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The 1993 John Scott Awards Go to Carlo Croce and Richard Smalley

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On November 19 in Philadelphia, the 1993 John Scott Awards were presented to Carlo M. Croce and Richard E. Smalley at a ceremony held at Thomas Jefferson University. Croce, director of the Jefferson Cancer Institute and Jefferson Cancer Center at Thomas Jefferson University, was honored for his pioneering research in understanding human cancer. Smalley, professor of chemistry and physics, Rice University, Houston, Texas, received the award for his development of supersonic jet laser beam spectroscopy, which contributed to the discovery of a third form of carbon, buckminsterfullerene, or C₆₀. The history of the award is reviewed. The 1993 winners are profiled and their most-cited papers are identified.

The John Scott Award: A Brief History

The John Scott Award was established over 175 years ago to honor the most deserving men and women whose discoveries have contributed to the "comfort, welfare, and happiness of human kind." It was created by John Scott, an Edinburgh druggist, who specified in his will that Philadelphia administer the prize:

*I, John Scott, late chemist in Edinburgh, do leave to the corporation of Philadelphia...four thousand dollars...the interest of which is to be laid out in premiums to ingenious men or women who make useful inventions, but no one of such premiums shall exceed twenty dollars, and along with which shall be given a copper medal with this inscription—
To the most deserving.¹*

Scott led an unremarkable life. He was not known for his scientific achievements or philanthropy, nor did he ever visit the US—leaving many to speculate on the reason for his bequest. The druggist seemed to admire Benjamin Franklin, Philadelphia's extraordinary scientist/entrepreneur,² and that may have motivated him to select Philadelphia as the home of the award.¹

After Scott's death in 1815, the executor of his will entrusted the administration of the \$4,000 trust fund set up for the award to James Ronaldson, formerly of Edinburgh but by then a prominent citizen and successful merchant in Philadelphia. Ronaldson turned the trust over to the Philadelphia City Council, which assigned the task of recommending award recipients to the Philadelphia Society for Promoting Agriculture.¹ The society presented the first awards in 1822 to 13 individuals, including Samuel Goodwin, inventor of a front door lock; Thomas Barnitt, inventor of a knitting machine; Isaac Conard, designer of a barrow for planting Indian corn; Daniel Niell, developer of a vertical printing press; and William Shotwell, who created a simple and effective garden weeder.

In 1834, the Franklin Institute became responsible for recommending award candidates to the City Council, based on inventions submitted to the institute. In 1869, the city established the Board of Directors of City Trusts, a group of 12 individuals charged with administering all charitable trusts left to the city. This board took responsibility for reviewing the candidates identified by the Franklin Institute.¹ Dur-

ing this period, recipients included men and women who developed various inventions, including sewing machines, typewriters, electric and pneumatic clocks, telescopes, railway car brakes, and artificial limbs.

Shifting Focus: From Practical Invention to Basic Research

The arrangement with the Franklin Institute continued until 1919, when the Board of City Trusts appointed an independent group of professionals to nominate award candidates. Members of this advisory committee were drawn from medicine, agriculture, science, engineering, and patent law. Shortly after meeting for the first time, the committee raised the amount of the honorarium from \$20, as dictated in Scott's will, to a maximum of \$2,000, based on the increased value of the trust since 1816. In 1970, the advisory committee members again raised the maximum amount of the honorarium to \$10,000.

The committee also shifted the award's focus from recognizing inventors of "gadgets" to researchers making fundamental discoveries in science and medicine. Recipients after 1919 included many prominent men and women of science, such as: Hideyo Noguchi, cited for research on the cause and prevention of yellow fever; Madame Marie Sklodowska Curie, discoverer of radium; Orville Wright, honored for developing flying machines; Thomas A. Edison, recognized for various major inventions; Guglielmo Marconi, inventor of wireless telegraphy; and Nikola Tesla, developer of the polyphase system of generating and distributing electricity.

Other noteworthy winners include Edwin H. Land for the invention of Polaroid; Sir Alexander Fleming for discovering penicillin; Sir Howard Florey for developing penicillin's use in medicine; Jonas E. Salk for creating the Salk poliomyelitis vaccine; Paul M. Zoll for inventing the heart pacemaker; John Charnley for creating to-

tal prosthetic replacements for the hip joint; Sir James Whyte Black for developing drugs such as cimetidine and propranolol which are used to treat peptic ulcers and cardiac disorders, respectively; and William J. Kolff for contributing to the development of artificial kidneys and hearts.

