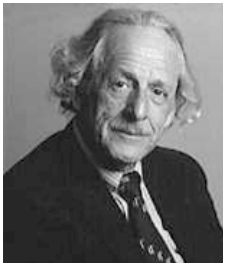

Current Comments®

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Shedding New Light on the Photosynthetic Process. Alexander N. Glazer Receives the 1991 NAS Award for Excellence in Scientific Reviewing

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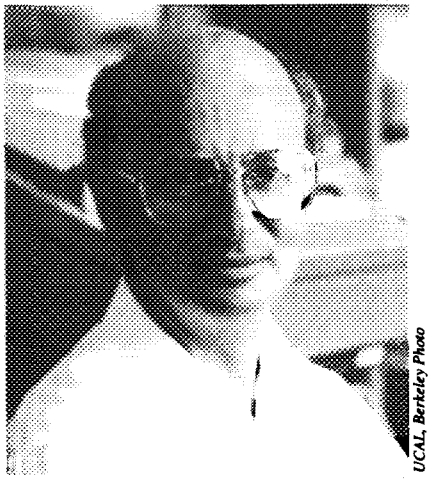
The National Academy of Sciences (NAS) Award for Excellence in Scientific Reviewing this year goes to Alexander N. Glazer, professor of biochemistry and molecular biology at the University of California, Berkeley. Every third year, the award is given in biology. The 1991 subfield was botany.

The citation, read at the annual awards ceremony the evening of April 29 in Washington, DC, stated Glazer received the award "for lucid, enthusiastic, informative, and gracefully written reviews explaining the structure and operations of phycobilisomes—the phycobiliprotein complexes that harvest light for photosynthesis in cyanobacteria." The award also carries a prize of $5,000.[1]

Readers of *Current Contents* ® (*CC* ®) will recall that this annual award is cosponsored by ISI ® and Annual Reviews of Palo Alto, California (Table 1). The prize, established in 1977, honors James Murray Luck, the founder of Annual Reviews, Inc.

In a departure from past essays on this award, we invited Glazer himself to write about the process of scientific reviewing. His views on this most important step in the scientific literature follow this introduction.[2]

In discussing past awards for excellence in scientific reviewing in *CC*,[3-14] we have invariably emphasized the crucial role of reviewing in the advancement of science. Preparing review articles is as basic to the scientific process as is peer reviewing and refereeing. Understandably, the number of qualified reviewers lags behind the increasing demand for such work.[15]



UCAL, Berkeley Photo

Alexander N. Glazer

Glazer's review paper "Phycobilisome. A macromolecular complex optimized for light energy transfer," which appeared in 1984 in *Biochimica et Biophysica Acta*, has received more than 164 citations to date.[16] Running a close second at this writing, with more than 162 citations, is his 1971 chapter "Papain and other plant sulfhydryl proteolytic enzymes," which is included in the book *The Enzymes*.[17]

In a telephone interview with *CC*, Glazer commented that he placed more value on requests for reprints of an article as an indication of broad interest in a paper than on citations alone. He said it had been his experience that some papers with few citations

Table 1: Winners of the NAS Award for Excellence in Scientific Reviewing, 1991-1979. The table includes their most-cited publication, 1945-1990. Citations and publication years of books refer to the most-cited edition. Asterisks (*) indicate publications with *Citation Classic*® commentaries. The *CC*® issue, year, and edition of the commentary follow the bibliographic data.

