PHYSICS and SOCIETY

The NEWSLETTER of the FORUM on PHYSICS and SOCIETY

Published by the American Physical Society, 335 East 45 Street, New York, New York 10017

VOLUME 5, NUMBER 4 OCTOBER, 1976

A FEEDBACK EFFECT OF THE PHYSICIST'S "PRAGMATIC" ATTITUDE TOWARDS MATHEMATICS

Robert Hermann, Harvard University

Several years ago, I wrote a letter[1] to Physics Today pointing out that the graduate mathematical training of physicists had fallen behind that of many engineers, and that this might have bad effects on the profession's newfound desire to expand job opportunities. Joel S. Spira responded[2] that he thought, to the contrary, that physicists learned more mathematics than was needed in a practical situation, and that they were too specialized to be of economic help to industry. Since this reflects traditional misunderstanding, I want to expand here on my original letter, based on my own experience as a mathematician who has worked extensively with both physicists and electrical engineers.

Although we inevitably have different perspectives (I am an academic mathematician and he is an industrial physicist) I believe that Spira misinterpreted my letter, and that we agree much more than he thinks. I also deplore extreme specialization in the training of physicists, and agree that something is wrong when young Ph.D.'s know nothing else than the details of "the spin reaction of something or other".

How to remedy this problem is a very deep question in educational theory and philosophy. I would guess, from the tone of his letter, that Spira would suggest more "practical" training. However, the engineering disciplines which are closest to physics have modified their traditional practical orientation and now insist that their students take formal training in many advanced applied mathematics subjects. Maybe this is a bad thing -- perhaps it explains why we now have energy crises and power blackouts! However, students trained this way seem to be in demand for jobs that physicists used to get, and I haven't heard anguished cries that they are totally unsuited to the practical world.

(continued on page 2)

REMINDER

THE FORUM WILL HOLD CONTRIBUTED PAPER SESSIONS AT THE CHICAGO AND WASHINGTON APS MEETINGS.

The deadline for the Washington Meeting is January 28, 1977. There is still plenty of time to submit a paper to that meeting.

CONTENTS

Physicist's Attitude Toward Mathematics . . . . . page 1

APS Guidelines For Professional Employment . page 4

Forum Officers and Executive Committee . . . page 7

PHYSICIST'S ATTITUDE TOWARDS MATHEMATICS (continued from page 1)

Now, this recent mathematical orientation of graduate training in, say, electrical engineering is not because the elders of the discipline were so beloved of mathematics. The fundamental reason is that, because of computers, technology and the social sciences are becoming much more mathematical. Physics, too, is becoming more mathematical, for better or worse, but physicists still believe in the amateur tradition that you only learn what you need when you need it. This might have been fine for Dirac and Einstein, but there do not seem to be any more young Diracs or Einsteins around. Here is a phenomenon which I personally have observed to be much more prevalent. An otherwise excellent physicist will spend essentially his whole career concerned with, say, the application of group theory to physics, but he does not understand (or painfully rediscovers) simple ideas about groups that are a hundred years old and that can now be taught very readily to undergraduates.

Since my original letter, I have made further inquiries, and have learned many details which confirm my diagnosis. For example, even graduate students in theoretical elementary particle physics in the best schools need take no mathematics beyond their undergraduate work. Physicists working in a leading industrial laboratory have told me privately that they cannot collaborate with other groups in the same laboratory interested in computer research because their mathematical language and background are so different.

Here is a comment that might seem minor but that I think (as a mathematician) is symptomatic. A key role in modern technology and economics is taken by a formulation of the calculus of variations called the "Pontryagin maximal principle". Now, this is basically a reformulation and generalization (and a very beautiful one!) of Hamilton's and Huygen's principles. One would think that physicists teaching classical mechanics, for example, would seize on it (and it is over twenty years old!) in order to show their students how physics ties in to these other disciplines. (It is also very useful for mechanics itself, e.g., in handling constraints.) However, I have not even seen a reference to it in the physics research literature!

In my original letter, I proposed that the group known as "mathematical physicists" might serve as the bridge that is needed to modernize physicist's mathematical education. On further reflection, I have concluded that this is, alas wishful thinking, at least as far as "mathemati-

(continued on page 3)

PHYSICIST'S ATTITUDE TOWARDS MATHEMATICS (continued from page 2)

cal physics" exists in North America. There are two disjoint sets of people calling themselves "mathematical physicists". The first are theoretical physicist who find that they need a greater than average acquaintance with mathematics to do their physics. Although they usually teach the graduate mathematical physics courses in universities, they inevitably know very little of the larger context of mathematics today, hence cannot be expected to teach very much in this direction to their students. The second, much smaller, set consists of people who are essentially pure mathematicians (with all the intellectual vices, but not necessarily all the virtues of professional mathematicians!) and work on admirably difficult, but specialized, mathematics problems (mainly on the fringes of functional analysis) that have historically arisen from physics. To the extent that they influence the mathematical education of physicists, it is towards "analysis", whereas physicists who want to work in a wider context (and even who want to be more effective physicists!) should know more algebra, geometry, and numerical-computer oriented mathematics. There is historically a third set of people -- exemplified by such men as von Neumann and Weyl -- but what has become of it? Doesn't the physicist's traditional attitude of "pragmatism" toward mathematical thought bear part of the responsibility for this situation?

