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DWG: Good morning everyone, and thank you for joining this conversation that we are having as the Defense Writers Group with the leadership of DARPA. Dr. Peter Highnam and Dr. David Honey. We met Dr. Highnam previously in another session when he was the Deputy Director. He's now the Acting Director of DARPA

Sir, it's great to have you. Thank you very much for taking some time to talk with journalists interested in military affairs.

Dr. Highnam: Thank you very much. It's interesting. Thank you for organizing such an interesting group of people. I look forward to making this into a real discussion.

If you'll indulge me, I'll begin with a little brief, just a short discussion to set some things.

DWG: We normally just do Q&A, but why don't you fire away. And I hope you might include a little bit on, because my question was going to be how has COVID-19 affected the work of DARPA and is there any work DARPA is doing that is relevant to the pandemic? So fire away, please.

Dr. Highnam: Let's begin there actually.

My own background, after being a DARPA program manager doing electronic warfare I went to NIH for three years and then to BARDA [Biomedical Advanced Research and Development Agency] so I've been involved in the planning for something like this, and

unfortunately back in 2006-2007 when H5N1 was the disease we were most worried about, HHS [Health and Human Services] stood up with a [strategic] national stockpile to look at the medications and other aspects of the responses to that.

It was one of those professional experiences that you never expect to need again, and unfortunately, or fortunately, it's turned out to be very useful to help me interpret things that are going on around us but also internally when it comes to operations, and also as we've pivoted a few of our internal programs and recently completed research programs to the COVID-19 fight.

Let's be specific. I've been an R&D guy my entire career so I'm always aware that that research [money] that you're doing today is not going to operations, not going for things regardless of the job, regardless of the company or organization that you're in. But we have some examples here around COVID-19 where the investments that DARPA made 10-15 years ago are ones that are now at the forefront of providing both interventions, treatments, diagnostics, and other ways we're going to get out of this mess.

For example, looking at the vaccines, DARPA at the moment does not have any vaccine programs, but we did. And under a program called [Adept], which I think was around 2013, it was how do you respond to a new pathogen quickly? How do you produce that vaccine? What would it need to look like? How do you ramp it up quickly in terms of production?

So the nucleic acid vaccines that we see today being discussed certainly have strong roots in that work. And prior DARPA work, we're now benefiting from those earlier investments.

Similarly there was a program called Rapid Vaccine Assessment at DARPA back around, I think it finished around 2012, because when we all look at the timelines associated with vaccine development, the identification of what you put in the vaccine,

then there's the testing of the vaccine that are critical.

This particular program, RVA, Rapid Vaccine Assessment, ended at least five years ago and produced an artificial immune system technology to help with, not with a testing of the vaccine in people. But if you were a major company or organization looking at which vaccines to pursue, that's a route to help you evaluate them robustly and quickly to trim down the early part of the pipeline. This is one of those cases where I did a little looking myself, and looked in the Patent Trade Office and patents that have been filed, some of the story is clear and it's laid out there, and some of the wins and successes.

So again, we're not doing any vaccines at the moment but we have been in this business, in this type of research before with the specific goal of pandemic prevention. One of our current programs that's now mature that's still going on is called the Pandemic Prevention Program and it is, the military need is, we need to be able to send personnel to anyplace in the world at any time. There may be pathogens there. How do we protect those people health wise before they go there? So how do you rapidly give them something as a prophylaxis, something that's a prevention mechanism -- vaccine ideally, but we know those take a long time to make sure they're safe and efficacious. But that's where the monoclonal antibodies came from. So don't fire up the immune system. Can we put something, with a known pathogen, can we devise, can we detect the appropriate antibodies? Can we put them into you into the individual or have the individual generate the antibodies on demand to provide a level of protection or treatment while they're being, potentially being exposed to that as we go forward?

Of course now we see a lot of coverage of many organizations identifying and pursuing antibodies. So DARPA's pivoted some of the current work that we're doing to that, but we've been also in this work since 2012-2013 as well. How do you find antibodies really quickly? How do you then find the most efficacious ones from people who have recovered? And then

what's the RNA or DNA recipe to produce those antibodies, because they're just proteins that we can then give to people to generate the antibodies on their own. It's very exciting work.