Year	Winner/Field	Cites	Bibliographic Data
1991	Alexander N. Glazer botany	164	**Glazer A N.** Phycobilisome. A macromolecular complex optimized for light energy transfer. *Biochim. Biophys. Acta* 768:29-51, 1984.
1990	James N. Spuhler anthropology	138	**Loehlin J C, Lindzey G & Spuhler J N.** *Race differences in intelligence.* San Francisco, CA: Freeman, 1975. 380 p.
1989	Sidney Coleman physics	1,238	**Coleman S & Weinberg E.** Radiative corrections as the origin of spontaneous symmetry breaking. *Phys. Rev. D—Part. Fields* 7:1888-910, 1973.
1988	Eric R. Kandel biology	773	**Frazier W T, Kandel E R, Kupfermann I, Waziri R & Coggeshall R E.** Morphological and functional properties of identified neurons in the abdominal ganglion of *Aplysia californica. J. Neurophysiol.* 30:1288-351, 1967.
1987	Gardner Lindzey psychology	138	**Loehlin J C, Lindzey G & Spuhler J N.** *Race differences in intelligence.* San Francisco, CA: Freeman, 1975. 380 p.
1986	Virginia L. Trimble astronomy	195	**Trimble V.** The origin and abundances of the chemical elements. *Rev. Mod. Phys.* 47:877-976, 1975.
1985	Ira Herskowitz biology	168	**Herskowitz I & Oshima Y.** Control of cell type in *Saccharomyces cerevisiae* mating type and mating type interconversion. (Strathern J N, Jones E W & Broach J R, eds.) *The molecular biology of the yeast* Saccharomyces: *life cycle and inheritance.* Cold Spring Harbor, NY: Cold Spring Harbor Laboratory, 1981. p. 181-209.
1984	Ernest R. Hilgard psychology	527	**Hilgard E R.** *Hypnotic susceptibility.* New York: Harcourt, Brace & World, 1965. 434 p.
1983	Michael E. Fisher physics	1,138	***Fisher M E.** The theory of equilibrium critical phenomena. *Rep. Progr. Phys.* 30:615-730, 1967. (46/80/PC&ES)
1982	Victor A. McKusick genetics	670	***McKusick V A.** *Heritable disorders of connective tissue.* St. Louis, MO: Mosby, 1972. 878 p. (13/79/CP)
1981	John S. Chipman economics	62	**Chipman J S.** The foundations of utility. *Econometrica* 28:193-224, 1960.
1980	Conyers Herring physics	919	***Herring C.** Diffusional viscosity of a polycrystalline solid. *J. Appl. Phys.* 23:437-45, 1950. (35/79/PC&ES)
1979	G. Alan Robison biology	2,105	**Robison G A, Butcher R W & Sutherland E W.** *Cyclic AMP.* New York: Academic Press, 1971. 531 p.

have generated reprint requests in excess of 1,000 copies. Clearly, his experience is not universal. Many factors influence the incentive for reprint requests and the motivation for citation as well. This topic merits more study.

During the last 15 years, Glazer's own research has focused on the structure, function, and assembly of macromolecular complexes. Specifically, he and his research group at Berkeley have been addressing one of the fundamental problems in photosynthesis—understanding the structural basis for the highly efficient energy transfer mechanism. This work was summarized recently in the *Journal of Biological Chemistry.*[18]

As Glazer informs us, we know that the conversion of light energy to chemical potential in biological photosynthetic systems is accomplished within macromolecular complexes composed of polypeptides and pigment molecules. A general feature of these complexes is the presence of numerous "antenna pigments" that absorb light and transfer the excitation quantum to a special chlorophyll or bacteriochlorophyll molecule in the "reaction center" for subsequent conversion to electron flow.

Such complexes often contain several hundred antenna chromophores per reaction center. Despite this, the overall quantum efficiency for the transfer of energy from the antenna to the reaction center is greater than

90 percent. Glazer and his team have characterized a class of large antenna complexes, called phycobilisomes, obtained from cyanobacteria.

These complexes of 7 to 15 million daltons (an atomic unit of measurement) consist of two classes of proteins, phycobiliproteins that carry covalently attached tetrapyrrole chromophores (bilins) and linker polypeptides, which function in the assembly of these particles. The bilin content of phycobilisomes ranges from 650 to 800. The bilins within phycobilisomes are arranged in such a manner as to provide a highly oriented pathway for energy transfer toward the photosynthetic reaction center irrespective of the point of absorption of the photon within the phycobilisome.

