

How Earnest C. Watson wowed crowds with his liquid-air extravaganza and turned a demonstration series into an iconic Caltech showpiece that has lasted 100 years.

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he year is 1922, and Caltech physicist Earnest C. Watson stands in front of a packed lecture hall filled with wide-eyed onlookers from across Southern California as he pours what appears to be boiling hot water from a bottle onto a table. Clouds of white fumes engulf Watson, and though it seems as if he should be severely burned, he remains miraculously unharmed.

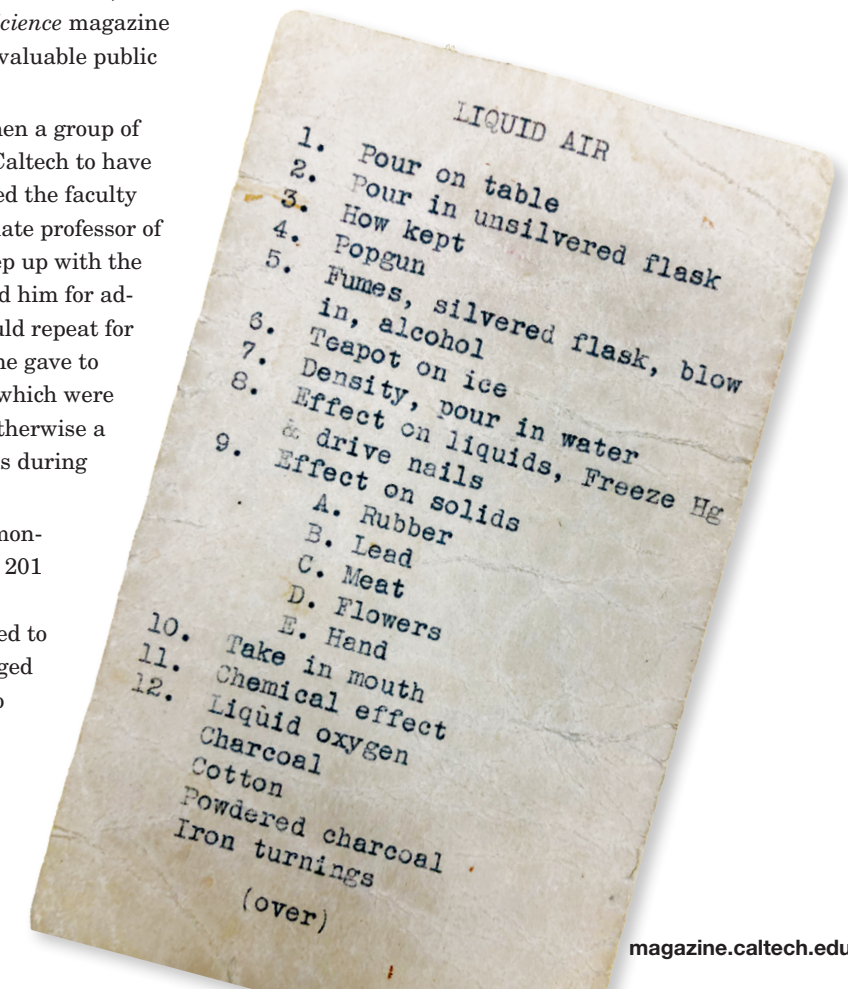
Of course, the result is anything but miraculous, as Watson would go on to explain. It is simply science. The liquid is not water, but air (a mixture of mainly nitrogen and oxygen), and it is cold—very cold—chilled at a temperature more than 300 degrees Fahrenheit below freezing. When the water touches the warmer air outside the bottle, it boils.

“There is really nothing more remarkable about this than there is about water boiling on a hot stove,” he would go on to tell the audience, according to his typewritten script.

Such began Watson’s famed liquid-air demonstration, which helped popularize an annual suite of demonstrations, and later lectures, that Caltech’s *Engineering and Science* magazine in 1959 called “one of the Institute’s most valuable public relations efforts.”

The series originated a century ago, when a group of local high school science teachers visited Caltech to have a conversation with Watson, who had joined the faculty three years earlier and was then an associate professor of physics. The teachers had struggled to keep up with the latest advances in the field, and they asked him for advice. Watson came up with an idea: he would repeat for them the weekly physics demonstrations he gave to Caltech’s first- and second-year students, which were designed to “add a little life to what was otherwise a dry problem course,” as Watson told crowds during his liquid-air introductory remarks.

Known first as the Friday Evening Demonstration Lectures, the events took place in 201 East Bridge, now known as the Feynman Lecture Hall. In 1964, the lectures relocated to Beckman Auditorium, and the name changed to the Caltech Lecture Series. In 1972, two



Right: Earnest C. Watson’s typed notes for his liquid-air demonstration.

years after his death, the Institute recognized Watson by renaming the series in his honor.

