Nov 1955 ("to solve a problem"), in CDWM; Agnew Bahnson, Jr., to Bryce and Cécile DeWitt, 1 Dec 1955, in BDW ("only effective way"); and Agnew Bahnson, Jr., to J. Robert Oppenheimer, 20 Oct 1955, in CDWM ("secret hope," "point a finger"). Dyson's memo of 22 Oct 1955 is also reprinted in DeWitt-Morette, *Pursuit of Quantum Gravity*, 75. See also Feynman to Wheeler, 2 Dec 1955; and F. J. Belinfante to Agnew Bahnson, Jr., 7 Jan 1956; both in CDWM. Several of the letters in support of the proposed Institute of Field Physics echoed comments about how best to foster original research in a university setting that leading science policymaker Vannevar Bush had recently published. See Bush, "The independent research institution," *Physics Today* 7 (May 1954): 19–21.

68. Talbert, "Conquest of gravity" (ref. 36), 1, 36.

69. Talbert, "Conquest of gravity" (ref. 36), 1.

and the president of the University of North Carolina, which he labeled a "protection clause." The clause was to be attached "to each and every" statement from the new institute, "whether public or promotional," to wit:

> The work in field physics and gravitation theory carried on at the University of Carolina at Chapel Hill, and financed by the Institute of Field Physics, as fund raising agency, has no connection with so-called "anti-gravity research" of whatever kind and for whatever purpose. Its scientists, basing their investigations upon verifiable data, accept the Newton-Einstein analysis of gravity as free of a single established exception, and as the most comprehensive physical description we have today. They seek the implications of gravity and other fields of force at the level of the elementary particles. More generally, the Chapel Hill project is a modest attempt to learn more about the nature of matter and energy.

Wheeler hoped that the statement "will exorcize the demons!"[70]

Even so, Wheeler was taking no chances. He composed a remarkable four-page memorandum to the president of the University of North Carolina at Chapel Hill to accompany the letters of endorsement he had collected for the new Institute of Field Physics. Wheeler graciously paid "tribute to the vision and energy of Agnew Hunter Bahnson" for initiating the effort and donating generously to support it. "His efforts impress me as the highest type of good citizenship," Wheeler continued: "Without the efforts of Mr. Bahnson and public spirited friends and corporations the new opportunities for scientific progress at Chapel Hill would not have happened." Nonetheless, Wheeler was eager to underscore that the university's physics department would remain solely responsible for "the wise spending of this money"—exactly as if the funds had come from the "Rockefeller Foundation or the Office of Naval Research." Moreover, Bryce and Cécile DeWitt, and the younger researchers they were eager to recruit to the new institute, should retain the freedom to pursue any research questions, as their own curiosity may direct. After all, Wheeler wrote with a flourish, "we all know that universities after a thousand years of trial have turned out to provide the best machinery for searching for truth for its own sake."[71]

70. John A. Wheeler, memo of 28 Nov 1955, in BDW ("To keep clear," "exorcize the demons"); Wheeler's memo included a mimeographed attachment with the text of the "protection clause."

71. John A. Wheeler to Harris Purks (acting president of the University of North Carolina at Chapel Hill), 25 Nov 1955, copies in both BDW and CDWM.

Most important, Wheeler devoted the longest section of his memorandum to "the absolute necessity to avoid identification with the so-called 'anti-gravity research' that may be today's version of the last century's search for a perpetual motion machine." Einstein's general theory of relativity, Wheeler took pains to underscore, "plus the most elementary facts about the strength of materials, leaves no place for machines to neutralize the force of gravity in the popular sense of the term." He explained:

> From time to time individuals try to construct such gravity neutralizing devices. I know of no single reputable physicist who has the least shred of observational or theoretical evidence against Einstein's theory. But some people will never believe the theory until it has been the target of as many crackpots as tried to demolish the law of conservation of energy. With such experiments at the level of bricks, airplanes and rockets neither the University of North Carolina nor the Institute of Field Physics has any connection or sympathy, I am assured by Mr. Bahnson.

