Current Comments®

The 1983 NAS Award for Excellence in Scientific Reviewing Goes to Michael Ellis Fisher for His Reviews of the Theory of Equilibrium Critical Phenomena

Number 18 May 2, 1983

On April 25, 1983, the National Academy of Sciences (NAS) presented the 1983 NAS Award for Excellence in Scientific Reviewing to Michael Ellis Fisher, Horace White professor of chemistry, physics, and mathematics, Cornell University. The award was presented at the academy's 120th annual meeting in Washington, DC. This is the fifth year that the award has honored an outstanding author of scholarly reviews.[1-4]

The NAS award was established in 1979 by ISI® and Annual Reviews Inc. to honor the founder of *Annual Reviews*, James Murray Luck, who served as editor-in-chief until his retirement in 1969. Luck remains on the editorial committee of the *Annual Review of Biochemistry*, which he founded in 1932. Luck and I were present at the awards ceremony.

The NAS award for scientific reviewing is one of the first significant awards to acknowledge the importance of review articles. Its purpose is to encourage scientists to write more and better reviews.

The NAS administers the award, which carries a $5,000 honorarium co-donated by ISI and Annual Reviews. The field recognized by the award rotates annually. The first award in 1979 recognized an outstanding reviewer from the life sciences. G. Alan Robison, University of Texas, was honored for his reviews on cyclic AMP.[1] In 1980, a physical sciences author, Conyers Herring, Stanford University, received the award for his reviews in solid-state physics, also known as condensed matter physics.[2] The third award in 1981 recognized a reviewer in the social sciences, economist John S. Chipman, University of Minnesota, for his surveys of the literature on international trade theory.[3] The 1982 recipient was again a life scientist. Victor McKusick, Johns Hopkins University School of Medicine, was honored for his reviews in human genetics.[4] This year, by honoring Fisher, the award recognizes another physical scientist.

Although ISI cosponsors the award, we are not involved in either the nomination of candidates or the selection of the recipient. An independent awards committee at NAS selected Fisher to receive the award.

The NAS cited Fisher for his "continuing sequence of reviews that put into proper perspective discoveries concerning critical phenomena and defined the fundamental problems he and others subsequently resolved." Critical phenomena occur as special, characteristic features of many transitions, as when matter changes from one phase—solid, liquid, or gas—to another. Under certain conditions, identified as "critical," the two or more phases in exact equilibrium may become identical so the transition vanishes! Research on critical phenomena focuses on the peculiar behavior of properties such as the specific heat and compressibility as the temperature,

Michael Ellis Fisher

pressure, etc., vary in the vicinity of a critical point; unexpected but "universal" laws of variation have been discovered.

Fisher's early education included University College School, Hampstead, London. He attended King's College, University of London, where he received a BSc in 1951. He then served as a flying officer in the Educational Branch of the Royal Air Force. Fisher returned to the University of London in 1953, and received his PhD in physics in 1957.

Fisher remained at King's College as a lecturer in theoretical physics in 1961, and later, reader and professor. In 1966, he joined the faculty of Cornell. He was named the Horace White professor of chemistry, physics, and mathematics in 1973. From 1975 through 1978, he served as chairman of the chemistry department at Cornell.

Fisher has published more than 225 publications since 1954. His early work was concerned with the solution of complex mathematical problems through electronic analog computing. His PhD thesis was on this topic, and he coauthored a book on it with his thesis supervisor, Donald M. MacKay.[5] He went on to study the theory of magnetism and the formation of polymers. Most of his original research since 1965 has been in the area of phase transitions and critical phenomena.

Among his many original articles, Fisher has written more than 25 review articles. Most of his reviews concern critical phenomena.[6-8] Several of these represent lectures he gave at various summer schools; including the University of Colorado in 1964,[7] and the Enrico Fermi International School of Physics, Italy, in 1970.[8] The proceedings from both of these lecture series have also been translated into Russian. Other reviews focused on the theory of critical opalescence in fluids,[9] and on the renormalization group, especially in relation to magnetism.[10]

Table 1 lists a selected bibliography of Fisher's reviews that were cited at least 15 times. Table 2 shows the *ISI/CompuMath®* research fronts that included his papers as *core* documents. Research fronts are formed when a group of current papers cite one or more papers identified as the core for that topic.