I have served on the John Scott Advisory Committee since 1975. The other current members are Louis J. Esposito, president, Board of Directors of City Trusts; Robin M. Hochstrasser, Donner Professor of Chemistry, University of Pennsylvania; Mildred Cohn, Benjamin Rush Professor Emeritus of Biochemistry and Biophysics at Penn; Gregory C. Farrington, dean of Penn's School of Engineering and Applied Science; Ann G. Eisman, director, Board of Directors of City Trusts; Louis M. Heidelberger, esquire, Reed Smith Shaw and McClay; Peter C. Nowell, professor of pathology and laboratory medicine at Penn; Charles Price, Benjamin Franklin Professor Emeritus of Chemistry at Penn; Jonathan E. Rhoads, professor of surgery at Penn; and Herbert L. Rothbart, director of the North Atlantic Area Agricultural Research Service, US Department of Agriculture.

Croce Honored for Pioneering Cancer Research

Carlo M. Croce is an internationally acclaimed geneticist whose research has defined the roles of chromosome translocations in human leukemias and lymphomas. Croce has also identified several genes implicated in blood malignancies, and has described the molecular-genetic events that result in Burkitt's lymphoma and lymphomas in patients with acquired immunodeficiency syndrome (AIDS). Burkitt's lymphoma is a type of cancer that results from unconstrained growth of beta-lymphocytes and is particularly common in African children. The committee noted that Croce was the first researcher to use cytogenetics and gene mapping in identifying oncogenes in-

volved in human malignancies and examining the genetic mechanisms involved in abnormal cell growth.

In addition to the John Scott Award, Croce received the Research Career Development Award of the National Institutes of Health (NIH) in 1975. In 1985 and 1993, the National Cancer Institute (NCI) of NIH presented Croce the Outstanding Investigator Award.

Currently director of the Jefferson Cancer Institute and Jefferson Cancer Center, Philadelphia, Croce is also chairman of the Department of Microbiology and Immunology at the Jefferson Medical College of Thomas Jefferson University. Prior to joining Jefferson in 1991, he directed the Fels Institute for Cancer Research and Molecular Biology at Temple University School of Medicine. Before that, Croce spent over 20 years at the Wistar Institute of Anatomy and Biology, Philadelphia, Pennsylvania, serving as an associate director and professor. He received his medical degree from the University of Rome in 1969.

In addition to his research and administrative duties at Jefferson, Croce is a member of the NCI's Board of Scientific Counselors, Division of Cancer Treatment, as well as the General Motors Cancer Research Foundation Awards Assembly. He is editor-in-chief of *Cancer Research* and is on the editorial boards of *Leukemia*, *Biotechnology*, *Chromosomes*, *Genes and Cancer*, *Gene Expression*, and the *Japanese Journal of Cancer Research*.

Croce's most-cited paper was published in the 1982 *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* and has received 652 citations through September 1993.³ It concluded that the *c-myc* gene is located on chromosome 8. The paper noted that abnormal regulation of this gene may be involved in malignant transformations. By identifying its location, researchers are able to study the regulation of *c-myc* gene expression in tumors.

A 1984 *Science* paper is his second most-cited work (301 citations).⁴ It concerned the development of a DNA probe which identified a gene locus, *bcl-2*, unrelated to known oncogenes. The *bcl-2* gene may be involved in the pathogenesis of B-cell neoplasms, and the probe could also be used in diagnosing follicular lymphoma in humans.

Croce's third most-cited paper (293 citations) was also published in *PNAS*, in 1983.⁵ It discussed the translocation of a *c-myc* oncogene which is sufficient for its transcriptional activation, and which may be an essential step leading to neoplasia in Burkitt's lymphoma.

Smalley Recognized for Contributions to Chemical Physics

Richard E. Smalley received a bachelor of science degree in chemistry from the University of Michigan, Ann Arbor, in 1965. After working as a research chemist at the Shell Chemical Company, he left in 1969 to pursue a master's degree and doctorate at Princeton University, graduating in 1973. He then did postdoctoral work under Donald H. Levy at the James Franck Institute of the University of Chicago. It was there that he pioneered supersonic jet laser beam spectroscopy, "one of the most powerful techniques in chemical physics."⁶

In 1978, Smalley joined the chemistry department at Rice University, Houston, Texas, where he continues to teach today. Smalley and colleagues developed a unique instrument—a laser vaporization cluster beam apparatus—for semiconductor research on silicon and germanium clusters. Harold W. Kroto, University of Sussex, Brighton, England, realized the instrument could be very useful for his research on the interstellar formation of long carbon chains in red giant stars. That is, it could simulate the high temperature conditions required for carbon chains to form in stars.