Wheeler quoted liberally from the series of "sensationalist" articles that had appeared that very week in the *New York Herald-Tribune*. "Such ideas are not merely fantasies; they are ruled out by everything we know today."[72]

With these assurances and safeguards in place, the Institute of Field Physics, Incorporated, was born. While Wheeler advised the university administration, Bryce DeWitt sent encouragement to Bahnson, who was beginning to worry that the fundraising effort might stall. DeWitt urged Bahnson to make his appeals directly to colleagues and fellow industrialists in person. "I am tremendously impressed by your ability to win the day by personal contact," DeWitt avowed, perhaps reflecting on his own interactions with the exuberant businessman. "I think it would be asking too much of even the most expert salesman to achieve success through the mails."[73]

Soon after Bryce and Cécile DeWitt arrived in North Carolina to head up the new institute, in January 1956, they made plans for more in-person fundraising. In June of that year, Bahnson sponsored an informal gathering near his summer home, in rural Roaring Gap, North Carolina, near the Stone Mountain State Park. The DeWitts were there, as were Freeman Dyson and Lothar Nordheim (a senior physicist at nearby Duke University), so that Bahnson and several wealthy friends could pepper the physicists with questions about gravitation. Representatives attended from the Glenn L. Martin aircraft-

72. Wheeler to Purks, 25 Nov 1955 (ref. 71).
73. Bryce DeWitt to Agnew Bahnson, Jr., 18 Nov 1955, in CDWM.

manufacturing corporation, the American Machine and Foundry Company, International Business Machines (IBM), as well as reporters from the *Winston-Salem Journal and Sentinel*.[74]

George Rideout, president of Babson's Gravity Research Foundation, attended the Roaring Gap meeting as well. DeWitt had visited with Rideout soon after moving back to the East Coast, early in 1956, and Bahnson invited Rideout to join the advisory board for the new Institute of Field Physics. Rideout and the Gravity Research Foundation remained closely connected with the Institute, making modest financial contributions each year and receiving Bahnson's often exuberant memoranda; Bahnson continued to participate in the summer "Gravity Day" workshops in New Hampshire. He closed his memo to advisory board members in June 1956 by quoting extensively from several of the prize-winning essays from the Gravity Research Foundation contests—including Deser and Arnowitt's essay, which, of course, Oppenheimer had dismissed as a "hoax."[75]

The meet-and-greet efforts worked. Before long, Bahnson had established a system of "patron memberships" and "sustaining memberships" for the Institute, with large donations coming in from private donors, major manufacturing corporations, and family foundations. Within the first three years, Bahnson raised almost $90,000 in donations for the Institute—more than $750,000 in 2018 dollars—beyond his own contributions, including substantial contributions from companies and foundations whose representatives had attended the Roaring Gap meeting. In his appeals to fellow businessmen, Bahnson emphasized regional pride rather than short-term benefits to particular corporations. The Institute of Field Physics, Bahnson urged, "should ultimately return great honor to the University and the State of North Carolina."[76]

Both Bryce and Cécile DeWitt became active in the fundraising campaigns as well. Bahnson often used his connections to arrange speaking opportunities for the DeWitts at local Rotary Club luncheons to help spread the word about the new institute, and coordinated with the DeWitts when they were planning

74. Agnew Bahnson, Jr., "Memorandum #4" to members of the Institute of Field Physics, 20 Jun 1956, in CDWM.

75. Bahnson, "Memorandum #4," 20 Jun 1956, in CDWM.

76. Agnew Bahnson, Jr., to Charles Shaffer (director of university development, University of North Carolina at Chapel Hill), draft fundraising letter dated 2 Jun 1961 ("return great honor"), in UNC; see also Bahnson to Shaffer, 15 Mar 1961, which includes an appendix, "Original Donors: First Three Years," in UNC.

travel. "I hope that Bryce's trip to New York will enable him to make some contacts at Union Carbide and possibly locate some other perspective [*sic*] members that I might be able to contact advantageously," Bahnson wrote to Cécile at one point.[77]

