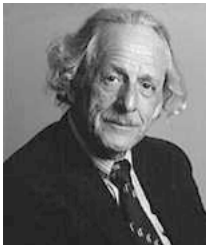
Essays of an Information Scientist: Science Reviews, Journalism, Inventiveness and other Essays, Vol:14, p.41, 1991 Current Contents, #11, p.3-9, March 18, 1991



Current Comments®

EUGENE GARFIELD
INSTITUTE FOR SCIENTIFIC INFORMATION®
3501 MARKET ST., PHILADELPHIA, PA 19104

The 1990 Nobel Prize Winners: A Citationist Retrospective

Number 11 March 18, 1991

For more than a decade, we have devoted essays to each year's Nobel Prizes. These reports, usually published six months or more after the prize, have provided a unique citationist perspective on the winners. In addition to identifying their most-cited works, especially *Citation Classics*®, we have highlighted work that has influenced key research fronts.[1]

When pertinent, we've also listed the winners' contributions to the review literature. And, where possible, we've contacted the Nobelists or close colleagues to determine whether or not our data reinforced or contradicted perceptions of delayed recognition, as in the case with Barbara McClintock.[2] Her 1983 Nobel for physiology or medicine may have been delayed, but she was widely recognized in the genetics community. In 1944, she was elected to the National Academy of Sciences.

In the first issue of *Current Contents*® (*CC*®) this year, I announced that our publication schedule for essays was changing to biweekly.[3] Not only did this restructuring reduce the space available for essays, it also reduced the resources available to conduct extensive bibliographic research. So, in keeping with this necessity, we have decided to provide only one or two brief examinations of this year's Nobel Prize winners, bearing in mind that access to the *Science Citation Index*®, in print and electronic formats, makes it convenient for readers to expand on our examinations, if they are so inclined.[4]

Before the awards were announced last year, the biweekly newspaper *The Scientist*® published a series of articles in which Nobel Prize contenders were listed, based on citation frequency and predictor awards.[5-7] One would think that with all of the non-Nobel awards that abound,[8,9] there would be few recipients not in that category. Nevertheless, this does occur from time to time.

One interesting aspect of this year's awards is the relatively low level of citations for several of the winners. This could be due to factors similar to those of the famous Watson and Crick paper in 1953,[10] for which they received the 1962 Nobel Prize in physiology or medicine. It had been cited just under 1,100 times when we last studied it.[11] This is an indication of obliteration by incorporation (a work so quickly becoming a standard in its field that researchers feel that it is unnecessary to cite the original material). In a sense, it is an honor to become obliterated, as I noted in a previous essay.[12]

Even *The New York Times* does not attempt to cover all the prizes in one story, but perhaps the highlights of each recipient called out below will prove interesting and informative.

The Awards

Officially, according to the will of Alfred Nobel, prizes shall be awarded "...to those who, during the preceding year, shall have conferred the greatest benefit on mankind." Further, the monetary awards are made from

the interest on the fund of his estate, apportioned "...one part to the person who shall have made the most important discovery or invention within the field of physics; one part to the person who shall have made the most important chemical discovery or improvement; one part to the person who shall have made the most important discovery within the domain of physiology or medicine; one part to the person who shall have produced in the field of literature the most outstanding work of an idealistic tendency; and one part to the person who shall have done the most or the best work for fraternity between nations, for the abolition or reduction of standing armies and for the holding and promotion of peace congresses."[13]

In addition, there also is the Alfred Nobel Memorial Prize in economic sciences, instituted by the Bank of Sweden at its tercentenary in 1968. This is subject to the same judging conditions as the Nobel Prizes and provides a monetary award equal to the other categories.

Chemistry

Elias J. Corey, Harvard University, Cambridge, Massachusetts, received the chemistry award for developing new ways to synthesize complex molecules normally found in nature—a system known as retrosynthesis, where natural compounds are synthesized by first breaking them down into their basic parts rather than trying to build them through trial and error. In addition to this, Corey developed computer modeling programs to assist researchers in this process.

Elias J. Corey, Chemistry

A look at the citation record reveals that Corey was the 73d most-cited scientist for the years 1981-1988[7] and the most-cited chemist during that period. Among his many papers, Corey's most-cited, "Pyridinium chlorochromate. An efficient reagent for oxidation of primary and secondary alcohols to carbonyl compounds,"[14] has been cited more than 1,600 times since publication in 1975.