Also COVID-19, we have crisper approaches for detection. Very accurate [inaudible] to detection going on in current research. We have epigenetics approaches for very sensitive and very specific detection of early and potentially asymptomatic individuals. Epigenetic, think of the genome and when the body, when a cell in the body has to respond to a change in its environment, perhaps exposure to a virus, different things happen in the cell. Different genes are activated, different pathways. And the analogy might be, we ourselves put Post-It notes onto the genome saying make more of this protein, make less of this one. And that's what we're doing with this epigenetics work. We're looking for those marks that our own bodies have responded to, our own cells responded to. And by finding those, identifying which marks, then we go look for, as early as we can, to see those signatures to identify potentially exposure or, again, potentially very early after being exposed to the pathogen.

And lastly in COVID-19, manufacturing. There's been quite a bit written about the supply chain, medical supply chain and how much comes from overseas. One of the programs that we have, a program called Make It, has been working in this area, again, for some time. Not specifically for COVID-19, but how do you make particular medications entirely from U.S.-based materials? And in a very different way than traditional approaches to manufacturing. So we're now looking at common antibiotics, other things that are used in an ICU, various drugs that span a technically broad space so that we can be sure, or as sure as we can, that we have a general approach to doing this.

I find being at DARPA at this time is exciting in some ways because we get to see the work, the research work that was funded, that was done 10-15 years ago now really starting to pay off and help us all. It's past investments, anticipated current

needs is the bottom line. And it's really good to see research paying off this way and to be so valuable.

DWG: Thank you. I'm going to start turning to everyone else now. I'm going to be asking people in the order in which they signed up whether or not they have a question. Then if they do, please unmute and ask your question when I recognize you. Everybody else, please try to keep muted as much as possible because otherwise we're going to hear dogs barking or other interruptions.

Let me just check, Dr. Honey, have you been able to join us and does your mike work? Let's just see if that's the case.

Dr. Highnam: David contacted me a second ago and said he's still having difficulty getting in. I gave him another number.

DWG: I'll welcome him on another try at any time. I see him listed as having signed on.

First on my list is Lauren Williams of FCW. Lauren, are you on the line and do you have a question?

DWG: I wanted to ask what sort of cyber programs that DARPA was working on this year, especially since it's an election year, and to see if there was any new initiative there.

Dr. Highnam: As always, DARPA has quite a few cyber programs running primarily in I2O, one of the six offices, the Information Innovation Office.

We have everything from massive configuration security, so think of the DoD context, very large system on a platform that typically may be isolated with hundreds or tens of thousands perhaps of individual computing elements and sensors and such. And just as in any industry situation, factories, refineries, all these come from different vendors. How do you ensure that they're configured correctly? Just think at home, if you ever

dare to open the lid on the configuration management of the router that you have from the ISP that gives you your internet, there are pages and pages and pages of configuration elements in that very simple, what is nominally a very simple, straightforward, single function device.

So think of a ship. Think of, in any large situation, the configuration security is a program I like a lot because when you open up what needs to be done there it's such an exciting technical space. It's such a clear win for the department and it's well along and we have a lot of really interested transition partners.

We also have programs such as Enhanced Attribution which is, again, these are university performers, company performers involved in open programs.

If you do something on the net your footprints remain, essentially, and marketing companies take advantage of this all the time. So some of the questions that we've had, the research questions were what else could we see? What else could be done with that? And there are some interesting results coming from that.

So in a sense both of these programs would be [inaudible] programs. One is don't do something to us because all people can see it. The other one is configuration security.

There are so many.

When we look into the confluence of AI in cyber, for example, that's a hugely rich space. The speed at which you have to operate has demanded that AI can now just be inserted into that and we have quite a few programs including HACCS, is one of those.

And then specifically to hardware security, when you open up the Electronics Resurgence Initiative which is largely in the

Microsystem Technology Office at DARPA, you'll find in our effort to ensure that DoD always has access to secure chips, there are quite a few programs in that mix on how to take an existing architecture from whichever country we buy them from, whether it's a special purpose device or a regular CPU, and what else do you add to it to ensure that that device honors the machine, honors the model that the manufacturer claims, and how do you embed that within the design process without incurring additional overhead? I think this type of work is incredibly exciting because this is embedding security for all of us and with clear DoD needs.

One thing I'd like to point out is that we have a But Bounty Program out there at the moment. I printed this off before I came in. It's finding exploits to thwart tampering. So we provided some hardware online and offered a Bug Bounty. And this is running from this month, July, through September. We're partnering with the Defense Digital Service and a company called Synnex to do this. It's up on our web site. It has all kinds of things. We had 500 entries at one point. We have 32 byte and 64 byte processes involved. And we've really just opened this up to the people to give it a shot, see if you can break these things. I think there are three different designs, hardware designs underneath that are being attacked, but maybe four. And we're really interested to see if we can do it.

DWG: How much money is the bounty?