Meanwhile, Bahnson continued to nurse his own interest in anti-gravity, his assurances to Wheeler notwithstanding. At one point, Bahnson wrote to Stanford physicist Leonard Schiff. Schiff, like Wheeler, was a senior theoretical physicist just then turning his attention to gravitation. One of Schiff's students (likely Dieter Brill) had recently published work on the positivity of energy in general relativity. Bahnson sent Schiff his own highly speculative ideas about extracting energy from space, and tied the ideas to research being conducted at the Institute of Field Physics. When Cécile DeWitt got wind of the exchange, she sent Bahnson a firm note. "I had recently expressly asked you not to importune Dr. Schiff. If you recall, my reaction to contacting Dr. Schiff to discuss your theories was an unqualifiedly negative one."[78]

Bahnson wasn't content to theorize. For years, despite the strong anti-gravity disclaimer penned by Wheeler (and assented to by Bahnson), he pursued his own table-top experiments as well, convinced that he and a colleague, T. T. Brown, had found hints of anti-gravitational effects in what amounted to a home-made flying saucer. Throughout the spring and summer of 1958, Bryce DeWitt and other physicists were called upon to evaluate several curious episodes, or "cases," in which Bahnson's device seemed to display anti-gravitational lift.[79]

Early in the process, Bahnson asked other physicists to evaluate his device. Edward Teller weighed in with several colleagues, concluding that Bahnson's device was displaying effects of large, electrostatic forces—rather than exhibiting anti-gravitational effects—likely because a voltage source had not been properly grounded, which allowed significant surface charge to built up on a portion of the device. (Teller took up the matter not only because of his

77. Agnew Bahnson, Jr., to Cécile DeWitt, 24 Jan 1961 ("Bryce's trip to New York"), in UNC. On the DeWitts' talks at Rotary Club luncheons, see also Bahnson, "Memorandum #11" to members of the Institute of Field Physics, 3 Feb 1958, in BDW; and Bahnson, "Memorandum #24" to members of the Institute of Field Physics, 15 May 1959, in BDW.

78. Cécile DeWitt to Agnew Bahnson, Jr., 13 May 1959, in CDWM.

79. Copies of Bahnson's engineering drawings of his device are available in BDW. A video of Bahnson and an associate conducting some of their experiments, with a youthful Bryce DeWitt making at appearance at the 14-minute mark, may be found at https://www.youtube.com/watch?v=vWuUJt7iSAo (accessed 3 Oct 2017).

relationship with Bryce DeWitt from the latter's Livermore days, but also because Teller was a close colleague of David Griggs, a geophysicist at the University of California, Los Angeles, and co-founder of the RAND corporation, who had served as U.S. Air Force chief scientist during 1951–52. Griggs, in turn, was a friend of Bahnson's.) Griggs reported his and Teller's conclusions to Bahnson, expecting Bahnson to be disappointed, but assuring him that their "considerations were undertaken in the spirit of sympathetic inquiry." Another physicist who investigated the device in person recalled that shielding for the strong electromagnetic fields was so poor that Bahnson's assistant's hair stood on end![80]

Bahnson remained unconvinced. Two weeks later, the chair of the physics department at the University of North Carolina—within which the new Institute of Field Physics resided—wrote to the university chancellor, outlining next steps. Another private donor would cover the costs for a further investigation of Bahnson's "high voltage gadget" over the summer. "This seems to me to be a very worthwhile summer project," the department chair wrote, not least because it should bring

> Mr. Bahnson back in line with orthodox scientific procedures. We believe that the therapeutic value of this experience will teach him much concerning the rigorous methods that must be followed in science. Perhaps then, he might concentrate more strongly on basic research (and raising funds for same) rather than attempting to find gold in veins that have been worked over for centuries past.[81]

Bryce DeWitt was recruited to help analyze the latest anomalous effects from Bahnson's device. At one point, he noted to the department chair (perhaps jokingly) that he had begun "sweating over the theory of superconductivity"—far from his usual research area—to improve his job prospects in case "Agnew decides to drop me," should DeWitt be too dismissive of Bahnson's pet project. The department chair replied with an update to DeWitt marked "top secret." He reported, "After a lot of work I see *nothing* which would enable Agnew to get a Development contract. Any representation to the

80. David Griggs to Agnew Bahnson, Jr., 13 May 1958 ("spirit of sympathetic inquiry"), in CDWM; Lou Witten, interview with Dean Rickles and Donald Salisbury, 17 May 2011. On Griggs's career, see Ivan A. Getting and John M. Christie, "David Tressel Griggs," *Biographical Memoirs of Members of the National Academy of Science* 64 (1994): 112–33.

