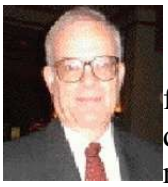
Dr. James C. Murday: Guardian of our Future

By C. A. Kennedy



The future is something palpable to Dr. James S. Murday. He knows its shape and feel. As the Chemistry Division Superintendent of the Naval Research Laboratories, he deals daily with a flood of innovative ideas and scientific discoveries, plans for research, new products under development and in the testing modes. Future time is the very stuff of his life.

Murday, informative and amusing with the merest whiff of iron beneath velvet, is at the apex of the organizational chart, (pictured below) supervising the six branches of the Chemistry Division at the Naval Research Laboratory, "located at the southernmost edge of Washington just before Maryland." Responsible for more than 100 staff and other employees, for a total of approximately 200 personnel who work daily in the Division, Murday racks up 60 and 70-hour and even 80-hour-weeks. No, Murday is affable and patient with a query: No, he said, neither golf nor hobbies take up space in his life, but he does own a cat.

Working with people and absorbing management and administrative skills began quite early for Murday. As the son of a military man and the eldest of twelve children one can well understand that he had ample opportunity to learn the intricacies of leadership, and to interact with others. Born in New Jersey, his family moved when he was three, and the rest of his youth mirrored that first relocation. "I'm an Army brat, and we moved every three years," he mused…no doubt recalling helping his parents shepherd his brothers and sisters on those triennial migrations.

His youthful travels endowed him with a global perspective, he said. "I had the opportunity to see both countries we had been fighting…Japan in the early 50s and 3 years in Germany in the late 50s "People are people all over the word…individuals in Germany and Japan are no different despite (the) hype of warfare."

While his eleven siblings went on to be nurses, engineers, psychologists, Murday was the only one who chose the physical sciences. "Science was an early love and physics came naturally, he said, "I was good at math." He probably inherited the mathematics "gene" from his father who, Murday said, "is an intuitive mathematician…Dad would run internal calculations and give the right answer. He is a very bright man."
Family is obviously a high priority with him and he relates that for his parents' 60th anniversary celebration everyone in the extended family wore T-shirts with all their 60 names printed on them …the original 12 children and all the spouses and grandchildren. The concept amused him. "We now have our very own cheesy T-shirt!" he said.

Murday and his wife, Marcia, a professor of mathematics at Northern Virginia Community College, have three children: One is in a surgical residency, another has a Ph.D. in psychology and a third took a Ph.D. in philosophy. Obviously extremely proud of his offspring as he lists their accomplishments, and caught just on this side of actual bragging, Murday lowkeys by adding, as most parents do, that he just wants them to be happy in their chosen professions

And Murday, the traveler, found a permanent home. He has logged more than thirty years with the Naval Research Lab, arriving in 1969, brand new Ph.D. in hand. It was the best offer he received, he

remembered with a smile in his voice, "I told my wife it would be three to five years, no more." The Murday family has settled in Springfield, Virginia, "a bedroom community for the Pentagon."

And, he says he has never regretted choice. " NRL is a nice place to work. There is a nice mix between basic research and applications. A self-described introvert more content with things than people, yet Murday cheerfully claims, " I'm the "father" of a group of 100 people…I get to be the dad."

"Many other professions are more status quo in that they don't fundamentally change anything for the future…which is what we do here. What you accumulate are building blocks…(you) leave something that others build on. (The world) will be fundamentally different and hopefully better by virtue of what we do."

"Research usually involves publication in journals, and then it takes a while for research to evolve into product." In Murday's purview research can be translated into technology and then into military application all within the Division. " New concepts, or new hardware, and the payoff is that the nation is more secure."

Nanotechnology is one of the arenas of cutting edge science that particularly captures his interest and efforts. He has been instrumental and active in "aiding and abetting" the development of the National Nanotechnology Initiative begun by the Clinton administration and continued under the Bush administration. He is on the National Science and Technology Council (NSTC), and serves as Executive Secretary of the Interagency Working Group on Nano Science, Engineering and Technology (IWGN) of that Council.

"Nanotechnology is really about establishing scientific understanding of things that are sized at nanosized scale, which is critical to understanding material properties. "The National Nanotechnology Initiative is enabling a revolution…building on a huge surge of understanding. If it weren't for this underpinning, the rate of progress would be a hell of a lot slower."

In practice, nanotechnology has been around at least 2000 years, Murday pointed out. "Romans used it to make glassware with different light and different colors… they employed nano-sized particles of gold embedded in glass. Of course this was on an empirical basis, and they didn't understand the science."

Everyone is familiar with carbon black used as a colorant in tires and printing inks, and that is nanosized. The petrochemical industry uses catalysts employing nano-size particles. "The concept of the atom began about 2000 years ago with the Greeks, and it wasn't until 1900 that we found out what it was. We moved from Empirical Era to Surface Science Era, which runs from 1960 to 1990. Then we got the analytical tools to measure dimensions of nanometer - this was the first revolution in nanoscience," Murday said. Key to understanding nanoscale were the inventions of the scanning tunneling microscope and the atomic force microscope

In a synopsis of his presentation as Keynote Speaker at the 9th Annual Foresight Institute Conference on Molecular Technology, Murday noted that… " the invention of surface analytical tools in the 60s and 70s enable science with one dimension in the nanometer range; commercial products based on that science are significant and growing. The invention of the proximal probes has stimulated science with all dimensions - dots, clusters, macromolecules and wires and tubes and vicinal surfaces and composites - in the nanometer range. The US National Nanotechnology Initiative, and the equivalents in other countries, seeks to accelerate progress in the scientific phase of discovery and

invention, and to transition rapidly those innovations into technological opportunities. An impressive infrastructure is under development to accomplish these goals."