In further recognition of the importance of reviews, ISI has published the *Index to Scientific Reviews™ (ISR™)* since 1974. Each year, *ISR* covers over 40,000 articles classified as reviews. We introduced a new research front index in the 1982 *ISR*.[11] The entire *SCI* file was processed to create over 2,000 research fronts. One of these concerned Ising models, for which two of Fisher's papers were core documents.[12,13] The research front is entitled "Ising model: axial interactions, chaotic behavior, commensurate phases, and critical behavior." Briefly, Ising models describe the interactions of ferromagnetic atoms, and are used to study phase transitions.

Fisher's publications were cited over 11,000 times in the period 1961-1982. He was among the 250 most-cited primary

authors for 1961-1975.[14] He also was among the 1,000 most-cited authors for the period 1965-1978.[15]

According to Fisher,[16] the single review which contributed most to his receiving the NAS award was probably his 1967 paper, "The theory of equilibrium critical phenomena," published in *Reports on Progress in Physics*.[6] This article also happens to be his most-cited paper—about 1,100 citations from 1967 to 1982. Fisher provided a few personal observations on his work when it was featured as a *Citation Classic*[17] in 1980. Lest anyone draw any general conclusions, let me remind you that more often than not, scholars have different perceptions than their peers of what is their most important work.

In his *Citation Classic* commentary for *Current Contents®*, Fisher said that his 1967 review was valuable to both researchers and graduate students because it provided a general introduction to modern ideas about critical phenomena. Even though important advances have been made since its publication, the review still helps to outline the discoveries that led to these new developments. Fisher also observed that his review had some value to researchers working in other specialties since "the usefulness of these (new) techniques of numerical analysis is by no means restricted to critical phenomena studies; thus the review has been helpful to various theorists interested in other applications."[17]

The importance of critical reviews to the advancement of science is well recognized but needs constant reiteration.[18] Our citation studies frequently show that many review papers become milestones in their fields. The utility of reviews is demonstrated through *Journal Citation Reports®*. Review journals achieve high impact in most fields. And the inclusion of review articles in certain journals undoubtedly increases the overall impacts we report.

Of course, it's a difficult task to write a good review article. The author must be familiar with current research, as well as

Table 1: Selected bibliography of reviews by M.E. Fisher that have received 15 or more citations.

Total Citations 1961-1982	Bibliographic Data
250	**Fisher M E.** Correlation functions and the critical region of simple fluids. *J. Math. Phys.—NY* 5:944-62, 1964. (Reprinted in: **Frisch H L & Lebowitz J L,** eds. *The equilibrium theory of classical fluids*. New York: Benjamin, 1964. Sect. III. p. 75-93.
15	**Fisher M E.** The nature of critical points. (Brittin W E, ed.) *Lectures in theoretical physics*. Boulder, CO: University of Colorado Press, 1965. Vol. VII C. p. 1-159.
1062	**Fisher M E.** The theory of equilibrium critical phenomena. *Rep. Progr. Phys.* 30:615-730, 1967.
51	**Fisher M E.** Magnetic critical point exponents—their interrelations and meaning. *J. Appl. Phys.* 39:981-90, 1967.
26	**Fisher M E.** Aspects of equilibrium critical phenomena. *J. Phys. Soc. Jpn.* 26(Suppl.):87-93, 1969.
96	**Essam J W & Fisher M E.** Some basic definitions in graph theory. *Rev. Mod. Phys.* 42:272-88, 1970.
85	**Fisher M E.** The theory of critical point singularities. (Green M S, ed.) *Critical phenomena. Proceedings of the International School of Physics "Enrico Fermi." Course LI.* 27 July-8 August 1970, Varenna on Lake Como. New York: Academic Press, 1971. p. 1-99.
17	**Fisher M E.** Phase transitions, symmetry and dimensionality. *Essays Phys.* 4:43-89, 1972.
386	**Fisher M E.** The renormalization group in the theory of critical behavior. *Rev. Mod. Phys.* 46:597-616, 1974.
58	**Fisher M E.** Theory of multicritical transitions and the spin-flop bicritical point. (Graham C D, Lander G H & Rhyne J J, eds.) *Magnetism and magnetic materials—1974. Proceedings of the AIP Conference No. 24.* 3-6 December 1974, San Francisco, CA. New York: American Institute of Physics, 1975. p. 273-80.

