Notes from the Edge

Insights into an Evolving Future

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FORECASTS

Londoners in 2050 Won't Need Cars. They'll be Living in an App-Powered Eco-Capital. The author presents an interesting picture of what he thinks London will look like in 2050. He envisions that the rail and underground system in 2050 will look recognizable to today's Londoners, but it would have expanded significantly. He does not think we will be swooshing around town in driverless pods or taking delivery of our groceries by drones.   **Future London**

Future of Farming: Driverless Tractors, Agricultural Robots. Within the next decade, farming as we know it is expected to be revolutionized by the use of self-driving tractors and robots that can perform time-consuming tasks now done by humans. Sales of major farm machinery may not have gained popularity yet, but the author predicts that an ever-present need to control farm costs and increase output will eventually drive farmers to adopt autonomous technologies. A fleet of smaller automated tractors could lift farmer revenue by more than 10 percent and reduce farm labor costs. Precision agriculture technology used today is already saving growers' money and increasing yields. Advances in this field could result in farm yields potentially rising by more than 70 percent by the year 2050.
Future Farming

TECHNOLOGY

'Super batteries' to be 3D printed from graphene ink. Wonder material graphene has been widely talked about in terms of its suitability for use in batteries, due to its impressive conductivity, but scientists have struggled with the fact it also has a relatively small surface area, which affects capacity. 3D

printing, where layers of graphene are assembled on top of one another, maximizing surface area in the process, offers a solution. Now researchers at Manchester Metropolitan University are analyzing techniques for printing with conductive graphene ink, in order to try and create batteries, supercapacitors and other energy storage devices. The batteries and supercapacitors would be used to power phones and tablets, or for solar, wind and wave power storage. **3D Printed Batteries**

Second skin blocks biological agents, but still gives soldiers room to breathe. Breathable clothing is important for soldiers looking to avoid heat stress and exhaustion, but in some situations, added protection is needed against biological and chemical agents. Current protective equipment struggles to effectively offer both at once, but now scientists at Lawrence Livermore National Laboratory (LLNL) have developed a material that begins to bridge the gap, using carbon nanotubes to actively block contaminants while still allowing water vapor to escape. The material is a flexible polymer membrane containing an array of aligned carbon nanotubes (CNTs), which function as extremely tiny pores. The key to how they block biological agents is simple: these tubes have a diameter of under 5 nanometers, which is 5,000 times smaller than a human hair, and crucially, less than half the size of most bacteria and viruses. **MOPP Gear of Tomorrow**

Combat helmet-mounted HUD combines information and infrared. Information can be a soldier's most important weapon, and Rockwell Collins has unveiled a new system that puts that weapon front and center. The company's Integrated Digital Vision System (IDVS) is a heads-up display that attaches to combat helmets and relays information from a command center, other warfighters or drones, as well as augmenting the wearer's vision with multispectral sensors. The system is designed to provide key data without distracting a warfighter from the task at hand. That data can take the form of maps, compass headings, and markers on people and objects, which are displayed on a transparent 1,920 x 1,200 pixel display before the wearer's eyes. Using four 18650 batteries, or eight CR123 batteries, the unit provides up to six hours of increased visibility in smoky, foggy, dusty, or dark conditions.
Helping the Warfighter See

Silkworms were fed graphene to produce 'super silk' and it could be the future of wearables. Graphene just keeps getting better and better. The so-called super material – a one-atom-thick layer of carbon that has proven to be incredibly strong, flexible, light and conductive – has now been fed to larval silkworms which then created "mechanically enhanced silk". The resulting silk was twice as strong, could cope with 50 per cent more stress before degrading, and after being heated at temperatures of up to 1,050°C was shown to be conductive. The latter means the silk could be a viable option for smart textiles, but also for medical devices embedded in the body. The find could have huge implications for the future of wearables, considering the conductive material could be weaved into textiles, and our clothing embedded with technology. We would no longer have to wear devices that are so often bulky and conspicuous but would have individualized garments concealing the tech. **'Super Silk'**

MEDICINE

Genetic matching technique means no rejection for transplanted cells. In research that could significantly improve the viability of human retinal cell transplant methods and help restore eyesight in patients with diseases such as macular degeneration, a team at Japan's RIKEN Center for Developmental Biology (CDB) has used a genetic matching technique to overcome the problems of rejection and the use of immunosuppressant drugs when transplanting retinal pigment cells. To avoid tissue rejection problems after implantation, it's possible to grow retinal pigment cells from induced pluripotent stem cells (iPSCs) created using the patient's own skin cells. **Accepting Transplants**