Marine unicellular cyanobacteria are believed responsible for 10 to 20 percent of the primary productivity in the oceans. Glazer's team recently found that the components of the photosynthetic apparatus of these organisms show marked differences from their counterparts isolated from fresh water or soil. Study of these organisms is providing new insights into the basic mechanisms of photosynthesis as well as into the ecology of this important group of cyanobacteria.

Brought up in Australia, Glazer earned his bachelor's (1957—first class honors) and master's (1958) degrees at the University of Sydney. His master's thesis concerned physicochemical studies of proteins.

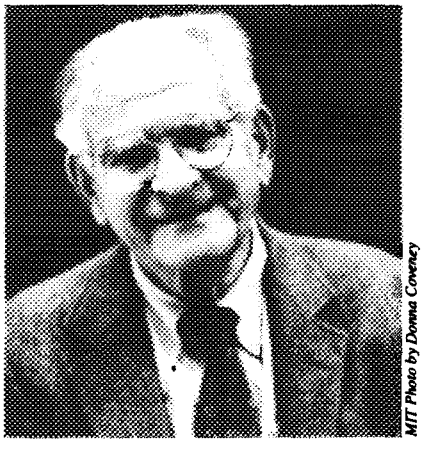
In 1957, he attended a lecture given at the University of Sydney by Emil L. Smith, who was then at the University of Utah, Salt Lake City. The lecture, on structure-function relationships in the proteolytic enzyme papain, captured his interest. So he traveled to the University of Utah, where he earned his PhD in 1960 in biochemistry. His honors include two Guggenheim fellowships (1970-1971; 1982-1983) and the Darbaker Prize (1980), given by the Botanical Society of America.

17 Other Researchers Honored

The annual academy awards event is not unlike the Hollywood Oscar awards. In addition to Glazer, 17 other researchers were honored for outstanding contributions to science. A check of our files indicates four of those receiving awards were past authors or coauthors of papers that became *Citation Classics* ®.

The academy's highest honor, the NAS Public Welfare Medal, went to Victor F. Weisskopf, Institute Professor of Physics emeritus, Massachusetts Institute of Technology (MIT), Cambridge. He was honored "for a half-century of unflagging effort to humanize the goals of science, to acquaint the public with the beneficial potential of nuclear technologies, and to safeguard the world against the devastation of nuclear war." Established in 1914, the award consists of a bronze medal.

In 1980, a paper Weisskopf coauthored with Julius Kuti of the Hungarian Academy of Sciences was the subject of a *Citation Classic* commentary. The paper was written in 1971 when Weisskopf was chairman of the physics department at MIT. It concerned lepton-nucleon scattering and pair production in the quark-parton model.[19]



MIT Photo by Donna Coveney

Victor F. Weisskopf

New NAS Award

The NAS established a new award this year. Vladimir Haensel, professor of chemical engineering, University of Massachusetts, Amherst, received the first award for "Chemistry in Service to Society," established by E.I. DuPont de Nemours & Company. The award, to be presented biannually, carries a prize of $20,000. Haensel was recognized for "outstanding research in the catalytic reforming of hydrocarbons, which greatly enhanced the economic value of our petroleum natural resources."

Other NAS awards went to Joseph H. Taylor, Jr., James S. McDonnell Distinguished University Professor of Physics, Princeton University (the John J. Carty Award for the Advancement of Science, $25,000); Bruce G. Collipp, consultant (Gibbs Brothers Medal, $5,000); Roscoe O. Brady, National Institute of Neurological Disorders and Stroke (Jessie Stevenson Kovalenko Medal, $25,000); Mark W. Kirschner, professor of biochemistry and biophysics, University of California, San Francisco, and Harold Weintraub, Fred Hutchinson Cancer Research Center, Seattle, Washington (they shared the Richard Lounsbery Award, $50,000, plus $20,000 traveling stipend).

