DEPARTMENT OF DEFENSE BLOGGERS ROUNDTABLE WITH JOHN PARMENTOLA, DIRECTOR OF RESEARCH AND LABORATORY MANAGEMENT, OFFICE OF THE DEPUTY SECRETARY OF THE ARMY SUBJECT: ADVANCEMENTS IN ARMY SCIENCE AND TECHNOLOGY TIME: 11:02 A.M. EST DATE: MONDAY, NOVEMBER 3, 2008

(Note: Please refer to www.dod.mil for more information.)

LINDY KYZER (Army Public Affairs): This in Lindy Kyzer with Army Public Affairs. We're very pleased to have you with us, thrilled to have Dr. John Parmentola, director of research and laboratory management, Office of the Deputy Assistant Secretary of the Army for Research and Technology. He's here to discuss some of the latest Army science and technology that will be on the slate at the 26th Army Science Conference taking place December 1st through the 4th.

And right now I'll go ahead and turn it over to Dr. Parmentola. Can everybody still hear me?

Q (Inaudible.)

MR. PARMENTOLA: Hello? Q Yeah, we can hear you.

MR. PARMENTOLA: Okay, great. Well, I'm very pleased that all of you could find the time to spend talking about the 26th Army Science Conference. This is the conference that takes place every two years, and typically at science conferences in the recent past we've had about 1,600 participants from 30 different nations. (Beeping noise.) It sounds like somebody else is getting online here. And we have a very rich and diverse set of speakers coming to the Army Science Conference. It's an international conference.

And this year we've decided to showcase a number of very important areas that we believe will give rise to disruptive technologies in the future. I'll talk a bit about this. The areas involve neuroscience, and there what we're after is really trying to understand how the brain works and to use that as a means of -- (audio break) -- human-like qualities into autonomous systems and computers as well as understanding who we are as human beings. And the knowledge we gain there is potentially far-reaching for a number of areas, including immersive technology.

One of the things that we're trying to realize in the Army is realistic virtual humans. These are virtually humans that recognize human speech but understand language, also are capable of perception, thought, cognition, incorporating emotions into them as well as cultural attributes. So at the Army Science Conference we'll have the state of the art in virtual humans.

In addition, in immersive technology, for the first time that I know of in the world we'll be able to actually project a three- dimensional image from one part of the Army Science Conference through a high bandwidth line to another part of the Army Science Conference where you'll be able to walk around that image. It's a three- dimensional holographic-like image. And this is something that will be demonstrated by one of our institutes in California, the Institute for Creative Technologies, which the Army funds.

In addition, we will have a great deal of emphasis on nanotechnology in various aspects of nanotechnology: the development in new materials as well as moving forward with advancing molecular electronics. One example of nanotechnology which will be showcased is quantum computing. In fact, one of the world authorities on this is Bob Clark, who will be traveling from Australia. He's currently the chief scientist of the Defense Science and Technology Laboratories in Australia, and he will be there to speak on this.

Again, immersive technology, biotechnology, and a new area which the Army is leading, and that is network science, which deals with systems that exhibit networking behavior. And these are not just human-engineered systems that we're used to, like the Internet, mobile, wireless networks, but also biologically evolved networks, of which there are many examples: human social networks; there are also social insect networks; there are ecosystems that form networks; there are cellular networks, for example the networking of neurons in the brain, which then connects back to neuroscience; and also molecular networks, for example the networking of proteins inside of cells that basically govern the behavior of cells, vulnerability to disease and so on.

So that's it. We're going to also have a significant number of women in science that will be at the Army Science Conference internationally. These are women who are leaders in their fields which are included in the areas that I described.

So I'm willing to open it up for questions if you'd like. I'm glad to answer any questions that you might have.

MS. KYZER: This is Lindy again, with Army Public Affairs. Chuck, did you have a question?

Q Yes, I did. Chuck Simmins from America's North Shore Journal. Can you talk about -- in the email that we got, one of the items was about -- (audio break) -- technology and the use of nanotechnology to improve the ability to ID biological threats and toxins. Can you talk about that a little bit?

