than common sense can teach" them. Its thesis is the concept "that philosophy has proceeded from speculation to science." It first examines "the shortcomings of traditional philosophy" and then turns to an exposition of "modern scientific philosophy," collecting "the philosophic results that have been developed through the analysis of modern science and the use of symbolic logic."

The author is professor of philosophy in the University of California at Los Angeles, well known for his previous books and other writing. Here he sums up the results of his earlier studies in a comprehensive and very readable treatise, containing within its pages all the necessary scientific information to give a modern world view.

Dr. Wightman has recently become the first holder of a new lectureship in the history and philosophy of science at the University of Aberdeen. His book was published in Great Britain last year, and the American edition is being released the middle of May. In it, he follows the stream of scientific thought from Thales to the philosophers of the twentieth century, relating each step of discovery to past and future. Science is revealed as "a struggle no less charged with humanistic value than the struggle for political liberty or national expression." Although the intimate relations between scientific theories and technological demands receive appropriate attention, Dr. Wightman does not regard "the socioeconomic as the sole directive in the cultural advance."

Books, Civilization, and Science

Warren Guthrie

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IT IS WITH A GREAT DEAL OF UNCERTAINTY AND HESITATION that one whose field is rhetoric and public speaking—that knack little better than cookery in Plato's eyes—even ventures near the habitat of men of science. To us science *is* a sacred cow; the scientist, in turn, commonly accepts our discipline as a part of college and university training, with some tolerance but with little enthusiasm.

Why, then, do I write of "Books, Civilization, and Science"? Because a few months ago it was my good fortune to moderate a discussion on this so sharply limited subject at the annual meeting of the American Association for the Advancement of Science in Cleveland. Participating in the discussion were Kirtley Mather of Harvard, Ralph Gerard of the University of Chicago, James Stokley of the General Electric Company, and David Dietz of the Scripps-Howard newspapers. Representing publishers of scientific literature were Hugh Kelly of McGraw-Hill, Charles Skelley of the Macmillan Company, Herbert S. Bailey, Jr., of the Princeton University Press, and, in the absence of Edward Crane of D. Van Nostrand Company, Dennis Flanagan of *Scientific American*. May I hasten to relieve them, individually and as a group, of all responsibility for any statement made in this report. The following lines are my effort, as moderator of the discussion, to summarize the content of that extremely interesting two hours. For such of value as it may contain, credit their contributions to the discussion itself; where it may seem in error or ill-considered, blame the inaccuracies of this reporter.

That there is great need for the writing and publication of scientific books directed to the general reader was apparent to everyone. With the achievements of science an ever-increasing force in our civilization, the need for wide dissemination of scientific learning and method hardly requires proof. Not only is there imperative need for the encouragement of scientific habits of mind; there is an almost equal necessity for acquainting the public with new discoveries and concepts resulting from current scientific research.

Further, the times seem to offer unusual opportunity for meeting this need. The reading public is interested in scientific matters. Its interest has made some scientific—and more pseudo-scientific—books best sellers. Scientists themselves are more aware of the need for interpretation of their field than in many decades. Forced into public life by the tremendous social impact of the discoveries they have made, they seek to help in the constructive, rather than destructive, use of their knowledge. And, finally, there is now an abundance of the kind of material in which the lay public will take interest. New and revolutionary ideas and concepts are literally streaming from our research laboratories. The novel is inherently interesting; the revolutionary demands attention.

With these factors immediately apparent in our discussion it might have seemed in danger of bogging down from lack of a problem, but such was far from the case. For the publishers frequently print, it was charged, and the public likes, the sales records show, the *wrong* kinds of scientific books. The best sellers dealing with matters scientific are those such as *Worlds in Collision* or *Dianetics*. More sound, more responsible, though less sensational works, even when written with an eye to the general public as audience, are seldom as widely read. It was with this problem that our group became largely concerned.