World's first ciliary microrobots could change the way we take medicine. Science fiction is fast becoming reality, with scientists in South Korea developing an astonishingly fast-moving remote-controlled microrobot designed to travel through the human bloodstream to deliver treatment directly to

the organs that need it. Developed by the Department of Robotics Engineering at the Daegu Gyeongbuk Institute of Science and Technology (DGIST), the new microrobot is highly maneuverable and moves a least eight times faster than its most recent predecessor, using a propulsion system inspired by the commonly studied ciliated organism, the paramecium. If it lives up to its promise, the new microrobot will be able to deliver heavier and more complex payloads to target areas than previous microrobots. Scientists envision an injectable microrobot that can dissolve harmlessly within the body after its mission is complete.   **Microrobot Delivery**

FUTURE OF WORK

Smart cities: The rise of new C-level executives. Increasingly, cities are adopting smart technology to become more energy efficient, improve transportation, make neighborhoods safer, manage traffic — basically use technology and the data it generates to create better places to live, work, and visit. As they do so, they are discovering the need for specialists to head the new departments that the smart technology is enabling. According to global digital business association *TM Forum*, the linked article lists the C-level executives that will lead future smart city dream teams.   **Smart Cities Future Leaders**

21 Cool Future Jobs. In this blog entry, the author shares on jobs that are just being conceptualized today but will be all the rage tomorrow, from DNA Engineers, to Mars Colonists and Virtual Reality Architects.   **What's Your Next Career?**

CONSEQUENCE MANAGEMENT

What Smart Cities Can Teach Enterprises About Security. In terms of cyber security, cities are similar to large enterprise networks. Cities are massive and they never throw out any information. That means that there is data being stored on outdated technology from 20 years ago that might not be secure. This also means that there is a mix of old and new technology sprawled across the city, including legacy applications and programs like PowerBuilder and intelligent smart city devices such as LED street lights that create security gaps and blind spots. Also, cities never shut down. San Diego runs 24 hours a day, 7 days a week, and 365 days out of the year, which means that from a security standpoint, you can't take the network offline or rip and replace old technology with new technology without interrupting the daily business operations of the city and its people. [*Note: As enterprises such as the DoD integrate ever-changing technology, assessing and understanding security weaknesses across all platforms helps to support the management of its security risk. – Ed*]   **Securing the City Gates**

Identifying Future Disease Hot Spots: Infectious Disease Vulnerability Index. Recent high-profile outbreaks, such as Ebola and Zika, have illustrated the transnational nature of infectious diseases. Countries that are most vulnerable to such outbreaks might be higher priorities for technical support. *RAND* created the Infectious Disease Vulnerability Index to help U.S. government and international agencies identify these countries and thereby inform programming to preemptively help mitigate the spread and effects of potential transnational outbreaks. Key findings include that of the 30 most-vulnerable countries, 24 form a solid, near-contiguous belt from the edge of West Africa to the Horn of Africa in Somalia — a potential "disease belt" in the Sahel region of Africa.
Transnational Infectious Disease

ECONOMICS

Is an Editable Blockchain the Future of Finance? Blockchain, the technology that underlies the cryptocurrency Bitcoin, has been celebrated as a way to change the way transactions of all kinds are made, but a suggestion to make an editable version of the technology is now dividing opinion. The consultancy firm Accenture is patenting a system that would allow an administrator to make changes to information stored in a blockchain. Accenture aims to create a so-called permissioned blockchain —an invitation-only implementation of the technology, and the one currently favored by banks. That would be

in contrast to permissionless blockchains, such as Bitcoin, which rely on the fact that they can't be edited as a means of providing an immutable record of transactions. Accenture insists that the feature would be used only in "extraordinary circumstances," so that troublesome errors could be undone. Blockchain purists, however, seem unimpressed by the idea, since the essence of the blockchain is that it is immutable - and editable version just turns it into a database. Tweaks to the fundamental nature of blockchain may rankle its earliest adopters — but they could also be what is required for it to graduate from the preserve of nerds to a system used by the world's banks.   **Editable Blockchain**

SUPPORT YOUR FRIENDS

Fall 2016 USAF Strategic Studies Quarterly. This issue takes a look at many of the deep futures topics *Notes From The Edge* readers have come to enjoy, such as bio-tech, AI, and Additive Manufacturing.   **USAF Foresight**

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.