MR. PARMENTOLA: Yeah. This is work of a young lady from the University of California Santa Barbara. Historically assays have been done using electrophoresis to say --

Q Can you define what an assay is first? I'm sorry; some of us might not know.

MR. PARMENTOLA: An assay is you have some analyte and you want some substance and you want to understand what it is, basically, and trying to assess that is basically performing an assay, okay, of that substance.

Q Thanks.

MR. PARMENTOLA: And there are a lot of substances we'd like to know what they are, not just biological organisms but also toxins, for example. And of course somebody takes a sample and then the question is is what's in the sample? And you'd like to be able to do that quickly and accurately. And there are a variety of methods that people use to do this.

One in particular that's been used for many years with biological systems is a method called electrophoresis, and there, you know, for example, you have an organism and there's a method for extracting its DNA and then you can chop it up. And what you can do is put an electric charge onto those pieces and then you immerse the pieces in a fluid and you have a voltage that goes across a tube. And it's like a horse race. You start them out at the starting line and then you watch them as they move along this tube in this fluid. And depending upon the nature of those pieces, they all reach the finish line at different times. And from that you can determine what the nature of those pieces are.

Well, it turns out that historically we did this in tubes that in dimension were micro in size, so micrometers. It turns out that a young lady at the University of California Santa Barbara started to ask the question, well, what if we did this down at the nanoscale? In other words, had tubes that were much smaller than the tubes that we were using. It turns out that she found out that the pieces have a very strong interaction with the surface of the tube, which changes the nature to which they travel down the tube. And through this she's been able to demonstrate that she can carry out these assays with greater speed and precision than previously.

So far it looks like if what she's done holds true across a number of different conditions and different types of substances, she could revolutionize our ability to be able to conduct these assays with great speed and precision. And this is very important, especially with biological organisms because if an attack takes place, we'd like to know what the nature of the organism or organisms that are involved in that attack -- we need to know them quickly.

So this way we are able to react properly and with precision to deal with it.

Q   Well, if I understand the implications of that then, Doctor, you're talking about a substantially smaller --

MR. PARMENTOLA: Compact, yes.

Q   -- unit to do the assay itself. You're talking about significantly less power required.

MR. PARMENTOLA: Yes.

Q   -- and you're talking about handheld technology.

MR. PARMENTOLA: Absolutely.

Q   Yeah.

MR. PARMENTOLA: Yes, very compact systems that are capable of speed and precision in terms of identifying -- (audio break). So looking at this, it's a major advancement over currently existing technology and it basically has to do with the nanoscale of the tubes and their interaction with the substances that you're trying to do the assay on.

So this is an exciting piece of work. I just recently learned about it about a month ago in one of our review meetings where she got up and described this, and she blew people away with this. So my guess is if it pans out -- I mean, this is basic research where she's demonstrated a capability, but, you know, it takes time, but if it holds true, my prediction is it will revolutionize this area.

Q Thank you, Doctor.

MS. KYZER: All right, then, Christian, did you have a question?

Q Yes, I do, actually. I mean, I would hope that you'd give me a little leeway here to maybe -- Dr. Parmentola, to maybe hit some of these bullet points that we got in this email because this reads -- I was joking with Lindy -- this reads like an episode of "Fringe" or "Heroes" or "Terminator" or something with some of these things in here. Can you give me an idea where we are and how realistic some of these things are that you've hit: regenerative medicine, replacing memory, quantum ghost imaging? I mean that's about the coolest name of a heavy metal rock band I've ever heard. (Laughter.) Virtual humans, this mind communication stuff. I mean, you've got to be kidding me. This reads like a science fiction script.

MR. PARMENTOLA: Nope.

Q Come on.

MR. PARMENTOLA: Everything I put there is true.

Q Okay. Can you go through each of those just quickly and just --

MR. PARMENTOLA: I went through the three-dimensional video teleconferencing. I though that would blow you guys away, but --

Q Yeah, that's --

MR. PARMENTOLA: You'll be able to sit there in a chair and we'll image your head and we'll put it -- pipe it through a high-bandwidth line; it will be on the other side of the Army Science Conference and people will be able to walk around it.