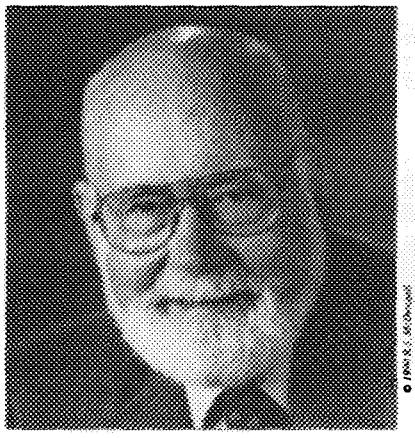
In a recent phone conversation with *CC*, Corey noted that important works can often be underrated by citation counts, using his 1953 paper, "Prediction of the stereochemistry of α-brominated ketosteroids,"[15] as an example. This paper, presenting work in stereoelectronics that is widely used today, has been cited only 85 times, probably due to its publication in a smaller journal. He notes that the work would have received a much higher number of citations had he also published the information in a review paper. However, he does not often write review papers.

Among the many key items in his bibliography of more than 700 publications, Corey feels that his 1989 book, *The Logic of Chemical Synthesis*,[16] will be one of his most important.

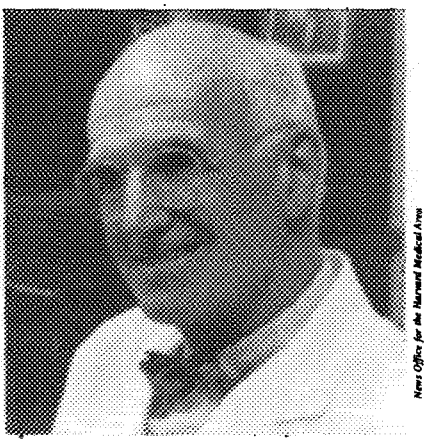
He has received numerous predictor awards, among them the American Chemical Society's Award in Pure Chemistry, the Wolf Foundation Prize for Chemistry, and the National Medal of Science. His Nobel award was clearly brewing for some time.

Physiology or Medicine

The prize for physiology or medicine was shared by two pioneers in the field of trans-



E. Donnall Thomas, Physiology or Medicine



Joseph E. Murray, Physiology or Medicine

plant medicine—E. Donnall Thomas, Fred Hutchinson Cancer Research Center, Seattle, Washington, and Joseph E. Murray, Harvard Medical School and Brigham and Women's Hospital, Boston, Massachusetts. Thomas is a member of the National Academy of Sciences and the recipient of, among other laurels, the American Cancer Society's Award for Distinguished Service in Basic Research, the Kettering Prize of the General Motors Cancer Research Foundation, the Robert Roesler de Villiers Award of the Leukemia Society of America, and the 1990 Gairdner Foundation International Award.

For the layperson, the work of Thomas and Murray probably best illustrates Nobel's desire that the award go to those who shall have "...conferred the greatest benefit on mankind." Naturally, it is impossible to measure these benefits easily. However, the work of these two laureates has visibly benefited individuals, providing thousands with longer, more productive lives.

Murray's pioneering clinical work, including his 1954 transplant of a kidney between humans, opened the door to the seemingly miraculous work that followed, including the work of Thomas on the transplantation of bone marrow.

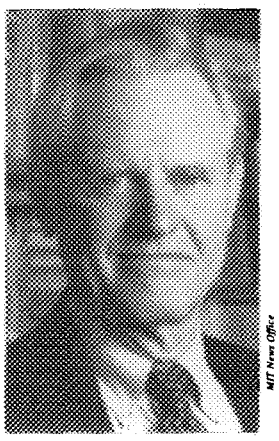
Murray's most-cited 1957 article, "Prolonged survival of skin homografts in uremic patients,"[17] was cited explicitly in more than 250 papers since publication. Clearly, the citation impact does not reflect the impact of his clinical findings. As a general rule, clinical papers do not achieve citation frequencies equal to those in basic science. Nevertheless, Murray's citation history shows that the sum of the citations to all of his papers is in excess of 1,600—an impressive total.

Thomas, on the other hand, was the 21st most-cited scientist for the period 1981 to 1988 and has been similarly ranked since we began these studies more than 10 years ago. As a matter of fact, his most-cited paper, "Bone-marrow transplantation,"[18] the first of a two-part review article, has been cited in more than 1,280 papers since publication in 1975.

