



R. N. Chianelli

The Coming Enviro-Industrial Revolution

In 1914 the United States was the world's largest debtor, owing 20% of its GNP to foreigners who also owned most of its chemical, communications and transportation industries. The vast portion of this money was owed to Great Britain, and there were those who claimed that Great Britain was achieving economically what she had failed to gain in the War of Independence. But the borrowed money was invested primarily in the expansion of the U.S. railroad system, which in turn fueled a great industrial expansion. The resulting industrial might not only repaid those debts but contributed heavily to the Allied victories in both World War I and II.

Today the United States has a GNP larger than Japan, France, Britain, and West Germany together, and we only owe 10% of it to foreigners. In addition the U.S. economy also leads all other nations in industrial worker productivity, spending on research and development, and number of scientists and engineers.

However, many indicators signal that our economic leadership is on the decline. Our position as a debtor nation has been steadily increasing, and we continue to import larger amounts of energy and more and more high tech items. Only in the aerospace industry do we maintain a commanding export lead.

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Many believe that this economic decline will inevitably continue to the year 2000 and beyond. I am not one of them. I believe the United States is on the verge of a new cycle of reinvestment and expansion in which materials (and thus MRS) will play a central role.

Why do I hold such an optimistic view? Because unlike almost all nations in the world, our economy has been of secondary concern for the past 55 years. Our primary efforts and a great proportion of our wealth have been directed to winning the Cold War. Our allies, whose economies flourished while we pursued this goal, assisted us by lending us the money required to complete the task.

This act was of itself a vote of confidence that we would eventually prevail. And together we have prevailed—in achieving not a military victory but an economic victory made possible by the superior ideas of Western democracy. This having been achieved, the United States can now turn attention to its economy with the same steadfast commitment it exhibited in achieving its previous goal. The outcome, in my opinion, is certain.

However, the transition period in which we now find ourselves is crucial. We often hear a debate centered around the "Defense Dividend" and how we should spend it. Some doubt that it will even exist. Military spending has always been perceived as a mixed bag in regard to its effect on the economy. Some believe that it saps our economy by diverting investment funds from other industrial areas necessary to be internationally competitive. Prof. Susan W. Sanderson of Rensselaer Polytechnic Institute's School of Management has argued that the Pentagon's demand for high cost, low volume products coupled with its procurement system have made many U.S. industries unequipped to compete internationally. I disagree. Aerospace is one of the few areas in which we remain very competitive because of the large technological spinoffs accrued from military programs in the commercial sector.

Regardless of your views on this subject, a large change is about to occur which is crucial to the nation and to MRS, whose technical symposia have traditionally been heavily funded by military research organizations. It is essential that we as an organization provide as much reliable information as possible to government in-

stitutions which will shape congressional views during this transition. We hope to do this more effectively through our newly established Washington, DC office.

But will the new U.S. investment and expansion period mean that we will make more and better computers, airplanes and automobiles? The answer to this will be in part "yes," but I think there will be much more to this next phase than just additional and better consumer goods. I believe we are beginning to see the beginning of an "enviro-industrial revolution" which will be led by the United States in the 1990s. We have in a very real sense reached the limits of a consumption-oriented economy. Although consumer-oriented industrial expansion will continue in the Third World and in the newly liberated Eastern Bloc countries, developed countries will expand in the "environmental quality of product sector" through sheer economic necessity driven by political realities.

Legislation in California regarding auto emissions and effluents from semiconductor manufacturing facilities are already the toughest in the world. Manufacturers are complaining, threatening to move to more hospitable places under the blanket of "international competitiveness," but the trend is undeniable. The companies that can meet these standards *and* remain competitive will be the giants of the 21st century. I believe U.S. companies will be there first, creating a whole new thriving area of ma-

terials research to counterbalance declining military research dollars, and this is good news for MRS.

New companies will emerge emphasizing efficient transportation vehicles or "cradle-to-grave" materials processing technology. One such company already establishing an enviable track record is AeroVironment (AV) Inc., whose battery-powered "Impact" automobile designed for GMC has received rave reviews for technology and performance. It could also be readily available on the market as soon as market factors demand it. And this may be sooner than later, given rapidly moving emissions standards and the 50% increase in oil prices projected to occur over the next five years. The same company has developed the battery-powered "Pointer" remote-controlled surveillance aircraft. Targeted to sell in the near future in the \$5,000-\$10,000 range, it could quickly become a commonly used weapon in the drug war. AV is also pioneering solar-powered aircraft such as the "Solar Challenge," which holds the distance and altitude records for such aircraft. The technology and its associated materials research are accelerating rapidly. We will see, I believe, a dramatic transformation in the 1990s from a fuel-intensive, polluting, industrial and transportation base to a highly efficient, nonpolluting base whose products and technology will be increasingly desired by the rest of the world to the benefit of all.

It is interesting to note that this transformation may already be starting in Pittsburgh, the home of MRS. A consortium of Pittsburgh-based industries (already successful in bringing Pittsburgh a thriving software industry) commissioned Carnegie Mellon University to study new uses for vacant Pittsburgh steel mills. The study has proposed revitalizing the U.S. rail system with magnetically levitated trains built in Pittsburgh. It proposes to start with a \$400 million, 19-mile line connecting downtown Pittsburgh to Greater Pittsburgh International Airport. Passengers would check their bags in Pittsburgh and be on the plane 10-15 minutes later. Other such centers would be built in metropolitan areas which would then be linked, creating a new rail network. This, according to a spokesperson for the consortium, is "an essential factor for the success of the U.S. economy."

The demand for materials science and technology in this coming period will be enormous. In the words of Lester Thurow, "We're going to have to *make* things to survive," and we're going to have to compete to do so. What is more important in the art of competitively making things than good materials science, and what can be more important to good materials science than the interdisciplinary environment of MRS?

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