LETTERS

Small Business R & D

I was surprised to read in the article by Colin Norman (News and Comment, 27 Nov., p. 1003) that some suggest the Small Business Innovation Development Act (H.R. 4326 and S. 881) would injure American research and development (R & D).

For years, academic studies such as those funded by the National Science Foundation (*1*) have found that small R & D firms have been the primary generators of major technological innovations. Moreover, scientific studies conducted at universities such as the Massachusetts Institute of Technology (*2*) have demonstrated that these firms have one of the highest rates of growth in employment, output, sales, exports, and productivity in our economy. Indeed, a study by the Office of Federal Procurement Policy (*3*) found that small R & D firms are the most cost-efficient performers of R & D.

Our country's economic problems and eroding scientific base make it imperative that we utilize the limited resources of the federal government in ways which will further both scientific research and economic development. It is unfortunate that some university administrators do not take seriously the scientific studies on the innovative contributions of small R & D firms and recognize the important contribution of the Small Business Innovation Development Act.

As chairman of the House small business oversight subcommittee, which originated H.R. 4326, I am keenly aware of the concerns that the universities have with the bill. I recognize their position that federal funds are essential to scientific research. I would hope that they could see the importance of reallocating a tiny share of that federal R & D funding to invest in furthering technological innovation. The goal of the House Small Business Committee is to enact a meaningful Small Business Innovation Development Act that will stimulate the innovation essential for our country's scientific and economic well-being. To achieve this, the committee has made every effort to be cooperative with the university and nonprofit community. I hope that the need for cooperation and compromise will be recognized by all parties and that a serious effort will be made to resolve the issues that are delaying enactment of this important bill.

It would be truly unfortunate if the national interest were subordinated to parochial interests and if the fruitful coalition between the small business community and the university community were to be torn asunder over the Small Business Innovation Development Act.

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References

1. National Science Foundation, *Science Indicators* (National Science Board, Washington, D.C., 1977).
2. J. O. Flender and R. S. Morse, *The Role of New Technical Enterprise in the U.S. Economy* (MIT Development Foundation, Cambridge, Mass., 1975); D. L. Birch, *The Job Generation Process* (Department of Commerce, Washington, D.C., 1979).
3. Office of Federal Procurement Policy, *Small Firms and Federal Research and Development* (Office of Management and Budget, Washington, D.C., 1977).

I take issue with much of Colin Norman's article "Small business bills upset the universities." Permit me to respond, not with respect to the merits of my initiative (which I would be happy to discuss with any interested readers), but rather to the misleading implications contained in the article.

The comment of Ronald Lamont-Havers concerning diversion of funds from high- to low-quality projects as an inevitable consequence of the proposal is one made by many in the university system. The only evidence that exists not only fails to support the conclusion, but, indeed, supports the contrary. At the same public hearing at which Lamont-Havers made the comment that Norman cites, he also testified as follows:

> What I would be concerned about, in saying that, would be the fact that funds are then set aside, protected funds, which would prevent one of our own investigators not being supported. That's all I'm concerned about. I'm not really concerned about protecting my own investigators as far as their funding, and any reduction in funds within that system is going to have a perturbation within our system.

If Lamont-Havers is "not really concerned" about whether or not there's funding, I leave it to your readers to decide what his true concern may be.

Newton Cattell of the Association of American Universities would have one believe that the entire proposed program will be funded from basic research budgets. Well in advance of your publication date the Small Business Committee addressed this concern by its agreement to accept an amendment to be offered by Senator Harrison Schmitt (R–N.M.) that would limit reallocation of basic research funds and funds expended through government-owned but contractor-operated facilities to 1 percent. Since intramural basic research is exempted in the body of the bill, the Senate version would result in no more of a reduction in basic research than approximately ¾ of 1 percent. In fact, the amendment was agreed to when the bill passed the Senate by a 90 to 0 vote on 8 December 1981. For a system that has benefited from the single largest "set-aside" program in American history (the National Institutes of Health grant system), to so cavalierly ignore the committee's attempt to address problems in a serious manner is, to me, disheartening.

Finally, Norman's article intimates that I bartered my support for the Administration's economic program and AWACS proposal for corresponding Administration support of S. 881. Those who know me well know that I do not work in such a fashion. I was promised nothing for adopting my positions with respect to any of the Administration's proposals and would never have been receptive to such an offer if made. To suggest otherwise is an insult to my integrity.

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As a scientist and coordinator of a committee of scientists, inventors, and innovators seeking passage of the Small Business Innovation Research Act of 1981, I would like to share our reasons for supporting this legislation.

The National Science Foundation's (NSF) Small Business Innovation Research (SBIR) Program, on which the legislation is modeled, has demonstrated that participating small firms make major contributions to scientific, technological, and economic development. A 1980 report by the House Science and Technology subcommittees on investigations and oversight and science, research, and technology recommended: "Federal agencies should examine NSF's SBIR program and implement similar type programs which comport with their needs." By requiring major R & D funding agencies to devote around 1 percent of their R & D budget to an SBIR program, this act gives legislative clout to the subcommittees' recommendation.

