

## Milestones on the thorny path of science

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*Milestone Series of Selected Reprints on Optics and Optoelectronics. Vols. 1–36, Series Ed. Brian J. Thompson, Univ. of Rochester, SPIE Engineering Press, 1989–1991.*

1. The Society of Photo-Optical Instrumentation Engineers (SPIE), which is well known for its great activity in the publication of varied literature on applied optics, has carried out a unique project in the last three to four years, the publication of a comprehensive (more than 30 volumes)<sup>1)</sup> series called the *Milestone Series of Selected Reprints (Literally-Milestones) on Optics and Optoelectronics*.

The idea of the published series has been formulated by the editors in the form of a slogan: "Milestones bring together in a single volume the key papers of the leading scientists and engineers in some particular area of physical and applied optics." Among the areas selected by the editors (which correspond to the volume names) are: polarization, nonlinear optics, coherence and fluctuations of light, turbulence in a refracting medium, optical activity, interferometry, holographic diagnosis of particles, acousto-optics, optical computers, laser destruction of materials, Raman scattering by a surface, ellipsometry, application of optical coatings, quasi-elastic scattering of light by macromolecular systems and liquids, etc.

The capacious volumes (about 600–800 pages) include from 60–80 to 100–120 reprints of the most important, in the opinion of the compilers, original articles on the corresponding area of optics. Even the list above, which is far from a complete list of volume names, shows that this is a rather inhomogeneous publication. At one end of the spectrum are volumes devoted to completely developed sizable areas of optics, for example, polarization, optical activity, nonlinear optics, coherence and fluctuations of light, etc. In order to provide a more specific representation of this area of the series, we present more detailed data on the last of the volumes listed above. Its editors are L. Mandel and E. Wolf, professors at Rochester University (USA), and they have limited the time period covered in the volume to 1850–1966. They included 93 reprints in *Milestones*. The volume begins with classic articles of Einstein, Van Zittert, Laue, and Zernike. A great deal of space is devoted to the development of the quantum theory of coherence in the 50s and 60s (including the work of Fano, Mandel, Gabor, Klauder, etc.). In the final section, which corresponds to the beginning of the laser era, are the well-known publications of Glauber, Haken, Senitskiĭ, Arecchi, etc., and these articles are devoted to coherent states, fluctuations in nonlinear systems, and the statistics of photon counts.

This volume gives an example of possibly the most rigorous approach to the selection of articles. Despite the fact that between 1966 and 1990 quantum and classical optics experienced several more quantum leaps, the editors apparently thought that the time to include them in *Milestones* had not yet come. In many respects, similar principles seem to have governed the compilation of the volumes on polarization (100 reprints beginning with the work of Nicol, Faraday, and Babinet), optical activity, acousto-optics, etc. At

the other end of the spectrum are collections devoted to subjects whose development began 15–20 years ago, and in some cases, only a decade ago. A characteristic example is the volume on optical computers (64 reprints of articles from 1980–1987). This volume discusses the possibility of creating a completely optical processor. This subject has been studied intensively in the last decade. The editors included the main publications on optical bistability and multi-stability, and variations on schemes for digital optical computers based on optically bistable elements. Articles on nonlinear analog computers and optical modeling of neural nets are also included. Despite the relatively short time period, this field has at least twice undergone a "reappraisal of values." In particular, the hopes for the competitiveness of digital optical computers have apparently not been realized. Actually the physics and technology of optical computers still remains in the formation stage, so that here time for the valid selection of "milestones" remains in the future. Thus, a volume like the one on optical computers can be seen as a unique collective monograph which presents a documentary retrospective on the development of the field.

This series also contains a large number of volumes at an intermediate position between these two ends of the spectrum. A serious, and to some extent painful problem is of course the selection of the "milestones" themselves, especially since virtually all volumes present reprints of papers published in the 1960's–1980's; that is, this series reflects to a certain degree the scientific rating of active scientists.

From this point of view, very specific comments could be made about virtually all volumes of the series. We will not, however, delve into this issue; after all we are talking about the first attempt to publish this type of series. We only note that in the development of selection principles it is hardly worth the effort to create a strictly regulated list of "Milestones." It seems that the goal of the publications of this type should be not so much to illustrate the canonized history of science, but, where possible, to reflect from all sides the life of science, the atmosphere of science.

To complete this review, let us focus on the undoubted merits of the *Milestone* series. There is no doubt that specialists, instructors at universities and technical institutes of higher learning, graduate and undergraduate students, have been provided with extremely valuable material. Publications like this one can certainly have a strong effect on instruction, on current scientific literature, and even on the atmosphere of science itself.