Q Yeah, I don't know -- the bald spot on the back of my head would be a little bit embarrassing.

(Laughter.)

MR. PARMENTOLA: Okay.

Q Can you go through some of these other ones?

MR. PARMENTOLA: Okay. Revolutionary demonstration of replacing memory. Okay, the idea here is Professor Joe Tsien, who heads a brain institute in Georgia.

Q Okay.

MR. PARMENTOLA: And we've been following Joe now for some time.

Q Okay.

MR. PARMENTOLA: And if you go on the Internet, what you'll find is that he's actually been able to selectively eliminate memory in a mouse. He has found the centers in a mouse's brain where he can actively eliminate a memory.

Q Okay. MR. PARMENTOLA: An episodic memory. He put the episodic memory there through putting the mouse through a terrifying experience --

Q Okay.

MR. PARMENTOLA: -- and then he managed to demonstrate that he could eliminate it.

Q Okay.

MR. PARMENTOLA: Okay, if you can eliminate it, you can also emplace memory as well. So Joe Tsien will be at the Army Science Conference and he will talk about this and the work he's done in realizing this capability. This is a remarkable discovery.

Q Yeah.

MR. PARMENTOLA: Absolutely remarkable. So you can imagine people who have horrifying memories --

Q Right.

MR. PARMENTOLA: -- it would be great if we could eliminate them so this way they're not plagued by these memories uncontrollably. And of course we have soldiers that have this problem, those that have Post-Traumatic Stress Disorder, for example --

Q Right.

MR. PARMENTOLA: -- as well as traumatic brain injury, but there are many other examples that occur in a civilian world of this type of thing.

Q Wow, okay.

MR. PARMENTOLA: Again, in medicine, here the Army has set up two new institutes to regenerate organs and tissue. And there is an example of this -- there's several, actually -- that have been accomplished. One is there was a case of an individual who, with a model airplane, lost the tip of their finger. And by the tip I mean the nail, the bone, the actual tip of their finger while they were starting up the airplane with their finger --

Q Okay.

MR. PARMENTOLA: -- and that has been completely regrown --

Q Okay.

MR. PARMENTOLA: -- the nail, the bone, the tissue.

Q Was this individual an adult? MR. PARMENTOLA: Yes.

Q Okay.

Q Cool.

MR. PARMENTOLA: And the way it's done is actually with nanotechnology, a nanopowder that is put on the wound and then tissue grows on the nanopowder, and as it grows you continue to put the nanopowder as the tissue continues to grow.

Q Wow.

MR. PARMENTOLA: Now, in other cases they've been able to actually grow bladders -- whole bladders.

Q Right.

MR. PARMENTOLA: They've repaired the uterine wall of women whose uterus has been damaged --

Q Okay.

MR. PARMENTOLA: -- by regrowing tissue inside the uterine wall. And there's one example of where a young girl who -- I don't know if I should talk about this, but -- it's kind of a touchy subject -- she was born without a sex organ --

Q Okay.

MR. PARMENTOLA: -- and that was regrown.

Q Okay, and all using the same sort of nanopowder for structure and all that kind of thing?

MR. PARMENTOLA: Yeah, what they do is they develop these materials that -- (audio break) -- towards a nanoscaffolding --

Q Yeah, yeah, yeah.

MR. PARMENTOLA: -- and they put the tissue on it so that the tissue can grow, and then they emplace it. And as the tissue grows, the nanoscaffolding eventually dissolves and it's harmless, but the point is that you can regrow the tissue itself.

Q That's incredible. Okay.

MR. PARMENTOLA: So this is an area where we're doing basic research to try and actually understand the signaling that takes place within tissue to enable this --

Q Okay.

MR. PARMENTOLA: Because the idea I -- you know, we all know that the salamander -- right, I can cut off a limb of a salamander and it grows back.

Q Right. MR. PARMENTOLA: Well, people have been able to actually grow a salamander's foot on top of a salamander's foot. In other words, they've taken a salamander's limb and they've actually grown two limbs from it. We figured out the signaling that enables them to do this.

