

Murray Gell-Mann Wins Nobel Prize for Physics

In awarding Murray Gell-Mann the Nobel Prize for Physics in 1969, the Swedish Academy of Science cited him "for his contributions and discoveries concerning the classification of elementary particles and their interactions." Their citation is perhaps intentionally general, for Gell-Mann has helped to shape and direct many of the major theories of elementary particles. As one of his colleagues put it, he is a "teacher of the profession," who perceives and communicates the implications of each new piece of knowledge.

The major innovations for which Gell-Mann is best known are strangeness, the Eightfold Way and quarks, all of which bear names chosen by him from the realm of literature and philosophy.

The property of strangeness was postulated to explain the behavior of a class of newly discovered strongly interacting particles. Abraham Pais had already noted that these particles must always be produced in pairs (associated production). Therefore the rate of decay of these particles was slow compared to the rate typical of strong interactions. The explanation of Gell-Mann¹ and independently, T. Nakano and Kazuhiko Nishijima² was that these particles possessed an additive quantum number of strangeness S ($S = 0$ for nucleons and pions) that was conserved in associated production but not in the decays.

The discovery of strangeness led to the development of particle classification according to $SU(3)$. Shoichi Sakata³ searched for a model in which all particles could be constructed from a neutron, a proton and a strange baryon—the lambda particle (along with their antiparticles). Sakata and his coworkers⁴ successfully represented each meson as built from a baryon and an antibaryon, and classified the mesons into a family of eight. When only strong interactions are involved all members of the family, or multiplet, act alike. However, weaker and electromagnetic interactions break the degeneracy and individual members may be distinguished by values of strange-



MURRAY GELL-MANN

ness and electric charge. Unfortunately the Sakata scheme could not accommodate the known baryons.

Gell-Mann⁵ and Yuval Ne'eman⁶ independently developed a scheme in which the baryons, like the mesons, formed a family of eight. This scheme was the Eightfold Way. All other particles and resonances could be fitted into various other multiplets and the masses could be related by the famous Gell-Mann-Okubo mass formula.⁷ The experimental discovery of the omega-minus,⁸ a "missing" particle predicted by $SU(3)$, was the classical experimental verification of the theory (PHYSICS TODAY, April 1964, page 57).

Although the Sakata model failed in its attempt to construct all particles from three known baryons, Gell-Mann⁹ and George Zweig¹⁰ subsequently postulated the existence of three fractionally charged quarks as the fundamen-

tal basis of $SU(3)$. Many experimentalists have searched for quarks, with one possible successful detection (PHYSICS TODAY, October 1969, page 55).

Gell-Mann received his BS from Yale at age 19 and his PhD from MIT when he was 22. After spending a year at the Institute for Advanced Study in Princeton and three years on the faculty of the University of Chicago, Gell-Mann went to the California Institute of Technology, where he was made a full professor in 1956. Since then he has spent one year on leave at the College of France and one year at the Institute for Advanced Study.

In 1959 Gell-Mann received the first Dannie Heineman Prize for Mathematical Physics from the American Physical Society and the American Institute of Physics. In 1967 he was



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awarded the Franklin Medal. He is a member of the National Academy of Sciences and a fellow of the APS.

—BGL

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AAPT Committee Studies Physics in Engineering

The Committee on Physics in Engineering Education was reactivated in April 1968 by Stanley S. Ballard, who was then president of the American Association of Physics Teachers. Although dormant since 1959, the AAPT committee was revived because of recent developments in the American Society for Engineering Education.

Reuben E. Alley Jr, committee chairman and professor in the electrical engineering department at the US Naval Academy, says that an ASEE survey report "clearly implies that physicists may be asked to restrict their offerings for engineering students to topics such as sound, optics, and modern physics."

This survey report appeared in the February 1968 issue of the *Journal of Engineering Education*. It concludes that of the responding 120 physics departments and 100 engineering departments teaching fundamental mechanics "the majority . . . are tending toward either a coordinated program in which the student takes engineering fundamentals and statics before taking a physics course or toward the more pro-

gressive program in which the student takes no physics courses until he receives fundamentals, statics, dynamics and strength of materials from the engineering departments."

The report also states that some electrical engineering departments are watching these trends and "are considering the possibility of teaching basic electricity to their students before allowing them to take a physics course." Another article in the November issue reports that all introductory-physics courses were eliminated from the new

AIP Study Examines Physics Work Complex

To what sort of work does a physicist move when he leaves academic training to take a job? What does the employer expect from him and offer in return? What do employers think of the academic training physicists bring from the universities? Susanne D. Ellis of the American Institute of Physics Education and Manpower Division has studied these and related subjects during the past two years, and AIP has recently released the report of her findings. It deals with such matters as funding, personnel policies, mobility (place to place and subject to subject), specialization of physicists and engineers, obsolescence. It ends with recommendations made by employers to the universities.

The study is based on interviews with 161 scientific supervisors, generally starting with vice presidents for research and research directors, at 40 organizations. The organizations included government, nonprofit and industrial ones. With the advice of the AIP manpower advisory committee the sample was selected to be representative of 1223 industrial organizations employing physicists in the 50 states of the US. Arnold A. Strassenburg, director of the AIP Education and Manpower Division, supervised what is labeled the "Work Complex Study."

The report explains that objectives and methods of the study changed between the time it was first conceived in 1966 and its actual conduct, beginning with National Science Foundation funding in 1967. The study began with declining physics enrollments and a threatening shortage of physicists. By the time it was funded, enrollments had stopped declining and cutbacks in federal funds had increased the pool of available scientific manpower.

One table in the report lists the 50 states and, for each one, the number

engineering curriculum at the University of Iowa.

The AAPT committee is studying the proposed fragmentation or elimination of the introductory course and is soliciting comments from physics teachers about their problems and successes in working with engineering departments. The committee is particularly interested in the quantity and type of physics, who teaches and determines course content, the type of communication between physics and engineering, the effort to improve high-school physics.

of industrial employees who are physicists, physical scientists, engineers, other professionals, technicians and other laboratory staff. Another table shows how many industrial laboratories in each state employ how many physicists. For example more than 300 physicists are employed at two laboratories in California and one in New Jersey; Wyoming has only one laboratory employing any physicists, and that laboratory has only one physicist.

Mrs Ellis finds that most advancement possibilities in large technically oriented organizations are now organized with a double ladder so that after his first few years a scientist has a choice. He can become an administrator and advance on one side or remain primarily a scientist and follow the other. The report indicates the titles, responsibilities, education and experience expected at various levels of both ladders. It also details hiring practices: contacts, interviews, offers and acceptances. Personal contacts lead to most PhD hirings, says the report, whereas the personnel department is usually directly involved in acquisition of lower-level personnel.

Geography affects employment policies. For example, California has solved many problems of support personnel with its junior-college program, whereas New York is only beginning to follow the same course. In Texas temporary shortages that occur with funding changes are often met by the loan of support personnel from one company to another. Denver and Boulder, Colo., form a region that is growing rapidly because it is a desirable place to live; consequently salaries there do not have to be as large as elsewhere to attract needed personnel.

Among her general findings Mrs Ellis reports that engineers are re-