References

1. R. Hermann, Letter to the Editor, Physics Today, December, 1972, p. 9.

2. J. Spira, Letter to the Editor, Physics Today, June, 1974, p. 15.

PHYSICS AND SOCIETY, the Newsletter of the Forum on Physics and Society of the American Physical Society is published for, and distributed free to, the members of the Forum. It presents news of the Forum and of the American Physical Society; and provides a medium for Forum members to exchange ideas. PHYSICS AND SOCIETY also presents articles, letters, and columns on the scientific and economic health of the physics community; on the relations of physics and the physics community to government and to society, and on the social responsibilities of science. Space is preferentially give to those analyses and opinions which are less likely to be published in the established journals such as Physics Today and Science. Letters, short articles, suggestions for columns, and Forum news items should be sent to the Editor, Martin L. Perl, SLAC, Stanford, California 94305.

PHYSICS AND SOCIETY is also distributed free to Physics Libraries upon request. Such requests and requests for other information should be sent to M.L. Perl.

MORE ON APS GUIDELINES FOR PROFESSIONAL EMPLOYMENT -- A Letter from Thomas P. Sheahen, National Bureau of Standards

This letter discusses the "guidelines for professional employment" which are under consideration by the APS Council. I believe I have a unique perspective regarding industrial physicists and their participation (or lack thereof) in the APS, and can explain why the guidelines should be endorsed by the APS.

In 1966, MIT gave me a PhD in physics and I immediately went to work at Bell Labs. I left there in 1973 to join a comparatively small company that builds instruments. I stayed two years before coming to the National Bureau of Standards.

It is my perception that when the APS speaks of "industry", it is applying an image of Bell Labs, IBM, Xerox and perhaps the various national laboratories like Oak Ridge and the National Bureau of Standards. I submit that the real world is made up more of small and medium-sized companies which have no resemblance whatsoever to the Bell Labs mileau. The APS should make it our concern to provide satisfactory working conditions for our colleagues in such industrial settings.

The object of any private company is, of course, to make a buck. During difficult economic periods (such as 1974-75), at many companies this goal is subordinated to that of keeping the wolf from the door, i.e., averting bankruptcy and maintaining enough cash flow to meet the payroll. About the time that bills go unpaid for 90 - 180 days, anything even vaguely resembling research is jettisoned in favor of immediate cash flow, with the result that research scientists become overqualified equipment installers and field engineers.

The business managers who run most of american industry have no idea what a physicist is, nor can they distinguish between one type of scientist and another. They appreciate absolutely nothing of the training or professional values that scientists have: the man who tells the truth about a product and thereby loses a sale is a fool who should be fired, or at the very least kept far from potential customers.

During my time managing a team of instrument builders (all of whom were of Bell Labs quality as scientists), I had the unpleasant duty to select individuals to be laid off. I was

(continued on page 5)

APS GUIDELINES (continued from page 4)

fortunate to have sufficient personal prestige that these individuals were retained by the company, being transferred to jobs that required little of their professional skills (e.g., routine calibration of instruments). At no time did the upper management ever entertain any thought whatsoever of the concepts embodied in the guidelines now being proposed to the APS. The notion of professionalism among the scientists simply did not exist in the mind of management. Had there been a set of APS guidelines at that time, junior managers such as myself would have had a much stronger hand in striving to preserve the jobs of our own people. As it was, statements by me that a man might want to finish a job he was nearly through with were met with blank stares.

The right to publish one's work is very much abused by management in private industry. My ability to obtain a better job was conditioned heavily by a good record of publications, all of which were unrelated to instruments made or sold by the company. Many of my colleagues could easily have published excellent papers in Reviews of Scientific Instruments or Journal of Applied Physics without infringing corporate secrecy at all. They were discouraged from doing so by the press of immediate revenue-producing activities, coupled with the knowledge that a single caution from a non-technical reviewer in the sales department could blockade publication permanently. Again, guidelines would have helped in this matter, by showing management what is the norm of professional activity by a scientist.

I have read much in recent years about the professor's obligations towards his graduate students, but I have seen nothing about our community's obligations to our own members. Every other professional society has endorsed the rather minimal guidelines that the APS Council is being asked to approve. (The American Chemical Society's more strident guidelines might provide our industrial colleagues with additional clout, but they are not at issue within the APS.) If we fail to endorse the guidelines, we are encouraging our own people to leave the APS and join the IEEE, the ACS, or many other professional organizations who have shown their concern for the professional employment of their members. Realistically, what binds the industrial physicist to the APS?