For the charge that they were at fault, the publishers had an immediate and effective answer. Most of the books against which the scientists were most

vocal were not listed by their publishers as "scientific." That the public regards them as such, say the publishers, is beyond their control. Furthermore, as Mr. Skelley pointed out, in at least one case in which a book that the panel regarded as unsound enjoyed a wide sale, the publisher voluntarily transferred his rights to another company at heavy financial loss. Other representatives of the publishing group made clear their interest in seeing that books presented on their scientific lists are acceptable to the scientific fraternity, as well as popular with the general public.

Nonetheless, the "wrong" kinds of scientific literature do get published. Feeling that there should be some protection to the public from the unsound, and a consequent greater interest in the best scientific writing, the panel offered several constructive suggestions.

First, to assist the publishers in their job of selecting those manuscripts that merit publication, it was suggested that some sort of board of review be created from the ranks of the scientists themselves. This board would be quick to eliminate the spectacular but nonscientific. To the criticism that such review might involve a kind of censorship that would deny the right of publication to any truly revolutionary work—sound or unsound—there was, however, no final answer. Consequently, the panel began to explore other means by which the same problem might be met. The answers seemed to lie in the development of a set of principles by which publishers might be guided, rather than in the support of a board of review.

Those principles followed, in general, a proposal presented by Dr. Mather. Underlying the plan was the realization that most members of the general public, and even some publishers, are unable to distinguish the "plausible but false from the astonishing but true." Always to be regretted, in a period when mass communication and general tension make the individual especially susceptible to propaganda, such false and sensational writing was felt to be more than a disservice to science and to civilization, and it may now be a positive danger. Step one in the selective process can come from a reawakening of those in editorial offices to one of the cardinal principles of scientific methodology in a free society.

In this sort of society the scientist is encouraged to be revolutionary, to conceive and proclaim new ideas. No truth is regarded as absolute, no answer ultimate. Only from new and frequently daring hypotheses can progress come. But this does not mean that every proponent of a new idea or theory deserves an immediate public hearing, backed by the reputation of a widely accepted publisher. That "testimonial" is hardly earned until the writer follows a procedure long tested in science, be he a venerable academician or a young unknown. Before the new theory is presented to the frequently gullible public, it should be submitted to a jury of the writer's peers—to those who by training and experience are most competent to examine and to criticize it. Such juries are legion—they are the professional societies of scientists, the technical journals of each of our fields of learning. Here scientific minds meet in direct association. Here is the cauldron of controversy where precious metal may be separated from dross. Here the new theory may survive its ordeal by fire.

No publisher, said Dr. Mather—and his colleagues seemed generally to agree—should yield to the temptation of selling a book full of radically new or obviously unorthodox ideas until he has learned of the previous presentation of those ideas to the scrutiny of the author's scientific peers in technical journals or at professional meetings. Wide acceptance by those judges was not felt necessary—scientists are sometimes as guilty of reactionary conservatism as the rest of us. Louis Agassiz' theory of a "great ice age" seemed just as preposterous to many people when first announced, as Velikovsky's theory of "worlds in collision" seems today. Agassiz' theory, in fact, was ridiculed as the "glacial nightmare." But Agassiz adhered to the routine described above; Velikovsky bypassed astronomers and geologists and went straight to the general public. Such failure to submit the material and gain at least a modicum of support should be a signal of clear and present danger to any publisher.

The second answer to the problem of the publisher was thought to lie in the labeling of his product. Since he must, after all, produce popular works if he is to survive, it was felt that even the most arrant nonsense might occasionally justify publication—even as does a *Forever Amber* or an *Anthony Adverse*. The labeling, however, should be careful, so that the pseudo-scientific is tagged as the fiction it actually is.

To the other half of the problem posed—the fact that responsible works, even when written for the general public, seldom secure a wide audience—the answers were far less clear. It's the familiar problem common to all of us in education—thoroughly adjusted to the captive audiences we so often face, we are frequently less than satisfactorily effective when confronted by the free world outside.

Our excuses for our ineffectiveness are, of course, many, and their actual truth makes them all the more persuasive. Competent and successful research scientists are generally too busy to undertake the job of clear and simple writing. Even when they assume that responsibility, they are frequently incompetent in the sense that they do not possess the flair essential to the dramatization of their ideas. After all, as the members of the panel so capably pointed out, it is inherently an extremely difficult and time-consuming task to translate the language of modern science into the vocabulary of the general reader. Time spent in this task is time *not* spent on productive research. Thus many of our most able scientists simply refuse to attempt to write for popular consumption.

