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Dr. Miles Drake, Vice President and Chief Technology Officer, Air Products and Chemicals, Inc. — 10-13-06

Dr. David Lemberg: Welcome to SCIENCE AND SOCIETY — our world, our well being, our future. SCIENCE AND SOCIETY is made possible, in part, by the generous support of the Chemical Heritage Foundation. If you'd like to receive a free transcript of this interview, please send an e-mail to copy@scienceandsociety.net and indicate "Dr. Miles Drake" in the subject line.

Our first guest is Dr. Miles Drake, Vice President and Chief Technology Officer at Air Products and Chemicals, Inc. He joined Air Products in 1986 as a Technology Manager for the company's European Electronics Research and Development Group. In 1990, Dr. Drake relocated to the U.S., where he became Director of Advanced Technology for the Global Applications Development Group. He was later named Director of the Corporate Science and Technology Center, followed by Director of Gases and Equipment Group Technology. Dr. Drake is also Chairman Elect of the Industrial Research Institute and a Fellow of the Royal Society of Chemistry. Miles thank you so much for being with us. Can we talk first about the Society of Chemical Industry? What is that organization?

Dr. Miles Drake: Well, it's an organization that started well over 100 years ago to bring together industrial chemistry companies and those interested in industrial chemistry. And it's evolved into an organization that has really been prominent in providing some of the most prestigious awards in chemistry to either people who made major contributions to chemistry that have benefited society, or to the industrialists that have really changed the industry in some way.

Lemberg: Miles, thank you. I'm thinking that the public, in general, is not aware of the wide impact of the field of chemistry. For example, some of the best nanoscientists that I know have degrees in chemistry.

Drake: Sure, and if you look at some of the awardees from the Society of Chemical Industry, for example the Perkin Medal that recognizes people that have made major contributions, this includes people such as Carl Djerassi who brought the contraceptive pill into fruition, which has had, as you can imagine, pretty major worldwide impact. This was founded on chemistry. Or, more recently, Gordon Moore, who is a chemist, who was co-founder of Intel that everybody's heard of and brought chemistry to the early days of semi-conductor manufacture because as Gordon Moore points out, the semiconductor industry is essentially, a chemical industry. It's making things for materials and transforming them into chips.

Lemberg: Miles, thank you. You mentioned the Perkin Medal. What other activities and awards does SCI sponsor?

Drake: Well, they have three major awards. There's the Perkin Medal, which is for people that have made lifetime dramatic impact on society. And these are based on chemistry. There's the Industry Medal for industry leaders, people that have created either major new industries founded on chemistry or have brought new management techniques, for example, to innovation or to industry. The founder of Merck was an awardee of that medal.

Now, more recently, we realized that with these two medals which we're rewarding, essentially, people who were at the peak or end of their career — which we reward with a significant dinner and the appropriate ceremony for both of those medals — we were missing out on having a venue to give a medal to someone that is earlier in their career that might be more inspirational to younger people in the chemical industry starting out on their career and thinking about what impact they're going to have, what might they do.

So, we created the medal we call the Gordon Moore Medal after Gordon Moore. And this is for people 45 years or younger that have made some significant contribution. Now, at that age and with that time in the industry, it's unlikely that you'll already see the huge impact of the contraceptive pill or the semi-conductor. But, it's the people we can see who we believe have made some significant contribution that might grow into a much greater one later on, but certainly is visible and making a difference to the quality of life and demonstrating the power of chemistry to bring improved quality of life, improved products and health and safety to the world. So, that now is the foundation of the Gordon Moore Award, which as I said, is for people under 45.

Lemberg: Miles, thank you very much. The Society of Chemical Industry and the Chemical Heritage Foundation recently held Innovation Day 2006. Can you tell us how SCI and Chemical Heritage Foundation came up with Innovation Day?

Drake: Well, this was, again, centered around this Gordon Moore Medal. And rather than have simply, an award dinner, we decided that it would be very good to match the Gordon Moore Medal for the younger innovator with the evening dinner, which is the Perkin Medal and with the appropriate dinner and ceremony. But, to use a day leading up to the Perkin Medal ceremony to have the award for the Gordon Moore Award at lunchtime and then, bracket that with what we called Innovation Day.

So companies in the chemical industry could send young starting high-potential innovators to a day when they could interact with each other, they could discuss big issues, hear some of the leading thinkers talk about major issues that there are for the world that can be solved by chemistry, have discussions, interact and generally, get an opportunity to network with their peers across other companies, and to enjoy, relish the thought that the chemical industry really is here to solve big society problems.

Lemberg: Yes, and it sounds to me as if it's a terrific opportunity to cross-pollinate and develop your vision and get new ideas.

Drake: Exactly, and the way we structure it is there'll be someone talking about, for example, materials driven by new energy needs, give a short talk and then, have discussion around what that means to the chemical industry, what opportunities there might be in each of the attendees' companies where they can bring the skills and knowledge of the company to try and solve some major problem.

Lemberg: Miles, thank you. Certainly, energy is on everybody's mind. Can you talk about a few other challenges to the chemical industry that Innovation Day is meant to address?

Drake: Well, if you look at some of the big challenges, clearly, there's alternative energy. There's making chemicals and products from alternative feedstocks, in other words, instead of starting with petrochemicals, which we know are limited and growing in cost and have a lot of issues around them, why not start with biomaterials or alternative materials that can, then, be transformed into the chemicals we need for the general needs of household, transport and all of the needs of society. So, it's going to alternative fuels. A very big issue the world is facing is the need for potable drinking water.

