Notes from the Edge

Insights into an Evolving Future

A Product of the **Futures Assessment Division**

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TECHNOLOGY

UAS Swarms Guided by Brain Waves. Past research has found ways to steer a drone just through the power of the mind. Now, researchers at Arizona State University (ASU) have built upon that with a system that allows a pilot to take control of a whole swarm of drones, both in the air and on the ground. Previous studies asked subjects to perform specific mental tasks that are easily readable, and turning the corresponding brainwaves into commands. In the ASU study the user simply watches the drones on a monitor and pictures them performing desired tasks; flying close together, spreading out, or docking with ground-based robots to charge batteries or swap information.   **Brain Power 1**   **Brain Power 2**

Navy Pilots Describe How the F-35's Brains Will Change Air Warfare. Navy pilots say piloting the F-35 Joint Strike Fighter on to the flight deck of U.S. aircraft carrier is almost like flying a plane that flies itself. Pilots would spend less time throttling and figuring for flight conditions and more time coordinating with other aircraft, working with huge volumes of data, and managing complex missions against ever-more sophisticated adversaries.   **Inside the F-35**

Mission Impossible: The Ridiculous Tech of Jason Bourne. Fiction and science fiction are great for musing about possible futures, but we do have a requirement to have those futures be grounded in reality (and physics… and truth…).
[Spoilers below]
Mission Unpossible

No Cell Phones, Wi-Fi Allowed In Small W.Va. Town. Would you believe there's a place where no one can use a cell phone? Where Wi-Fi is not allowed? Where even finding a radio station can be a difficult task? There's a town in West Virginia a few hours south of Pittsburgh where all that is true. Green Bank is a place where you can hear nature. Where you can hear yourself think. And that's because some very important listening is going on. You see, Green Bank is home to the largest moveable radio telescope in the world. **Can You Hear Me Now?**

CYBER / ARTIFICIAL INTELLIGENCE

"Robots in the future will not be programmed. First they will learn through reading [interpreting text]*, then then through seeing* [interpreting images]*, then through hearing* [interpreting sounds]*"* – Prof Paul Horn

How Today's Jungle of Artificial Intelligence Will Spawn Sentience. From time to time, the Singularity Hub editorial team unearths a gem from the archives and wants to share it all over again. The link below takes you to an article summary. If you are at a .mil machine you may not be able to get to singularityhub.com. Give it a try from home (it's a good article! Trust us!) **AI and Sentience**

AI's Language Problem. Machines that truly understand language would be incredibly useful. But we don't know how to build them. **"Sorry, I couldn't find the answer to your question."**

Machine Learning Algorithm Spots Depression in Speech Patterns. Researchers from the University of Southern California have developed a new machine learning tool capable of detecting certain speech-related diagnostic criteria in patients being evaluated for depression. During diagnostic interviews, *SimSensei* listens to patients' voices for reductions in vowel expression characteristic of psychological and neurological disorders. These patterns may not be sufficiently clear to human interviewers. The idea is (of course) not to replace those interviewers, but to add additional objective weight to the diagnostic process (i.e., "human-machine teaming"). Author Jamie Metzl mentions this technology, and the general concept, in his short story *"A Visit to Weizenbaum"* in the *War Stories from the Future* anthology. **Speech Patterns**

Rise of the Hacking Machines. Will computers get better at cybersecurity than humans? Experts hope the answer is yes. For starters, the first machine-based search of online hacker marketplaces identifies over 300 significant cyberthreats every week. **DARPA Grand Challenge** **Zero Day Exploits**

ECONOMICS

Poorer than their parents? A new perspective on income inequality. The real incomes of about two-thirds of households in 25 advanced economies were flat or fell between 2005 and 2014. Most people growing up in advanced economies since World War II have been able to assume they will be better off than their parents. For much of the time, that assumption has proved correct: except for a brief hiatus in the 1970s, buoyant global economic and employment growth over the past 70 years saw all households experience rising incomes, both before and after taxes and transfers. As recently as between 1993 and 2005, all but 2 percent of households in 25 advanced economies saw real incomes rise. The economic and social impact is potentially corrosive. Researchers noted that, "[A] significant number of those whose incomes have not been advancing are losing faith in aspects of the global economic system. Nearly one-third of those who are not advancing said they think their children will also advance more slowly in the future, and they expressed negative opinions about free trade and immigration." **Poorer than Parents**