Recognizing that agencies have different missions, the legislation leaves the selection of SBIR topics solely to the agencies. A representative of NASA testified that he found the "contributions and potential" of small firms "particularly relevant" for basic research. It is likely, however, that most agencies will follow the NSF's lead and fund predominantly applied work.

Regardless of what categories of

topics are chosen, the cosponsors of the act in Congress have maintained that funds allocated for basic or applied research or development should not be shifted out of those categories. Neither the Senate nor House version requires agencies to reallocate funds traditionally set aside for university and medical school basic research or funds going to current demonstration projects. The NSF's estimates of the fiscal year 1982 science budget show that each agency could fund even a purely applied program if it so chose.

The act is sensitive to the importance of ensuring quality R & D. Both the Senate and House versions emphasize the importance of peer review, and, unlike most other federal programs, require applicants to successfully complete a feasibility study before they can compete for major funding. In addition, the Office of Science and Technology Policy is granted a major role in implementing the act.

As scientists and as citizens, we should remember what the growth of small firms in California, Massachusetts, and elsewhere has meant for job opportunities; scientific, technological, and economic development; and funding university-based research institutes and academic departments. Throughout the debate over this legislation, no one has denied that research consistently indicates that small R & D firms are (i) the primary source of major innovations in our economy; (ii) have one of the fastest U.S. rates of growth in net employment, sales, exports, productivity, revenue, and tax dollars (and we should also remember that federal support for science requires tax dollars); (iii) are among the most cost-efficient performers of R & D; (iv) find government awards a major stimulus for their formation and growth; and (v) rapidly diversify into private sector work after receiving government work. The Small Business Innovation Research Act of 1981 will simultaneously serve the interests of industrial and academic scientists and our fellow citizens.

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Radiation Effects

In "Genetic effects of the atomic bombs: a reappraisal" (11 Sept., p. 1220) W. J. Schull *et al.* provide interesting data and analyses. Their major conclusions could be presented more fairly, however, if they reported standard errors along with statistical estimates.

For example, from data in their table 5 they estimate the increase per rem in sex chromosome aneuploids at 4.65 per million and zygotic doubling dose at 504 rems, but they provide no explicit assessment of the variability of these estimates. According to their table, 12 of 5058 children of distally exposed parents and 16 of 5762 children of proximally exposed parents exhibited sex chromosome aneuploids. They estimate the average gonadal dose at 87 rems and compute the increase per rem as

$$\frac{1}{87}\left(\frac{16}{5762} - \frac{12}{5058}\right) = 4.65 \times 10^{-6}$$

and the zygotic doubling dose as

$$\frac{12/5058}{4.65 \times 10^{-6}} \doteq 504 \text{ rems}$$

The standard error of the difference in two binomials produces a standard error for the increase per rem of

$$\frac{1}{87}\left[\frac{(16)\,(5746)}{(5762)^3} + \frac{(12)\,(5046)}{(5058)^3}\right]^{1/2} = 11.2 \times 10^{-6}$$

Applying the empirical logit (*1*) produces a one-sided 95 percent lower confidence bound for the zygotic doubling dose of 75.8. The upper bound is infinity, since the confidence interval for the increase per rem includes zero.

These computations incorporate only binomial sampling error and not the uncertainty associated with the average dose of 87 or with nonsampling errors. They show that, although the estimates may be the best possible, they should not be memorialized.

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References

1. D. R. Cox, *The Analysis of Binary Data* (Methuen, London, 1970), chap. 3.

Schull *et al.* report that they find little in the way of phenotypic evidence of heritable effects in the progeny of persons exposed to irradiation from the atomic bombs dropped on Hiroshima and Nagasaki, this in spite of the somatic mutational events (chromosome anomalies and neoplasms) observed earlier in the same population of exposed individuals. Implied by this disparity is a potential differential sensitivity of somatic and germ cells to radiation-induced mutagenicity.

Evidence being gathered in studies of chemical mutagenesis points in a similar direction. In a recent examination of available information about the cytogenetic effects of chemicals in somatic and germ cells in vivo I found 76 chemicals to have been tested in both cell types. Of the 45 that elicited positive responses in somatic cells, 19 were negative in germ cell assessments. More important, no compound was found to produce a positive effect in germ cells but not in somatic cells. In other words, the germ cell models detected only about 60 percent of mutagenically active substances.

This, as well as the conclusions reached by Schull *et al.* about human effects of radiation exposure, implies a relative insensitivity of either the germ cells themselves or of the assays used for detecting germ cell mutations. The inability to detect significant effects in the radiation study by means of several highly sensitive indicators of genetic damage suggests the former to be the case, perhaps because of DNA packaging, repair mechanisms, meiotic "sieve" and so on. It is not clear, however, whether the germ cells of animals are similarly unsusceptible or whether the assays used to detect such effects are relatively insensitive.

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Inasmuch as we regarded our estimate of the doubling dose as preliminary, subject to many sources of error in addition to the traditional sampling one (particularly with respect to the subject of dose), we have been reluctant to place errors on our estimates. We hope to do so later. We certainly share with Louis the concern that these values "not be memorialized," for data continue to accumulate and doubtless will do so for some time; also, new technological developments make alternative methods of estimation possible.

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