And again, that's something that is going to be solved by chemistry and chemical engineering, finding new ways to purify cheaply and simply, to recycle, to reuse water across the world. And then, of course, there's the continuing growth of speed, complexity and importance of communications technology. And of course, chemistry, people don't, necessarily, realize this, but chemistry is at the foundation of these technologies.. In order to get faster chips, to get better, more efficient devices, one's looking always at improving the chemistry that leads to shifts in the fundamental level.

And we had a discussion centered around what are those new areas that chemistry's bringing to the electronics and communications area. And, for example, a big new area is the discovery now that you can make semi-conductor devices, you can make flat panel displays, color displays using only polymers. Instead of using silicon and metals, you can use polymers. And therefore, that leads you to a future where, perhaps, you can have easily made, printable reel-to-reel electronics, which means that electronics becomes cheap enough to be completely ubiquitous. You can have it in your clothing, everywhere. And that's another area that is going to be enabled by sophisticated chemistry.

Lemberg: Miles, thank you so much. Let's talk about how these activities actually get done. How does innovation and research work in most chemical and materials firms?

Drake: Well, that's a very big question, but let me just touch on some aspects of it. Essentially, if you look at a chemical company, really one is looking for the solutions that customers are going to need both today and into the future. And there are two major strands to innovation. One is relentless drive to make things more efficiently, make them use less materials, to make a given polymer, for example, to use less energy. So, there's a lot of innovation centered around what we call process technology, improving the processes, saving energy, saving materials.

The other aspect, of course, is to identify where there's a need for completely new products and new solutions. In this case, that's looking for new materials and improving materials in a way that will enhance products. So, the chemical industry, of course, has huge breadth because there's everything from, for example, in our company, Air Products, we span things like providing hydrogen to improve the cleanliness of fuels generated in refineries. You need to remove sulfur. That means hydrogen. You need to shift the carbon, hydrogen balance. So, we have process technology that could make hydrogen very efficiently on a large scale.

At the same time, we're looking at new surfactants — working agents or commonly, soaps — which can help make far better, faster coating technologies. And these become very sophisticated small-scale products. But, the innovation spans everything, as I said, from big process, down to very sophisticated chemistry.

Lemberg: Miles, thank you. Could we now look at the next step? How do R&D and manufacturing fit together to turn a great idea into a great product?

Drake: We think of innovation as creating something which a company can produce and customers will use and there's money exchanging hands. And you're actually solving problems with it. To get to that level, it's even more than research and manufacturing because any product innovation actually requires a whole set of people to be able to work together to make it happen. And that includes within your company, of course, it includes the people that have perhaps come up with the innovation and designed the new product. There's the manufacturing people and the process technology people that have been able to make that into either a data plan to make it or design and engineer a new plan. So, there might be a lot of engineering involved.

And then, of course, there's the other aspect, which is the sales, marketing and supply chain people that are looking at how to deliver it, how to make it meet the customers' specifications consistently. So, for any new product, there's a very wide range of people in the company that are involved in making it happen. And what everyone has to look at now is how do you successfully get all of these people to understand what needs to be done and to team together to make a new product happen? And that's always a challenge, and it's something that we're getting more and more sophisticated and sort of organized around, making that happen.

Lemberg: How to create an effective team, how to have an effective communication between the different parts of the team.

Drake: Exactly, and that's where innovation is much more. The sciences are five percent. The 95 percent is getting everyone working together, as you pointed out. It has to be innovation as a team sport. It has to be done by a broad team and they have to understand together, what they're trying to accomplish. It's very much a team and management issue to make new products happen.

Lemberg: Thank you. Miles, you are the Chief Technology Officer at Air Products and Chemicals. Can you talk about the CTO's role in research and innovation and particularly, in the chemical industry?

Drake: Well, the CTO really has the role to make sure that the whole system of innovation is operating effectively. And that covers a span of things. It includes have we got the right people in place and are we hiring, developing and seasoning people such that our company really has high-caliber people able to bring new ideas and then, turn them into action? And then, at the same time, there's what I alluded to, the whole process of innovation, which is have you got a systematic way of bringing ideas forward and turning them into valuable products for customers that, then, they'll create value in the company?

And there's a whole big set of issues around connecting strategy of the business to where you want to look for your innovations and where you want to put resources, in order to get innovations. But, as you can imagine, that amounts to finding a way to have the right priorities around your research agenda, your development agenda and your new product introductions. And that whole system has to be looked at and managed to be as effective as possible because the chemical industry is one that does need continuous innovation in product and in process and is very competitive, in order to keep the costs at the right level and in order to keep your products competitive and meeting an ever increasing customers' specifications. So, it's very critical that you have very good systems to do that.

Lemberg: Miles, thank you. In our remaining time could blue sky for us and see what the next 10 years may bring in some of these challenge areas we discussed.

Drake: Well, I think, for example, we're looking at advanced battery materials. The need for fuel cells by hybrid vehicles and the integration of automotive with battery power is driving a whole set of new things in battery materials. In fact, it's driving completely new concepts in batteries. I alluded to the change that's happening with polymer electronics and polymers. This is going to drive big changes in how electronics get integrated into products in our daily life. I think there's still a way to go in getting to sort of improved energy from solar cells. That's still a chemically-based problem that there's still going to be a lot to work on.

And in general, I think the whole issue of sustainability energy effectiveness and the use of minimum materials in making chemicals is going to be a big driving force over the next decade and it's going to drive a lot of innovation, as is the whole question of CO_2 emissions and the legislation that is likely to come in terms of tapping $C0_2$. That's going to drive each chemical engineering and chemical innovation.

Lemberg: Miles, thank you for a terrific conversation today.

Drake: Thank you, it's been a pleasure chatting today.