

Judging the value of physics research

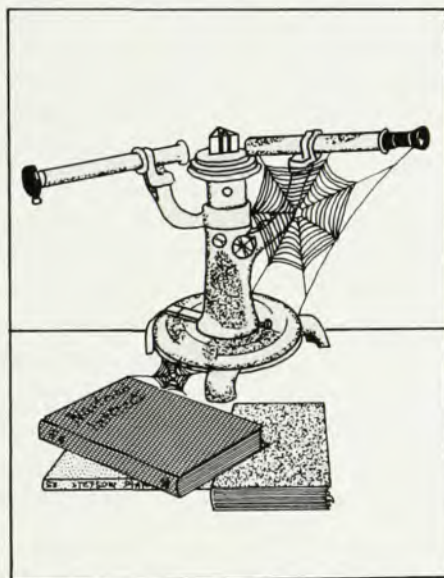
During the past year there has been a great deal of discussion in the media of the levelling off of research support and of what the consequences of this are likely to be for the national welfare. The discussion reveals a remarkable degree of agreement with a point of view well expressed in your own editorial of last June in which you stated that a continuation of the current levelled-off condition would be "suicidal from the point of view of the national welfare." You stated further that we should attempt to "convince policy makers to come to their senses" and that "research support should at least expand no more slowly than the rate at which the Gross National Product is expanding."

I would like to argue that even though just about everybody apparently agrees with the above analysis it is really quite false; moreover it is in a way even more interesting to consider the question of why so many people believe this nonsense as it is to discuss the arguments usually given in support of it. First, however, I would like to clear away one potential source of confusion. The term "national welfare" is, of course, not self-explanatory, although anyone who has thought very much about the history of support for physics research is almost certainly going to conclude that the welfare of the nation has a lot to do with military technology. This raises an ethical question that I do not wish to discuss here. I am concerned only with the question of the conditions under which the general community is affected in any way by the activities of its research scientists. In other words, I wish to discuss simply the effectiveness of research whether in terms of weapons, civilian technology or increased understanding of the universe in some nontrivial sense.

Everybody is aware of most of the conditions that are necessary for research to be effective—enough money, enough high-caliber personnel, a suitable organization structure and so on. What is almost universally ignored, however, is the critical importance of the *historical development* of a given field of scientific research. I do not at all wish to imply that there are any universal laws for this historical devel-

opment—merely that it always occurs.

In the development of any given field there are periods when, according to one's system of values, research is more effective or useful or interesting than at other times. It is admittedly difficult to anticipate such periods, but it is downright dishonest to pretend that it is impossible. Moreover, in the real world where money and manpower are limited, we can not avoid the responsibility of making such admittedly uncertain judgments. As a rather well known example consider the field of low-energy nuclear physics. The historical development here has been es-



pecially straightforward. In the early part of this century this was a field of enormous scientific interest not only to scientists but to the intelligent layman as well. In the late 1930's it became clear that the field had considerable military potential, and it was rational to make considerable funds available to exploit this potential. Continued funding was justified through the next two decades on the basis of anticipated military and industrial applications. Today the field continues to develop, but it would be disingenuous to claim that current research has any *reasonable* probability of affecting the general community or that much of great intrinsic interest is about to be discovered. Accordingly, it is hard to avoid the con-

clusion that a further cut-back in support for this field would be in no way detrimental to the national welfare.

What is true for low-energy nuclear physics is true to some extent for many other fields. Only in high-energy physics and astrophysics—cosmology is it *reasonable* to expect that fundamental discoveries of wide general interest will still be made.

Now I know that it is very easy to counter these arguments by appealing to past experience, by pointing to some illustrious personage who thought physics was essentially complete by 1900 or to some other famous individual who once dismissed nuclear power as impractical. The trouble with these arguments is that they are *too* easy to make. They are basically specious and self-serving, like most quasi-historical analogies, and they should not be used to avoid the responsibility we all have of trying to determine what will be the most likely course of development in physics in the foreseeable future.

Accordingly, it seems to me that there is no rational basis for arguing that the national welfare (however it may be defined) is seriously threatened by a levelling-off or even by a considerable retrenchment in funding for most areas of physics research. Moreover, to claim that support for physics or any other science should be tied to the GNP makes about as much sense to me as to claim that such support be tied to the sunspot cycle.

