

Such a view of applied research is not necessarily accurate—even when it concerns problems outlined by Crewe.

The terms "applied" and "basic" appear to have become associated with "directed" and "undirected." The distinction lies in whether specific goals are to be attained within a definite time interval. In the extreme, directed research may have dictated in advance the tactical approach to a problem and the kind of results desired. Conversely, undirected research in the extreme may be totally devoid of long-range planning. Most research falls between these two extremes. This fact blunts the distinction between applied and basic research. The question, then, is how much applied research should be pursued. For example: Is applied research appropriate to either a master's thesis or a doctor's dissertation?

Applied research is not the easiest kind of research. Usually research must be completed within a specified time interval; consequently the plan of attack must be carefully considered. Applied problems involve usually more than one area and often more than one discipline. The results of such investigations and their significance must be communicated accurately and clearly to persons knowledgeable in the scientific and technical aspects of the problem. To be adequate to these demands the researcher must have intuitive foresight, breadth of outlook and depth of understanding. These attributes are the basis on which the skill of precise thinking can be developed. They are the same attributes we hope to see in our graduate students. From these considerations, applied research may furnish appropriate problems for graduate research in, for example, physics—or any of the natural sciences.

R. Hobart Ellis Jr's editorial in the same issue suggested very realistic economic motives for pursuing applied research. There are equally realistic educative motives for the judicious acceptance of applied research as appropriate to graduate programs in the natural sciences.

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Cutting NBS budget

The cut, by Congress, of the budget of the National Bureau of Standards (PHYSICS TODAY, August, page 51) accentuates the peril that has threatened this valuable institution for quite some time. Whether the present stress on mission orientation is justified or not, it appears reckless to sacrifice to it a service of such importance to the scientific community for a gain of just \$7.8 million (!).

Your story attributes this continuous misery to the lack of skill of NBS experts in expressing themselves to congressional committees. It appears to me that both Congress and the NBS dispose of plenty of witnesses, expert in science as well as communication, who could testify for the quality of men and topics sacrificed by this ruthless and petty decision.

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Baccalaureate Origins of PhD's in Physics

The "State and Society" section of the August PHYSICS TODAY published a report, "NAS Data Give Baccalaureate Origins of PhD's in Physics," stating that of all US students who earned PhD's in physics during 1958-66, 70% received their bachelor's degree from PhD-granting institutions, 19% from MS-granting institutions and 11% from four-year institutions. This report cites earlier data from M. Hugh Trytten, National Academy of Sciences, which indicate that in 1936-45 four-year colleges had been the origin of 35% of the 1160 physics PhD's. It continues with a discussion of "causes of decline," and concludes that four-year colleges now produce only about 11% of future physics doctorates.

Is there a decline in physics PhD's with baccalaureates from four-year or undergraduate colleges? Intelligent answers to questions related to the role and importance of various types of educational institutions require more than a superficial treatment. Analysis is not as simple as the PHYSICS TODAY report assumes. Several points should be considered: (1) It is not possible in principle to determine the present importance of various types of educational institutions, as baccalaureate



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