Dr. Highnam: It's depending on the sophistication of the attack and the things that are found. We didn't list it in the press release.

DWG: Is there a range?

Dr. Highnam: Fame and glory I think is part of it. For an academic team this is a huge deal. There's a monetary reward to it, I'm sorry I just don't have it.

DWG: Okay.

Next on my list is Michael Gordon of the Wall Street Journal. Michael, would you like to unmute and ask a question?

DWG: Thank you.

Sir, at the beginning of this meeting in your presentation you discussed your efforts on forward-looking thinking about how to deal with pandemics, how to create vaccines, how to deal with the supply chain. I think those of us who have been sort of following how the government has responded to this threat have the impression which I think is supported by evidence, the government was essentially caught flat-footed, was behind the curve, has been struggling to catch up, and has now got its warp speed effort.

What I'd be interested in hearing is to what extent was DARPA integrating with the CDC or with other elements of the government to increase preparedness for this sort of event? Or were you just pretty much operating in your own silo and doing some interesting research, but research that the rest of the government didn't draw on?

Dr. Highnam: Let's begin by talking about how DARPA transitions results from its programs. How DARPA originates programs, how it starts them, why it starts them, how they execute, and then how we look to transition the results.

So at any given time we have north of 250 programs running. And every one is different. Space related, 5G, AI, biology.

In the bio space certainly among this type of work, when DARPA got these programs running back in 2008, 2009, one of the programs back then was how to make vaccine quickly once you knew the recipe that you wanted. Ten million doses of H1N1, an influenza vaccine, were made by engineering tobacco plants to express the vaccine for us. So ten million doses. That company

is now involved in the COVID-19 fight. Again, we're not doing vaccines at the moment, but they're now talking commercially, they're now in trials, and so on.

Similarly to the nucleic acid vaccine, DARPA de-risked the technology at the beginning but worked at that time, as we do today, with the NIH, with other parts of Health and Human Services, and certainly very closely with BARDA and ASPR, the Assistant Secretary for Preparedness and Response, and the biomedical research and development authority in HHS. So this is very much a team effort.

When DARPA gets into it we have a DoD use case or use cases, but we recognize that the way these things, these technologies become really available to the department and available in a broader sense is by coming back through the commercial world, or coming back through the parts of the government that do this at a larger scale, and certainly the bench, the place with the deepest bench anywhere in vaccine development is the National Institutes of Health. So we're very much in partnership on all these things that I mentioned. The antibody discovery work, some of the first blood samples from U.S. persons that came through Health and Human Services, NIH, and were then with DARPA research teams. Again, DARPA doesn't do research in-house. These are small businesses and universities outside who had already proven in earlier DARPA funded work that they could identify and characterize the most interesting efficacious antibodies very quickly. And this time they did it in a few weeks. Then that information is shared back into that larger context with the rest of the government and outside. Much of it's even public.

Things like this are very much an all of government activity and DARPA gets in there and de-risks things with the Department of Defense use cases driving, but we recognize the transition back to us, back to the department, and back to national security has to be in the larger context.

I hope that helps.

DWG: David Honey, are you on? Are you able to hear me and speak?

Dr. Honey: Yes.

DWG: Excellent, so you've joined us. So we now have both the Acting Director and Deputy Director of DARPA on.

Let me go to my next questioner. Carla Munoz of Jane's. I see that you're on. Do you have a question?

[Pause]

Okay, I'm going to move on.

Sandra Irwin, Space News. Are you on and do you have a question?

DWG: Yes. Thank you so much.

I have a question either for Dr. Highnam or Honey, whoever wants to comment on this. I was wondering if the DARPA Tactical Technology Office has any plans to do another launch challenge given the difficulties of the recent one, that nothing really -- it was not successful. So I was just wondering if you all think there will be another one in the future. Thanks.

Dr. Highnam: At this time we don't expect to do something quite like that. We learned a lot from the period when DARPA announced that launch challenge to when we finished it out, we learned a lot about how the market had changed so quickly, and frankly, there's so much access to space and so many companies at the moment, it would be great to have a few more, but the role of DARPA in driving another launch challenge, we would have to have something very specific in mind in order to warrant doing that.

DWG: Can you say maybe what are some of the things that DARPA would be interested in doing? What are some of the specific needs that you foresee for DARPA or maybe for a [state] launch in the future?

Dr. Highnam: I would say, sorry, I apologize for being unclear.

We have ready access for the things that DARPA needs to do and use cases that we're seeing at the moment from different commercial sources including being able to put up various assets of many kinds and flavors. So we don't see the need at this moment to do something akin to the launch challenge as such.