In 1984, Brady wrote a *Citation Classic* commentary on a paper he and his colleagues published in 1967 on enzymatic factors in Fabry's disease (290 cites).[20] He also was coauthor with Peter H. Fishman of a paper on gangliosides written in 1976 that became a *Citation Classic* in 1984. At that time, it had been cited in more than 505 publications.[21]

In 1984, a paper coauthored by Kirschner and colleagues in 1977 on peptide mapping was the subject of a *Citation Classic* (it had more than 1,830 cites).[22]

Other honorees: Richard N. Zare, Department of Chemistry, Stanford University, California (NAS/Occidental Petroleum Award in Chemical Sciences, $10,000); Noam D. Elkies, John D. Loeb Associate Professor of the Natural Sciences, Harvard University (NAS Award for Initiatives in Research, $15,000); Steven L. McKnight, Carnegie Institution of Washington, DC, and Robert Tjian, professor of molecular and cell biology, University of California, Berkeley (shared NAS/Monsanto Co. Award in Molecular Biology, $20,000).

Paul Greengard, professor of molecular and cellular neuroscience, Rockefeller University, received the NAS Award in Neurosciences ($15,000); Jean-David Rochaix, Department of Molecular Biology, University of Geneva, Switzerland (Gilbert Morgan Smith Medal, $15,000); Robert M. Walker, McDonnell Professor of Physics and director, McDonnell Center for the Space Sciences, Washington University, St. Louis, Missouri (J. Lawrence Smith Medal, $20,000).

Greengard was a coauthor on three different papers that became *Citation Classics* in 1983 and 1984. All the papers were published as part of a series in the *Proceedings of the National Academy of Sciences of the USA*. One paper, written in 1969 with J.F. Kuo, Emory University, Atlanta, Georgia, concerned nucleotide-dependent protein kinases in animals. It had been cited more than 750 times.[23] Another dealt with the mammalian brain and the effect of antipsychotic drugs (475 cites).[24] The third paper, which had 895 cites, was devoted to a study of drug effects on the rat brain.[25]

Others receiving awards include Daniel L. Schacter, professor of psychology, Harvard University (Troland Research Award, $32,000); Melvin I. Simon, Anne P. and Benjamin F. Diaggini Professor of Biological Sciences, California Institute of Technology (Selman A. Waksman Award in Microbiology, $5,000); and Maarten Schmidt, Francis L. Moseley Professor of Astronomy, California Institute of Technology (James Craig Watson Medal, $15,000).

Anthropologist Named in 1990

Last year's award for scientific reviewing went to James N. Spuhler for reviews in cultural and biological anthropology. Leslie Spier Professor Emeritus of Anthropology, at the University of New Mexico, Albuquerque, and an affiliate of the Genetics Group, Los Alamos National Laboratory, Spuhler's career as a scholar spans four decades in the field of anthropology.[3]

As we mentioned earlier, this year we asked Glazer to provide some comment on the scientific reviewing process. He brings an interesting and meaningful perspective to reviewing, which I'm sure you will enjoy. Certainly, the ratio of reprint requests to citations is frequently quite high, for reviews and research papers, but there is little published evidence to support any generalizations.

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SCIENTIFIC REVIEWING

Back to Introduction

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There is a strong and useful analogy between a scientific review and an incomplete jigsaw puzzle. The assembly of an interlocking jigsaw puzzle of a thousand or more pieces involves recognition of both the complementarity of the outlines of particular pieces and of the fragments of the picture on their surfaces. If some of the pieces are missing, the jigsaw puzzle will remain incomplete. Nonetheless the shapes of the gaps and the partial picture gives clues to how the missing pieces might look and what images they might carry.

The above analogy did not spring forth spontaneously while I was actually assembling a review, sitting on the floor attempting to sort hundreds of papers, according to content, into a finite number of piles so as to leave a clear path to the door. Rather it surfaced after I was invited to write this essay and enliven it with some personal insights or anecdotes.