Thomas has been one of the most-cited authors for several decades. Had he received the 1990 Gairdner prize a few weeks earlier, he certainly would have been included in *The Scientist*'s list of "nominees."[7]

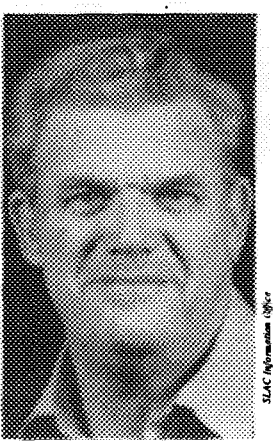
Physics

The 1990 award for physics was shared by Henry W. Kendall and Jerome I. Friedman, Massachusetts Institute of Technology, Cambridge, and Richard E. Taylor, Stanford



Henry W. Kendall, Physics

Jerome I. Friedman, Physics



Richard E. Taylor, Physics

University, California. Their experiments confirmed the existence of quarks (the subatomic particles that make up protons and neutrons). This experimental work built on the theories of Murray Gell-Mann (winner of the 1969 Nobel Prize in physics) and George Zweig, California Institute of Technology, Pasadena.

Their classic 1969 paper, "High-energy inelastic *e-p* scattering at 6° and 10°,"[19] has been cited more than 265 times. In addition, Taylor's 1978 paper, "Parity non-conservation in inelastic electron scattering,"[20] has been cited more than 420 times, making it the 12th most-cited paper from the journal *Physics Letters B*.

In addition to their publications, these three physicists received the 1989 W.K.H. Panofsky Prize, named for their mentor—the driving force behind the creation of the Stanford Linear Accelerator Center, where much of their work was performed.

Were they likely choices for the Nobel? None of the three physicists has been elected to the National Academy of Sciences, though Kendall, of course, is quite a "visible" scientist, as the chairman and a founder of the Union of Concerned Scientists.

If we were to attempt to predict prizewinners in physics, one way would be to list discoveries not previously recognized by the Nobel committee, which we might do by reviewing our research-front database.[21] The names of these 1990 physics prizewinners would stand out in the high-energy physics research front devoted to quarks.

Economics

The 1990 Nobel Memorial Prize in economic sciences was awarded to Harry F. Markowitz, City University of New York, New York, Merton Miller, University of Chicago, Illinois, and William F. Sharpe, Stanford University. The award was given for pioneering work in the theory of financial economics and corporate finance—a departure from work previously honored in its more narrow focus and practical applications. As noted by Franco Modigliani, Massachusetts Institute of Technology, a collaborator with Miller and the winner of the 1985 prize, the recognition of these three is "the final seal of approval" for recognizing "for the first time that finance is a major area of economics."[22]

All three recipients are citation superstars, based both on their most-cited papers and on the sheer number of highly cited papers. Sharpe's 1964 paper, "Capital asset prices: a theory of market equilibrium under conditions of risk,"[23] has been cited more than

Harry F. Markowitz, Economics

Merton Miller, Economics

William F. Sharpe, Economics

1,000 times since it was published in 1964 and was the subject of a *Citation Classic* in *CC*, January 9, 1979.[24]

Miller's most-cited paper, a collaboration with Modigliani published in 1958 in the *American Economic Review*, "The cost of capital, corporation finance and the theory of investment,"[25] has been cited more than 700 times.

Finally, Markowitz's most-cited paper, "Portfolio selection,"[26] has been cited more than 415 times since 1952. Markowitz received the 1989 ORSA/TIMS von Neumann Theory Prize in Economic Science.

Based on citations and awards, these economists were likely candidates for the prize. However, in an informal pool of 40 economists, conducted last October, not one was listed among the top three candidates.[27] We only can assume that the Nobel committee selected a field that was long overdue for recognition.

Literature

The 1990 prize for literature went to Octavio Paz, the first Mexican writer to win the award, for his "impassioned writing with wide horizons, characterized by sensuous intelligence and humanistic integrity."

Paz has produced an influential body of work, including his poem *Sun Stone*,[28] published in 1957. This was inspired by the Aztec calendar stone, with the poem's 584 lines matching the 584 days of the calendar's cycle. This poem has been described by a critic as "one of the most important poems to be published in the Western world."[29] Another major work for Paz was his *The Labyrinth of Solitude: Life and Thought in Mexico*,[30] published in 1961, which is an analysis of modern Mexico and the Mexican personality.

In my 1980 essay, "The 100 most-cited authors of 20th century literature. Can citation data forecast the Nobel Prize in literature?"[31] I noted that Paz was the second most-cited author of literature who was still eligible for the Nobel (only living candidates are considered), behind Jorge Luis Borges, who died in 1986. In addition to this citation ranking, Paz also has received some of the world's most significant awards for literature. Prior to the 1990 Nobel Prize, he received a Guggenheim award (1943), the Cervantes Prize (1981), considered the most important award for literature in the Spanish-speaking world, and the Neustadt Prize (1982).