5 technologies that can change your financial markets forever. This article shares on the five technologies which can revolutionize the financial markets in the coming years: **artificial intelligence and natural language processing, robo advisers, quantum 'sealed envelope', bitcoin and blockchain technologies, and big data and analytics.** **Changing Economic Markets**

Smart sutures send wireless status reports from wound sites. Flexible electronics that work with the body have been advancing quickly, doing everything from measuring our blood oxygen levels through our skin to monitoring our muscles using a tattoo. Now, a team of researchers from Tufts University has taken flexible electronics to their next logical step, embedding them in sutures that can monitor the body from the site of the stitching and broadcast their findings to a Bluetooth-enabled device. Once stitched in place both in mice and in tissues samples in a lab dish, the threads were able to collect data on their surroundings including the pressure, stress, and temperature at the suture site. They were also able to measure the pH and glucose levels, which can be key markers in determining how well a site is healing and whether or not infection has set in. In the studies, the threads were attached to a circuit board that measured about the size of half a credit card, which was located on the skin of the mice. That board, using Bluetooth, was able to send data to a smartphone and a computer.   **Smart Sutures**

CRISPR – The Future is Now, but for How Long? We have two more CRISPR articles for NFTE readers this month. The first article involves the first (known) human studies involving DNA altered by CRISPR, set to start in China this month. In June, a US proposal to run a similar study received approval by a federal ethics and safety panel, but it faces months of additional regulatory hurdles before it can go ahead. Both the US and Chinese scientists would use CRISPR to edit immune-system T cells in patients with cancer in an effort to make those cells destroy malignant cells.

   The second article addresses this November's *Eighth Review of the Biological Weapons Convention*. The novelty and importance of CRISPR is not that it can enable the genetic editing of a pathogen — tools for this have been available for decades. What CRISPR does is make the technology widely available, allowing even largely untrained people to manipulate the very essence of life. Since it is impossible to put the genie back into the bottle, what can Nations do to secure the safety of their populations?   **CRISPR Trials**   **Bioweapons Convention and CRISPR**

What is 'smart' nutrition, and how will it revolutionize food? What exactly the smart nutrition revolution constitutes is open to debate, but we will define it here as the outsourcing of dietary choices to artificial intelligence — be it smart refrigerators that choose menus for us or nutrition apps and virtual assistants, all of which will increasingly play a commanding role in what we "choose" to eat.

   Now imagine a world where we aren't throwing away half of our produce. Researchers at the Potsdam Institute for Climate Impact Research in Germany found that the average amount of food wasted per person per day has increased from 310 kcal in 1965 to 510 kcal in 2010. By 2050 that number could go as high as 850 kcal. In 2010 researchers calculated that 20 percent more food was available than what the human population needed. With the world population expected to rise to nine billion in 2050, we could feed the world's projected population without large increases in agricultural productivity if we reduce food waste. This has a second-order effect of reducing the impact on increasing water and energy requirements.   **Smart Nutrition**   **Waste Not Want Not**

Israel Proves the Desalination Era Is Here. Just a few years ago, in the depths of its worst drought in at least 900 years, Israel was running out of water. Now it has a surplus. That remarkable turnaround was accomplished through national campaigns to conserve and reuse Israel's meager water resources, but the biggest impact came from a new wave of desalination plants. "The Middle East is drying up," says Osnat Gillor, a professor at the Zuckerberg Institute who studies the use of recycled wastewater on crops. "The only country that isn't suffering acute water stress is Israel." That water stress has been a major factor in the turmoil tearing apart the Middle East, but Edo Bar-Zeev, of the Zuckerberg Institute for Water Research, believes that Israel's solutions can help its parched neighbors, too — and in the process, bring together old enemies in common cause.   **The Desalination Era is Here**

