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The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

## Waste and Duplication

Part of the difficulties now facing the scientific community arise from a lack of effective communication between scientists and the public. In view of the highly specialized content of much of science, some failure of communication is inevitable. However, even on an elementary level there is imperfect transfer of views which arises out of semantics. Consider the words *research* and *development*. In the press, in Congress, and even sometimes among scientists the two words are used interchangeably. Newspapers and other media usually refer to the \$15 billion of the budget devoted to R&D as if it were to be spent for research; actually only about one-tenth of the total is devoted to this purpose. The public cannot discriminate in this matter, and as a result science carries much of the burden for justifying great expenditures for hardware. An additional confusion arises from the coupling of *research* and *development*. If the two words are synonymous, then all who are engaged in either pursuit must be scientists. Now, most scientists feel comfortable in the presence of engineers, but there is no reason why we should be blamed when some engineering effort goes awry. "Scientists fail in effort to orbit space vehicle" is a typical headline.

One of the worst examples of an inappropriate coupling of words is the phrase "waste and duplication in research." Perusal of the *Congressional Record* shows that this phraseology is often employed. Indeed, being against waste and duplication is a modern equivalent of being against sin. The coupling has been used so much and has gone so long unchallenged that in many minds waste and duplication have become synonymous. In reality, duplication in research activities is often desirable. If a study is intrinsically worth doing and leads to positive results, confirmation of the work is essential. This helps maintain the integrity of science and markedly enhances the value of findings. In basic research there is usually no such thing as duplication, even when two scientists or groups start out to investigate the same phenomena. They approach the problem in different ways either conceptually or technically. During research, unexpected side avenues appear, and these are followed in differing ways. As results become available, interpretations of the data differ. If one group makes significant progress, the results are quickly communicated either by the grapevine or in formal meetings. Research activities of the second group are adjusted accordingly. Thus, "duplication" in basic research occurs only when results are not freely communicated, as for instance in highly classified studies.

One can defend the view that duplication is desirable purely on the basis of the benefits of competition. When two or more groups are known to be active in the same area of research, constructive rivalry sets in. This is a spur to imagination, to the exercise of ingenuity, and to devoted immersion in hard work. The situation is analogous to competition in the business world. With few exceptions, monopoly situations do not lead to optimal progress.

"R&D is an abbreviation that corrupts the true meaning of the word *research* while enhancing *development*, giving it, by association, implicit scientific status. To couple waste tightly to duplication in the context of research merely demonstrates ignorance, for duplication is vital to research and invigorates it. Scientists should seize every opportunity to correct semantic errors of this type, for they are barriers to effective and needed communication between us and the public.—P.H.A.