We have never attempted to forecast the Nobel literature prize. Typically, the citation levels for literature candidates are quite low

until the authors become the source of significant study after achieving some major recognition. In the case of the Nobel Prize, it is this event that causes an increase in citations. This is just the reverse of the science awards where significant work generates a large number of citations prior to the award, and receiving the Nobel has very little effect on the level of future citations.[31]

Peace

To complete the list of laureates, the 1990 Nobel Peace Prize was awarded to Mikhail S. Gorbachev, president of the USSR, for his efforts in bringing the Cold War to an end with his policies of openness and restructuring. Unfortunately, recent events may work to undermine both his efforts and his credibility, as he has overseen the armed intervention in the independence movements in the Baltic republics and reintroduced press and media censorship.

Conclusion

Since the world of science has produced thousands of Nobel-class discoveries in the last 50 years, the odds of anticipating those the committees will deem most deserving are low. And, it is this point I wish to stress in closing out this year's overview. We continue to identify hundreds of highly cited authors worldwide, many of Nobel class, as a reminder that the world produces an extraordinary array of original and important discoveries of benefit to mankind. Despite a proliferation of awards, local and international, an amazing number of important discoveries are not publicly recognized.

The quest for the Nobel Prize, as dramatically portrayed by Carl Djerassi in *Cantor's Dilemma*,[32] can be a game of intrigue beset with trials of timing, politics, talent, and luck. Ideally, though, it is a glorious celebration of the creative genius and hard work of a select few.

Somehow, for the small percentage of the population with an aptitude for scholarship, the scientific quest is fundamentally all that matters. But, the need for recognition is a universal motivation. Most scientists, however, find this fact of life somewhat embarrassing.

* * * * *

My thanks to Mark Fitzgerald and Katherine Junkins for their help in the preparation of this essay.

REFERENCES

1. **Garfield E.** Do Nobel Prize winners write Citation Classics? *Current Contents* (23):3-8, 9 June 1986. (Reprinted in: *Essays of an information scientist: towards scientography.* Philadelphia: ISI Press, 1988. Vol. 9. p. 182-7.)
2. ----------. The 1983 Nobel Prizes. Part 2. Myth or reality: premature discovery is not the same as being ignored! Barbara McClintock and the prize in medicine. *Current Contents* (7):3-10, 18 February 1985. (Reprinted in: *Ibid.*, 1986. Vol. 8. p. 60-7.)
3. ----------. The impact of citation indexes on biochemists and sociologists—a survey by L. Hargens and H. Schuman. Part 1. Methodology. *Current Contents* (1):5-12, 7 January 1991.
4. ----------. Announcing the *SCI Compact Disc Edition*: CD-ROM gigabyte storage technology, novel software, and bibliographic coupling make desktop research and discovery a reality. *Current Contents* (22):3-13, 30 May 1988. (Reprinted in: *Essays of an information scientist: science literacy, policy, evaluation, and other essays.* Philadelphia: ISI Press, 1990. Vol. 11. p. 160-70.)
5. **Martello A.** Twelve prolific physicists: likely 1990 Nobel contenders. *The Scientist* 4(17):16; 25-6, 3 September 1990.
6. ----------. Scientists with the right chemistry to win a Nobel Prize. *The Scientist* 4(18):16-7, 17 September 1990.
7. ----------. Which scientists might be honored with the Nobel Prize? *The Scientist* 4(19):17-8, 1 October 1990.
8. **Garfield E.** The awards of science: beyond the Nobel Prize. Part 1. The determination of prestige. *Current Contents* (4):5-14, 24 January 1983. (Reprinted in: *Op. cit.*, 1984. Vol. 6. p. 17-26.)

