



Yuval Ne'eman and Murray Gell-Mann

The Eightfold Way

by Rodger F. Whitlock '65

Physicists welcomed the news last month of the discovery of a subatomic particle which may bring some order out of the apparent chaos among nuclear particles. The omega-minus, discovered by scientists working with the particle accelerator at Brookhaven National Laboratory in New York, confirms a theory proposed independently, three years ago, by Murray Gell-Mann, professor of theoretical physics at Caltech; and Yuval Ne'eman of Israel, now research fellow in theoretical physics at Caltech. The theory relates nuclear particles to each other in a manner reminiscent of Mendeleev's periodic table of the elements. It sets up "family relationships" between many of the strongly interacting particles now known. (Strongly interacting particles are those subject to the force known, appropriately enough, as strong interaction. This is one of the four known fundamental forces, the other three being weak interaction, electromagnetism, and gravitation.)

Called the eightfold way, after Buddha's list of eight virtues that lead to the cessation of pain, the theory is based on eight quantum numbers, assignable to almost any particle, which evaluate certain characteristics of a particle. These quantum numbers, especially formulated for the manipulations of the eightfold way, are such novel concepts that several of them do not yet have names. From the values for these quantum numbers, which can be predicted via the eightfold way, many of the particle's properties (such as mass, decay time, or decay products) can be predicted to a high degree of accuracy.

Just as Mendeleev's periodic scheme brought some order into the elements known in 1870, so does the eightfold way bring about an orderly

and symmetric arrangement of many of the nearly 100 fundamental particles known today. It also provides a logical base for a naming system for particles to replace the current colloquial names. Though the names are still primarily Greek letters, they now have more meaning.

As proposed, the eightfold way had a gap — an unknown particle, conspicuous by its absence. To fill this gap, a new particle, the omega-minus, was hypothesized. If the particle were to be discovered, the gap would be filled and the Gell-Mann-Ne'eman theory would be verified in one important respect.

It was felt, moreover, that this verification would make the eightfold way a certainty, since the properties prophesied for the omega-minus were so unusual that they could not be predicted by extrapolation alone.

The omega-minus was discovered using the 33 BEV alternating gradient synchrotron at Brookhaven to accelerate protons for the production of K-minus mesons. These were separated from the beam by a 400-foot array of magnetic and electrostatic devices. The K-minus mesons were then directed into the 80-inch bubble chamber and photographs taken of the trails left in the chamber. Out of 100,000 photographs, one omega-minus trail was found and confirmed by analysis with an IBM 7094.

The omega-minus has a mass of 1676 million electron volts or about 3400 times the mass of an electron. It decays into a xi particle and a pimeson. The xi particle eventually decays into a proton, with the production of two more pimesons, one at each decay step. It has a spin angular momentum of 3/2, and a positive parity.