

## Robert F. Curl Jr.—Nobel Laureate in Chemistry

MARC A. SHAMPO, PhD\*<sup>‡</sup>; ROBERT A. KYLE, MD\*<sup>‡</sup>; AND DAVID P. STEENSMA, MD<sup>‡</sup>

\**Mayo Clinic, Rochester, MN, and †Dana-Farber Cancer Institute, Boston, MA*

American chemist Robert Floyd Curl Jr, shared the 1996 Nobel Prize for chemistry with 2 other chemists, Richard Errett Smalley (1943-2005) of Rice University in Houston, TX, and Sir Harold Walter Kroto (1939- ) of the University of Sussex in Brighton, England, for their discovery of fullerenes, a previously unrecognized form of carbon that opened up a new aspect of chemistry—fullerene science. Fullerenes are hollow, spherical clusters of carbon atoms bonded together into highly symmetric, cagelike structures. Ongoing research on fullerenes has focused on the synthesis of C<sub>60</sub>, the smallest stable fullerene. Although many applications of the results of this research have been predicted, they have not yet been realized.

Curl, the son of a Methodist minister, was born on August 23, 1933, in Alice, TX, 40 miles west of Corpus Christi. When he was 9 years old, his parents gave him a chemistry set. He decided then that he wanted to become a chemist. He received a BA degree from Rice University in 1954, after which he went to the University of California at Berkeley to study with Kenneth Pitzer, who later became president of Rice University. In 1957, Curl was awarded a PhD degree from the University of California. He was a research fellow of E. Bright Wilson at Harvard University in Cambridge, MA, in 1957-1958. Curl completed his fellowship and in 1958 became an assistant professor of chemistry at Rice University. He was promoted to associate professor in 1963 and to full professor in 1967. From 1992 to 1996, he served as chairman of the department of chemistry, and in 1996, he was honored by being named the Harry C. and Olga K. Wiess Professor of Natural Sciences at Rice University.

Curl, Kroto, and Smalley made their Nobel Prize-winning discovery during a period of 11 days in 1985. At



the time of their discovery, Kroto was using microscope spectroscopy techniques in England to analyze gas in carbon-rich giant stars and clouds of gases in interstellar space. He had discovered long, chainlike molecules of carbon and nitrogen in stellar atmospheres and in gas clouds. Kroto needed a means of vaporizing carbon to study how the carbon chains of fullerene form. Because Kroto did not have the equipment needed to accomplish his tests, he contacted his friend Curl at Rice University. Curl told Kroto that his colleague Smalley had designed and built an instrument that could be used to vaporize carbon and was an authority on cluster chemistry, the study of aggregations of atoms or molecules that range in size from microscopic to visible. Smalley's instrument, a laser-supersonic cluster-beam apparatus, could vaporize almost any known material into a plasma of atoms and then be used to study the resulting clusters.

Kroto left England and arrived at Rice University on September 1, 1985, and immediately began to work with Smalley and Curl on the vaporization of carbon and the study of long-chain carbon molecules. By September 12, 1985, the 3 chemists had discovered the structure of C<sub>60</sub>, one of the long-chain carbon molecules. Under certain laser vaporization conditions, most of the new carbon molecules had a structure of C<sub>60</sub>.

Geometrically, C<sub>60</sub> is a polygon with 60 vertices and 32 faces, 12 of which are pentagons and 20 that are octagons. The laureates gave the C<sub>60</sub> structure the whimsical name *buckminster fullerene* after Richard Buckminster Fuller (1895-1983), the American architect whose geodesic dome design had a similar structure. Chemists began calling C<sub>60</sub> *buckyball* for the netlike structure of fullerene.

Besides receiving the Nobel Prize, Curl has received many awards and honors. In 2001, Antigua and Barbuda issued a stamp (Scott No. 2518a) in his honor.

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