In 1985, Kroto worked with Smalley's team at Rice to create such conditions. A

surprising result of their collaboration was the serendipitous discovery of a third natural form of carbon—the stable C_{60} molecule. Because it is shaped like a geodesic soccer ball, the molecule is also called buckminsterfullerene and “buckyballs” in honor of R. Buckminster Fuller, inventor of the geodesic dome. Fuller won the 1979 John Scott Award for this invention.

The discovery of C_{60} was reported in a 1985 *Nature* paper and has triggered an explosion of multidisciplinary research.⁷ This was discussed in a recent *Current Contents*® (CC®) essay, which included an interview of Kroto reprinted from *Science Watch*®, the Institute for Scientific Information®'s (ISI®'s) monthly newsletter that reports on citation-based trends in research.⁸ Kroto described the discovery of buckminsterfullerene in a recent *Citation Classic*® commentary on the *Nature* paper.⁹

The *Nature* paper is Smalley's most-cited work, with 1,082 citations through September 1993.⁷ His second most-cited work (359 citations) concerned a “cookbook-level recipe for the production of C_{60} in sufficient quantities for general chemical experimentation” and was published in the 1990 *Journal of Physical Chemistry*.¹⁰ His third most-cited paper (283 citations) was on the fluorescence excitation spectrum of HeI_2 and was published in the *Journal of Chemical Physics* in 1976.¹¹

Smalley has received numerous awards for his contributions to the discovery of buckminsterfullerene and other advances in chemical physics. These include the 1991 Irving Langmuir Prize in Chemical Physics, the Popular Science Magazine Grand Award in Science and Technology (1991), the American Physical Society (APS) International Prize for New Materials (1992), the Welch Award in Chemistry (1992), and the Ernest O. Lawrence Memorial Award (1992).

Smalley is chairman of the Rice Quantum Institute and a member of numerous professional organizations, including the

American Chemical Society, APS, American Institute of Physics, American Association for the Advancement of Science, and Materials Research Society. He currently serves on the editorial boards of *Chemical Physics Letters*, *Journal of Cluster Science*, and *Molecular Physics*.

1992 Winners

Last year two biochemists were honored with the John Scott Award.¹² Kary B. Mullis was cited for discovering the polymerase chain reaction (PCR) in 1983 while at the Cetus Corporation. A simple method for producing millions of copies of specific DNA sequences, PCR technology has revolutionized research in molecular biology, biochemistry, and medicine. His primordial paper on PCR published in 1987 has already been explicitly cited in more than 1,000 papers.¹³ For this discovery, Mullis shared the 1993 Nobel Prize in chemistry with Michael Smith, University of British Columbia, who developed site-directed mutagenesis techniques for redesigning DNA sequences.

Britton Chance, University of Pennsylvania, received the 1992 John Scott Award for his fundamental contributions to quantitative biochemistry. In particular, he pioneered many clinical applications, including magnetic resonance spectroscopy, photon migration imaging, and other non-invasive tools for medical research. He was recognized as one of the most-cited scientists of the twentieth century in the very first author citation ranking we published.¹⁴ He has coauthored over 1,000 papers, including numerous *Citation Classics*.¹⁵

Conclusion

The John Scott Award is one of the most prestigious Philadelphia science prizes—over 100 awards are given by Philadelphia-based local and national organizations. Several of these were highlighted in a previous CC essay.¹⁶ The John Scott Award is also one of the oldest science prizes in the US.

Over 500 people have received the award to date, far too many to discuss here.

Science awards and prizes are an important form of public recognition for outstanding research. But as I've often noted, the number of deserving scientists far exceeds the number of available awards. Our many studies of highly cited authors have identified hundreds of researchers of Nobel class. And ISI's *Citation Classics*[®] feature has considerably expanded the opportunities for

researchers to be recognized for their high impact work.

The John Scott Award committee, which recommends candidates for the prize to the Philadelphia Board of Directors of City Trusts, invites *CC*[®] readers to suggest nominees for future recognition.

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