We've talked about this internally. The things that we need to do, the things that we know need to be done at the moment, we have ways of doing it and we would be competing -- we don't know what the advantage would be to do that, to do another one.

DWG: Let me move to Mallory Shelbourne of USNI News. I see you're on, do you have a question?

DWG: Yes, thank you so much. And thank you both for being here.

My question is Navy related. I wonder if you can talk about DARPA's role with unmanned systems as the Navy's started pursuing their own programs of record, and I'm wondering whether you could speak to whether there would be a follow-on to Overlord, and just speak to how DARPA fits in here with unmanned vehicles.

DWG: Overlord is a program that's not a DARPA program, so I can't speak to that. But I can speak to unmanned vehicles more generally.

Interestingly, Mike Lahey, who is the current Director of [PEACHCO]. When he was a DARPA program manager he ran one of

the first unmanned combat air [vehicles], [UCAP] around 2000 before it became a thing. Now he's back.

More recently, as you noted, the Navy's picking up interest, and we've transitioned at least one unmanned vehicle, the Sea Hunter to the Navy for them to [inaudible]. Airborne, in water, on land. There's a huge amount of work still to be done on unmanned or autonomous vehicles.

You may have seen last weekend we had a flight test of something called Gremlin. I think it's up on DARPA's Twitter feed. This is where we launch a jet UAV from a plane, so it's air-launched and it's air-retrieved. So there's a little autonomy in there in terms of station keeping and mission execution.

So there's a lot to be done.

In terms of newer programs at DARPA, maritime. We have Sea Train. How do we find a way, this will need to be evolving against AI or autonomy, how do we shape hulls? How do we put three or four hulls in trail, probably? Very closely in trail through different sea states, to really be very efficient. Think of bike racing, sitting in the [peloton], being up close behind the guy in front. We have to be constantly tracking that.

So there are potentially huge wins in terms of fuel efficiencies, autonomous long haul work.

And also we have a program called [No Mars], which is, if you were to design a sea vessel completely from scratch with no intention of ever having people on it, including perhaps repair at sea, what would you do different? What I like about it is does the notion of [us] even matter? Think of no aircon, no messing, no state rooms. It's a very different place to be. There's a huge amount of work in the airborne space, of course, in the [Blackjack] programs, more autonomy there too, as well as maritime.

Great question. Thank you.

Dr. Honey: I would add in that I think when you look at where our AI programs are going and the investments that we're making, that is probably going to lead to a revolution in autonomous vehicles, and I'm very optimistic that we'll see some great work come out of that area as well.

DWG: Rebecca Kheel of TheHill. I see you're on. If you have a question you're next, and then Rachel Cohen of Air Force Magazine.

DWG: Thank you for doing this.

I was hoping you could talk to us more about the research into antibody therapies for COVID-19. You've mentioned it a couple of times, but I was hoping you can get a bit more into how that's going, what progress is being made, when we might be able to see that being available, anything like that.

DWG: There are multiple teams, for those who don't know how DARPA operates internally, we don't do any of the research in-house, it's all done by others. And when the first blood samples became available back in March from recovered U.S. persons, they went to universities such as Vanderbilt, Duke, small businesses such as [Epscilera] and others. They rapidly found and began to characterize antibodies that would be particularly efficacious against this virus. That work has continued and of course many other companies and universities are now doing this as well because the technologies to do this came in large part from DARPA investments over the last decade.

So the good news is this time to get to the point of discovery and characterization was relatively fast.

Now it's to the really important steps of determining safety in people, efficacy. These are the phase one, phase two. And then

a broader mix of people, more diverse demographic and so on for phase three trials.

Again, we're not executing those trials. Those are being run by the big pharma companies who are now working with both the antibodies they've discovered in-house as well as with some of those coming from teams that DARPA has sponsored.

I'm not trying to be elusive here, but this is something that changes day by day. We're aware of imminent press release from some of these companies, but these have a dramatic impact on share prices. What we care about is getting them through clinical trials and getting them out there and getting them available to people [proper] access, which was our original intent with the programs that we did, as well as the treatment processes.

We're very encouraged. There's some absolutely appropriate due diligence going on, and I'm optimistic.

DWG: Rachel Cohen of Air Force Magazine. I know you're on. Do you have a question? Then after you will be Jeff Seldon of Voice of America.

DWG: I do have a question, thank you. My mike goes in and out, so let me know if anything --

So you're still fairly new in this particular job and I'm curious sort of what your list of priorities are. And as the S&T environment is evolving and there's new players popping up within DoD, if you have any ideas of how you want to do things differently, or DARPA's role in that ecosystem going forward.