81. Everett D. Palmatier (physics department chair, University of North Carolina at Chapel Hill) to W. B. Aycock (university chancellor), 29 May 1958, in CDWM.

contrary would be fraudulent." Like Teller and Griggs, DeWitt and the department chair concluded that Bahnson's device responded to strong electrostatic forces, rather than producing anti-gravity effects. The chair concluded, "We must get together immediately to study the various relationships—Agnew-yourself-Cécile-the Institute-the Dept, etc.—the time has now arrived for a showdown." It was time to "make certain that somebody's wings are clipped!"[82] Luckily for the DeWitts, no "showdown" proved necessary. Bahnson backed off his claims and threw himself back into fundraising efforts to support the fledgling institute, while wrapping up his science-fiction thriller, *The Stars are Too High*, in which a gravity-defying flying saucer helps resolve Cold War tensions.[83]

The Institute's earliest success came in January 1957, when the DeWitts hosted a conference on "The Role of Gravitation in Physics" at the new institute. The meeting, which included forty-five physicists, attracted scattered experts from eleven nations and helped to nucleate a new research community dedicated to the study of gravitation. Later called "GR1," the Chapel Hill conference became the first in a series of international conferences on the subject of general relativity.[84] As one of the young American participants later recalled, the Chapel Hill conference was the first "conference in which postwar students of general relativity were able to participate, and it was a marvelous experience for us."[85] Among many notable achievements, the conference stands out for having fostered the first definitive theoretical demonstration

82. Bryce DeWitt to Everett Palmatier, n.d., ca. Jul–Aug 1958 ("decides to drop me"), in CDWM; Palmatier to Bryce DeWitt, 13 Aug 1958 ("top secret," "wings are clipped"), in CDWM.

83. Agnew H. Banson, Jr., *The Stars are Too High* (New York: Bantam, 1959).

84. The notion that the Chapel Hill conference was part of a series was only retrospectively conferred. The now well-established "GRn" naming convention appears to have been André Mercier's idea, with the 1955 conference in Berne marking the jubilee of special relativity (though, ultimately, it would mark Einstein's death) becoming GR0, and Chapel Hill becoming GR1. Hence, although the Chapel Hill conference (and the Berne conference before it) appears to have triggered the later conferences, there was at the time no conscious effort to link them to a series, despite today's naming convention. See André Mercier, "General relativity at the turning point of its renewal," in *Studies in the History of General Relativity*, ed. A. Kox and J. Eisenstaedt (Boston: Birkhauser, 1992), 109–21. See also Lalli, *General Relativity and Gravitation Community* (ref. 5), 47–54.

85. The remark, while capturing something of the broader, more inclusive spirit of the Chapel Hill conference, is not strictly accurate: the earlier Berne conference had also allowed for postwar relativists to attend and contribute to the proceedings (e.g., Felix Pirani, Jurgen Ehlers, and others). Moreover, Cold War tensions prohibited certain people from attending the Chapel Hill meeting. Our thanks to Roberto Lalli for discussion of these points.

that gravitational radiation is a robust feature of the general theory of relativity, rather than an artifact of any particular formalism.[86]