Yet there can be no doubt of the necessity of making science clear to the layman. The tragic results of his ignorance and misunderstanding are constantly before us. And it must also be recognized that it is a far easier task to put the achievements of science into terms that can be understood by the public than to

bring that untutored public up to the standard of education that will make them able to comprehend the specialized language of the scientist. Certainly there can be no virtue in dullness or lack of clarity.

Some progress is being made. The occasional scientist who does succeed in popularizing his science is no longer a pariah. To an extent undreamed of a generation ago, he may even receive critical acclaim. Step one in improving the public appreciation of scientific achievement must be a continuing recognition of the value of this kind of writing. Its importance in the whole advancement of civilization grows greater by the day.

Further, there are now available competent science writers—men whose primary skill is communication, but whose scientific training provides them with the basic knowledge required for accurate reporting of scientific achievement. To these men should be given the wholehearted support and encouragement that can come only from those actually engaged in the research reported by the writers. Not only do they merit help in general—they should be given the opportunity to collaborate with top-flight research scientists in carrying the results of this research into the minds of the mass reading audience. Science writers have already been able to do this job in many instances. With wholehearted support, they can do much more.

There are, of course, many pitfalls in the path of successful collaboration. It is, however, one answer to the problem of making reports more palatable, and for the scientist who begrudges any time taken from his laboratory it may be the only practical one. Even the "ghost writer" of Washington and Hollywood fame may one day find his niche in science, also.

Two additional solutions were proposed. Each would involve the acceptance by the scientist of his responsibility to write clearly and interestingly, and his willingness to work at his skill as at any other necessary technique. The results should justify the effort. Magazines of relatively large circulation can provide the testing ground for the scientist willing to learn the necessary skill in communicating his ideas. By submitting articles with regularity—seeking an ever more cogent style—the research scientist can begin to compete with his less able but more dramatic colleague for popular interest. Such magazines provide one means of disseminating information to an increasingly large audience as well.

The last answer proposed by the panel was even more fundamental. Perhaps, if the scientist is to assume his full responsibility for the communication of his knowledge to a troubled world, he must be more of that world himself. His interests can no more be limited by the four laboratory walls than can the results of his tests and research. Although his forte may be science, his study of, and interest in, the humanities must never lag far behind.

Here our British colleagues offer an encouraging lead. Broader in their educational training in almost every instance, generally more catholic in their interests and tastes, almost always more skilled in their use of language, they succeed in arousing interest where we often fail. Where our own writers have combined scientific achievement with broad, humanistic interests, we, too, have achieved science and sanity at the same time.

Preoccupied as I am with the field of communication, it was a heartening experience to see this concern on the part of the scientist. Ours *is* one world in the sense that the achievement and success of each of us has its inevitable effect on the lives and fortunes of others. Only when we seek mutual understanding and progress on the highest generally popular level available can that effect be the forward movement of all things—books, civilization, and science included.

Science and Literature

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MOST PEOPLE LIKE TO BE WRITTEN ABOUT, whether they can justify the feeling or not. Scientists are no exception. Of course, we like to see our technical papers quoted, for that helps give our own particular contribution the emphasis it deserves. We don't mind seeing our names in the newspapers, either, for no particular reason unless we believe that well known means well paid.

Next to appearing in print ourselves, we get a certain vicarious satisfaction from being associated with publicized matters. It is only human to feel that "it's my laboratory," or "my committee," or "my field of work" that is receiving so much attention. And I think it is perfectly all right to feel a little pleased, too, that people are taking such an interest in science-fiction. This seems to show that they have an interest in science and, indirectly, even in you and me. We might as well like it, for we cannot change the fact that a version of science and scientists is being presented to a growing group of readers in this way.

We may please ourselves by believing that science has a good deal to offer to the field of literature. Aren't scientists and science worth writing about? And don't people ever get tired of stale adventures, stale surprises, and stale ways of killing and of hiding