

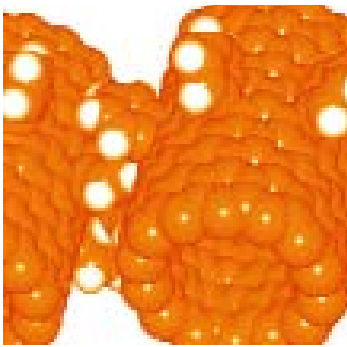
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CHAPTER 1

The Promise of Nanotechnology

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Nanotechnology is a field of science and engineering that deals with structures having at least one of their three dimensions less than 100 nanometers (nm). (A nanometer is one billionth of a meter.) We have "living proof" of the importance of nanostructures in that living systems are complex assemblies of nanoscale components: macromolecules, protein complexes, organelles, quasi-inorganic systems (e.g., shells, bones), etc. The marvelous functions performed by living systems (logic, memory, motion, chemical synthesis, energy conversion, even our self consciousness) are the direct result of nanoscale structural complexity.

The transistors, numbering in the millions, that constitute the chips that drive our computers and cell phones, are clearly nanostructures. Thus, the field of nanotechnology is extremely broad ranging from molecular biology to electronics and beyond. Although research and development in nanostructures has been going on for decades, and commercial products based on nanostructures have been available for decades, interest in the field has accelerated recently in scientific circles as well as at government agencies and in the investment community.

The growth of interest in nanoscale science and engineering is due to the conjunction of several factors: improved nanofabrication and microscopy techniques; recognition that novel properties become available in synthetic nanostructures; the anticipation that a commercial and societal revolution, similar to that produced by the semiconductor industry, will result from research in nanotechnology and, finally, increased government funding of nanoscale science and engineering.

History tell us that the fruits of research are impossible to predict. However, history also tell us that certain areas of research can be recognized as highly promising, even at an early stage. This was the case for molecular biology, 30 years ago, and we see that the research efforts begun then are bearing fruit today in improved health care and greater understanding of genetic diseases, to name only 2 impacts.

Similarly, in the early days of computer technology it was clear that investment in computer science research would bear valuable fruit. Yet, none of the early pioneers in computer science anticipated the World-Wide Web. In the early days of research in optical fibers no one anticipated the enormous optical communication network we have today. With the invention of the transistor in 1947 the importance of semiconductor research was widely recognized but no one in their wildest dreams would have envisaged billions of transistors in low-cost personal computers operated by school-children.

So, taking this history of research into account, there is every reason to anticipate that research on nanotechnology, if intelligently funded and pursued, will bear fruit that fully justifies today's enthusiasm.

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