Table 2: List of *ISI/CompuMath®* research fronts that contain core documents by M.E. Fisher. A=research front number. B=research front name. C=number of citing documents in the front. The core papers by Fisher are listed after each research front.

A	B	C
80-0006	Renormalization group, equations of state, and their applications to crossover behavior and bicritical points	111
	Fisher M E & Nelson D R. Spin flop, supersolids, and bicritical and tetracritical points. *Phys. Rev. Lett.* 32:1350-3, 1974.	
	Pfeuty P, Jasnow D & Fisher M E. Crossover scaling functions for exchange anisotropy. *Phys. Rev. B—Condensed Matter* 10:2088-112, 1974.	
80-0161	Percolation theory: cluster distribution, renormalization groups, and Monte Carlo methods	183
	Fisher M E & Essam J W. Some cluster size and percolation problems. *J. Math. Phys.—NY* 2:609-19, 1961.	
	Fisher M E. The theory of condensation and the critical point. *Physics* 3:255-83, 1967.	
80-0411	Critical points, scaling, and Ising models for ferromagnets	23
	Fisher M E. Rigorous inequalities for critical-point correlation exponents. *Phys. Rev.* 180:594-600, 1969.	
80-0529	Nonlinear and linear critical slowing-down in kinetic Ising models	112
	Fisher M E & Racz Z. Scaling theory of nonlinear critical relaxation. *Phys. Rev. B—Condensed Matter* 13:5039-41, 1976.	
80-0534	Renormalization group calculations in Potts models	70
	Straley J P & Fisher M E. Three-state Potts model and anomalous tricritical points. *J. Phys. A—Gen. Phys.* 6:1310-26, 1973.	

past advances in the field. While relatively few scientists choose to take the time and energy that review writing demands, the effort is rewarding to the author and reader alike. Fisher points out, "Writing a review article helps the author's own research because it often clarifies the way ahead. It also gives the author a chance to rethink current understanding and insight."[16]

Fisher went on to say that his teaching responsibilities at Cornell also contribute to his reviews as does his research. He believes that a good lecture is like a "minireview"—one has to distill, summarize, and organize the subject matter before presenting it to students. And questions students ask can identify areas that need to be better explained. So, in describing what it takes to be a good reviewer, Fisher said: "You know the old saying, 'Those who can, do; and those who cannot, teach.' Well, those who can both 'do' *and* 'teach' make the best scientific reviewers!"[16]

Fisher's affiliations with professional and honorary societies include the Royal Society of London and the Institute of Physics, London. Fisher is a member of several US institutions as well—the American Academy of Arts and Sciences, the Mathematical Association of America, the American Chemical Society, and the American Physical Society. His awards include the American Physical Society's Langmuir Prize in 1971, and the 1973 Richtmeyer Memorial Lecture Award of the American Association of Physics Teachers. He has recently been awarded the Boltzmann Medal for his contributions to statistical mechanics by the Commission on Thermodynamics and Statistical Mechanics of the International Union of Pure and Applied Physics.

In 1980, Fisher and his colleagues, Kenneth G. Wilson, Cornell, and Leo P. Kadanoff, University of Illinois, won the prestigious Wolf Prize for their "path-breaking developments...in general the-

ory of...critical behavior at transitions between thermodynamic phases of matter."[19] Fisher received a special citation for "bringing together, and teaching a common language to, chemists and physicists working on diverse problems in phase transitions."[19] The Wolf Prize is often considered to be an indicator of future Nobel prizewinners.[20] In fact, Wilson went on to win the 1982 Nobel prize in physics.