The Earnest C. Watson Lecture Series, which was popular from its inception, has always been free and open to all. “Realizing the general public’s interest in the Institute and in the results of science, the Institute has decided to invite the general public to attend these lectures. Modern points of view will be emphasized and some of the great epoch-making experiments will be reproduced,” read the original press release from October 12, 1922. So many people showed up in the early days (Watson noted that one couple drove in regularly from Hemet, in the San Jacinto Valley) that lectures often had to be repeated in the same evening to accommodate the crowds.

Judith R. Goodstein, former university archivist at Caltech, along with her husband, David L. Goodstein, the Frank J. Gilloon Distinguished Teaching and Service Professor, Emeritus, and professor of physics and applied physics, emeritus, presented a 1997 Watson Lecture called “Earnest Watson and the Amazing Liquid-Air Show,” during which David Goodstein recreated some of Watson’s demonstrations.

Though Watson presented on other topics, including “The Science of Musical Sounds,” it was the liquid-air demonstration that became his calling card. Judith Goodstein said Watson was inspired by similar Friday evening lectures at the Royal Institution in London, specifically a talk given by James Dewar in 1904, in which the Scottish chemist demonstrated how to liquefy hydrogen gas, a feat he had become the first to accomplish six years earlier.

Watson, in order to elicit further reactions from the audience, would swirl liquid air in his mouth, freeze liquid mercury into a solid hammer and use it to drive nails, and dip flower bouquets, hot dogs, and rubber balls into liquid air and promptly shatter them, among other crowd-pleasing demonstrations.

Early speakers in the series also included Charles Galton Darwin (a visiting professor and grandson of Charles Darwin), whose topic was gyrostats; Arnold Sommerfeld, a distinguished physicist from the University of Munich, who offered a lecture demonstration on oscillations and resonance phenomena; and Caltech’s Arnold Beckman, then an assistant professor of chemistry, who frequently presented on the subjects of ionic theory and atmospheric gases.

Over time, the Watson Lectures ventured into fields of scientific research beyond physics. Linus Pauling, the late Nobel laureate and Caltech professor of chemistry, spoke on the

nature of chemical bonds. Harry Bateman, the late Caltech professor of mathematics, physics, and aeronautics, gave a presentation about the humorous side of mathematics.

In recent years, the Watson Lecture Series has featured such Caltech luminaries as Kip S. Thorne (BS ’62), Richard P. Feynman Professor of Theoretical Physics, Emeritus, who spoke about black holes, wormholes, time travel, and gravitational waves; Ken Farley, W. M. Keck Foundation Professor of Geochemistry and Mars 2020 project scientist, who discussed the Perseverance mission; and Dianne Newman, Gordon M. Binder/Amgen Professor of Biology and Geobiology, who explained how her lab is trying to better understand the microbes that thrive without oxygen and cause chronic infections.

“The Watson Lectures are a key part of Caltech’s intellectual life; they are both a place where the Institute’s research meets the surrounding community, and

