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R&D in an Inflationary Environment

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The Annual AAAS Report on Research and Development is an immense service to the Nation. We at OTA are very grateful for it and find it most helpful in our work for the Congress. I feel certain that my counterparts in the other congressional agencies (GAO, Congressional Research Service, and the Congressional Budget Office) would tell you the same.

While OTA tends to focus more on the substance of R&D and its implications, we are inescapably drawn into such budget concerns as multi-year funding, impacts of inflation, and the like. One of our recent reports has to do with the impact of inflation on federal R&D costs. We found that the apparent degree of inflation experienced in R&D varies significantly from one federal agency to another as well as between different groups performing R&D. For example, inflation costs on R&D are generally greater than the aggregate measures of inflation in the economy. But cost escalation for university-based research is substantially less than for industry-based R&D.

One must be cautious about interpreting such results, however. We believe that most of the difference can be due to the fact that compensation to researchers in universities has not kept pace with industry and also that the universities may not have kept pace in keeping research plant and equipment up to date. If these differences turn out to be explanatory variables then we should receive the "good" news about lower inflation costs in academia with a great deal of concern and caveats.

In thinking about R&D both here in the U.S. and abroad it seems increasingly important to give closer attention to innovation in how we organize to fund, support, and provide oversight to R&D. Several thoughtful observers have suggested that more direct links be forged between industry and the research community. Properly orchestrated, this re-emphasis of a relationship that has been stronger in America's past could lead to a more productive use of capital than the alternative of using industrial tax revenue for federally funded and directed projects. I think this could be particularly fruitful in areas of R&D specifically relevant to industrial interests. The potential benefits of such a closer association between these institutions transcend the issue of efficiency of funding because the interpersonal relationships that could emerge via review and oversight, student "co-op" training, etc., could enliven and enrich the people involved. We need to experiment with new arrangements among our institutions just as we need to be innovative in our laboratories!

Another impression I have of R&D is that the time it takes to go from "R" to "D" and thence to "T" (technology) gets progressively shorter--or is it simply that I am getting older? I prefer to believe that the acceleration of the pace of R&D reflects the intensity of efforts these days. But it might also reflect a condition where "D" and "T" have been heavily exploited and that "R" simply hasn't had enough attention to stay out in front!

Thus, as we crash into the 80's we find ourselves, like Alice in Wonderland, falling into a "micro" world, epitomized by single living cells and sub-micron devices. In both cases we witness whole new areas of opportunity to provide for human want and need through the exercise of human ingenuity. In both cases -- genetic engineering and micro-electronics-- the rate of change is

so great that the stress of accommodation by users is exceeded only by the inability of our social, religious, and legal institutions to deal with these developments. It is almost always true that powerful new ideas -- whether they relate to hardware or literature -- can play both destructive as well as constructive roles. But it is folly if not dangerous to attempt to block the advance of scientific understanding about how things work -- natural law -- in the hope that somehow the result will be a retention of innocence and therefore deliverance. The exercise of moral judgment must be made upon the development and application of technology, not upon the expansion of knowledge and understanding. Oliver Wendell Holmes once remarked on this issue in the following way, "True science knows no bounds. It penetrates into every domain without fear and serves all men without prejudice or favor. It's work is to substitute facts for appearances, demonstrations for impressions, and beneficial realities for those many things ignorance and greed proclaim to be impossible. For suffering humanity it is hope and promise."

This brings me to a few thoughts about the rationale for placing increased emphasis on research and development. People on planet earth are swept up in rapid social change and also in a turbulent transition away from traditional well-springs for capital formation, economic growth, and national security. A principal resource used in the past to achieve these ends has been our heritage of bio-geo-chemically enriched "natural" resources. From here on out we must increasingly depend upon human ingenuity -- especially as expressed in technology -- to supplant the loss of "natural" resources.

Yet, investment in education, research, and development languishes. This lack of re-investment constrains our longer-term options in a manner

closely analogous to mid-term problems that result from lack of re-investment in modern plant and equipment for industrial production. We still seem to be bent on emphasizing numbers of people and measuring progress by the quantity of resources we consume. Is it not time to focus instead on helping each individual reach his or her full potential? Or measuring progress by how little consumption of new resources is required to provide a given standard of living? Resource productivity, rather than resource production seems to be the greater current challenge to R&D. Similarly, a focus on using R&D to provide economy at smaller, rather than larger, scale may be an important new imperative for us for a variety of reasons.

In these days of emphasizing "productivity" of workers, capital, and other resources we must be careful to keep in mind what we mean by "productivity". For example, R&D to develop improved understanding of pollution (and therefore of ways to ameliorate it) can be described as a "non-productive" activity since it doesn't contribute to production. Such a narrow view of productivity can be easily counter-productive. It is hoped that additional criteria such as social utility can be applied to establish priorities and make decisions about allocating resources to R&D. A sufficiently broad view of "non-productive" R&D expenditures will reveal major benefits to people. The challenge to R&D is to counter the argument disclosed in a conversation between two urbanite businessmen, "... the way I see it, there's a trade-off for everything. If you want a high standard of living, you settle for a low quality of life."

We have built great civilizations through the exploitation of our rich endowment of resources. Ingenious use of resources such as energy has led to a nearly general obsolescence of traditional brute application of manual

labor and has provided riches to millions that are beyond the dreams of kings who lived a scant few hundred years ago. But each generation, in using resources, has an inherent obligation of inter-generational equity. Our obligation is to conserve our depleting physical resources with knowledge and wisdom. This must be our bargain with the future. There seems to be little evidence in either our classrooms or in our laboratories that we accept this responsibility. Rather we seem more intent on drilling even for the last pool of oil as though tomorrow is all that counts. A vigorous and sustained R&D program is one of the few ways we can be equitable across generations.

Finally, a few thoughts about the scope of R&D. Where are the frontiers? We deal simultaneously with both ends of the scale of things -- from sub-nuclear particles and highly esoteric notions of symmetry to awesomely complex systems of atoms, molecules, and organisms. We conjure up theories and models and test them with ingenious experiments. The two-way interaction of experiment and synthesis via theory is a powerful process but not without its frustrations and limitations. Nils Bohr once remarked that it is very difficult to make an accurate prediction, especially if it is about the future! I would posit that there is a relatively under-attended area of great importance in terms of societal dynamics that especially merits more support for experimentation and synthesis. This area lies at the next level of aggregation beyond organisms; our various social institutions and modes of behavior. Social inventiveness -- for example, the GI Bill that followed World War II -- has had incalculable impact, not only on R&D but upon the whole fabric of society.

One can readily argue that the limits which are imposed by natural law and even by technology on our ability to provide for human need and want are

not the big problem, at least for the intermediate future. Rather we are more bounded by lack of understanding of our peculiarly human world; that of our institutions and of conflict resolution in a pluralistic society. Does this not then speak for research and demonstration that complements that of the usual scope of R&D? It, too, represents a frontier of knowledge vital to our progress and also our very survival.