Full Circle

A few years ago, I was walking near the old Union Station in Pittsburgh with a colleague only slightly younger than myself, when we happened upon some large-scale relics of the steel industry displayed for public viewing. "You don't see too many of those in public parking lots," I offered. "Um… what is it?" was the response. I suppose I was just a little surprised that a prominent materials scientist did not recognize a Bessemer converter—arguably the principal source of wealth during the U.S. industrial revolution—but this conversation took place back when steel was in decline, and many university Materials Science and Engineering departments had dropped it from the required curriculum.

Times change. For the last year or two, about a third of the students graduating from my own department have taken jobs in the steel industry, where scarcely any had gone in the preceding decade or two. Currently, the steel companies are recruiting heavily, and trying hard to hire our best and brightest students. The shake-out and resurgence of the steel industry is a case-study in international market economics, but it is also an example of a widespread phenomenon in the sociological history of materials science: Interest in any particular topic is cyclic. And it is not a nice, smooth, and manageable sine-wave type of function, either: it is more like an aperiodic square wave, with unexpected sharp rises and precipitous drops.

In another example of this interest-cycle, the nuclear industry and nuclear research in the United States are undergoing a striking renaissance, following a nearly total collapse in construction and research funding following the accident at Three Mile Island in 1979, and then the much worse one at Chernobyl in 1986.

Although the underlying needs for materials, and for research on them, follow predictable trends, the drivers for changes in research funding are usually external. Energy needs continued to grow after the Three Mile Island accident, but public concerns over reactor safety had more influence than the growth in energy demand, and alternate solutions were sought. Now that some of those are showing signs of running out, and concern about global warming is on the rise (yes, even in the United States!) nuclear power is beginning to be attractive again.

"Interest in any particular topic is cyclic."

In an interest-cycle embedded within a cycle of interest, there has recently been renewed attention to a famous bet about the price of basic commodities, between Paul Ehrlich (professor of Population Studies at Stanford University) and Julian Simon (professor of Business Administration at the University of Maryland). In 1980, Ehrlich bet that the price of a selection of commodity metals would be higher in 10 years because of the ever-increasing demand. Simon took the bet, confident that technology would make the extraction of the metals cheaper, or would find alternatives for those that were really running out. Simon won. Not only did the overall price of the agreed basket of commodities drop, but every single item in the basket (tin, nickel, chromium, tungsten, and copper) had fallen in price by 1990; each for a different reason. The recent flurry of interest in the old bet has arisen because the long-term trends of increasing demand and shrinking supply have caught up with and overtaken the shorter-term issues. If Ehrlich had bet on what the prices would be in 2007, rather than 1990, he would have won.

What does this mean for materials research? Well, commodity prices are going up, so look for a resurgence of interest in research on extraction and refining of certain metals, on the identification of substitutes for them in critical applications, and on technologies for recycling them from scrap. If I were a betting man, like Ehrlich or Simon, I would be looking at cobalt (for superalloys) and tantalum (for electronic packaging) as critical resources both in the long and the short term. Supply is beginning to get short, it's in difficult places, and there are no clear substitutes for these elements in critical applications.

George Santayana is often misquoted, or his aphorism is deliberately cleaned up, but he actually wrote "Those who cannot remember the past are condemned to repeat it." If you do not remember studying certain materials topics from the past, like extraction, materials substitution, alloy design, steel, or radiation effects in materials, then you may have to learn (or relearn) them. If you do not remember that research areas can quite suddenly lose support, you may have an uncomfortable repetition of other peoples' experience, too. If the world cannot remember that wars have usually been fought over access to strategic resources, then we will all have to learn how important it is to fund research into materials for critical applications.

Fortunately for us, the principles of materials science are quite transferable and readily applied to a wide range of problems—just look at the breadth of topics at an MRS meeting—so materials researchers will always be flexible enough, if they so choose, to adapt to the jarring changes of the square-wheeled interest cycle that we all have to ride.

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