Dr. Highnam: I've had the luxury of being a program manager in this model before, a four year tour, but also serving in R&D organizations elsewhere in the government including the IC. And for a few years I ran the intelligence version of DARPA, IOP.

So I've been back at DARPA now about two and a half years for this tour, so I've had time to, working very closely with the DARPA Director, Steve Walker, on the context in the Defense Department, what needs to be done, what was going on, what was evolving. And you'll see DARPA as we do always, we change -- there's always a changeup of the mix of things that we're doing. This is in part recognition of what's going on, has to be what's going on around us because when we frame and launch new activities internally we have to answer questions and one of those questions is what is the state of the art, who's doing what, also if you succeed, who cares? So if it's merely engineering it's not a DARPA problem. If somebody else is already doing it, it's not a DARPA problem. But DARPA for 62 years now has operated outside the comfort zone of most other R&D agencies and organizations because we don't have any in-house labs to maintain or to keep doing things the way they've always done them, we're able to go out and find though open competition the best teams anywhere to do it.

Also because all of our people, Dave Honey and myself included, we're all ephemeral in the DARPA model. We all come here for limited tours. So the place never gets stuck doing something just because we do something.

So your question is right on. Now with Steve Walker finished his tour as Deputy Director and Director, he's now moved to industry. Now we have the opportunity to rethink some of the things that we're doing, albeit in the context of a pandemic.

That's why two years ago when I came back to DARPA we really increased the focus on AI. So with that $2 billion investment we announced in September of 2018, we look at what we're doing in biology, there are so many things we can do there not so much biomedical but operational biology. And I really regret I didn't bring in with me a brick that I like to use as a prop. This brick is [grown]. It's not concrete. It's the notion of being able to produce a landing pad for a helicopter, not by bringing heavy gear and pouring cement to lay that down and mix

it and put it down, but by coming in and spraying it onto gravel or sand or whatever's there, and within a few days having a landing pad in place.

So there are so many opportunities that are, again, outside the comfort zone of other places that DARPA continues to get into and de-risk. That's the nature of the DARPA machine.

DWG: I had a really quick first question on what your priorities are.

Dr. Highnam: We're reliant on the NDS, so National Defense Strategy, so for us, broadly, it's defense of the homeland, deter and prevail against high end adversaries, effectively prosecute stabilization, and execute a broad range of fundamental but still in that DARPA sense applied research in AI, in biology, in electronics and in all types of computing.

DWG: Jeff Seldon of Voice of America. I see you're on, if you have a question you're next. And Robert Ackerman of Signal will be after you.

DWG: Thank you very much for doing this.

I was curious with COVID-19, how has that changed the way DARPA looks at national security? Has it impacted your thinking of your approach at all? You mentioned the National Defense Strategy which focuses mainly on big power competition, but there are elements in there about infectious disease.

Is the way that DARPA thinks about this changing at all?

Dr. Highnam: This is where we have the luxury in this moment of benefiting from the research that's taken place over the last 10-15 years that is directly relevant to this pandemic. DARPA excluded it, again, for DoD purposes, but it has immediate and broad civilian application.

So that's why for us one of the three major elements [inaudible] the NDS is to effectively prosecute stabilization efforts. This is both in terms of increasing performance of our own people, gray zone activities, working at city scales, dealing with disease. And we have to be able to put forces wherever they need to be when they need to be there, so how do we, the department, protect those folks as best we can before they go in? If we find out, for example, that there's a novel disease or a known disease, for which there may not be a full range of treatments or vaccine that's readily available.

Again, to be here at DARPA this time and to be able to benefit from that prior work and watch what's going on and watch the vaccine, the antibody discovery, the very sensitive diagnostics of the things that are now coming online to emergency use authorizations from prior research is tremendously exciting. And there's so much more to do.

When you take disease by itself, or if you look into a distressed population -- food security or water or other, so back to stabilization in an under-governed place or a broken place somewhere in the world, water shortages engender disease. Distress in populations causes health issues to be dealt with. Food shortages. All these things are in the mix and are being considered.

We're looking for the research programs that we can frame in the DARPA context to go after some of those things. It's a great question and I feel privileged so much thought had been given to this by DARPA folk who came before us.

Dr. Honey: One of the big things I think the work force has [inaudible] is that this really reinforces the model of needing to plant those trees 10-15 years in advance. So I think for a lot of the program development that the PMs are going through right now, what I see going on is people are really trying to follow that model of look ahead 10-15 years. It's not that we're worried about the next COVID, it's 10 or 15 years out

there, that's a very hard thing for us to do.

