INTRODUCTION

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The Board of Directors of Annual Reviews Inc. first discussed the initiation of an *Annual Review of Computer Science* more than a decade ago, when scattered review articles about computers and artificial intelligence had begun to appear in one Annual Reviews series or another. The project gathered momentum as a result of extensive mail surveys, personal interviews, and three planning meetings during 1983 and 1984 when the general coverage and specific contents of the initial volume began to emerge. Questions raised in the mail surveys and elaborated on in detail at those meetings included: Is an *Annual Review of Artificial Intelligence* and/or *Computer Science* needed? Is this the time to establish it? Can such a new series make a significant contribution to the research and educational literature in the broad field of computer science? If so, what should be its scope and focus? What major subjects should be covered, and with what frequency? Should engineering/applications receive major attention? How does one define "computer science?"

Computer science has been defined by Peter Denning as embracing every aspect of the processes that transform information (1). By that view, electronic computing machines offer a technological impetus to computer science, but hardly bound it; "computational science" might have been a happier choice of phrase.

During the preliminary discussions that led to the delineation of the *Annual Review of Computer Science*, another working definition offered was: "whatever is taught in university departments of computer science." This was a useful starting point, but it gives short shrift to the indispensable contributions of industrial and government research laboratories. One important historical function of the Annual Reviews has been to aid in the definition of a scientific discipline and to set critical standards for excellence within it, as well as to provide information useful to research workers, teachers, and students. Thus, as this series and the field itself continue to evolve, I foresee that the domain of the *Annual Review of Computer Science* will become the operational definition of computer science.

Annual Reviews Inc. was founded by Professor J. Murray Luck of Stanford University with the establishment of the flagship series, *Annual Review of Biochemistry*. Since then, 26 additional series have been added; a complete listing of titles and initial publication dates follows.*

*Readers should refer to the forms bound in the back of each book for listings of all available volumes and other ordering information.

Biochemistry (1932)
Physiology (1939)
Microbiology (1947)
Medicine (1950)
Plant Physiology (1950)
Psychology (1950)
Physical Chemistry (1951)
Nuclear and Particle Science (1952)
Entomology (1956)
Pharmacology and Toxicology (1961)
Astronomy and Astrophysics (1963)
Phytopathology (1963)
Genetics (1967)
Fluid Mechanics (1969)
Ecology and Systematics (1970)
Materials Science (1971)
Anthropology (1972)
Biophysics and Biophysical Chemistry (1972)
Earth and Planetary Sciences (1973)
Sociology (1975)
Energy (1976)
Neuroscience (1979)
Public Health (1980)
Nutrition (1981)
Immunology (1983)
Cell Biology (1985)
Computer Science (1986)

When the *Annual Review of Biochemistry* was launched in 1932, there were but a handful of review journals, fewer still in English. Of course, the overall scope of science was far smaller; if we adopt Derek Price's doubling time of 12 years, one would estimate that in 1932 the number of scientists and of publications was only about 5% of the number today. In the past 55 years both productivity and complexity have been enhanced by the use of computers and other instrumentation, and conceptual insights have steadily accumulated. It is now difficult if not impossible for the scientist in most specialties to keep up with the primary literature in a given field, and all the more to remain literate in broader aspects of scientific research. The review thus plays an indispensable role in connecting the individual with the broader scientific culture.

In response to a perceived need to bring greater recognition to authors of review articles that make significant contributions to the scientific literature, the National Academy of Sciences Award for Scientific Reviewing has been presented annually since 1979, and is briefly described in the Academy's 1985 Award Committee's brochure as follows: "Prize of $5,000, awarded annually for excellence in scientific reviewing published anywhere. Established in honor of James Murray Luck, sponsored jointly by Annual Reviews Incorporated and the Institute for Scientific Information Incorporated. Presented in the biological sciences in 1985, and the physical sciences, including applied mathematics and engineering, in 1986."

Recipients:

1979	G. Alan Robinson	1983	Michael E. Fisher
1980	W. Conyers Herring	1984	Ernest R. Hilgard
1981	John S. Chipman	1985	Ira Herskowitz
1982	Victor A. McKusick		

The recipient for 1986 is Dr. Virginia Trimble, professor of physics, University of California, Irvine, and visiting professor of astronomy, University of Maryland, in recognition of "her numerous comprehensive, scholarly,

and literate reviews, which have elucidated many complex astrophysical questions, and have informed and enlightened the astronomical community." Dr. Trimble believes that review articles are particularly valuable to education: "A student who's getting geared up to do a thesis needs to find out quickly where his thesis work fits into the great scheme of things. The same applies to someone starting a post-doctoral project in a new subject or somebody teaching a new subject for the first time. The actual audience that reads reviews is larger than that, but that's where I think reviews are particularly needed. And those are the people I try to keep in mind when I write them" (2).

Interdisciplinary convergences are the source of many of the most revolutionary and fruitful advances in science. Conversely, the review is the main source of commentary from the field back to primary contributors, taking part in the evaluation of the validity and significance of a given author's work, and very often providing provocative ideas for its further exploitation.