Looking forward into the possibilities inherent in nanotechnology, Murday said nanoscience will clearly benefit the evolution, or revolution, in acquisition and processing of information. It will enable us to continue the rapid pace in computational power as in the last 25 years. " Nano will solve the hardware problems, but people will have to solve the software problems," Murday commented. The hardware will be smaller and faster.

As information technology transforms, there will be cultural changes also. There will be an increase in the relocation of the work place to the home or decentralized centers. Computers will be integrated into every aspect of life from clothing to homes to medical devices. Information technology and medicine will probably reap the earliest benefits. Look for wholly automated systems that will pilot your automobile. When the technology solves the problem of avoiding obstructions and the selection of the methods, driverless cars can become a reality.

National security will be enhanced; he said, for example, by the use of microsensor systems using NRL technology, sensing devices could protect Senate office buildings against anthrax. Masks using nano-size high surface filters versus marble size now in use could protect individuals. Another Navy application will help solve the corrosion problem always present in the electrochemical environment called the ocean. There will be different ways to apply titanium/ aluminum micron size particles to some materials, and this is already being done, he said.

The Research and Development' Magazine's 39th Annual Awards announced that among the top 100 inventions/applications for 2001 was a coating developed by NRL for parts and hard surfaces, reducing friction and wear, Murday explained. The nanostructured coating (powder) was used by Inframat Corporation in a thermal spray gun to obtain high performance coatings on mechanical parts, employing a grain size on the order of 100 nanometers. (This is also an example of NRL laboratory results benefiting developments in the civilian sector.)

Another example of research results for the Navy is the use of more composite materials on ships. "When you have a fire on board, you can't leave the ship," Murday said, " and composites resist burning …very few organics do this. Nanostructured clay mixed with a polymer improves resistance to burning significantly and meets ship fire codes. This is a very important contribution."

Ever cautionary that advances could be 10, 20 and 30 years hence, Murday said the coming decades could bring such marvels as prosthetic devices that control the hand by using the mind, and an artificial retina attached to the optic nerve - already being tested on rabbit's eye." Hearing aids allowing the deaf to hear are already being used. The cost of computers will continue to be driven down, and there will be voice recognition communication with computers.

"We will learn how to interact with the nervous system, and go in and help. There will be sophisticated electronic devices small enough and compatible, attached to the existing nervous system for sensory apparatus. We will learn how to regenerate stem cells and nerve cells and restore spinal system nerves running up and down the spine.

Asked about fears expressed by some people about the new technology, Murday answered: " Am I afraid Nano will cause disaster? No. I lose sleep over energy sources…we have used roughly half of the petroleum reserves." Alternative energy sources are fine, he said, but can't provide the amount of

energy needed. "It is more important not to run out of energy."

"Everything (in the economy) is driven by the cost to produce. Our standard of living is likely to slip. We may find it more expensive to drive to work. We may have to work at home or at a telecommute center, he said. "The last 100 years was a great time to be alive because of cheap oil, a relatively inexpensive source of energy."

Murday is also interested in the future of education in the United States. Education is important and is to be concerned about, he said. "Any good scientist worries about education and getting students. Fifty percent of grad students in sciences in U.S. are not U.S. citizens…in some ways we are raiding the world of the best minds."

Major industrial areas were bombed during World War II, and it took 50 years to rebuild the infrastructure. Education has now been rebuilt (in those countries) and the good students won't come to the U.S. The next 50 years will look very different from last 50; we will have to compete harder in science because they won't feel the need to come to the US. There has been a brain drain for 50 years that will slow and stop. We need to get our own brainpower motivated because it won't be coming from overseas.

Murday said he has interacted with education as a scientist by going into elementary classrooms for science enrichment sessions. "Chemistry is pervasive. We need chemistry to accomplish cooking and cleaning," he said, quizzing the interviewer on the chemistry of baking cupcakes. "A lot still has to happen to bring this into schools. Grade schools are major problem (when it comes to) teaching math and science. It's not something that resonated with people."

Teachers don't have to become scientists, but we need to educate them on how to teach math and science, he said. Computers can be teachers' aides.

"Let's dream a little," Murday said. "Virtual reality. With a headset and a computer you have a total virtual environment." Perhaps hearkening back to the reserved boy in Germany who could learn the German language but dreaded recitation in front of the class, Murday described learning languages by talking to the computer…painlessly learning accents and syntax and spared any embarrassment because your teacher is an interactive computer system. "It adapts to your best learning skills and does so in scenarios that play into your interests, such as a ballet performance or a soccer match. With these educational applications, the student is immersed in the subject, immersed in learning."

What else can Murday foresee in scientific advancements? As a hemophiliac who has successfully handled the hereditary blood disorder all his life, he hopes for a cure for this condition for those who have it and those who carry it. "I would just as soon that problem went away," he said. And, with his fine mix of humor and serious thought, he also jokes that it would be nice if science could do something about improving eyesight since he must wear prescription lens.

Asked for a closing thought on nanoscience and nanotechnology, Murday concluded with: "Nano is a size scale. Nanotechnology potentially impacts all materials, and all materials can benefit. Improvement can open opportunity to understanding, and manipulation, of materials to do something better. Some materials will be significantly improved."

"And we are materials."

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