Dr. Highnam: A really nice article by Chairman Langevin and Ranking Member Stefanik in the Hill in May that spoke exactly to this. And when's the best time to plant a tree? Ten yeas ago. When is the net best time? Today.

So we have opportunities. We have, back to the specific question, we have immediate needs which are not really DARPA's but we've pivoted with CARES Act funding to bring research results to the current fight. But we're also looking ahead.

So what has become the long pole in the response? Is the intervention safe? Is it efficacious at the broadest possible demographic? So there's more to be done and DARPA will be involved, but again, working closely as I mentioned before with the NIH, with the CDC, with BARDA and parts of Defense Health.

DWG: Robert Ackerman, if you have a question you're next. Then Agence France-Press after that.

DWG: Thank you.

FY20 is winding down, FY21 is almost upon us. How will your technological priorities be changing in FY21 compared to what you've just had in FY20?

Dr. Highnam: There isn't a major shift. Actually the bulk of our planning is looking into '22 at this point because the way timelines work, and when we post an opportunity for research, research proposals to come to us, if we posted it to August the 1st we would be receiving proposals mid to late fall. They would be reviewed. Research winners would be selected. And then within a few months after that contracts would be awarded. So now we're into the middle, we're into second quarter of calendar year '21 and those things are now getting underway.

So in terms of new directions, you'll see increasing emphasis in

AI, in electronics, IT, space, more on direct energy, in quantum. Then in biology, both, a little bit more on operational biotechnology, things that other people are probably not going to be getting into that we need to find out what can be done there to rally help the department.

DWG: Sylvie Lanteaume of Agence France-Presse? I see you're on. Do you have a question?

DWG: Hello. Yes, I actually have a question.

I was wondering if you have any program specifically designed for the Space Force and what you could tell us about it.

Dr. Highnam: The programs that we have running at the moment were, again bac, to the timeline I just went through, those were put in place before, I think certainly before the Space Force was being discussed for most of them, but, or occurred during the last few months. In that sense, not designed for the Space Force but absolutely of value to.

Let's talk about a couple of things. One, we launched another satellite I think about three weeks ago and this one is exploring how to produce very high quality optical characteristics, optical apertures using MEM, Micro Electronics Materials, to change the mirror shape. This is actually [inaudible].

On the larger scale we have the entire Blackjack program which is how do we take advantage of LEO and all of the proliferation of primarily communications oriented systems that commercial industry is putting up all the time.

So we're working with those companies. They have communications, they have launch, back to an earlier question, that they're providing for their own commercial purposes. We're adding additional sensor payloads in terms of infrared payloads, optical payloads, and RF, radio [SIGINT] payloads. And a lot of

computes as well.

Space for us is a place that almost demands access to autonomy and AI technologies because things happen so quickly and they need to happen there. They cannot be brought back down to the ground all the time.

So these and other technologies that we're doing I guarantee will be of great interest and use to the Space Force and we work closely with the new, for example Space Development Agency to, they're a way point for some of these things as we invest in them, mature them, they can now move across to SDA and for use for space purposes.

DWG: Ellen Millheiser of Synopsis, I see you're on. You're next if you have a question, followed by Theresa Hitchens.

DWG: Hi. I don't really have a question except are y'all doing any biological work at this point? I know you said you did the pre-work on what they're doing for the vaccines. Are you doing anything now?

Dr. Highnam: Yes. The Pandemic Prevention Program is active and so we have some things already going on there anyway. We were looking at Zika and Chikungunya before COVID. Then we added an emphasis, it now dominates that particular program, on COVID-19 work, antibodies and so on.

The epigenetics work is a program called Echo. That's the host-based response to early infection or challenge by a pathogen. That's incredibly active at the moment. We're working with parts of the Air Force on work to understand safety in planes. That's pretty much complete.

There are quite a few things where, again, yes, we benefitted from the earlier work but we're also able to, with the help of CARES Act funding, to add additional emphasis inside existing programs to go hard after the COVID-19 challenges. Again,

diagnostics, treatments, and so on.

DWG: Theresa Hitchens of Breaking Defense. I see you're on, do you have a question?

DWG: Yes, I do.

You mentioned that you're looking ahead at getting into more AI efforts. There are a lot of AI efforts ongoing at DoD. What direction are you looking to go that's different from what the other cross-services, the other DoD institutions are doing? Thank you.

Dr. Highnam: Thank you for the question.

Back in 1960 DARPA really launched into the field of AI. DARPA at that time funded what became AI as a field, and we've been funding this continuously ever since.