9. - - - - - - - - - . The awards of science: beyond the Nobel Prize. Part 2. The winners and their most-cited papers. *Current Contents* (50):3-12, 10 December 1984. (Reprinted in: *Ibid.*, 1985. Vol. 7. p. 405-19.)
10. **Watson J D & Crick F H C.** A structure for deoxyribose nucleic acid. *Nature* 171:737-8, 1953.
11. **Garfield E.** The 250 most-cited *Citation Classics* from the essential decade 1955-1964. *Current Contents* (5):3-15, 4 February 1985. (Reprinted in: *Op. cit.*, 1986. Vol. 8. p. 37-49.)
12. - - - - - - - - - . The 'obliteration phenomenon' in science—and the advantage of being obliterated! *Current Contents* (51/52):5-7, 22 December 1975. (Reprinted in: *Ibid.*, 1977. Vol. 2. p. 396-8.)
13. Nobel Foundation Directory, Printed in Sweden by Sturetryckeriet AB—Stockholm 1989.
14. **Corey E J & Suggs J W.** Pyridinium chlorochromate. An efficient reagent for oxidation of primary and secondary alcohols to carbonyl compounds. *Tetrahedron Lett.* 1975(31):2647-50.
15. - - - - - - - - - . Prediction of the stereochemistry of α-brominated ketosteroids. *Experientia* 9(9):329-31, 1953.
16. **Corey E J & Cheng X M.** *The logic of chemical synthesis.* New York: Wiley, 1989. 436 p.
17. **Dammin G J, Couch N P & Murray J E.** Prolonged survival of skin homografts in uremic patients. *Ann. N. Y. Acad. Sci.* 64:967-76, 1957.
18. **Thomas E D, Storb R, Clift R A, Fefer A, Johnson L, Neiman P E, Lerner K G, Glucksberg H & Buckner C D.** Bone-marrow transplantation. *N. Engl. J. Med.* 292:832-43, 1975.
19. **Bloom E D, Coward D H, DeStaebler H, Drees J, Miller G, Mo L W, Taylor R E, Briedenbach M, Friedman J I, Hartmann G C & Kendall H W.** High-energy inelastic *e-p* scattering at 6° and 10°. *Phys. Rev. Lett.* 23:930-4, 1969.
20. **Prescott C Y, Atwood W B, Cottrell R L A, DeStaebler H, Garwin E L, Gonidec A, Miller R H, Rochester L S, Sato T, Sherden D J, Sinclair C K, Stein S, Taylor R E, Clendenin J E, Hughes V W, Sasao N, Schuler K P, Borghini M G, Lubelsmeyer K & Jentschke W.** Parity non-conservation in inelastic electron scattering. *Phys. Lett. B* 77:347-52, 1978.
21. **Garfield E.** ABCs of cluster mapping. Parts 1 & 2. *Current Contents* (40):5-12, 6 October 1980; (41):5-12, 13 October 1980. (Reprinted in: *Op. cit.*, 1981. Vol. 4. p. 634-49.)
22. **Prokesch S.** 3 U.S. economists win Nobel. *New York Times* 17 October 1990. p. D1; D6.
23. **Sharpe W F.** Capital asset prices: a theory of market equilibrium under conditions of risk. *J. Finan.* 19:425-42, 1964.
24. - - - - - - - - - . Citation Classic. Commentary on *J. Finan.* 19:425-42, 1964. (Smelser N J, comp.) *Contemporary classics in the social and behavioral sciences.* Philadelphia: ISI Press, 1987. p. 320.
25. **Modigliani F & Miller M H.** The cost of capital, corporation finance and the theory of investment. *Amer. Econ. Rev.* 48:261-97, 1958.
26. **Markowitz H.** Portfolio selection. *J. Finan.* 7:77-91, 1952.
27. **Memmott M.** Chicago economist 3-1 favorite. *USA Today* 9 October 1990.
28. **Paz O.** *Sun stone.* (Rukeyser M, trans.) London: New Directions, 1962.
29. **Wakeman J, ed.** *World authors, 1950-1970.* New York: Wilson, 1975. p. 1112-4.
30. **Paz O.** *The labyrinth of solitude: life and thought in Mexico.* New York: Grove, 1961. 212 p.
31. **Garfield E.** The 100 most-cited authors of 20th century literature. Can citation data forecast the Nobel Prize in literature? *Current Contents* (4):5-11, 28 January 1980. (Reprinted in: *Op. cit.*, 1981. Vol. 4. p. 363-8.)
32. **Djerassi C.** *Cantor's dilemma.* New York: Doubleday, 1989. 230 p. (See also: **Garfield E.** *Cantor's dilemma* by Carl Djerassi: through fiction, the real world of science. *Current Contents* (47):3-7, 20 November 1989.)

Editorial Schedule Change

With the first issue of 1991, ISI ® implemented a schedule change in the front matter for *Current Contents.* ® *Citation Classics* ® and the *ISI* ® *Press Digest*, including *Hot Topics*, now appear every other week. They alternate with either an essay by Eugene Garfield, a reprint with an appropriate introduction, or an essay by an invited guest.