Beyond the Chapel Hill meeting, Bahnson's donations and avid fundraising enabled the DeWitts to host several prominent experts as visiting lecturers at the new institute, and to fund graduate students and postdoctoral researchers as well, including Ryoyu Utiyama, Oskar Klein, Peter Higgs, Christian Møller, and Felix Pirani. In just over a decade, the Institute graduated seventeen PhD students and hosted twenty-seven postdoctoral associates, helping to seed a younger generation of experts in general relativity.[87] Following the Chapel Hill meeting, the Institute also helped to organize the first-ever meeting devoted solely to the problem of unifying quantum theory and gravitation—a pursuit that DeWitt had attempted in his Harvard dissertation—which took place in Copenhagen during July 1957. The Chapel Hill conference led to another follow-up meeting (proposed by André Lichnerowicz and Marie-Antoinette Tonnelat at the close of the Chapel Hill conference), held in Royaumont, France, during the summer of 1959. Between the Chapel Hill meeting and the conferences in Copenhagen and Royaumont, the DeWitts and their Institute of Field Physics helped to set much of the agenda for the new wave of research on gravitation over the next several years.[88]

86. Joshua Goldberg, "US Air Force support of general relativity, 1956–1972," in *Studies in the History of General Relativity*, ed. A. Kox and J. Eisenstaedt (Boston: Birkhauser, 1992), 89–102, on 91 ("marvelous experience"). See also Kennefick, *Traveling at the Speed of Thought* (ref. 6), 128–39; P. R. Saulson, "Josh Goldberg and the Physical Reality of Gravitational Waves," *General Relativity and Gravitation* 43 (2011): 3289–99; and Dean Rickles, "The Chapel Hill conference in context," in *The Role of Gravitation in Physics: Report from the 1957 Chapel Hill Conference*, ed. Cécile M. DeWitt and Dean Rickles (Berlin: Max Planck Institute for the History of Science, 2011), 7–21.

87. A complete list of students, postdocs, and visitors is available in DeWitt-Morette, *Pursuit of Quantum Gravity* (ref. 45), 79–81.

88. The Institute of Field Physics provided administrative support for the July 1957 Copenhagen meeting; see Agnew Bahnson, Jr., memorandum dated 25 Sep 1957, in BDW, and Bryce DeWitt's report on the meeting, which he prepared for the U.S. Air Force's Wright Air Development Center, in CDWM. On the Copenhagen meeting and the DeWitts' influence on the community's ensuing research agenda, see Alexander Blum and Thiago Hartz, "The 1957 quantum gravity meeting in Copenhagen: An analysis of Bryce S. DeWitt's report," *European Physical Journal H* 42 (2017): 107–57. On the 1959 Royaumont meeting (often dubbed "GR2"), see Goldberg, "US Air Force support" (ref. 86), 91; and José M. Sánchez-Ron, "George McVittie, the uncompromising empiricist," in *The Universe of General Relativity*, ed. A. J. Kox and Jean Eisenstaedt (Boston: Birkhauser, 2005), 189–221, on 210–14. On ties between the Chapel Hill and Royaumont meetings, see the fundraising proposal to the Richardson Foundation for the Institute of Field Physics, ca. Feb 1960, and Paul Johnston (Director, State Department of

Bahnson, meanwhile, continued to test the boundaries of his affiliation with the Institute of Field Physics, and the patience of the DeWitts, until his death in early June 1964 (when he crashed his airplane, at age 48). Not long before Bahnson died, in fact, Nobel laureate Max Born wrote to John Wheeler, to report on a visit that Bahnson had paid to him. Bahnson had wanted to discuss a nonlinear field theory that Born and Einstein's former assistant, Leopold Infeld, had pursued during the mid-1930s, inspired by Einstein's general relativity. Born reported to Wheeler that it quickly became clear that Bahnson "was not a physicist at all and understood nothing of the mathematics of the problem." Rather, Bahnson's interest in the work "is just wishful thinking," and that following their conversation, Born was "a little afraid that he [Bahnson] may use my name in a way which is not conform [*sic*] with my principles. For I dislike fantastic ideas in science and still more the technical interest in new discoveries particularly if it is directed toward increasing a power of nations." Wheeler confided in response that "I myself generally find that I have gone through a fairly stiff exercise period at the end of one of these conversations" with Bahnson, but that—despite Bahnson's "initiative and generosity" in getting the Institute off the ground—Bahnson did not "speak for the Institute of Field Physics but as a private individual." Wheeler and the DeWitts, after all, had worked hard to make it so.[89]