So for us, we parse it into pretty much three areas of work or three wave at the moment.

The first was the expert systems, that was going to rule the world. The Japanese next-generation computing project back in the '80s was a really big deal on this. So DARPA funded through that. So if you use one of the home tech preparation kits that takes you through a bunch of rules, that at that time was called AI. It wouldn't be today, but it was then.

Then the basis of the neural network that we're seeing, that we're all enjoying wins from today, that came from fundamental work done back in the '70s and it's now the availability of the high performance inexpensive computing data that's causing the rise and more widespread use today.

So DARPA is continuing to invest in AI technology. Again, we announced a $2 billion investment back in September of '18, and that's spread over five years.

But when you look into our programs, well over a third contain AI technologies or exploiting them in very different ways. Or are pushing the boundaries of what comes next. So wave one was describe. Wave two is recognize. Wave three we believe is explain. And after that come a number of other potential phases. We don't know yet what they will be.

So the intersection of AI technologies with pretty much everything is now a given. There's a major issue with robustness for these technologies. There is no discipline of AI systems yet, AI systems engineering. We're doing some of that leg work but others outside need to do that too.

We recognized that universities were being funded, a lot of their faculty and post-docs and grad students were going to industry very quickly to do AI work.

So one of the things that we introduced, again announced in September of '18, were something called AI exploration. Where DARPA posts a topic of interest. We give the outside teams an opportunity -- 30 days -- to respond. And then we make award within 60 days after that. So if you're ever watching government acquisition you'll know this is lightning speed. We've now done I think -- each award's up to a million dollars. And this intends to be fast enough to be within the lifetime of a master's student. To be within the lifetime of a post-doc. To really give them room to push the limits, for us to explore something and know something knew, to frame some of our bigger programs.

So it's incredible use, very popular. We've had well over 600 proposals so far in the two years or so we've had this running. We've had $120 million awarded in this particular effort, and we've maintained our timelines, so it's a very popular thing.

Working with JAIC, the Joint AI Center in the Department, every service lab is doing AI, every company is doing AI in some ways.

And what we do internally, again, before we launch something, are we state of the art in what we want to do here? Are we pushing it? Are we redefining it? If not, why should DARPA do it? That's the continuous question. And we always partner with others to get things done.

Dr. Honey: I think that one of the key differences now is that we see -- you mentioned the JAIC and there are other organizations too, that are now stood up to actually deploy, productize and sustain our AI R&D development into the field. I find that to be a very exciting development that wasn't there before and that was desperately needed.

DWG: My question was actually about what is the future direction? What's the DARPA hard problem in AI that you're gearing up to look at when you said that you want to put more investment in?

Dr. Highnam: It's across the board. Again, we've had the whole push for 40 years or so in [expert] systems come and gone. Neuro nets and reinforcement learning and the things around that are very big and being applied in many places. But they're not robust yet. And training these things and retraining them, for example, is still a bit of a black art. So a form of verification would, the notion of flying or trusting your life to decisions being made by a system autonomously today, I wouldn't do it without having humans involved, without having controllers wired in in some way.

So we're going now into explaining. So the AI system needs to be able to say this is the result I have. How did I get here? What's the result? Not just for an analyst but perhaps in real time as well. Putting for flight control systems to have not just the normal flight control laws that keep the bird flying, but allow it to have some AI-enabled flexibilities to enable it to adapt to certain other conditions but still keep within a feasible flight control envelope and guarantee that behavior. There's so much to do there.

And then when we start applying it, each field we apply things to, whether it's drug discovery we're doing some very interesting leading work, with challenges actually, bringing AI to 5G technologies.

So there are so many different application areas, and there's so much that needs to be done to make the current AI technologies robust, and to figure out, and to explore and define what the next wave of AI technologies or their emphasis will be.

DWG: We've got time for one more question.

First of all Zach Biggs of Center for Public Integrity. I see you're on. Do you want to go next?

DWG: That would be great, thank you.

I wanted to ask, you referenced an interest in operational biotechnology moving forward and an area you think DARPA should be focused on. If we go back about 15 years there was a series of programs that DSO did that was really focused on troop enhancement. There was persistence in combat, soldier self-care, super troop program, all these biotechnology efforts to improve performance and in some cases improve duration. All of those things generally fizzled out or at least what was publicly available suggest that those programs didn't transition into major technologies at the Pentagon.

Do you see a role where DARPA's going to focus on troop enhancement based on these biotechnologies? Is that part of what you're talking about with operational biotechnology? And did I miss something? Did those prior programs yield something now, 10-15 years later, that is improving what troops can do?

