

JAMES JEANS AND *The Mysterious Universe*

The controversial best seller heralded the
end of an era in science popularizations.

Daniel Helsing received his PhD in literature from Lund University in Sweden in 2019. He is a freelance critic and translator and teaches comparative literature at Linnæus University in Växjö and Karlstad University, both in Sweden.



Daniel Helsing

Can physics help answer questions about who we are, why we are here, and what the meaning of life is? In the UK in the 1920s and 1930s, many writers expounded the new physics of the time—relativity and quantum mechanics—in popular books with philosophical leanings. Some of those books were popular in both senses of the term: They explained physics to laypeople, and they sold extraordinarily well. That booming market turned some popularizers into celebrities. Of those authors and their books, none were as successful as James Jeans and *The Mysterious Universe*, published in 1930.

In the first chapter,¹ Jeans reflects on the meaning of life in a seemingly indifferent universe. And for him, modern physics does have something to say on the matter: It leads people to recognize an intimate connection between human beings and the universe. The philosophical framework underpinning Jeans's work—a form of metaphysical idealism, in which ultimate reality is “mind-like” rather than “matter-like”—may strike modern readers as odd.

Many present-day popularizers, from Neil deGrasse Tyson to Sean Carroll, would probably agree with Jeans on the importance of addressing existential questions, since they frequently explore such questions in their own books and television shows. But they would likely take issue with Jeans's idealism. Reading Jeans today illuminates a long tradition of existential, bestselling popular science and inspires an investigation into the philosophical assumptions in current popularizations.

Who was James Jeans?

Born into a family of journalists in 1877, James Hopwood Jeans was a precocious child who learned how to read and count at an early age. In 1896 he left his childhood home in London for Trinity College at the University of Cambridge. After completing his studies in mathematics and physics in 1903 and briefly working as a lecturer in mathematics, he accepted a position as a professor of applied mathematics at Princeton University in 1905. He stayed there for four years before returning to Cambridge to become the Stokes Lecturer in applied mathematics.

During the first half of his scientific career, Jeans did research in statistical mechanics and blackbody radiation. He is perhaps best known today for the Rayleigh–Jeans law—

originally derived by Lord Rayleigh in 1900 and amended by Jeans in 1905—which describes the radiation intensity of a blackbody at a given temperature as a function of wavelength. The law was derived in a classical framework and is valid only for long wavelengths. For shorter wavelengths, the function goes to infinity; that problem became known as the ultraviolet catastrophe.

Jeans tried to avoid the ultraviolet catastrophe within a classical framework by introducing additional hy-

potheses, but he eventually concluded that the attempted solution was a dead end. In his *Report on Radiation and the Quantum-Theory*, written for the Physical Society of London in 1914, Jeans argued that quantized energy, as suggested by Max Planck in 1900, was necessary. The report aided in the development and acceptance of quantum physics in the UK.

From 1914 on Jeans shifted his research from the very small to the very large—from atoms and molecules to stars and the universe. He received the University of Cambridge's Adams Prize for his essay “Problems of cosmogony and stellar dynamics,” which was published as a book in 1919. Jeans went on to serve as the honorary secretary of the Royal Society of London for a decade, all while keeping up his prolific research on stellar dynamics. He published more than 35 astronomical papers between 1913 and 1928. One of his last technical publications was the book *Astronomy and Cosmogony*, in which he summarized his astrophysical research and attempted to survey the field generally. After 1929 Jeans diverted his energy to science popularization.²

The Einstein boom

Physics came to the forefront of the British public imagination during the final decade of Jeans's career as a researcher. Astronomers Arthur Eddington and Frank Dyson organized expeditions to test Albert Einstein's general theory of relativity during the solar eclipse of May 1919 (see the article by Daniel Kennefick, *PHYSICS TODAY*, March 2009, page 37). After the results were made public in November 1919, the world experienced what has been described as a “relativity circus.”³ Almost overnight Einstein became a global superstar and an icon of genius, international science, and the



JAMES HOPWOOD JEANS (1877–1946) was a prolific physicist and science popularizer. (Courtesy of the AIP Emilio Segrè Visual Archives.)

modern world (see the article by Paul Halpern, *PHYSICS TODAY*, April 2019, page 38).

