



Celestial Lockup

How black holes came to be named

The term "black hole" has a deep, dark past and a notorious reputation. In June 1756, on the banks of the Hooghly river in Calcutta, India, at the British garrison of Fort William, 144 British men and two women were taken prisoner by the troops of the new Nawab of Bengal, Siraj-ud-daula. Siraj's men incarcerated at least sixty-four of the hostages for a



night in a tiny cell known as the "black hole."

Only twenty-one survived the hot night, which was suffocating, literally. Ever since that horrific event, the words "black hole" referred to a place of confinement, a locked cell, where it was anticipated that once you went in, you never came out. How did the term come to signify objects in outer space?

Toward the end of the 1960s, when astronomers were coming to recognize that massive stars in the universe might actually collapse to a singular point (with, theoretically, infinite density and zero volume) upon running out of fuel, they had a problem. For many years, theorists had been calling such an entity a

"gravitationally collapsed object," a real mouthful to pronounce over and over again in a lecture. Soon, some shortened the awkward phrase to "collapsar," while others preferred "dark star." In short, the terminology kept shifting. That all changed in 1967, when the noted Princeton University physicist John Archibald Wheeler supposedly linked the term "black hole" to the cosmos. The attribution of that lexical connection, however, has recently been challenged.

Wheeler told his side of the story in the following fashion. It was the fall of 1967 and Wheeler was attending an impromptu conference at the NASA Goddard Institute for Space Studies in New York City. Radio pulsars had just been detected for the first time, and astronomers were asking whether those mysterious, pulsed radio waves were coming from red giant stars, white dwarfs, or neutron stars. According to Wheeler, he told the assembly that his "gravitationally collapsed objects" might be responsible. "Well, after I used that phrase four or five times, somebody in the audience said, 'Why don't you call it a black hole?' So I adopted that," said Wheeler.

While pulsars were first detected in 1967, their existence remained a well-kept secret until 1968; the public announcement of the discovery was made in February 1968, when a paper on the topic was finally published in *Nature*. Did Wheeler misremember the nature of the conference? There was a meeting on supernovae at the Goddard Institute in November 1967, but Wheeler's name

is missing from the official conference proceedings.

Indisputably, Wheeler used "black hole" during an after-dinner talk at the annual meeting of the American Association for the Advancement of Science in New York City on December 29, 1967. The term made it into print when an article based on that talk, titled "Our Universe: The Known and the Unknown," was published in *American Scientist* in 1968. Wheeler owes his black-hole fame to that popular paper.

Yet firm evidence exists that the term actually arose much earlier, even in print. It was casually bandied about at the 1963 Texas Symposium for Relativistic Astrophysics. Reporting on the Texas conference, the science editor for *Life* magazine at the time, Albert Rosenfeld, used the term "black hole" in an article on the newly discovered quasars. He noted how astrophysicists Fred Hoyle and William Fowler suggested that the gravitational collapse of a star might explain the quasar's energy. "Gravitational collapse would result in an invisible 'black hole' in the universe," wrote Rosenfeld. Rosenfeld today is sure *he* didn't invent the term but overheard it at the meeting, although he cannot recall the source.

The phrase was mentioned again a week later at an American Association for the Advancement of Science meeting held in Cleveland. Ann Ewing of *Science News Letter* reported that astronomers and physicists at the conference were suggesting that "space may be peppered with 'black holes.'" The person who used the term there was Goddard Institute physicist Hong-Yee Chiu, who had originated the term "quasar" in 1964 in *Physics Today* and had also at-

tended the Texas Symposium. Was he introducing another fun term to the public? No, answers Chiu; he borrowed it from the man who may have coined the phrase from the start.

From 1959 until 1961 Chiu was a member of the Institute for Advanced Study in Princeton, and during that time Princeton physicist Robert H. Dicke, both an experimental and a theoretical contributor to the study of gravitation, spoke at a colloquium about how general relativity predicted the complete collapse of certain stars, creating an environment where gravity was so strong that no matter and not even light could escape. "To the astonished audience, he jokingly added it was like the 'Black Hole of Calcutta,'" recalls Chiu. A couple of years later, when Chiu started working at the Goddard Institute, he heard Dicke casually use the phrase there again during a series of visiting lectures. In this way, Dicke may have released the term into the scien-

tific atmosphere. Loyola University physicist Martin P. McHugh, who is working on a biography of Dicke, discovered it was one of Dicke's favorite expressions, for he often used it with his family in an entirely different context. His sons told McHugh that their father exclaimed, "Black Hole of Calcutta!" whenever a household item appeared to have been swallowed up and gone missing.

Wheeler still deserves a large portion of the credit for placing the phrase into the scientific lexicon. Given Wheeler's status in the field, his decision to adopt the moniker bestowed a gravitas upon it, giving the science community permission to embrace the term without embarrassment. "He simply started to use the name as though no other name had ever existed, as though everyone had already agreed that this was the right name," said his former student, Caltech physicist Kip S. Thorne.

Wheeler's strategy worked splendidly. Within a year of his New York talk, the idiom had gradually begun to be used in both newspapers and the scientific literature—although for a while at first it was written down as "the black hole," an expression so exotic it needed to be held at a distance within quotation marks. Some, like Richard Feynman, thought the term was obscene. "He accused me of being naughty," Wheeler recalled in his autobiography, *Geons, Black Holes, and Quantum Foam: A Life in Physics*. But Wheeler was attracted to its link to other physics terms, such as "black body," an ideal body that absorbs all the radiation that falls upon it and is also the perfect emitter. A black hole does the former but not the latter. It emits nothing . . . zip . . . nada. We look in and see only a dark emptiness. "Thus *black hole* seems the ideal name," concluded Wheeler. Moreover, it fit the very physics of the situation. The collapsed stellar remnant, with its infinite density, was literally digging a hole—a bottomless pit—into the flexible fabric of space-time.

"The advent of the term black hole in 1967 was terminologically trivial but psychologically powerful," said Wheeler. "After the name was introduced, more and more astronomers and astrophysicists came to appreciate that black holes might not be a figment of the imagination but astronomical objects worth spending time and money to seek." The black hole had finally made it into the big time.

MARCIA BARTUSIAK, a professor of the practice in the MIT Graduate Program in Science Writing, is now writing a biography of the black hole.

The Black Hole is a source of Enlightenment.



Physicist John A. Wheeler (right), often credited with assigning the term "black hole" to gravitationally collapsed stellar objects, stands alongside a German colleague, Eckehard W. Mielke, in 1985.



Coherent infra-red oscillator

circles parallel plate structure

input pin

input reflects through plate as a plane wave

output pin

small flat in frame

The drive of the previous frog can be modified to give an oscillator in the infra red region by replacing the cavity by a Fabi-Pérot cell in the parallel plate resonator. The transition is of the $\delta \nu \approx 1$ type in a symmetrical top molecule. Probably Arsenic would be employed.

R.H. Dicke.

A 1956 entry from the notebook of gravitation researcher and theorist Robert H. Dicke (top left). "Black hole" was one of Dicke's favorite phrases, at home and on the Princeton campus, in the late 1950s and early 1960s.

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COURTESY ROBERT H. DICKE

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