The writing of scientific reviews is rarely accompanied by hilarious incidents or sudden revelations which come upon the author when attempting to reconcile conflicting information. It is an unenviable task usually undertaken while one's colleagues are gamboling on snow-covered slopes, touring the world, or spending long hours in research directed at making the review obsolete before it appears.

Before setting down my own views on the scientific review, I thought that it would be

prudent to consult authoritative works which had doubtless appeared on this subject. I started with a broad search of the computerized catalog database covering over six million books in the nine-campus University of California system and the California State Library under the subject word "reviewing." A surprise—the search retrieved fewer than 150 titles. Variants on the subject word did not produce additional relevant titles. Almost all of the books were concerned with reviews and the techniques of reviewing books, poetry, drama, and the arts. In a few cases, the reviewing of scientific and medical books received some modest attention. *Reviews and Reviewing: A Guide* [1] includes two quotations relevant to scientific reviewing.

"*The reading public deserves to be helped in learning what constitutes science, to appreciate the nature of scientific controversy, and to understand what are scientific facts and concepts, as opposed to speculations and what is just rubbish...*" [2] Another view assumes that the reviewer is a competent writer, with well-expressed ideas. "*He must know the subject under discussion and must be able to speak with 'authority' derived from efficiency* (sic) *in the field. He must be able to appreciate the validity of the points made, perceive the adequacy in coverage, discriminate what is new and original from the derivative, and evaluate the significance of the new. And he must be able to recognize errors. Ideally, he should not be too limited in his narrow field, but have certain broader insights.*" [3]

A point made in an elementary primer on reviewing fits the category of "many a true word is spoken in jest," "*It would seem too obvious to require stating that the reviewer must begin by reading the work (or viewing the picture or hearing the opera) which he is to review. Yet many so-called 'book reports' have been written on unread books.*" [4]

Finally, Robert A. Day in his excellent monograph *How to Write and Publish a Scientific Paper* [5] has a four-page chapter entitled "How to write a review paper" with helpful comments on organization and format. It is hard to know whether his prefatory quote from James Russell Lowell

Nature fits all her children
with something to do,
He who would write and can't
write, can surely review.

is meant to encourage or discourage potential reviewers among his readers.

The inevitable conclusion that can be drawn from the above perfunctory literature search is that the specific art form of scientific reviewing has generated little critical attention.

Two Requirements

I will now move hesitantly to my own ill-defined impressions. The following remarks on scientific reviewing lay no claim to stating consensus opinions. I feel that a review of a given subject area should be written both for a broad scientific audience as well as for those working in the field. This objective places two initial requirements on the review. First, the readers should not be assumed to understand the jargon and the countless acronyms of the particular subject. The second requirement deals with context. The review should provide an explanation of the manner in which the particular subject fits into the broader field of which it is a part.

In describing a biological system, in particular, it is helpful to distinguish which of its features are idiosyncratic and which conform to patterns more generally observed. One of the charms of research in biology is that it mines the infinite wealth of unique aspects of different organisms. The beauty and functional attributes of these unique aspects can only be fully appreciated when they are broadly considered in the organismal and ecological context. A review that focuses solely on the biochemistry, or physiology, or ecology of an organism is surely less interesting, satisfying, and thought-pro-

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voking than one which attempts an interdisciplinary treatment.

Considerable effort is required to write a comprehensive, critical scientific review. Given the hundreds of reviews now published each year, at best a review brings the author numerous reprint requests (but few later citations), favorable casual comments from a few colleagues, and some criticism from one or two whose work was not mentioned.

What then is the motivation for the effort? Einstein[6] once wrote, "*There exists a passion for comprehension, just as there exists a passion for music. That passion is rather common in children, but gets lost in most people later on. Without this passion there would be neither mathematics nor natural science.*"

I believe that it is this passion for comprehension that serves as the hidden persuader to the scientific reviewer. It is the drive to assemble hundreds of ill-related facts into a pattern approaching coherence and in this process to uncover new principles and relationships.

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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.