A decade ago, Dr. Eugene Garfield of the Institute for Scientific Information commented on the importance of scientific reviews to the advancement of original research, noting that "citation studies have shown that review articles frequently become milestone papers comparable in importance to experimental or theoretical papers in the same field." He went on to say, "there still is an insufficient supply of high-quality scientific reviewers. One reason why many scientists are not prone to try their hand at review writing is that it is quite demanding. It requires much time and discipline to write a readable, authoritative review. To keep up-to-date on the literature, especially in a rapidly growing field, is a difficult task" (3).

The continued leadership of Annual Reviews among review journals may be related to certain special features: Above all it is a voluntary and altruistic cooperation of working scientists on behalf of their colleagues. Authors are given no monetary compensation, but most have regarded an invitation to contribute as a badge of honor and esteem. Many younger writers have found writing a review an instructive challenge to their own broader thinking, and have received due recognition in return. Editorial committees also contribute the larger part of their time gratis: The editors' honoraria are nominal considering the time, work, and scholarly creativity actually entailed. The Board of Directors, likewise, serves without compensation. This pattern has been sustained mainly to minimize costs and prices so as to maximize the distribution and impact of the Annual Reviews and keep them accessible to impecunious students. It also enhances the inspirational motif of a voluntary, idealistic scientific community.

Authors, selected by the editorial committees, are asked to contribute not just briefly annotated bibliographies, but critical assessments of current work in their fields. Critical reviews require a high order of thoughtful synthesis, and I know from my own experience what a self-education is called forth.

The reviews are annual in two senses: The book is published annually, and readers can expect that a given topic will be revisited at timely intervals. The pace of publication schedules rather than of science, and the nonlinearity of the latter, make unfruitful the idea of a precise annual rhythm in reviewing a specific topic, nor is it necessarily desirable to retain identical topics indefinitely.

Difficult packaging problems remain: Inevitably, any Annual Review may contain articles that overlap the interests of other series. We try both to coordinate the planning activities of the various editorial committees and then to enumerate the related articles after each volume's Table of Contents. We have undertaken various experiments (e.g. periodic reprint volumes that repackage articles from several volumes), have others in mind, and would certainly welcome readers' suggestions.

One indicator of the scientific utility of Annual Reviews is the citation impact factor, the average number of times a given article is cited in the follow-on scientific literature. According to tabulations published by the Institute for Scientific Information in its Journal Citation Reports (1984), the *Annual Review of Biochemistry* stands first among all scientific journals with an Impact Factor of 29.4 . This index refers to the 1984 citations in all covered journals to ARB articles in 1982 and 1983. Of the 50 topmost journals ranked by impact factor, 9 were Annual Reviews. In order, these were *Biochemistry, Immunology, Plant Physiology, Astronomy and Astrophysics, Neuroscience, Physical Chemistry, Pharmacology and Toxicology, Genetics,* and *Physiology*.

Of course such tallies take into account only formal citations of articles in the Annual Reviews. We have no way to calculate how often an Annual Review bibliography was the source of other retrievals from the historic literature. Our authors can be assured, however, that their labor is used to good effect by their colleagues.

New technologies, from xerography to computer-based communications, certainly influence the patterns of scientific interaction, and are bound to affect the uses of Annual Reviews. Our primary aim is service to the scientific community, and we therefore place no hindrance on individual fair use of xerocopying of single articles. We may face a dilemma in how to enforce a fair price for the service offered by a volume that, in an institutional library, serves mainly as the master plate for innumerable clones. By keeping volume prices low we aim to provide the convenience of the whole book in the hands of a student or individual researcher. Using the volume entire is also more likely to serve a broader educational function, enabling the reader to browse over areas remote from an initial specialty.

From my own perspectives of twenty years ago, I would have been surprised to find how tenaciously printed books have maintained their roles in scientific communication, in contrast to electronic networks (4). As of 1986,

it is obvious that computer science has added much more to the flood of print than has been diverted to electronic media. The quality of collective contributions can be and is being greatly enhanced by electronic mail and text-processing systems. Even the esthetics of typography is individualized by systems like Donald Knuth's TEX. But I believe that this decade will see the peak in the use of print-on-paper for primary scientific dissemination. Electronic databases are becoming indispensable, both for primary data like protein and DNA sequences, and for the bibliographic resources now serving every major library and many individual subscribers. As long as hardcopy print is used at all, reviews are likely to prefer it; but the Annual Reviews should surely also be accessible online.

The special skills and perspectives of the participants in the *Annual Review of Computer Science* will thus be especially helpful to the future system design of Annual Reviews overall. We can speculate that the *Annual Review of Computer Science* may also be the locus of experiments, if for no other reason than the prior access enjoyed by that community to the paraphernalia of computer-based communications. Thus the Board of Directors of Annual Reviews has multiple reasons to look forward to the *Annual Review of Computer Science* as an extension of its family of Reviews.

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1. Denning, P. 1985. The science of computing: what is computer science? *Am. Sci.* 73(1):16–19
2. Trimble, V. 1986. Personal communication. *Curr. Contents* (28):7–10
3. Garfield, E. 1977. *Curr. Contents* (14):5–8
4. Lederberg, J. 1978. Digital communications and the conduct of science: the new literacy. *Proc. IEEE* 66(11):1314–19