Demand was growing for texts explaining the new, revolutionary picture of the universe. Eddington wrote one of the earliest book-length popularizations, *Space, Time and Gravitation: An Outline of the General Relativity Theory*, published by Cambridge University Press in 1920. It was favorably but not widely reviewed. The book sold well and was reprinted several times during the 1920s.

Einstein, too, wrote a popularization of relativity, *Über die spezielle und die allgemeine Relativitätstheorie* (*Relativity: The Special and General Theory*), published in German in 1916 and translated to English in 1920. But he lacked Eddington's gift for marketing physics to laypeople; his book was dry and did not sell as well. The slew of books on relativity that followed initiated what literary scholar Elizabeth Leane calls the "Einstein boom" in popular physics publishing⁴ in the 1920s and 1930s.

As early as 1922, interest in relativity seemed to be waning. Magazines and journals claimed that Einstein was "last season" (*Nouvelle Revue Française*, January 1922) and that "even philosophers have had enough of relativity" (*Mind*, October 1922; both quotes are from reference 5, page 56). But two developments saved the genre. First, most popularizers widened

their scope to include the other modern-physics revolution, quantum mechanics. Second, they discussed the new physics' significance and implications for philosophy and spirituality.

Although popularizations of relativity continued to appear—some of them written by famous writers such as Bertrand Russell and John W. N. Sullivan—the books that dominated the market took the broader view. Literary scholar Michael Whitworth singles out three books, all published by Cambridge University Press, as particularly influential: Alfred North Whitehead's *Science and the Modern World* (1925), Eddington's *The Nature of the Physical World* (1928), and Jeans's *The Mysterious Universe* (reference 5, page 62). Of those, *The Mysterious Universe* was by far the most successful.

The making of a popularization

The Mysterious Universe was not Jeans's first popular science book. Sydney C. Roberts, the secretary at Cambridge University Press, persuaded Jeans to write one in 1929. The result, *The Universe Around Us*, became an immediate best seller and sold more than 11 000 copies in the first few months alone (reference 6, page x). In comparison, Eddington's *The Nature of the Physical World* sold only around 10 000 copies in the UK in over a year.⁷ But both those figures pale in comparison with those of *The Mysterious Universe*.

In 1930 Allen Ramsay, vice chancellor of the University of Cambridge, invited Jeans to deliver the Rede Lecture, the university's prestigious annual public address whose roots go back to the 16th century. Encouraged by the success of *The Universe Around Us*, Jeans agreed to publish an expanded version of the lecture as a book, *The Mysterious Universe*. It was published on 5 November, the day after Jeans gave his highly anticipated talk. An editor at the *Times*, Harold Child, reported that "the whole office is buzzing about Jeans." In anticipation of its popularity, Cambridge University Press printed 10 000 copies for the initial release. But those were not enough. "For the next few weeks," Roberts says, "our chief concern was to keep *The Mysterious Universe* in stock" (reference 6, page xi).

Shortly after the Rede Lecture, the BBC aired six weekly lectures, "The Stars in Their Courses," by Jeans. The first one was promoted on the 14 November cover of the BBC's weekly magazine *The Radio Times*. The following week's issue featured an article by Richard Church—with the eye-catching title "Einstein: Why don't we boil him in oil?"—about Jeans and the changing attitudes toward scientists.⁸ That media attention boosted the sales of *The Mysterious Universe*, and by the end of 1930, the book had sold 70 000 copies in the UK. The sales remained high into 1931, and by the end of that year, *The Mysterious Universe* had been reprinted eight times along with a second, revised edition (reference 5, page 71).

Before settling on the title, Jeans considered two alternatives: "The Wasting Universe" and "The Shadowland of Modern



Physics" (reference 7, page 52). Those titles hint at different aspects of Jeans's vision of the universe and at his intentions beyond explaining science for laypeople. The philosophical ambitions of *The Mysterious Universe* are apparent already in the first few pages of the first chapter, ominously named "The Dying Sun."

