

BOOKS & ARTS

Hollow centre

Nanotechnology is a discipline in the throes of an existential crisis.

The Dance of Molecules: How Nanotechnology is Changing our Lives

by Ted Sargent

Thunder's Mouth Press: 2006. 304 pp. \$25

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Every field needs its founding genius. For many in nanotechnology, this figure is Richard Feynman, on the strength of his 1959 lecture "There's plenty of room at the bottom", in which he discussed the problem of manipulating and controlling things on a small scale. Yet this canonization is entirely retrospective: there is little evidence that Feynman's lecture made much impact at the time, and he rarely returned to the topic to develop his thoughts.

Perhaps a better candidate for nanotechnology's father figure is former US president Bill Clinton, whose support for the National Nanotechnology Initiative converted overnight many industrious physicists, chemists and materials scientists into nanotechnologists. In this cynical — although popular — view, the idea of nanotechnology did not emerge naturally from its parent disciplines, but was imposed on the scientific community from outside. As a consequence, nanotechnology is a subject with an existential crisis — is there actually any firm core to this subject, any consensus as to what defines nanotechnology?

This is the problematic territory that Ted Sargent tries to map out for general readers in *The Dance of Molecules*. For example, he defines the goal of nanotechnology as "to design and build matter to order, specified by a functional requirement". Fine, but it may leave followers of an earlier discipline, materials science, puzzled, as this is their slogan too. He begins by maintaining the centrality of quantum mechanics, but really this is just an assertion of the centrality of chemistry. The book's title might point to brownian motion, but this idea isn't pursued. Sargent is forced to conclude that nanotechnology's central theme isn't scientific, but sociological — a culture of interdisciplinarity that searches for convergence between increasingly atomized scientific fields.

There is one version of nanotechnology that does have clarity: Eric Drexler's vision of scaled-down mechanical engineering. It is this revolutionary vision that underlies much of the popular image of nanotechnology as seen in science fiction, films and computer games. Yet very few scientists take this view seriously. This



Clear target: the Institute for Soldier Nanotechnologies applies science to meet military needs.

leaves a problem for popularizers who wish to reflect the scientific consensus. They can rebut the Drexler vision in detail, or simply dismiss it with appeals to the authority of scientists such as the late Richard Smalley. Sargent takes a third course: he simply does not mention it. This seems to me to be the most unsatisfactory approach of all. If one thinks the Drexler vision is wrong, one should say so, otherwise the reading public will be confused.

Lacking a strong core of science, the book is written thematically, as a tour of applications to health, environment and information. Quantum dots appear frequently, and the description of molecular electronics is duly circumspect about the balance of potential and practical difficulty. The descriptions of bio-nanotechnology carry less conviction — and that of molecular motors is misleading. Many will find Sargent's overwrought style irritating; perhaps the oddest of the many strange and strained metaphors and similes is his description of photolithography as being "like crop circles formed when the sun blazes through round partings in the English permacloud".

Nanotechnology, above all an applied science, has experienced a possibly unprecedented push for an early consideration of its social, environmental and ethical impacts. Here, Sargent's rhetoric is overwhelmingly positive, and the need for public engagement is seen solely in terms of defusing possible

opposition. We're promised an end to cancer, sight for the blind, and, via unconventional solar cells and the hydrogen economy, an end to our dependence on fossil fuels. The possible downsides are largely limited to the potential toxicity of some nanoparticles. Even in military applications, the emphasis is on defensive applications and on the possibility that nanotechnology will make it much easier for the West to wage a 'clean war', in which combatants are easily distinguished from everyone else. I don't think you need to be a radical anti-technology activist to greet this claim with some scepticism.

The difficulties for nanotechnology include its incompletely formed disciplinary identity and lack of clear definition, the overselling of its immediate potential economic and societal impacts, and its association with extreme utopian and dystopian visions. A good popular book could help to overcome these difficulties by setting out the science that underpins nanotechnology, making realistic claims for what applications and impacts will be possible and when, and presenting a more sophisticated understanding of the relationships between science, the economy and society. This book does not fulfill this need. ■

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