Now, let me turn to the question of why most people should apparently subscribe to this rather absurd notion that the national welfare is somehow tied to ever increasing expenditures on physics research. A distinction has to be made here between physicists and laymen. To the layman, the superficial argument based on the great past achievements of physics is no doubt persuasive. He is in no position to note the progressive trivialization that is so obvious to the professional. Moreover, there is a strong tendency among people employed by the media to amplify the conventional wisdom of the moment. I am reminded of the situation regarding the employment market for physicists. Up to about a year and a

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half ago, "everybody" knew that the nation had a shortage of PhD physicists. In a letter to *PHYSICS TODAY* published in February of 1969 I pointed out that in fact there had been for some time a surplus, and within a few months the conventional wisdom had discovered that there was indeed a "job crisis." There is of course a connection between my present letter and the previous one. If my present arguments are correct the employment situation will become much worse than the "expert" projections indicate, and it will last until the output of physicists becomes commensurate with their value. This brings me finally to the attitudes of physicists themselves. Generally we are a skeptical group, and it is therefore a little strange that wildly inflated claims for our importance could be made so frequently without challenge. After all, most of us could assess such claims easily enough by looking at the publications of our colleagues. Of course there is a question of economic interest, but I really do not believe that this is the determining factor. The real cause, it seems to me, is that most physicists seem utterly incapable of assessing the importance of their own work. They toil day after day and year after year and seem to exhaust themselves as readily on the most trivial and useless investigations as on the most fundamental discoveries or the most revolutionary inventions. Whatever the reason, I believe that a more realistic assessment of ourselves and of our relation to the larger world will prove, perhaps, to be necessary in the difficult days ahead.

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Science exploited by business?

The naive pro-business bias of *PHYSICS TODAY*'s editorials is getting out of hand. Your comments on pollution and nuclear reactors are a particularly bizarre example of this trend—the public's suspicion and rejection of science and technology is blamed on those nasty scientists who criticize current practices of the scientific establishment. In this case it is the AEC's allowable radiation dose rate.

I would like you to know that I am

suspicious of science and technology because I believe that our results are exploited by American corporations for profit with zero regard for the welfare of the people. In particular, I have zero confidence in the willingness or competence of any corporation to truly evaluate the safety of any product, let alone a nuclear reactor. And if it be said that the AEC is responsible and not private enterprise then the AEC will have to convince me that it is not, in the final analysis, dominated by the economic interests of America's corporate enterprises.

JOSEPH SCHWARTZ
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Inaccurate cancer statistics

The August issue was most informative and thoroughly enjoyable, and I was especially pleased that you included an article ("Nuclear Physics in Medicine" by Gordon Brownell and Robert Shalek, page 32) dealing with physical medicine and particularly the disease cancer.

It grieves me, however, that the authors' statistics were so imprecise. They state (page 34) that one human in eight dies from cancer. The accurate figure is one in six. I don't think even physicists should be allowed this margin of error, plus or minus 0.25. I'm sure their other data are much closer to the mark.

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Working for the DOD

I am disturbed, not by the editorial position of *PHYSICS TODAY* or the establishment-controlled council of the American Physical Society, but by the goals and tactics of some within the physics community. As an example consider the ideas expressed in the "article" by Jay Orear in the May issue of *PHYSICS TODAY* (page 9) and the contradiction that arises.

I do not know anyone in the physics community who is for war, poverty or pollution. The US Government has departments that deal with each of these problems with the goal of attaining peace (freedom), prosperity and a

nonpolluted environment for ourselves and others. How these objectives are to be reached involves political decisions, and because of this there will be those who do not agree with or support the methods selected to obtain these objectives. Whereas one person may feel he is making a contribution to the problems of society by working on pollution problems, another person may desire to serve by doing DOD-supported research. After all, some people still feel that it is a privilege to serve their country whether in the military service, in DOD research, in the Peace Corp's, working on pollution problems, and so on. Of course each person should be able to make his own choice, and to my knowledge no one has been forced to work on DOD research. Also, why should a physics problem suddenly be off limits for academic physicists just because the results will be of interest to the DOD?

On the one hand we are to be forbidden, by a "Hippocratic oath," from helping one department of the government through our research projects, and on the other hand we are strongly urged by the same people who wrote the oath to help other departments. A contradiction? I think so.

We should not force people to work on projects they can not support nor should we forbid others from working on them if they so desire—each person should be free to make his own choice. If, as academic physicists, we choose to work on problems that have political overtones, we should be exceedingly careful not to influence students with our own personal political beliefs. Students, especially undergraduates, are very impressionable and our influence could be regarded as a misuse of our academic positions. Universities should not be used as a political force since this would make them a primary object of legislation, which would be the end of the "search-for-truth" education as we now know it. As it turns out however, it is not the DOD researchers who are misusing their academic influence, it is those who oppose it, for they are the ones indoctrinating students with their own personal political views.

I feel that open discussion of ideas is essential (faculty indoctrination of students is not open discussion), and for this reason I strongly recommend that *PHYSICS TODAY* continue its present policy of publishing letters, articles, and editorials of interest to physicists even though they contain controversial ideas.

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As a Navy employee I make no apology for working for the defense of the United States. I object to the Ameri-