Q Okay.

MR. PARMENTOLA: Okay? So we're beginning to understand how this process occurs, and if we can, it holds the hope of being able to regrow limbs --

Q Yeah, absolutely.

MR. PARMENTOLA: -- on people, right?

So, let's see -- quantum ghost imaging. Okay, this has to do with an application of a famous paradox that goes by the name of Einstein-Rosen-Poldolsky Paradox.

Q Okay.

MR. PARMENTOLA: Okay? Einstein never liked quantum mechanics, and so he came up with a demonstration that quantum mechanics didn't make sense. And the way it works is you have a source of light. I mean, for the sake of being technical call it a source of photons.

Q Okay.

MR. PARMENTOLA: And this particular source is such that photons get radiated in exactly opposite directions from a point, okay? But the nature of these photons is such that they obey the laws of quantum mechanics, which means that the photons themselves are what are called entangled photons. In other words, each of them is in simultaneously different states, but the states are connected to each other. In other words, as the photons propagate outward -- and they can propagate very long distances -- if I make a measurement on one of those photons, the other photon knows about it.

Q Okay.

MR. PARMENTOLA: Okay? And this is what Einstein called, you know, the peculiarities of quantum mechanics that didn't make any sense. You know, how is this possible -- action at a distance -- where the distances can be huge. It can be on one part of the universe and another. It doesn't matter.

Q Okay.

MR. PARMENTOLA: Well, the guys out at ARO are funding people to demonstrate that what you can do is take such a system -- where you have photons being emitted in these states, entangled states -- where one of the photons interacts with an object. Well, when it interacts with that object, it affects the other photon, maybe some great distance away.

And the idea is by interacting with that object or scanning that object, you can recreate the image in another location, without having a camera or a piece of film or you -- to image it directly.

Q So it's like a stain that something blasts or something like that?

MR. PARMENTOLA: What it's sort of like is, you know, having a tracing tool where you have an image, let's say, that you want to trace. You have a pen that goes over the image. And then that's connected to another one on another piece of paper that exactly imitates what it is that you're tracing with the other pen.

So if I had to pick an analogy, it's like that, okay?

Q Okay.

MR. PARMENTOLA: But it takes advantage of a remarkable property of quantum mechanics to try and do this.

Q And how real -- how close is this? How realistic is this?

MR. PARMENTOLA: Well, I mean, I think there's a good chance they'll be able to accomplish this. But it will be described at the Army Science Conference.

Q Right, okay.

MR. PARMENTOLA: I mean, this is serious science -- people doing really serious science to try and see if one can actually do this. So you'll be able to talk to people there and they'll be able to explain to you where they are with respect to it.

Q Okay. And then lastly, how about the mind communication.

MR. PARMENTOLA: Okay. That's an interesting project. What that does -- and actually, it's on "60 Minutes", by the way. Somebody just sent me a link, okay?

The Army Research Office, over a number of years, has made investments in neuroscience. And through investments, what's become clear is you can actually relate individual human thought to electrical impulses that occur on the surface of the skull.

Q Okay.

MR. PARMENTOLA: And these electrical impulses form a pattern and some of them are localized on different parts of the skull.

So the idea here is that you could wear a cap that is sensitive to these electrical impulses, pick up the pattern. And then you can amplify those small signals, send it over a wire and connect it to a device. So if you think of a thought, "turn on", it will automatically turn on that computer or that device. And if you do it wirelessly -- it doesn't have to have a wire.

And the idea here is, suppose there are people that, for example, suffer from Lou Gehrig's disease or do not have arms, right? But they're capable, still, of thinking clearly, exercising their thoughts. You can set up an environment where they don't need keyboards. They don't need anything, except their thoughts, to be able to do things.

Q Wow!

MR. PARMENTOLA: So it has applications in the military where, for example --

Q It's like that movie "Firefox".

MR. PARMENTOLA: Right. Exactly! Yeah, exactly.

Q As long as the computer can keep up with the speed of the mind, I guess. MR. PARMENTOLA: Yeah.

Q I mean, I guess that's sort of the bridge.