After emphasizing "the littleness of our home in space" and the isolation of most stars as they wander "blindly through space," Jeans reveals that the universe provokes "something akin to terror" in him: "We find the universe terrifying because of its vast meaningless distances, terrifying because of its inconceivably long vistas of time which dwarf human history to the twinkling of an eye, terrifying because of our extreme loneliness, and because of the material insignificance of our home in space—a millionth part of a grain of sand out of all the sea-sand in the world" (reference 1, pages 1 and 3).

Questions about the meaning of life amid that abundant meaninglessness preoccupy Jeans and inspire him to use poetic language. "Is this, then, all that life amounts to," he asks, "to stumble, almost by mistake, into a universe which was clearly not designed for life, and which, to all appearances, is either totally indifferent or definitely hostile to it, to stay clinging on to a fragment of a grain of sand until we are frozen off, to strut our tiny hour on our tiny stage with the knowledge that our aspirations are all doomed to final frustration, and that our achievements must perish with our race, leaving the universe as though we had never been?" But rather than turning to religion for an answer, Jeans turns to science: "Astronomy suggests the question, but it is, I think, mainly to physics that we must turn for an answer" (pages 11–12).

The answer, however, is not straightforward

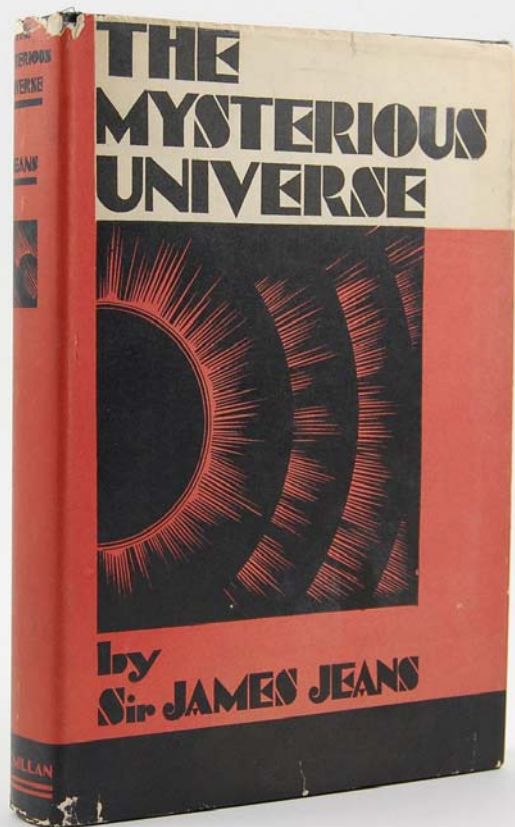
On the one hand, thermodynamics suggests that the universe is heading inexorably toward dissolution. The eventual heat death of the universe—a uniform, homogeneous state in which

THE 1919 SOLAR ECLIPSE provided the first experimental evidence of the theory of general relativity. Using glass photographic plates, Arthur Eddington and Andrew Crommelin imaged the eclipse, as shown here after restoration and modern processing. When stars were close to the Sun—and visible during the eclipse—they appeared displaced due to the bending of light by the Sun's gravity, as predicted in general relativity. The observation created demand for popular science books explaining the topic. (Courtesy of ESO/Landessternwarte Heidelberg-Königstuhl/F. W. Dyson, A. S. Eddington, and C. Davidson.)

life is impossible—was a popular idea in the Victorian era.⁹ For Jeans, that fate was as certain as anything in science, although in the last chapter, he does allow for the possibility that the idea may prove to be mistaken. The approaching heat death inspired Jeans's sense of life's meaninglessness. In a universe bound for destruction, we live on "a fragment of a grain of sand" (page 11) next to that dying Sun.

To Jeans, physics suggests that planets and life are exceedingly rare. The mechanisms of planetary formation were unknown at the time, and Jeans used his platform to promote his own theory, the tidal theory originally formulated in 1917. In it, a star happened to pass by the Sun some 2 billion years ago, and that near collision created huge stellar tidal waves, which ejected fragments of solar matter into space—and thus the planets were formed. Jeans estimated that near collisions between stars are extremely rare, and as a result, so are planets and life. That rarity adds to his sense of "our extreme loneliness."

On the other hand, according to Jeans, physics also holds the key to understanding the universe and ourselves. In the last chapter, "Into the Deep Waters," Jeans develops his vision of the philosophical implications of emerging physics. He suggests that we are similar to the cave dwellers in Plato's allegory of the cave: We see and study the shadows of reality, not reality itself. But through physics and mathematics, we are beginning to glimpse reality.