CONCLUSIONS

Even as he nursed his continuing interest in anti-gravity, flying saucers, and science fiction, Agnew Bahnson devoted significant effort to fundraising on behalf of the fledgling Institute of Field Physics during the late 1950s and early 1960s. In conjunction with the University of North Carolina's Office of Development, he launched a campaign in 1960–61 to endow the new institute, seeking to raise another $250,000 (more than $2 million in 2018 dollars). In a typical pitch to prospective donors, Bahnson explained, "This type of basic

Administration, Raleigh, NC) to Everett D. Palmatier (department chair, Physics, University of North Carolina, Chapel Hill), 18 Feb 1960, both in UNC. Note also that the MATS service, originally offered to fly international scholars into the Chapel Hill conference, was also later utilized for the Royamont conference, and the two later GR conferences, in Warsaw and London. See Goldberg, "US Air Force support" (ref. 86), 89–102.

89. Max Born to John Wheeler, 20 Mar 1964, available in CDWM; and Wheeler to Born, 31 Mar 1964, in BDW.

research cannot be related to the interest or the financial advantage of any corporation, foundation, or individual. It is strictly eleemosynary for the interest of human progress." Drawing on his extensive network, by June 1961, Bahnson had succeeded in raising more than half of the goal, buoyed by major donations from such corporations as IBM, American Machine and Foundry, Grumman Aircraft Engineering Corporation, Westinghouse Electric, and even Hanes, the hosiery manufacturer, which was based in Bahnson's home town of Winston-Salem.[90]

Though Bahnson emphasized "interest in human progress" and local pride in his fundraising pitches, at least one of the donors to his project—the Glenn Martin aircraft manufacturing company, in Baltimore, Maryland—had more practical goals in mind. (Glenn Martin eventually became part of Lockheed Martin, the major aerospace corporation and defense contractor.) Indeed, less than two weeks after Bahnson had originally written to Bryce DeWitt to propose what would become the Institute of Field Physics, back in the spring of 1955, DeWitt had received a similar invitation from George Trimble, a vice president at the Glenn Martin company.[91]

The timing was no coincidence: both Bahnson and Trimble had been encouraged to recruit DeWitt by George Rideout, President of Roger Babson's Gravity Research Foundation, soon after DeWitt had received first prize in the foundation's annual essay contest. Trimble opened his letter to DeWitt by explaining that he and Rideout had recently been "commiserating on the unfortunate state of the affairs that knowledgeable folks do not wish to get 'mixed up' in the field of gravity research." Yet Trimble and his colleagues at the aircraft company felt they had a real stake in the subject; indeed, as he continued in his letter to DeWitt, "our industry was vitally concerned with gravity."[92]

Trimble explained that the Glenn Martin company aimed to invest in basic research on gravitation, but had not as yet been able to find qualified researchers in the field, which (as he observed) "at the present time is peopled largely by mad men and quacks." Hence the Glenn Martin company planned to establish its own research laboratory, which Trimble grandly described as an "industrial

90. See, e.g., W. B. Aycock to W. D. Carmichael, 17 Octr 1960; Agnew Bahnson, Jr., to Charles Shaffer (University Development office, University of North Carolina), 15 Mar 1961 and 2 Jun 1961 ("This type of basic research"); and Charles Shaffer to Agnew Bahnson, Jr., 29 Jun 1961; all in UNC.

91. George S. Trimble to Bryce DeWitt, 10 Jun 1955, in BDW.

92. Ibid.

version of the Institute for Advanced Study."[93] Though Trimble failed to entice DeWitt to run what became Glenn Martin's Research Institute for Advanced Studies (RIAS)—DeWitt was convinced that only a university environment could foster the kind of intellectual freedom that he sought—Trimble remained in contact with both DeWitt and Bahnson as they launched the Institute of Field Physics. Trimble served as a member of the Institute's advisory group and arranged a contribution from Glenn Martin to Bahnson's follow-up fundraising efforts.[94]