MR. PARMENTOLA: And this creates remarkable applications. I mean, soldiers would be able to communicate without using voice. So they're essentially stealth -- completely stealthy in an environment where they can communicate with each other solely through thought processes.

Q Well, I'm blown away. It's amazing stuff!

MR. PARMENTOLA: Okay. So I mean -- so these are the type of things that we're exploring in the Army. And I'd really like to see all of you guys at the Army Science Conference.

Q Thanks a lot for that rundown.

MS. KYZER: Great.

And Ryan, did you have a question?

Q Yeah. I have a quick follow-up in regards to the regeneration work.

So you sound like you're doing -- making progress with the tissue scaffolding work, but that definitely means we have to -- if you lost your arm, you have to go to the hospital, et cetera, which you probably would have to anyway.

But there was that MRL -- I think was MRL -- mouse thing where they got a mouse to regenerate and you know, to transfer this regenerative property via the liver to other mice who didn't have the property.

Was there any progress with regard to that?

MR. PARMENTOLA: Gee, I'm not aware of that one. So you're ahead of me on that one. I'm not aware of that particular demonstration.

So the emphasis on the Army is largely organ regeneration. And the thing is, they haven't been able to -- I mean, the liver itself, it regenerates itself. There are certain parts of the body -- like bone regenerates. So liver regenerates. If you damage the liver, it'll grow back.

The thing is, we don't fundamentally understand at a basic research level how that takes place. Why it is that certain organs do and certain organs don't. Clearly, some signaling that goes on, which prevents certain organs from regenerating. Like, for example, the skin.

What tends to happen with skin is that scar tissue forms. And there's clearly signaling that's taking place that places a higher priority on scar tissue -- probably largely to protect humans from infection -- you know, rather than grow back the skin normally with ordinary skin tissue.

Obviously, for a salamander -- a salamander doesn't form skin tissue. You can remove its limbs, cut off its tail, and it will just completely grow it back as normal tissue. So the issue is really trying to understand how the body limits certain tissue and organs -- because the skin is an organ, actually -- from just growing back normally. And that's in a basic research area.

On the applied area and more oriented towards clinical medicine, there are techniques that people have developed, which, you know, we don't understand it at a fundamental basis, but we know they work. And that research is continuing. And hopefully, it will lead to further and further breakthroughs that will enable us, for example, to try to grow complex organs -- you know, something like a heart, for example, actually grow a heart.

I believe they've grown -- at least I recall reading somewhere -- they grew a mouse heart from stem cells, but I may not be quite accurate in that. But I do remember reading something like that. But this is an exciting area. I mean, it just brings up all kinds of possibilities for trying to help people that have suffered traumatic injury.

Q Okay. Thank you.

MS. KYZER: And Henry, did you have a question?

Q Not at the moment. I'm still kind of digesting everything.

MR. PARMENTOLA: I'll be talking with a virtual human at the Army Science Conference, by the way.

Q Yeah. Explain that a little bit. Can you go into that in a little bit more detail -- what you mean by a virtual human?

MR. PARMENTOLA: Okay. Q And talk about how it would respond to a Turing test.

MR. PARMENTOLA: Ah! Here's a guy who knows his business, you know, yes!

Well, you know, the virtual humans we now have developed are obviously not as sophisticated as a human being. However, what we're trying to do is to create realistic-looking and acting human beings. By that I mean their facial features, their speech, the way they respond to questions, the body language is consistent with what we would call normal human communication.

We build in -- we have models that are incorporated into the design of these virtual humans that involved emotion, thinking, natural language processing and I actually interact with virtual humans in terms of asking them questions and they're responding.

Q So this is like a robot or something?

MR. PARMENTOLA: No. It's projected. It's animated.

Q Oh, okay, okay. I'm sorry.

MR. PARMENTOLA: It's completely animated.

Q Think Max Headroom.

MR. PARMENTOLA: But what we're trying to do is create photo realistic.

Q Would this be for -- sorry. Would this be essentially for training simulations? The kind of immersive simulations the Army's been working on for a while?