Graphene-based sheets make dirty water drinkable simply and cheaply. Engineers at the Washington University in St. Louis (WUSTL) have developed graphene-based biofoam sheets that can be laid on dirty or salty dams and ponds to produce clean drinking water, using the power of the sun. This new technique could be a cheap and simple way to help provide fresh water in countries where large areas of water are contaminated with suspended particles of dirt and other floating matter. The system works by drawing up water from underneath like a sponge where it then evaporates in the topmost layer, leaving behind any suspended particulates or salts. Fresh water then condenses on the top, where it can be drawn off and used.   **Amazing Graphene and Clean Water**

Physicist who foresees global cooling says other scientists tried to 'silence' her. Regardless of the causes of climate disruption, we're going to have to deal with the consequences. What if things are about to turn around... sharply? Are we prepared for that alternative future?
Is it Time for the Maunder Minimum?

ENERGY

This Very, Very Detailed Chart Shows How All The Energy In The U.S. is Used. One caveat: Our engineer friends aren't completely satisfied with the way waste energy is lumped into a single blue bar. For such a detailed chart, thermal efficiency losses, transmission losses, mechanical losses, etc… are just "waste". It's still a pretty cool graphic, even for a non-engineer.   **How we use our Energy**

How Blockchain Technology Could Decentralize The Energy Grid. The author postulates that, one day, we might generate more power locally using solar panels, and homeowners might become makers and traders of power as well as passive consumers. This could be a reality, using Blockchain technology to help keep track of electrons flowing through the system. Just as the blockchain has allowed people to track and authenticate Bitcoin transactions, it could help mediate transactions of energy units through a cooperative, decentralized network.   **Getting in on the Energy Trading Market**

Breakthrough solar cell captures carbon dioxide and sunlight, produces burnable fuel.
Researchers at the University of Illinois at Chicago have engineered a potentially game-changing solar cell that cheaply and efficiently converts atmospheric carbon dioxide directly into usable hydrocarbon fuel, using only sunlight for energy. The finding is reported in the July 29 issue of *Science* and was funded by the National Science Foundation and the U.S. Department of Energy. Unlike conventional solar cells, which convert sunlight into electricity that must be stored in heavy batteries, the new device essentially does the work of plants, converting atmospheric carbon dioxide into fuel, solving two crucial problems at once. A solar farm of such "artificial leaves" could remove significant amounts of carbon from the atmosphere and produce energy-dense fuel efficiently.   **Artificial Leaves**

These Solar Panels Can Generate Electricity Using Rain. A group of scientists in China have developed a new method for making an "all-weather" solar cell that is essentially triggered by both light from the sun and raindrops. The key? A thin layer of graphene applied to the surface of the solar cells.
Amazing Graphene - Rain-activated Solar Cells

MIX

The Marines are conducting a test that could drastically change how combat troops deploy. The Marine Corps Warfighting Lab just completed a live-force experiment in 29 Palms which examined how Marines might operate in the future. Solutions aren't just found in technology, but also in force structure and operating concepts.   **MAGTF Integrated Experiment**

DRAGONCON AWARDS

Here at FAD, we have a philosophy to always support your friends (and your Marines) in their endeavors. *MCSEF* Supplement Contributing Creative Editor and noted science fiction author Chuck Gannon is up for an award at this year's DragonCon for his novel *Raising Caine*. Please take a few moments and sign up at this link to vote for him: **DragonCon - Vote for Chuck Gannon**

ART OF THE FUTURE PROJECT

The Atlantic Council's *Art of the Future Project* (formerly *Art of Future Warfare*) seeks to cultivate a community of interest in works and ideas arising from the intersection of creativity and expectations about how emerging antagonists, disruptive technologies, and novel warfighting concepts may animate tomorrow's conflicts. The Project partnered with the Futures Assessment Division to host a Science Fiction Futures Workshop in which published authors Max Brooks (*World War Z*), Charles E. Gannon (*Caine Riordan* series), and August Cole (*Ghost Fleet*) worked with 18 talented science fiction writers from across the services, with the goal of bringing the ***2015 MCSEF*** future worlds to life. Look for the stories to be published soon.
Art of the Future Project

This newsletter is intended to highlight issues and ideas which may prove significant in the evolving future. In keeping with our focus on both alternative futures and analysis, items in this bulletin will generally be of an alternative nature, or drawn from atypical sources.