Early in their discussions, Trimble offered to connect Bahnson and the DeWitts with the Air Force, since Glenn Martin was already a major defense contractor.[95] Before long, an Air Force lieutenant colonel visited the new Institute of Field Physics in Chapel Hill, and offered to stay in touch. Bryce DeWitt followed up in July 1956, suggesting that perhaps the Air Force might help underwrite some of the costs of the upcoming January 1957 Chapel Hill meeting. The matter was passed to Joshua Goldberg, a recent PhD physicist who had just taken a position at the Air Force's Aeronautical Research Laboratory at the Wright-Patterson Air Force Base in Ohio, upon completing his dissertation on gravitational physics under the supervision of Peter Bergmann at Syracuse University.[96] (Bergmann himself had been an assistant of Einstein's in the 1930s.)

The relative positions of the DeWitts and Goldberg during the autumn of 1956 are striking. With Bahnson's funds and support from the university, Bryce and Cécile DeWitt could launch into hiring students and postdocs, and planning their upcoming conference. Goldberg, on the other hand, wrote to Bryce that he was "somewhat isolated" at the Air Force laboratory, and hoped that DeWitt could send him reprints, to help him "get caught up on developments

93. Ibid.

94. See, e.g., Agnew Bahnson, Jr., minutes from annual meeting of members of the Institute of Field Physics, 29 Apr 1958, in BDW; Charles Shaffer to Agnew Bahnson, 29 Jun 1961, in UNC. RIAS soon hired physicist Lou Witten—father of Fields medalist Ed Witten—to spearhead its efforts in the study of gravitation. One of the lasting contributions was publication of *Gravitation: An Introduction to Current Research*, ed. Lou Witten (New York: Wiley, 1962), which included an influential review article by Richard Arnowitt, Stanley Deser, and Charles Misner on the so-called "ADM" formalism for general relativity: Arnowitt, Deser, and Misner, "The dynamics of general relativity," in Witten, *Gravitation*, pp. 227–65. See also Lou Witten, interview with Dean Rickles and Donald Salisbury, 17 May 2011.

95. Agnew Bahnson, Jr., to Bryce and Cécile DeWitt, 28 Dec 1955, in BDW.

96. Bryce DeWitt to Lt. Colonel G. M. Leies, 25 Jul 1956, in CDWM; Joshua Goldberg to Bryce DeWitt, 3 Oct 1956, in CDWM. See also Goldberg, "US Air Force support" (ref. 86).

in the field." Goldberg went on: "So far we have no money for contractual research. Every day the expectation is what [*sic*] within a month some will be forthcoming. I suppose that is the way it will remain until the day it shows up." In the meantime, Goldberg's thesis advisor, Bergmann, suggested that in lieu of direct payments to support the Chapel Hill meeting, the Air Force could provide transportation for a few participants who were based outside the United States.[97] Goldberg and the DeWitts pursued the plan, and in the end, the Air Force was able to provide some direct funds for the meeting as well as arranging Military Air Transport Service (MATS) for several workshop participants.[98]

Much as with Trimble, RIAS, and industrial support for research on gravitation, the early Air Force efforts thus piggybacked on institutions and relationships that had been forged by Babson, Rideout, and Bahnson. With Goldberg's support at the Air Force, however, there was an important difference: unlike the private patrons, Goldberg was himself an expert in the field and was able to contribute to the new projects intellectually as well as administratively. After he met Cécile and Bryce DeWitt in person at the 1957 Chapel Hill meeting, they immediately began sharing plans for ways to continue to foster support for the field. The DeWitts could work with Goldberg as a partner, not just a patron.[99]

By the time of Agnew Bahnson's death in 1964, the study of gravitation enjoyed a dramatically different institutional base than it had in 1948. Locally, the situation deteriorated for the DeWitts after Bahnson's death. His widow transferred funds to the university rather than to the Institute of Field Physics, which complicated planning for hiring postdoctoral associates and graduate students at the Institute.[100] Moreover, while Bryce DeWitt was promoted to

97. Goldberg to DeWitt, 3 Oct 1956 (ref. 96).

98. See correspondence ca. Oct 1956–Jan 1957 in CDWM, as well as Rickles, "The Chapel Hill conference in context" (ref. 86), 16–17. Soon Goldberg did have some modest funds to distribute, and his office was able to support several theoretical research projects in gravitation, including several physicists who were based in Europe; Goldberg, "US Air Force support" (ref. 86). Cf. John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (Cambridge, MA: MIT Press, 2006).

