Is it Relevant to be Completely Relevant?

ERNEST Hemingway's dictum for starting a new chapter was: Write a simple declarative sentence; so here it is. *I do not like writing editorials.* Why? Simply because I doubt many read such stuff and those that do must quickly forget the platitudes. Such is my yearly complaint.

Last year's effort told of my sabbatical wanderings, beginning with reminiscence of an Atlantic crossing on the S.S. France (my guess that it was the last opportunity for that gracious way to cross has most unfortunately been proved correct). I know of one (well-respected) man who read last year's editorial and found it interesting, so I will try again (on the basis of such a significant sampling!) to impose my personal observations upon you and hope for the best.

The autumn scene rolls by the train window in a slashing rain, dampening further an already murky mood. For some reason, Wordsworth's opening lines from "The World" come out of a long-way-back exposure to English Literature:

"The world is too much with us; late and soon,
Getting and spending, we lay waste our powers;
Little we see in nature that is ours;. . . ."

To me this is an elegant way of saying that most of us are caught up with doing so much there is little time for quiet moments for books or journals.

In their often frenetic existence, engineers have grown too impatient to chase authors down their labyrinthian channels bestrewn with integral signs and the like. This is not unreasonable, as the practicing man deals largely with concepts which he can judge from his experience are either viable or not. He may frequently depend upon recent graduates to assess the details of mathematically abstruse developments. However, I wonder if even very recent graduates can follow detailed analyses.

It seems to me that the imposition of requirements for advanced degrees upon college teachers has had the effect of bringing into the undergraduate curricula concepts and methods formerly reserved for graduate school. As a consequence, the teaching of undergraduates, and pre-college students as well, has become broadened, diffused, and largely lacking in the vigorous drilling on fundamental manipulative skills which are essential to conduct of original work and the comprehension of this type of work by others. We are losing certain essential "grass roots." I am perennially made cranky by the appearance in my graduate classes of many students who are overwhelmed by

$$\int_0^{2\pi} \cos^2\theta \mathrm{d}\theta$$

They even seem to have forgotten that tables of integrals still exist—and to reduce simple quadratures without their use is surely an impossibility for them. This syndrome is not limited to the United States, as an excellent professor of mathematics I know from Leicester, England, has confessed that in drafting examinations he must be careful not to pose questions which involve integrals requiring any skill in their reduction to elementary functions. This all points to a trend to graduate generalists with both a distaste for applied mathematics and an inability to develop concepts from basic principles.

Many might object that such ideas do not fit with the stress now laid on the necessity for strict relevance in all areas of research. Since the days of MacNamara, the credo that research must be severely limited to concepts which can be demonstrated at the *outset* to be cost effective has been applied quite relentlessly not only in the United States but elsewhere, such as in England, where industry has been particularly antagonistic to the support of academic research.

In this connection, there is an interesting article in the October 1974 issue of *European Scientific Notes (ESN),* a monthly publication of the Office of Naval Research Branch Office, London. In this report, J.H. Schulman, the current Scientific Director of ONR London, not only shows that the interaction of science and technology is dynamic, i.e., changing with time, but also strikes a necessary blow for the need for an admixture of basic and applied investigations. As the ESN are not widely distributed, I thought it worthwhile (and, I hope, interesting to our readers) to quote rather liberally from this article.

Dr. Schulman writes: "The care and feeding of science and its practitioners continues to be a topic of lively discussion by British science editors, government research counsels, R and D managers, officials of learned societies, and miscellaneous commentators on UK educational and industrial policies. Some remarkable ironies are evident in the current expressions of British opinion on this subject; for example, an industrial R/D management is advocating increased basic research while prestigious spokesmen for British science are advising their colleagures to strive for greater relevance."

These views are drawn by that author from several recent publications. The scientist's view of himself has been attacked in *Nature,* August 1974 and in the *New Scientist* (same date). In the former, the scientist's posture as a creative artist should require that, like his musician counterpart, he be submitted to re-auditioning periodically to determine if he (the scientist) deserves to keep his "chair." The artists—writers, painters, and composers—must accept a ruthless existence in which his survival depends upon his maintaining a high degree of productivity judged not by only his peers, but mainly by contemporary society. *Nature* asks why scientists are not willing to live by these rules but, rather, demand continuing support while reserving the right to work on whatever they personally find interesting regardless of how unnecessary their work may be.

Dr. Schulman goes on to relate that Sir John Kendrew (retiring President of the British Association for the Advancement of Science) has advised scientists to re-examine the premise that the prime motivation for their research is the absolute good of pursuing knowledge for its own sake. He suggested that most present-day research might appear to future (science) historians as medieval scholasticism now appears to us.

Counter to this is the most significant part of the "1973-74 Annual Report and Accounts of the Central Electricity Generating Board" which relates that experience in this industry has shown that unexpected plant problems can be tackled more effectively when a store of basic knowledge has been built up rather than when the problem has to be overcome on an ad hoc basis without adequate scientific knowledge. As a result, the Board has decided to shift funds to basic studies from their (over 90%) commitment to applied work by reducing attention to low priority problems in the short-term area.

Schulman points out that this jumbled picture becomes clearer from the overview of the relationship between science and technology given by Langrish in *Nature,* August 1974. Although Langrish's study shows that current university-based research is out of phase with industrial research, it has not always been so. He pointed out that the organic chemical industry in England (in latter 19th century) was generated

from university work (done in Germany!), but that, subsequently, universities centered on better understanding while their industrial counterparts concentrated on extending uses without theoretical bases. Langrish was led to conclude that the relationship between these seemingly divergent camps is not fixed, but dynamic and possibly cyclic. If this be correct, then it is not rational to expect that technical innovations occur solely because of "demand pull" ("relevant research") or "discovery push" ("undirected research"). My own observation is that both paths must be taken and, hence, a mix of support is essential.

Langrish (as Schulman relates) notes that basic forces may be operating to influence industry to turn more to original research because of new concerns about resource depletion, environmental pollution, and ecological factors involving health and human safety. Thus industry (and I hope governmental agencies) must pay more attention to securing a basis for understanding what they are doing. Dr. Schulman concludes that the present spokesmen for science, in urging relevance upon their colleagures, are making "a belated response to social and economic forces that were very visibly building up for much longer than a decade. It is quite possible that the current strong focus on this objective is blinding many people to the dynamics of the science-technology relationship, a condition in which *neither* nor technology will be well served."

My own view is that it is as meaningless to argue one cause against the other as it is to argue about religions. We have to solve our problems by a judicious balance of support for both short-term and long-term studies, and the responsibility lies with those making decisions in government, industry, and granting foundations, and with those colleges involved in the education of future engineers and scientists where the need for recognition of a balanced approach must be inculcated (including the lost emphasis on ability to manipulate elementary mathematics).

The policy of this Journal will continue to seek such a balance within its capability to do so from the manuscripts submitted. Let us hope that all of you out there, both engineers and scientists, will be encouraged to assist us to so serve you in this respect.

Finally, I wish to thank most heartily the reviewers cited below, our contributors, and the dedicated publications staff of the AIAA for their work in 1974. You can depend upon all of our efforts here to bring you an improved archival journal in 1975.

John P. Breslin
Editor-in-Chief

Reviewers for *Journal of Hydronautics*, September 1, 1973—August 31, 1974*

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*Because it is difficult to include the reviewers for September, October, November, and December 1974 in this issue of the Journal, they will be listed with reviewers for 1975 in the January 1976 issue.