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HI-TECH, BIO-TECH: UNLEASHING KNOWN UNKNOWNS

— Annie Jacobsen

It is a common saying among scientists that if the twentieth century was the century of physics, the twenty-first century will be the century of biology. Viewed from a defense science perspective, and coupled with ever-increasing advances in technology, the world is now experiencing a revolution in hi-tech, bio-tech affairs.

Leading the most radical advances in this arena today is DARPA, the Defense Advanced Research Projects Agency, a military research unit inside the US Department of Defense.

What might this mean for mankind?

It is noteworthy that DARPA, founded in 1958 in response to Sputnik, is relatively new to bio-tech. During the Cold War, the Pentagon maintained a kind of aloof indifference to biologists, or, in the words of Nobel Laureate Joshua Lederberg, a "blindness to the pace of biological advance." Not until the Berlin Wall came down – and with it the revelation of a covert, hi-tech Soviet bioweapons program – did DARPA bring biologists into its ranks.

DARPA scientists quickly began looking inside the human body, toward developing technology that could transform humans from the inside out. The results are wide-ranging, from genetic engineering through synthetic biology to animal-machine dyads.

Today, these programs fall under the rubric of transhumanism: the idea that man can and will alter the human condition fundamentally through augmented cognition and human performance modification using hi-tech, bio-tech means. DARPA leads the world in pursuit of this science and it is necessary to recognize the military-application goals.

With countless examples to draw upon, perhaps no single area better represents the hi-tech, bio-tech debate than DARPA's brain-computer interface programs. In these programs, a single microchip, or an array, is implanted in the soft tissue of the brain with a variety of goals, from restoring memory to enhancing intelligence and response time.

DARPA has been interested, theoretically, in brain-computer interfaces since the 1970s but it took twenty-first century advances in biotechnology and nanotechnology for the science to break new ground. By 2002, after successfully implanting electrodes in the medial forebrain bundle of a rat's brain, DARPA scientists were able to remotely control the animal's movements through a maze, raising questions about free will.

By 2004, with a mandate to develop "order of magnitude increases" in this technology, DARPA began work on "human-machine dyads," with the goal of coupling man and machine. During the wars in Iraq and Afghanistan, of the 2.5 million who served more than 300,000 returned home with brain injuries. DARPA initiated a series of brain implant programs that presently sit at the forefront of the hi-tech, bio-tech world.

In the Restoring Active Memory (RAM) program, scientists have developed and are testing implantable wireless neuroprosthetics to overcome amnesia. In the Reorganization and Plasticity to Accelerate Injury Recovery (REPAIR) program, scientists seek to understand how the brain makes computations and organizes information, also using brain implants. The Systems Based Neurotechnology for Emerging Therapies (SUBNETS) program treats post-traumatic stress disorder by surgically implanting multiple

electrodes in various regions of the brain as well as a microchip between the brain and skull of those wounded in war.

The chips wirelessly transmit data back to an information operations center, which has the capacity to send electrical impulses remotely to different regions of the veteran's brain to relieve symptoms like anxiety and delayed reaction time, a kind of twenty-first century electroshock therapy on the go.

These and other hi-tech, bio-tech DARPA innovations may provide an opportunity for civilian scientists to revolutionize our understanding of the human mind and uncover new ways to understand and treat disorders like Alzheimer's, schizophrenia, autism, epilepsy, and traumatic brain injury. These are important goals. But these programs also raise questions about unintended consequences—known unknowns.

The potential for deliberate misuse of hi-tech, bio-tech was recently summarized by a long-serving group of Pentagon science advisors called the Jason group. These scientists pointed out that chip-in-the-brain programs could pave the way for a dystopian nightmare – namely for "predictable, high quality brain-control to

become a reality." That hi-tech, bio-tech comes with its own double-edged sword. "An adversary might use invasive [brain-computer] interfaces in military applications," the Jasons warned. "An extreme example would be remote guidance or control of a human being." In this twenty-first century world of science, almost anything can be done. Just how far should biotechnology go?

Biotechnology will allow for cloned humans. Biotechnology will allow for the manipulation of brain chemicals like oxytocin (the brain's moral molecule) to control emotions associated with fear and trust. Biotechnology will allow for synthetic biology, the engineering of living organisms to create new biological organisms to perform functions that do not exist in nature. These are but a few examples.

Yet, with every scientific breakthrough comes the potential for grave harm. The creation of synthetic organisms could damage an existing ecosystem. The creation of human-machine dyads could take away a person's free will. Who decides where the line in the sand is drawn, where risk outweighs reward?

Just because something can be done, does not mean it necessarily should be done. To strike a balance between bio-tech's boundless promise and its inherent existential threats, discussions must be had. Discourse always shines the light on known unknowns.

Annie Jacobsen is a journalist and bestselling author. Her newest book is The Pentagon's Brain: An Uncensored History of DARPA, America's Top-Secret Military Research Agency.