99. See, e.g., correspondence between Joshua Goldberg, Cécile and Bryce DeWitt, 1957–58, in CDWM; and Goldberg, "US Air Force support" (ref. 86).

100. Compare with similarly fragile relationships that supported research on the foundations of quantum theory during the 1970s, which was likewise largely sponsored by private donors and nontraditional institutions. Though such patronage helped sustain efforts at a time when the research topic appeared far from the mainstream, these relationships lacked the long-term

a tenured professor in the department of physics, Cécile DeWitt was demoted to a lecturer—despite her own significant accomplishments in the field and her tireless administrative efforts, both at the Institute and as the founder of the annual summer school at Les Houches, in her native France.[101]

Though the Institute of Field Physics failed to flourish after its main patron died, support for research in the field continued to grow. After being courted by Glenn Martin's RIAS laboratory, mathematical physicist Alfred Schild convinced his home institution, the University of Texas at Austin, to found a new Center for Relativity, in 1962.[102] Schild rapidly parlayed his international contacts—solidified by the new "GR" conference series, which had begun with the 1957 Chapel Hill meeting and continued to receive Air Force support—to recruit several young researchers to the center, including Roger Penrose, Roy Kerr, and Jürgen Ehlers. When it became clear that the DeWitts were looking to leave North Carolina, Schild recruited them both to Austin as well: both were hired as tenured full professors in 1972, and Bryce DeWitt became director of the Center for Relativity.[103]

By that time, federal support for research in gravitation had become more readily available; the DeWitts, for example, secured a major grant from the U.S. National Science Foundation (NSF) to conduct an updated test of general relativity during a 1973 eclipse, and by the mid-1970s, agencies like the NSF began to invest (modestly at first) in what would become enormous projects like the Laser Interferometer Gravitational-Wave Observatory, or LIGO. Central to many of those efforts were figures—like the DeWitts, John Wheeler, and their students—who had gained experience and built networks to sustain the field before federal support had materialized.[104]

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institutional security available from more typical funders or universities: Kaiser, *How the Hippies Saved Physics* (ref. 9), chaps. 5–6.

101. Weinberg, "Bryce Seligman DeWitt" (ref. 40), 9–10; DeWitt and DeWitt-Morette oral history interview with Kenneth Ford (ref. 40); and DeWitt-Morette, *Pursuit of Quantum Gravity* (ref. 45), 85–87.

102. See the correspondence between Welcome W. Bender (Vice President, RIAS), Lou Witten, and Alfred Schild, Jan–May 1957, in the Alfred Schild Papers, Box 86-27/2, Briscoe Center for American History, University of Texas at Austin.

103. On Schild and the founding of the Center for Relativity, see, e.g., Engelbert L. Schucking, "The first Texas Symposium on Relativistic Astrophysics," *Physics Today* 42 (Aug 1989): 46–52, on 46–47; on the DeWitts' move to Austin, see Weinberg, "Bryce Seligman DeWitt" (ref. 40), 10.

104. On the 1973 eclipse experiment, see DeWitt-Morette, *Pursuit of Quantum Gravity* (ref. 45), 43–50; and Weinberg, "Bryce Seligman DeWitt" (ref. 40), 11. On early funding for what

Since the end of the Cold War, meanwhile, private funding from wealthy donors and philanthropic foundations has once again come to play a significant role in areas like relativity and cosmology, and their intersections with quantum theory. For every Kavli Center for Cosmology or research project funded by the John Templeton Foundation, we may hear echoes of earlier, generous patrons—most notably, Roger Babson and Agnew Bahnson—whose enthusiasms and eccentricities helped to spark the "renaissance" of relativity.

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would become LIGO, see Harry Collins, *Gravity's Shadow: The Search for Gravitational Waves* (Chicago: University of Chicago Press, 2004), chap. 17.