Dr. Highnam: Some of the earlier programs, different things came out of it. Different ways of training high end athletes, for example. Climatization technologies and approaches. But

I'm with you, I think that was exploratory work and bits and pieces came from it but nothing I could point to at the moment as a clear win.

But today when I talk about operational biotechnology, I talk again, I don't have my prop with me, but growing a landing pad and the logistics burden that no longer exists in order to do that, to improve operational flexibility. That's huge. To be able to have a very low power device that pulls drinking water even from relatively arid air at altitude. That's a really interesting device. In terms of physiological interventions, that's operational biotechnology. We have a lot there.

Physiological interventions, we have a program out called [Hela] and we have a couple of others where the types of injury that we see from service folk who wear body armor, there's blast injuries. Those are unique and they're damaging and frequently hard to heal. So what about an electronic bandage, a "smart bandage" that understands the sensing, when to apply different chemical gradients or interventions in and around the wound to promote healing rapidly?

Or as we deploy troops worldwide, two of the major issues that we encounter, actually we encounter as tourists as well, is sleep deprivation. So what can we do to more rapidly adjust the sleep cycle?

And the, delicately put, traveler's stomach issues from encountering different conditions, different types of food, a different microbiome, how do we help our people rapidly adapt to these things?

So physiological interventions. What I really like is a program to take someone who's injured in the field and [inaudible] bio stasis, and have them held in condition so, not frozen, but they have a wound that needs to be treated by a more serious medical facility to help them stabilize long enough to get back to that facility without degrading further.

These are things that DARPA's into, again, with Defense Health, with the service medical labs, and with the NIH and other medical facilities as possible.

So the things that you mentioned, I wasn't here at that time. I remember some of those. But the noes we're doing now as we're moving forward I like how the Biotechnology Office is setting up these things. Physiological interventions, operational biotech, detect and protect, so what's in the atmosphere around you, what kind of interventions do you need to have there, and a little bit on warfighter performance, but it's not. It's not the dominant piece of the bio portfolio.

DWG: We're past the top of the hour so let me just ask the two of you, Dr. Highnam and Dr. Honey, any closing thoughts before we wind this up?

Dr. Honey: Again, I want to thank you for the opportunity to have this session today and I apologize it took me over 20 minutes to get in, but I think the DARPA model has proven itself with time. I think it's still a challenge to get the word out there on how it works, why it works. I think as we see a number of other organizations who want to copy us and generally fail at doing it, it's hard to do. Getting the right people and the right ideas in place is a real challenge,.

But again, I think for those looking to the future, there are a lot of really fantastic ideas coming out of our program managers. You'll see them in the [Inaudible] coming up. There's not much we can really say specific to those.

But I think when you look across the offices, I think that we have made the right decisions on where to focus our efforts. Again, as Peter mentioned, the National Defense Strategy really does have great guidance for us. I would take just one thing out of that that I think, as someone who grew up during the Cold War, I see a lot of parallels to today, and so I think a lot of

the challenges that we face, especially as our adversaries are able to embrace ever-increasingly high performance commercial technology, a place like DARPA and the rest of our R&D ecosystems is really needed in order to stay ahead.

Thank you.

Dr. Highnam: For me, I want to bring it back and use the COVID-19 situation. DARPA, we all are benefiting from investments made by those who came before us at DARPA and in the other biomedical research places and companies. And to be able to see, to be able to, with full department support and Hill support, to add additional activities on top of mature technology as well as to revector or add emphasis to existing research and all the work being done by others and seeing it picked up and taken into emergency use, authorization requests, into the clinical trials across the board is incredibly exciting. It just speaks to the power of this model at DARPA, I call it the DARPA machine, which they got right when they designed it back in '57. Temporary people. It's projects based. We have no fixed assets. We rent our building. It's a place that's designed to always be on and driving and pushing the leading edge. And COVID-19 and the response, it's an amazing example of that.

It's a real privilege to be the current steward.

DWG: Thank you very much. And thank everyone for joining us. That concludes our session.

I always find these DARPA sessions fascinating. I hope we can do another one in 12 months or less. So please keep us in mind.

Dr. Highnam: Thank you. Great questions.

DWG: That's it, ladies and gentlemen. Talk to you next time. We're not likely to be doing sessions in August. If something comes up that I feel you all would really want I'll book it, but

I haven't got anything booked for the moment, but we will be very busy in September and October. So I look forward to talking to you then.

Again, thank you Dr. Highnam, Dr. Honey, and everyone else.

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