Murray Gell-Mann

(1929–2019)

Theoretical physicist who won a Nobel for codifying fundamental particles.

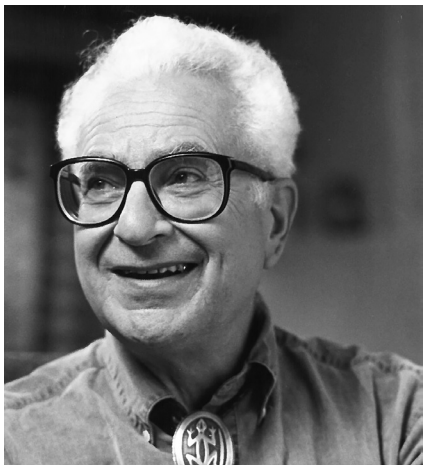
Nobel laureate Murray Gell-Mann once described himself as "a character out of Damon Runyon". Like the novelist's gritty characters (they inspired the musical *Guys and Dolls*), Gell-Mann had flair, and peppered his exacting speech with slangy cracks and sarcastic put-downs. He mocked the scientific establishment's jargon by giving his inventions jokey names. He worked incredibly diligently, but often claimed to be simply tossing off ideas. He attributed his first major insight to a slip of the tongue, and wrote the equations for two other seminal breakthroughs on napkins. He died on 24 May 2019.

Gell-Mann was a theorist in elementary particle physics. When he entered the field in the late 1940s, powerful accelerators were starting to make particles beyond the familiar proton, neutron and electron. Researchers badly needed the equivalent of a periodic table to map the relationship between all of these. Gell-Mann's most noted contribution was to create one, and to use it to show where more new particles could be found.

Born in 1929 in Manhattan, New York City, Gell-Mann went to Yale University in New Haven, Connecticut, at 15, to study physics. In 1948, he entered the Massachusetts Institute of Technology in Cambridge, determined to earn a PhD in two years. He castigated himself for taking an extra six months to write up his thesis. In 1951, he moved to the Institute for Advanced Study at Princeton, New Jersey, to work with Robert Oppenheimer.

The next year, as a 22-year-old postdoc with Enrico Fermi at the University of Chicago, Illinois, he tackled a knotty problem. A class of recently discovered particles — produced in abundance in cosmic-ray collisions — had unexpectedly long lifetimes. "Easy come, easy go" was a tenet of the particle world. These were therefore labelled "strange" particles. In a talk at the Institute for Advanced Study, the famous slip of the tongue gave him an idea that the particles had a previously unknown fundamental property — he labelled it "strangeness". (Others independently had a similar idea.) Strangeness was a new quantum number: something that expresses the values that certain kinds of particle can have.

At first, he was afraid to commit himself to print. A conscription notice at the end of the Korean War — his exemption paperwork had not been filed properly — prompted him to send an article to the *Physical Review*. It referred to the new "Curious Particles", and the editors objected. The published



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version concerns "New Unstable Particles" — a phrase he deemed "sufficiently pompous".

In 1955, Gell-Mann moved to the California Institute of Technology (Caltech) in Pasadena. That year, he also married the archaeologist Margaret Dow. A few years later, he devised a scheme to codify particles, grouping all those known into eight families — the Eightfold Way, he named it in joking homage to Buddhism. Given all the other theoretical ideas flying around, few physicists paid heed. One family in Gell-Mann's scheme had a glaring hole. At a conference in July 1962 at CERN, Europe's particle-physics laboratory near Geneva, Switzerland, he urged experimenters to find the missing particle, naming it the Omega Minus.

At lunch with two of the experimenters, attending from Brookhaven National Laboratory in New York, he sketched out on a napkin how the particle might be found by indicating the particles into which it would decay. The two — Nicholas Samios and Jack Leitner — took the napkin back to Brookhaven, and used it to convince their director to give them high priority for running time on the lab's accelerator. They then found the Omega Minus. It was a triumphant discovery, and it vindicated the soundness of Gell-Mann's entire scheme. Gell-Mann called Samios and said, with his usual nonchalance: "Nick, I hear you have found something very interesting."

The second napkin episode took place the next year, in the faculty dining room at Columbia University in New York City. Over lunch, his host Robert Serber asked Gell-Mann if the particles of the Eightfold Way were formed by mixing and matching subunits. "So I showed him why I hadn't considered it," Gell-Mann said. Scribbling equations on what was to hand, he explained that such subunits would have to have fractional charges. By the time of his talk the next day, however, he'd thought, "What the hell, why not?" and proposed the idea. Reacting against "pretentious scientific language", Gell-Mann called the subunits quarks, after a passage in James Joyce's *Finnegans Wake*.

Meanwhile, Richard Feynman, whose office at Caltech was next to Gell-Mann's, proposed a similar idea, calling the subunits partons. This led to a long feud in which the two vied over the name, Gell-Mann mocking Feynman's idea as "put-ons". When members of the physics community tried to conciliate by calling the subunits "quark–partons", Gell-Mann prevailed.

In 1969, Gell-Mann was awarded the Nobel Prize in Physics "for his contributions and discoveries concerning the classification of elementary particles and their interactions". For the next few decades, he continued to be a leader in developing the theory of particle physics. In those years, Samios recalled, "when I'd ask a particle theorist why they were working on something like current algebra or group theory, the answer was invariably, 'Because Murray is working on it!'"

Given his writing habits and hypercritical temperament, few expected him to undertake a popular book. In 1994, he published one. *The Quark and the Jaguar*, he called it; the quark represented the simple side of nature, the jaguar the complex.

In talks, Gell-Mann liked to dwell, not on the triumphs of himself and others, but on the confusions, mistakes and vacillations that blocked their way. The practice was closet self-congratulation, some carped. But there was more to it. Gell-Mann would sometimes recite to audiences a ditty that he had seen on the wall of a doughnut shop:

As you ramble on through life, Brother,
Whatever be your goal,
Keep your eye upon the doughnut,
And not upon the hole.

Gell-Mann would add: "I try to keep my eye on the hole." ■

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