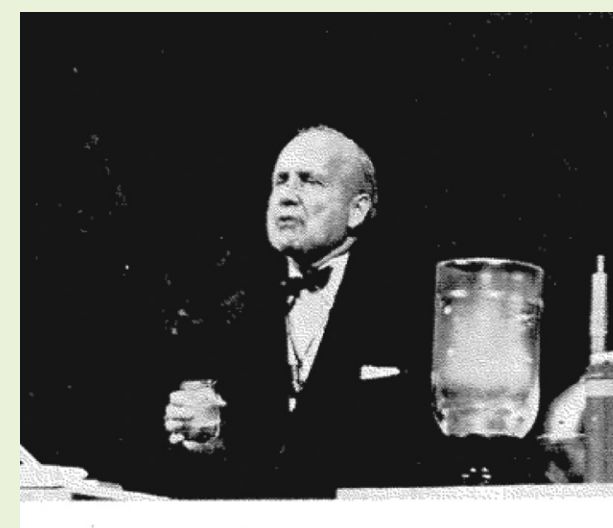
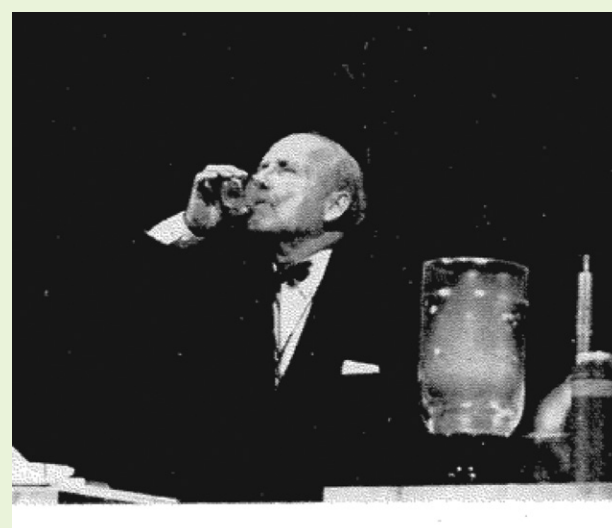
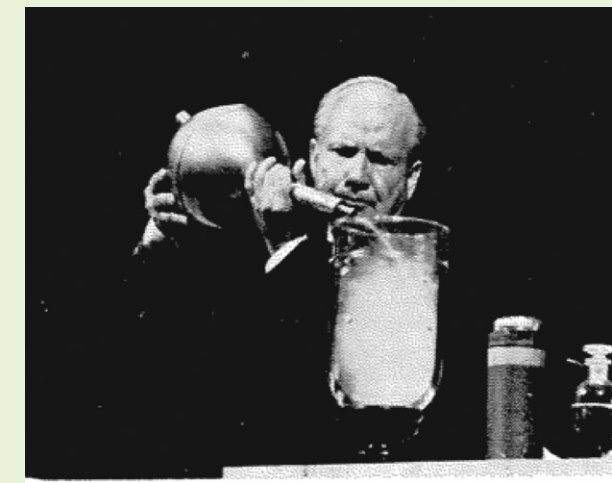
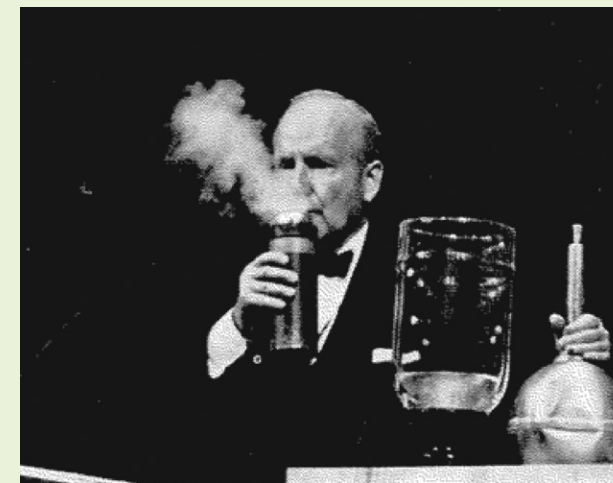
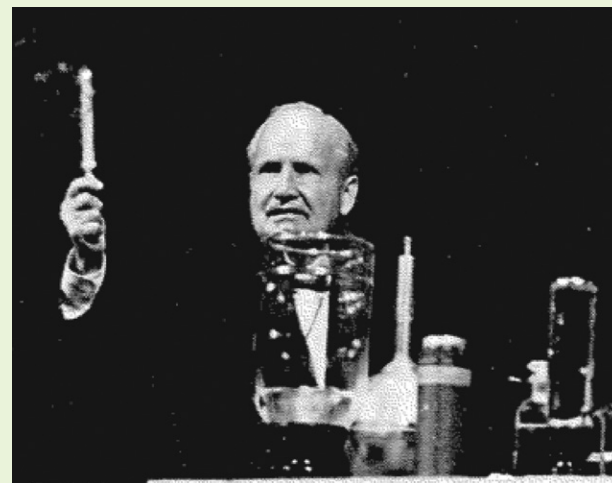
an opportunity for us to pause and reflect on the broader meaning and impact of our work,” says John Eiler, the Robert P. Sharp Professor of Geology and Geochemistry, and chair of the Institute Programs Committee, which plans the Watson Lecture Series.

Back in his day, Watson himself, along with his liquid-air show, were star attractions that helped Caltech forge a strong bond with the community. In fact, the demonstrations became so popular during his tenure at Caltech that Watson grew to be in great demand up and down the West Coast as a speaker. His show remained a hit even after his retirement in 1959 as a professor of physics and dean of the Caltech faculty. The Institute asked Watson to revive the show to mark the series’ move to the newly built Beckman Auditorium on October 12, 1964. A Caltech press release at the time described the presentation as “a one-man scientific circus performance.”

“I remember seeing Earnest loading his car prior to one of his often long and strenuous trips with his famous liquid-oxygen demonstration,” wrote the late Ernest Swift, former Caltech professor of analytical chemistry and chair of the Division of Chemistry and Chemical Engineering, in Watson’s 1970 obituary. “I think those trips were one of the most effective means ever used for establishing good relations with the high schools of the west.”

Claire Bucholz, assistant professor of geology, will present the next lecture in the 2022-23 season on January 18, 2023, with “When Earth Breathed Deeply,” in which she will discuss how our planet’s atmospheric oxygen levels have increased by many orders of magnitude over time, profoundly affecting biological and chemical cycles on Earth’s surface. 📺

A playlist of recent Watson Lectures available to watch on YouTube can be found here:



Right: Watson giving his liquid-air demonstration in Beckman Auditorium on October 12, 1964.

Demonstrations of this kind should be undertaken only after thorough training and with the use of proper safety equipment.