THE FIRST EDITION OF *THE MYSTERIOUS UNIVERSE* came out in 1930 and sold 70 000 copies in the UK by the end of that year. In the book, Jeans explains to a lay audience the latest research on quantum mechanics and general relativity with a philosophical bent. (Courtesy of Laura Massey/Alembic Rare Books.)

Jeans emphasizes that science is incomplete and that we may yet see “the river of knowledge” turn in unexpected ways. But he contends that physics has shown that some ideas we took for granted are almost certainly wrong. In particular, Jeans argues that we must give up science’s long-cherished materialistic and mechanical worldview, which posits that nature operates like a machine and consists solely of material particles interacting with each other. The “age of mechanical science had passed,” Jeans says, but we still have “a bias towards mechanical interpretations” (pages 98 and 135). The new physics is counterintuitive and reveals a universe more mysterious than expected.

What, then, does science say about the nature of the universe? Jeans uses modern science in his speculations, but he cautions that he is “a stranger in the realms of philosophical thought” (page viii). And those speculations are what many critics interpreted as Jeans going off the deep end.

Jeans embraces a variant of metaphysical idealism. Not only does the universe begin “to look more like a great thought than like a great machine” (page 137), but some kind of active agent seems to be involved: “If the universe is a universe of thought, then its creation must have been an act of thought” (pages 133–134). Although Jeans does not think that such a creative act of

thought necessarily had humans or human emotions in mind, he does posit the existence of some kind of creator—a “Great Architect” who appears to be a “pure mathematician” (page 122). And if true, then the mind “no longer appears as an accidental intruder into the realm of matter; we are beginning to suspect that we ought rather to hail it as the creator and governor of the realm of matter” (page 137).

The upshot of Jeans’s philosophy is that the sensations of terror and alienation described in the first chapter may be unwarranted. As it evolves, life approaches ultimate reality: “Those inert atoms in the primaeval slime which first began to foreshadow the attributes of life were putting themselves more, and not less, in accord with the fundamental nature of the universe” (page 138). And we humans, with our capacity for mathematical thought, are more in accord with the fundamental nature of the universe than any other life-form on planet Earth. In other words, physics leads us toward, not away from, a deity. In the end, physics provides our souls with a home in the cosmos in the form of metaphysical intimacy with the Creator.

The descent of Jeans

As sales of *The Mysterious Universe* skyrocketed, critics started opining on Jeans’s vision of the universe. The press homed in on the speculative qualities of the last chapter and tended toward sensationalist interpretations. The *Daily Herald*, for example, framed Jeans’s conclusions as science versus religion, as evidenced in the title “Scientist challenges the churches: Mankind just an accident” (reference 5, page 70).

Scientists and highbrow critics started to distance themselves from *The Mysterious Universe*, in large part because the book’s success provoked them to air their concerns publicly. Physicist Herbert Dingle, writing in *Nature*, expressed admiration for Jeans’s ability to explain physics in lay terms but criticized his philosophical speculations. Dingle argued that since Jeans had the means to reach large numbers of laypeople “who seek guidance in matters of philosophy and religion,” Jeans had a responsibility not to overstep the boundaries of science. Dingle did acknowledge the importance of putting forth hypotheses in science, but not hypotheses that “pose as the sole prophets of God.” And in that regard, Jeans failed. Dingle wrote, “we feel strongly that he is darkening counsel, not by words without knowledge, but, much more dangerously, by knowledge without equivalent balance of judgement.”¹⁰ Many scientists agreed with Dingle’s assessment.

