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LETTERS

Meeting the Competition

Philip H. Abelson's editorial "Evolution of industrial research" (15 July, p. 299) describes the restructuring and reduction of research at one American chemical company. The company says that this is necessary in "a fierce and unforgiving global competitive market." There are other, probably better, ways to meet competition. Bennett Harrison, professor of political economy at Carnegie Mellon University, summarized the situation (*1*):

> Faced with the twin prods of higher costs and stronger competition, companies could have opted for the only sensible long-term solution consistent with a rising standard of living: increasing productivity. Major investments in new technology, more constructive and cooperative labor-management relations, and the closer integration of market research and product design with actual production would all have helped. Indeed, during the same period our Japanese, German, Italian, and Scandinavian competitors were pursuing precisely such strategies. Instead, more and more American corporations opted to restore profitability by cutting costs, especially labor costs.

It is instructive to recall some past actions of American industry that affected its competitive position. The steel industry opted not to install the continuous casting method used in Japan. American automakers did not recognize the oil crisis of the 1970s as a signal to build small cars. New England textile machinery makers standardized and narrowed their lines of products. At the same time the Germans kept innovating and ended up with the business.

Continuous innovation and improvement are essential to remain competitive. A. P. Gelbein (*2*) has exposed the myth of "the lean, mean, fighting machine syndrome" in which research and development efforts have been downsized. The dream that the company that has cut its own research can buy the innovation elsewhere is just that. The company that develops the new and better process may commercialize it itself, leaving the established company with an outmoded and noncompetitive process. Large companies should also reflect on why they are less innovative than small companies. Japan makes goods using 50% less energy than American companies, which places the latter at a competitive disadvantage.

O. Harari (*3*) reports that more than 75% of the downsizing in Europe and the United States has shown little if any long-term improvement in profitability or productivity. He feels that layoffs result from a knee-jerk crisis mentality. Statistics cited by R. B. Reich (*4*) indicate that less than half the downsizing firms expecting higher profits, higher productivity, or improved customer service got them. Within a year half of the firms had refilled the positions.

This "evolution of industrial research" will have a ripple effect. There will be less funds to support research universities and fewer jobs for their graduates. In a time of crisis we would hope for more research, not less. Certainly, our society needs new, environmentally benign processes to help us research the goal of a sustainable economy.

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Abelson's editorial discussing Alexander MacLachlan's speech about industrial research emphasizes evolution caused by pressures of global research. I suggest that such pressures have always been there and have not always been recognized by those in the field.

Research is something like searching for lost treasure in the sea. The shipwreck tends to scatter the gold on the ocean floor. The search will lead to the exciting find of the first few coins. Further searching will lead to discovery of the casket containing most of the gold nearby. The rest of the coins are scattered nearby, and continued searching leads to fewer and fewer pieces of gold. The search continues to grow more costly, even though technology may improve the techniques used and lower the cost. Finally, the supply of gold coins is exhausted, regardless of the technology and the expense. The search must then begin in another area if more treasure is to be found. Oil companies have experienced this in exploration for new revenue streams for many years.

The fact that a company finds it necessary to curtail research and development means that the return on its research investment is too low. By placing dollars elsewhere, the company can obtain a better return. For many years research chemists have lamented the fact that the "golden age" of research is over, and MacLachlan

certainly shows that the DuPont Company believes that this is so. This means one of two things: either the people going into research are incapable of generating ideas worthy of research (from the standpoint of a return on investment), or such opportunities no longer exist in the field chosen for research. In the case of DuPont, in the field of polymers, when the cost of internal development was too high to be absorbed, it indicated that the area being searched was no longer a rich field and that perhaps one should look elsewhere. However, when a company is very rich, the field must be extremely valuable or the research will not "pay off."

The standard reply by the industry is, "we'll buy our research from somewhere else." This would indicate that the probem is neither the researchers nor the paucity of ideas, but rather is in the guidance of the research or the selection of areas chosen for research. Many times, the decision of where to search is not the choice of those doing the research, but of financial analysts who say, "We have found gold here before, keep searching." Often, when gold is searched for, silver is found and those paying for the search are not interested. They may not know how to market the silver or feel that only a market for gold exists.

Most often, large companies do not buy their research from other large companies (unless those companies are in trouble themselves), but purchase research from smaller companies or from universities. No doubt, the cost structure for research is better at smaller companies, where overheads tend to be lower. Research can often be purchased from small companies for far less than it is worth, because of the inability of the small company to bear the cost of commercialization, which tends to dwarf research costs. At universities, the cost is lower still, as proved by the tremendous rush by all major companies to align themselves with the industrial transfer folks at the best research universities. Intellectual property rights always present the biggest obstacle in all of these negotiations, because the universities and small companies want a good return for the funds invested, whereas the purchasing companies want those costs to be small in order to provide a higher return. The fact that universities are not charging full costs, that is, the cost of failed research, makes them the cheapest cost provider for purchased research. Serendipitous discovery also provides an incentive for government to fund such research, thus providing industry with research at no direct cost to the purchasing companies. Unfortunately, this opportunity is afforded to all comers, and the mark and the yen have proved to have astonishing purchasing power over the last decade. It's something like having a fire sale for certain customers who have responded by buying everything in sight.

Those of us in small companies will either find the funds to support our research from those willing to take a high risk for a commensurate return, or progress will cease. Fortunately, in the chemical and biotechnical fields with which I have been associated, there are such people. They are unwilling to pay for research in which vast sums have already been expended because they realize there is little to be found and the cost will be high. But for new and innovative chemistries, there is an amazing quantity of funds available.

Concerning the lack of need for Ph.D.'s, we should remember that in the early days of genetic engineering, 5 to 7 years of postdoctoral experience was the norm. Shortly after the discovery of the value of genetic engineering, these postdocs were commanding a salary 30% higher than other scientists in the area. The universities quickly responded, and salaries became more moderate. Whereas DuPont was reducing its hiring of technically trained people, the biotechnology and pharmaceutical industries quickly took up the output of our universities. It reminds me of the swings in petroleum engineering students and salaries. In 1982, R. L. Whiting of Texas A&M University told me that there were 600 graduates, only two of whom had jobs in petroleum engineering, and two freshman students. Our students have never been slow to determine whether they should enter a field if they have good information about the field. When there are no jobs or the pay is poor, the students will evaporate like the morning dew.

To those who bemoan the poor students, my reply is to tell them that chemical research is rewarding for those who have a new idea of where or how to search. For those who don't, latch on to someone who does. If you can't do one of these, get ready to be frustrated by the lack of jobs in research.

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Predicting Protein Crystal Structures

We write to call attention to a passage in a figure legend of a recent research article by David Barford *et al.* (*1*). The article reports the crystal structure of human protein ty-