

NY Times quotes Dr. Canton regarding Convergent Technologies

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ON THE WEB

Scientists of Very Small Draw Disciplines Together

By BARNABY J. FEDER

LOS ANGELES, Feb. 7 – Nanotechnology, biotechnology, electronics and brain research are converging into a new field of science vital to the nation's security and economic clout.

Or so say influential research agenda-setters like the National Science Foundation, along with a loose-knit group of government, academic and industry researchers who are trying to accelerate the convergence process. "Leading scientists are stepping forward and saying, 'We don't have departments organized for this, but this is what's hot,'" said Philip J. Keukes, chief architect for quantum science research at Hewlett-Packard Laboratories.

Mr. Keukes was speaking at the closing session of a three-day meeting here that attracted a wide range of researchers interested in the convergence, as well as a smattering of investors, analysts and representatives of groups primarily concerned about possible negative consequences.

The organizers believe that there are potentially large benefits to nanotechnology, which focuses on materials and processes with dimensions so small they are affected by the behavior of individual atoms and molecules. But they say the greatest opportunities lie in bridging the gaps between the rapidly growing ranks of

nanoengineers and researchers in other fields – professionals who often use such different terms to describe their work that their common interests go unnoticed.

For instance, nanotechnology researchers suspect that the natural world's ability to assemble atoms into complex tissues with very exact specifications may hold the key to making vast quantities of minute, inexpensive pollution sensors or solar cells. Bioengineers, on the other hand, are looking to artificial nanostructures as possible drug delivery systems or as scaffolds to help injured organs repair themselves.

Such convergence was given a name late in 2001: NBIC, for nanotechnology, biotechnology, information technology and cognitive science. The concept is new enough that researchers have not yet agreed on a pronunciation for the acronym. Some say "EN-bick"; some say "NIB-bick."

But convergence advocates are already laying plans to ask the Bush administration to invest hundreds of millions of dollars a year in a new program to encourage collaborative work in NBIC technologies, according to James Canton, a technology consultant involved in the effort through the National Science Foundation. "NBIC are the power tools of the 21st century," said Mr. Canton, who is president of the Institute for Global Futures, a technology trends research firm in San Francisco.

Putting the tools together, not just for researchers but in the curriculums of the nation's schools, has become a top priority for Dr. Mihail C. Roco, who heads the National Nanotechnology Initiative, a program created by President Bill Clinton and expanded by President Bush that this year will oversee \$780 million in nanotechnology research grants by numerous federal agencies.

"We have an obligation not to get sidetracked," Dr. Roco said in Los Angeles. The NBIC concept grew from a meeting Dr. Roco convened in 2000 to explore the social implications of nanotechnology research. The field derives its name from the nanometer, which is a billionth of

a meter, roughly the length of a line of five hydrogen atoms.

Nanoscale innovations include novelties like tubes of carbon that are far stronger and lighter than steel and tiny light-emitting structures, called quantum dots, that are being used as identification tags in biological research. But because all the activities of living cells are governed by nanoscale interactions of atoms and small molecules, nanotechnology researchers looking for new ways to make and use nanomaterials are increasingly finding their interests overlapping with experts in biotechnology.

Similarly, electronics experts are looking to biotechnology and nanotechnology as they seek innovations that will allow them to construct far smaller and faster computers than today's silicon processors, and to create equally tiny data storage systems and communications devices.

Experts in cognition – which includes the way the brain processes the sensory data it receives from the nervous system and from proteins or other compounds in the blood – have also been invited into the fold. Their inclusion has focused the NBIC on technology applications that could improve human health or even advance human performance in areas like memory, mood control or the ability to communicate with machines.

A number of speakers emphasized the educational and organizational changes needed for success. “Convergence is about setting up the right social system so that advances in one area rapidly move into others,” said James C. Spohrer, an executive at I.B.M.'s research center in Almaden, Calif., who recently became head of a new group there focused on innovations to support the 170,000 consultants and technicians in I.B.M.'s Global Services unit. “The nano is hard, the biology is hard, the cognitive stuff is hard,” he said, “but a new science of putting it together is really hard.”

The group also wrestled with how to broaden discussion to include input from potential critics. Dr. Roco said that another meeting focused on social implications would be held next year and that I.B.M.

would probably join with the National Science Foundation to hold a meeting on the business implications next fall.