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The Productive Environment for Innovation

The Department of Defense and the Arthur D. Little Company have recently conducted a stimulating historical study of the conditions that foster successful research, developments, or inventions—the key ideas that have given to major weapons their high operational capabilities. The results give useful, even if still tentative, leads to understanding the elements of the laboratory environment that are most conducive to successful innovation.

The physical scientists who worked on the study sought initially for objective characteristics of a productive laboratory which they could count and measure. They found, however, that these characteristics appeared to be far less important than were attitudes, motivation, personal relations, and the way in which the laboratory was managed.

They found, too, and with some surprise, that improved weapons come chiefly through many relatively small steps rather than a few giant ones. The transistor and the high-temperature shock tube have been called major breakthroughs, but more typical examples were the development of ablative cooling, magnetic (instead of jewel) bearings for gyros, the low-cavitation propeller, and zone-melting as a technique for purifying metals.

Typically, these and the other achievements they studied occurred only if three elements were all present: a clearly understood need; a source of relevant ideas, information, insight, and experience; and men and money to commit to the job. In a few cases a new idea appeared so promising that it was pushed through to successful development even though a specific need was not yet apparent, but the trigger that set off the burst of activity that led to a useful new development was most commonly the explicit recognition of a need. Ideas not related to a recognized need were likely to lie fallow. Necessity still seems to be the mother of invention.

In a few instances the developmental activity was funded through a contract specifically intended for that purpose. More usually, after the need and the idea were brought together, money was borrowed or taken from some other source. Retrospectively, it is easy to justify these diversions of funds. A need and a promising idea for its solution existed. Informal cost/effectiveness estimates typically showed the potential value multiplied by the probability of success to be 10 to 100 times the predicted cost. They were good gambles, so instead of waiting 6 to 12 months for a new contract, the company or university paid the expenses from its own funds, or borrowed money intended for related work or other activities, or (in a few cases) used funds that had been made available on a discretionary basis. The desirability is obvious of providing effective laboratories with funds that are under the discretionary control of the men who are directly acquainted with the need, with what seems to be a good idea, and with the probability of its successful development.

The Department of Defense is to be commended for this study, and for its planned continuation. It might have allowed the history to stay buried. It is good that it did not, for now it has some stimulating suggestions for improving its own research and development management, and some of these suggestions will be appropriate to other agencies and laboratories. We will continue to spend much on research and development; critical analysis of past accomplishments can help us to spend future money more effectively.—DAEL WOLFLE