I don't think the numbers question (i.e., loss of members) is nearly as important as simply doing what is right for our own colleagues. The guidelines do not harm the tenured

(continued on page 6)

APS GUIDELINES (continued from page 5)

faculties that comprise the central core supporting the APS. If they seem irrelevant to IBM, Bell and Xerox, it is only because these companies already have scientific managers. The benefits to physicists in lesser corporations would be enormous.

The APS Council will approve the guidelines if enough of the members indicate their support for the guidelines.

EDITOR'S NOTE: Further letters or articles on the issue of APS Guidelines for professional employment will be welcome

---

SCIENCE COURT INFORMATION PACKET

Persons interested in holding a seminar at their institution that deals with the Science Court may be interested in obtaining a packet of information assembled by the Forum. The packet contains:

1. Three papers from the literature describing and commenting on the Science Court concept:
   a) A. Kantrowitz, American Scientist 63, 505(1975).
   b) Task Force of President Advisory Group, Science 193, 654(1976).
   c) B.M. Casper, Science 194, 29(1976).
2. Two position papers given at the "Colloquium on the Science Court" (September 20-21, 1976; Leesburg, VA):
   a) Richard Simpson's talk favoring the Court.
   b) Earl Callen's remarks opposing the Court.
3. A list of possible speakers who could be invited to speak on the subject.

To obtain this packet, write to the Forum Secretary-Treasurer,

Dr. Thomas P. Sheahen
Technology - A158
Office of Energy Conservation
National Bureau of Standards
Washington, D.C. 20234

FORUM ON PHYSICS AND SOCIETY OFFICERS AND EXECUTIVE COMMITTEE

CHAIRMAN:

Lee Grodzins
Room 26-421
Physics Department
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139
(617)253-4244, 253-4294

VICE CHAIRMAN:

Benjamin S. Cooper
3106 Dirksen Senate Office Bldg.
Senate Committee on Interior and
Insular Affairs
Washington, D.C. 20510
(202)224-0611

SECRETARY-TREASURER:

Thomas P. Sheahen
Tech A 158
Office of Energu Conservation
National Bureau of Standards
Washington, D.C. 20234
(301)921-3275

DIVISIONAL COUNCILLOR:

Earl Callen
Physics Department
American University
Washington, D.C. 20016
(202)686-2549

PROGRAM COMMITTEE CHAIRMAN:

Benjamin S. Cooper

EXECUTIVE COMMITTEE:

William Blanpied
Office of Science and Society
National Science Foundation
Washington, D.C. 20550

Martin Blume
Building 510A
Brookhaven National Laboratory
Upton, New York 11973

Anne H. Cahn
Prog. on Science & Int'l Affairs
Harvard University
9 Divinity Avenue
Cambridge, Massachusetts 02138

Vernon J. Ehlers
Physics Department
Calvin College
Grand Rapids, Michigan 49506

John Gibbons
330 South Stadium Hall
University of Tennessee
Knoxville, Tennessee 37916

I. Richard Lapidus (past chairman)
Physics Department
Stevens Institute of Technology
Hoboken, New Jersey 07030

Joel Primack
Physics Department
Univ. of California, Santa Cruz
Santa Cruz, California 95060

Brian Schwartz
National Magnet Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Barry M. Casper (past chairman)
School of Public Affairs
University of Minnesota
Minneapolis, Minnesota 55455

A P S M E M B E R S: J O I N T H E F O R U M O N P H Y S I C S A N D S O C I E T Y

To become a member of the Forum fill in this form and mail to:

Thomas P. Sheahen, Forum Secretary/Treasurer
Tech A 158
Office of Energy Conservation
National Bureau of Standards
Washington, D.C. 20234

I wish to join the Forum.

Name (Please Print)_____

Address_____

_____

Dues are 2.00/year

JOURNALS NEEDED

The Scientific Aid for Indochina Project is collecting scientific, technical, engineering and medical journals for Viet Nam. If you wish to donate such journals (runs are preferred) contact Prof. E. Cooperman, Physics Department, California State University at Fullerton, Fullerton, California 92634.

PHYSICS AND SOCIETY
The Newsletter of the
Forum on Physics and Society
of the
American Physical Society

Vol. 5, No. 4 October, 1976

The American Physical Society
335 East 45th Street
New York, New York 10017

Non-Profit Org.
U. S. POSTAGE
PAID
New York, N.Y.
Permit No. 2937

*
ARTHUR Z ROSEN
PHYSICS DEPARTMENT
CAL POLY STATE UNIVERSITY
SAN LUIS OBISPO CA 93407