2. The chief editor of this publication, Brian Thompson, professor at Rochester University, states in his preface that it is true that "nothing can replace the reading of original articles, even if there are good critical surveys, textbooks, and monographs."

This is equally true for specialists and those approaching work in a new field. Hardly anyone will try to refute the truth of the statement; but real life is another matter. Unfortunately, one can regretfully state that an ever increasing number of new specialists receive an education which makes

almost exclusive use of "secondary" sources. Therefore, many authors of university courses undertook more or less successful attempts to include in their textbooks fragments of classic treatises and current original publications, materials which give an idea of the individuality of science, and where possible, provide a lively representation of the history of science. A good example is the well-known Berkeley physics course; recently the American Institute of Physics republished the remarkable book of Robert Wood, *Physical Optics*, for this purpose. In the opinion of the reviewer, the optimal solution would be the publication of "readers" which include key publications on the main areas of a general physics course; unfortunately, so far no one has succeeded in realizing such projects.<sup>2)</sup>

Now, with the appearance of this series, the problem can in principle be considered solved to a significant degree for courses in physical and applied optics. Of course, the problem of access to the publication in university libraries remains.<sup>3)</sup>

3. In reading volumes of the *Milestone* series one is forced to consider once again the many problems associated with the current state and the future of scientific literature. There is a rather widespread opinion about the progressive reduction of the value of individual journals due to the "industrial" character of science.

It is thought that *Milestones* which current science will leave for its descendants, will be built from many small stones from various research groups. The study of science provides a certain theoretical basis for this: the average lifetime of a journal article, calculated from the frequency of citation, does not exceed 4–5 years.

The selections of the type of the publication under review provide excellent material for independent evaluation. The reviewer naturally did not set the goal for himself of completely analyzing the problem; nonetheless, familiarization with these volumes shows that in optics and in optical physics, the value of individual efforts, and consequently, individual publications is, as before, very high. Here, the advancement of an idea and its final theoretical and experimental development, is even now, in many cases, the concern of small research groups. There are no special problems in isolating real key publications. It becomes all the more valuable to publish them in collections like the *Milestone* series.

4. The *Milestone* series can also be regarded as the reflection of the ever more distinct world trend in recent years to increase the number and variety of paper information carriers.

It must be said that already 8–10 years ago an impression was being formed that the future, in any case in the area

of scientific information, promised a sharp reduction in the role of paper publications, and the sunset of publishing. This was a time when the prospects of "electronic" journals began to be actively discussed, and large libraries opened computer rooms in which readers could directly access databanks. It seemed that under these conditions, direct contact of scientific personnel with paper information carriers such as traditional journals and books would begin to diminish.

Analysis of today's situation indicates, however, the exact opposite trend. Computers have created a revolution not only in the processing and accumulation of information, but also in publishing. Thus, today's scientist is literally overwhelmed with printed publications: new journals arise (in physical and applied optics and optoelectronics the annual increase in recent years has approached 6–8), proceedings of a truly immense number of conferences are published punctually (despite the fact that many reports appear later in the form of articles in professional journals). The selection of excellent published monographs, manuals, and textbooks is ample, and the number of publishers specializing in scientific literature is increasing. And one cannot help but note also the impressive progress in the quality of publications. Scientific books or journals published by leading firms also have a certain esthetic value; the rejection of a purely utilitarian approach to scientific publication is becoming more and more distinct.

All this increases the quality of the professional life of the scientist; new opportunities also appear to obtain information, and to express individuality, self-affirmation, exposition and popularization of ideas. The burgeoning of publishing makes an enormous contribution to the intellectual atmosphere of the scientific community.

5. The variety of printed publications discussed above fills the offices of scientists, the shelves of libraries, and university book stores; the cost of excellent published journals and books is still a small part of other expenditures in science and education.

Under these conditions, publications like the *Milestone* series, publications which make it possible to present the results of research from a new point of view, and to increase the effectiveness of the use of scientific potential, reveal new opportunities in education and face a bright future.

<sup>1)</sup>As to future prospects: there are about 20 more volumes already being advertised by the SPIE.

<sup>2)</sup>Possibly the only example of this type of publication in domestic literature is S. P. Kapitsa's publication of prefaces to the publications of classic researchers in natural science (see *Collected Forewords* (in Russian), Nauka, M., 1983).

<sup>3)</sup>A complete set of the *Milestone* series has been deposited by the publishers in the Lenin Library in Moscow.