



Perspective

Research, Like Map-Making, Must Be Kept Modern

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THE WORD RESEARCH covers a very wide variety of extremely diverse activities. We should be able to divide these into meaningful classes, and for each class we should have a name. If these two essentials, a sound classification and a good terminology, are not available, how shall we discuss research intelligently? Yet, what classes and what names do current usage offer us? I think we most often talk of applied and basic research. Frankly, I know of no common synonym for applied research, although there are several for basic research. Surely it is not possible to divide such a complex of activities that is represented by research into two classes, applied and basic. That, I think, is too simple a dichotomy. It is as though we should agree to call all colors black and white, disregarding the rainbow shades that so obviously surround us and even the various shades of gray.

In an attempt at more satisfactory description, I offer a very old and famous analogy. It involves a territory and a map. The territory represents the physical reality in which we live; the map represents the concepts of the territory. These are two entirely different things. Moreover, a map is never identical with a territory imbedded in our scientific knowledge. For philosophical reasons it is important to bear in mind that the map is never the territory. No matter how detailed a map is made, there are always minuter details which must be left off.

The map we now have—the map called science—consists of natural laws, of theories, hypotheses, and guesses, dealing with the relations between events. In short, certain parts of the territory, the main features and relations between them, are accurately shown on the map. These are the so-called natural laws and well-established theories. Other parts of the territory and the relations therein are merely guessed at.

Now let us expand this analogy. Reality is a territory; science is a map. Then the map-making process is scientific research. The scientist's objective in his research is to make the map more detailed and more accurate; he seeks to understand reality. But to use the map is to get somewhere and get something—that is technology; existing knowledge is applied for the improvement of man's material welfare, but without any direct attempt to increase man's knowledge. In

terms of this analogy, you can see the difficulty of making a clear distinction between scientific research and technology, for it is almost impossible to use a map for going places and doing things without learning something more about the territory; and what is learned about the territory can be added as rough notes and sketches on the map. I think it is for that sort of procedure—where the prime purpose is to go and do something and the useful by-product is to add to the map—that we need such a term as “applied research.” Thus, applied research is concerned mainly with the solving of practical problems and only secondarily with adding to scientific knowledge. To my mind, the old-fashioned term “pure” must now stand for mere map-making, that is, for making the map without thought or care as to whether the map can or ever will be used.

Let us now add a third dimension. We need to add contour lines to distinguish between the mountains and valleys and we need additional symbols and legends if we are to map in greater depth, say, to deal with the soil zones and mineral resources. This third dimension, this mapping in depth, will represent what we commonly call “basic research.” I should never say that a research is basic or that it is not basic. What I should try to estimate is the basicness of the research, that is to say where it falls on some scale of basicness. Moreover, I think you will find the history of the development of any area of science commonly shows a move toward increasingly basic research. It is inevitable that we should start with the observable phenomena which limit the scope of the investigation. An effort must then be made to introduce quantitative measurements and finally there must be a drive to explain still more basic concepts and to link up with the more mature surrounding sciences.

The pioneer made maps of the lakes and forest trails that were appropriate to the times. Is it adequate that we should continue to map in the same old way but in greater detail, showing perhaps each tree in the forest? Or are we to map in a different way at a different level, showing the soils and mineral resources, our great new cities, and our modern transportation systems? (*Excerpts from Dr. Anderson's Presidential Address before the American Association of Cereal Chemists, Buffalo, N. Y., May 25, 1953.*)