Philosophers also criticized Jeans. Ludwig Wittgenstein told his students that he loathed *The Mysterious Universe* and charged it with “a kind of idol worship, the idol being Science and the Scientist.”¹¹ In her 1937 book *Philosophy and the Physicists*, L. Susan Stebbing criticized Jeans and Eddington for invoking emotions when explaining science. She also argued that Jeans’s understanding of idealism and materialism were outdated and thus his attempt to explore the “‘philosophical implications’ of the new physics” resulted in “cloudy speculations” rather than substantial insights.¹²

The broader philosophical landscape in the UK was chang-



CARL SAGAN (1934–96), the prominent science popularizer, on the set of his 1980 TV show *Cosmos*. In his show and book of the same name, Sagan injects existential questions into his scientific discussion, similar to James Jeans. (Courtesy of Science History Images/Alamy Stock Photo.)

ing at the time. Idealism had dominated academic philosophy starting in the 1860s. But shortly after the turn of the 20th century, philosophers G. E. Moore and Bertrand Russell started to attack idealism, and by 1930 it was rare in the British philosophical world. Most philosophers eschewed the idealists' emphasis on metaphysics and questions about the nature of being and turned instead to logic, positivism, and linguistic analysis. While idealism was common among physicists in their popularizations in the 1920s—Eddington and Whitehead, the other best-selling authors at the time, also had idealist views—the general trend among philosophers was to turn away from it.¹³

The scientific and philosophical critiques of Jeans and idealism affected the entire genre of popular physics books. Although many popularizers kept publishing, the hype and the excitement surrounding the genre had waned. Eddington's and Whitehead's idealist views had not met with as much resistance in the 1920s; it was Jeans's book that brought the criticism to the fore and spelled the end of idealism in popular science. Whitworth comments that the "very blurring of science, philosophy and art, which had stimulated the science books of the mid-1920s, was now seen by philosophers and scientists alike as an unwelcome breaching of disciplinary boundaries" (reference 5, page 72).

Popular science did not disappear. But following World War II and the creation of the nuclear bomb, it transformed as scientific institutions and journalists sought to restore public faith in science. As a result, much popularization focused on the social implications and practical applications of science. Space exploration and astronomy remained popular—for example, the works of Fred Hoyle and Arthur C. Clarke¹⁴—but grand philosophical and poetic narratives didn't attract similar levels of public attention as *The Mysterious Universe* did for a few decades.

Finally at home in the cosmos?

This year marks not only the 90th anniversary of *The Mysterious Universe* but also the 40th anniversary of Carl Sagan's *Cosmos*, the best-selling popular science book and television series, which helped create the modern celebrity scientist.¹⁵ Sagan guided readers and viewers through the world of modern science and created a grand narrative in which humanity is the product of natural processes reaching all the way back to the Big Bang. Similar to Jeans, Sagan not only explained science, he also used it to address existential questions. Also like Jeans, Sagan posited a connection between human beings and the universe. In the opening sequence of the first episode, standing on a cliff by the sea, he says, "The cosmos is also within us. We're made of star stuff. We are a way for the cosmos to know itself."

After the enormous success of Sagan and *Cosmos*, popular science books that present grand narratives and address existential questions have had a sustained market. But popularizers rarely express philosophical views of Jeans's flavor; idealism

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has broadly remained out of favor since the 1930s. Instead, contemporary popularizers typically promote some version of naturalism, which philosopher David Papineau defines as the view that “reality is exhausted by nature, containing nothing ‘supernatural’, and that the scientific method should be used to investigate all areas of reality, including the ‘human spirit.’”¹⁶ That view often has the implication that meaning and purpose are human inventions with no objective existence.

In his 2016 best-selling book *The Big Picture*, cosmologist Sean Carroll develops and supports that aspect of naturalism: “Purpose and meaning in life arise through fundamentally human acts of creation, rather than being derived from anything outside ourselves. Naturalism is a philosophy of unity and patterns, describing all of reality as a seamless web.”¹⁷ In other words, people construct meaning in an inherently meaningless universe. And engaging in science is one of the primary ways of making life meaningful.

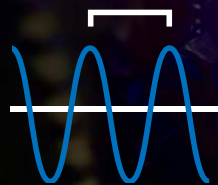
Contemporary readers of popular science may find naturalism almost self-evidently true—of course we create meaning and project it onto the universe; of course meaning and purpose do not exist objectively. But Jeans’s extension of idealism to physics was similar. He developed his views when idealism was prevalent among his fellow popularizers and had been commonplace in academic philosophy for decades, just as naturalism is today. Could the feeling of naturalism’s self-evidence say more about our moment in time than the universe itself? Our scientific models and explanations may be naturalistic, but does that mean that ultimate reality is too?

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