BOOKS: HISTORY OF PHYSICS

Complex Facets of a Strong Interactor

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In the early 1970s, when the war in Vietnam was still raging, Murray Gell-Mann was on sabbatical at CERN, the European Center for Nuclear Research in Geneva. Through their children's car pool, the Gell-Manns became friends with our neighbors in a tiny French village across the border from Switzerland. Murray abruptly halted the relationship when our neighbors sought to discuss his role in Jason, the controversial military advisory group. On another occasion, while we were hiking together in Colorado, Murray found some choice mushrooms and complained that another physicist got the credit for his idea of mushroom gathering in the Aspen mountains. These recollections illustrate aspects of Murray Gell-Mann that are recurring themes in *Strange Beauty*, a biography by science writer George Johnson—the breadth and diversity of Murray's activities and erudition, his aversion to criticism, and his need for recognition of his accomplishments, which are many.

Strange Beauty
Murray Gell-Mann and the Revolution in Twentieth-Century Physics
by George Johnson
Knopf, New York, 1999. 446 pp. $30. ISBN 0-679-43764-9.

Gell-Mann is the scientist who probably contributed the most to the translation of experimental facts into the building blocks of what is now known as the Standard Model of particle physics (which joined electromagnetism and the strong and weak nuclear forces in a single framework). Murray's ideas, starting with the "Eightfold Way" (a group-theory scheme for classifying baryons and mesons), strongly influenced my own graduate research. But until I read Johnson's skillfully and engagingly written biography, I did not appreciate how firmly Murray's imprint was already implanted on the basic concepts of "strange particles" and "hypercharge" that I had learned as an undergraduate working at high energy physics laboratories—concepts that turned out to be crucial to the elaboration of the Standard Model.

A biography of a physicist can serve several purposes other than the entertainment of those who knew the subject. One is to present the human face of science and its practitioners. Johnson's portrait of Gell-Mann strikes an appropriate balance, reflecting admiration without undue adulation. A second function is to enhance public understanding of science, and a third is to contribute to the history of science. On all three counts, I found myself awarding high marks in the first half of the book and becoming somewhat disappointed toward the end of it.

Johnson's description of scientific developments that preceded Gell-Mann's arrival on the scene and of his early contributions are cogent and entertaining, despite minor errors here and there. The step-by-step tracking of the process that led Murray to the correct classification of strange particles combines a clear presentation of the scientific concepts with a fascinating picture of the creative process of scientific deduction and of the sociology of breaching the barriers imposed by collective conventional wisdom. The concept of symmetry breaking is explained with commonly used analogies, and the discussion of superstring theory is fairly well presented. Johnson's descriptions of quark confinement and the renormalization group, however, are somewhat unclear and confusing.

Prediction proved. The omega-minus particle hidden in the trails of this bubble-chamber photograph led to the acceptance of the Eightfold Way.

Although Gell-Mann's ability to find order in the data spewing out of accelerator facilities dominated progress in theoretical particle physics for about two decades, almost every major stepping-stone of his was also independently found by a competitor. Johnson provides generally thorough coverage of the developments with which Murray was associated during the period that spawned our present understanding of strong and weak interactions in terms of renormalizable gauge theories. There are a few lapses, such as referring to J. B. French, Weisskopf's collaborator on the important Lamb-shift calculation, simply as "one of his students." A nod to the contribution of Soviet physicists Gerstein and Zeldovich to the vector minus axial vector theory of weak interactions would have been appropriate. There is also an anonymous reference to "another physicist" who postulated the existence of two distinct neutrinos—an important idea that Gell-Mann and Feynman had entertained but failed to publish. Attributions become more erratic in sections on developments since the Standard Model. These mention mainly Murray's students and friends and occasionally an antagonist. For example, the role of 't Hooft's mentor Veltman in the technical developments that led to the mathematical underpinnings of the Standard Model goes unnoted, as do the inventors of four-dimensional supersymmetry—the version applicable to the real world—although a full chapter is devoted to "superphysics."

Johnson paints a convincing portrait of Gell-Mann's personality, which is in turn charming, irritating, and generous. Murray's support for his younger competitor George Zweig, co-discoverer of quark theory, is a prime example of his generosity. (I experienced this side of Murray first hand: his support was invaluable when I was bumping my head against the glass ceiling in Europe.) Johnson also describes, with veracity and sensitivity, the tremendous care and concern Murray had for his wife Margaret during her fatal illness.

At times there are overly detailed elaborations of minor incidents in Gell-Mann's life, but Johnson captures well his subject's inner scientific conflicts. Were quarks actual particles? Or were they just convenient mathematical tools? Would S-matrix theory or quantum field theory provide the correct description of particle physics? Johnson suggests that Murray's difficulty in resolving such conflicts contributed to his failure to publish some of his ideas in a timely fashion. Indeed, Johnson unnecessarily belabors what he refers to as "writer's block"; among other things, he devotes an entire chapter to Gell-Mann's difficulty in writing *The Quark and the Jaguar*. As Johnson notes, paraphrasing a 1983 talk by Gell-Mann, Murray "had always believed it improper to write about one's uncertainties." This is well-taken advice in a field generally characterized by a frenzy to publish. What Murray Gell-Mann may have conceived of and failed to write about is far less important than the tremendous impact his work has had on the field of elementary particle physics.

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