Next year, the NAS Award for Excellence in Scientific Reviewing will be presented to a reviewer in the social and behavioral sciences. Nominations should be submitted to Bryce Crawford, Home Secretary, National Academy of Sciences, 2101 Constitution Avenue, Washington, DC 20418, before September 15, 1983.

* * * * *

My thanks to Aaron A. Packman and Amy Stone for their help in the preparation of this essay.

REFERENCES

1. **Garfield E.** The NAS James Murray Luck Award for Excellence in Scientific Reviewing: G. Alan Robison receives the first award for his work on cyclic AMP. *Essays of an information scientist.* Philadelphia: ISI Press, 1981. Vol. 4. p. 127-31. (Reprinted from: *Current Contents* (18):5-9, 30 April 1979.)
2. ----------. The 1980 NAS James Murray Luck Award for Excellence in Scientific Reviewing: Conyers Herring receives second award for his work in solid-state physics. *Essays of an information scientist.* Philadelphia: ISI Press, 1981. Vol. 4. p. 512-4. (Reprinted from: *Current Contents* (25):5-7, 23 June 1980.)
3. ----------. The 1981 NAS James Murray Luck Award for Excellence in Scientific Reviewing: John S. Chipman receives third award for his reviews in economics. *Current Contents* (18):5-8, 4 May 1981.
4. ----------. The 1982 NAS fourth J.M. Luck Award for Excellence in Scientific Reviewing goes to Victor McKusick for his mapping of the literature in human genetics. *Current Contents* (18):5-9, 3 May 1982.
5. **MacKay D M & Fisher M E.** *Analogue computing at ultra-high speed.* New York: Wiley, 1962. 395 p.
6. **Fisher M E.** The theory of equilibrium critical phenomena. *Rep. Progr. Phys.* 30:615-730, 1967.
7. ----------. The nature of critical points. (Brittin W E, ed.) *Lectures in theoretical physics.* Boulder, CO: University of Colorado Press, 1965. Vol. VII C. p. 1-159.
8. ----------. The theory of critical point singularities. (Green M S, ed.) *Critical phenomena. Proceedings of the International School of Physics "Enrico Fermi." Course LI.* 27 July-8 August 1970, Varenna on Lake Como. New York: Academic Press, 1971. p. 1-99.
9. ----------. Correlation functions and the critical region of simple fluids. *J. Math. Phys.—NY* 5:944-62, 1964.
10. ----------. The renormalization group in the theory of magnetism. *Proceedings of the International Conference on Magnetism,* 22-28 August 1973, Moscow. Moscow: Nauka, 1974. Vol. I. p. 51-79.
11. **Garfield E.** ISI's "new" *Index to Scientific Reviews (ISR)*: applying research front specialty searching to the retrieval of the review literature. *Current Contents* (39):5-12, 27 September 1982.
12. **Fisher M E & Selke W.** Infinitely many commensurate phases in a simple Ising model. *Phys. Rev. Lett.* 44:1502-5, 1980.
13. **Selke W & Fisher M E.** Monte-Carlo study of the spatially modulated phase in an Ising model. *Phys. Rev. B—Condensed Matter* 20:257-65, 1979.
14. **Garfield E.** The 250 most-cited primary authors, 1961-1975. Part I. How the names were selected. *Essays of an information scientist.* Philadelphia: ISI Press, 1980. Vol. 3. p. 326-36. (Reprinted from: *Current Contents* (49):5-15, 5 December 1977.)
15. ----------. The 1,000 contemporary scientists most-cited 1965-1978. Part I. The basic list and introduction. *Current Contents* (41):5-14, 12 October 1981.
16. **Fisher M E.** Telephone communication. 22 February 1983.
17. ----------. Citation Classic. Commentary on *Rep. Progr. Phys.* 30:615-730, 1967. *Current Contents/Physical, Chemical & Earth Sciences* 20(46):18, 17 November 1980.
18. **Herring C.** Distill or drown: the need for reviews. *Phys. Today* 21(9):27-33, 1968.
19. Fisher, Wilson and Kadanoff share the Wolf Prize. *Phys. Today* 33(9):81, 1980.
20. Prizes that predict Nobel winners. *Science* 210:294-5, 1980.