MR. PARMENTOLA: Exactly. And you know, it's sort of like -- what is it? You know, you saw the movie "Beowulf", right?

Q Yeah.

MR. PARMENTOLA: Well, it would be doing "Beowulf" without having the actors, okay?

Q Okay.

MR. PARMENTOLA: I mean, instead of using the actors and then trying to use animation to supplement what you want the characters to do, it's purely done through animation. And of course, the script is actually embedded through software programming, okay? Through these models that you have for individuals -- virtual humans.

So getting back to the Turing test: of course, one approach that we're taking to that is can I create a virtual human such that if I introduced them into a massive multiplayer online game, that that virtual human can fool virtual humans -- fool humans into believe that that virtual human is actually human.

Q Wow! Okay.

MR. PARMENTOLA: I mean, that might be what you'd call a type of Turing test, right? So we're moving towards using massive multiplayer online games as an experimental laboratory to see if they're good enough to convince humans that they're actually human. And that's one of the objectives in terms of trying to realize realistic, virtual humans.

MS. KYZER: Great. It sounded like we might have had a couple of other folks join us. Is there anyone else on the line who has a question?

Q Yeah. I've just got a quick question. This is Sharon Weinberger.

Could you talk about the holographic imaging and what you see as the applications going forward on that? Obviously, sort of teleconferencing would be one, but what are other thoughts on that?

MR. PARMENTOLA: Well, I mean, I think that that's -- one of the main objectives is to be able to not -- I mean, if we spent the amount of money we have on travel on this, we would be so far advanced in this area that it might not eliminate travel, but it would enable people to participate in meetings with their actual images -- realistic in real time -- interacting with live humans in that context.

And of course, you know, on the battlefield there would be plenty of applications for this type of thing between command centers, for example.

Now, in terms of how it works, the way it works is you take projected images of the object that you want to actually project in another location. So you take two-dimensional projections of that object. And then what you do is you compress those images and you ship it along a high bandwidth line. And at the other end, we have created programs that are capable of three-dimensional reconstruction in real time. So you can take those two-dimensional projections and actually reconstruct the three-dimensional object.

And then there is a special technique that the guys at the university of -- at the Institute for Creative Technologies developed where they have a holographic sheet that's on a mirror. It's not quite transparent. It's sort of translucent. And you have a projector that projects that three-dimensional reconstruction onto that holographic sheet that's spinning at high speed. And if you synchronize it properly, what you wind up doing is creating the actual three-dimensional image. The eye can't differentiate it.

In other words, it's done at such a rapid rate that it actually looks for all intents and purposes as a three-dimensional image and you walk around it. You lay the back, the sides, the front and so on.

Okay, that's the way it works.

Q Well, that's a combination of traditional lasers, holograms and some --

MR. PARMENTOLA: It's not -- it doesn't involve lasers.

Q Okay. So it --

MR. PARMENTOLA: It involves just an ordinary projector that's synchronized in a particular way with a rotating mirror that has a holographic sheet on it, that enables the projection of this into a three-dimensional type of image.

But what it relies on the ability to be able to take two- dimensional projections and piece them back together to create the three-dimensional object.

The guy who's done this -- his name is Paul Debevec. Paul is a very well known person in Hollywood. He's worked on the movie "Matrix". He's done a lot of work in a number of different movies -- "King Kong", "Superman Returns", "Spider-Man" -- a whole list of movies where Paul is one of the leaders in photo-realistic animation. And he and I came up with this idea as to how to combine things that he was doing with an idea I had years ago on how to do this. And he's going to demonstrate it at the Army Science Conference.

MS. KYZER: Are there any other questions out there? No.

Well, thank you so much, Dr. Parmentola, for your time. Do you have any closing remarks?

MR. PARMENTOLA: Well, I'd like to thank everybody for their time and the interesting questions that you've asked. And I hope I convinced you that we're making science fiction into a reality.

So please take an opportunity to come to the Army Science Conference and see how the Army is creating the future for our soldiers.

MS. KYZER: Great. Thank you so much.

And thanks everyone for your time. You can find the transcript at defenselink.mil/blogger.

This concludes today's roundtable.

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