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RETHINKING ROCKET FUEL SOURCES
Access to space is rising in importance, but prohibitive launch costs and a growing focus on green energy and environmental impact have made it difficult for some companies to justify the expense of conducting experiments and missions in space. These barriers to market entry, however, may be receding thanks to the creation of a new biofuel. The firm bluShift Aerospace recently launched a biofuel powered commercial rocket for the first time. The 20 foot long, 550lb. rocket, known as *Stardust*, flew a mile high and carried a payload composed of nitinol alloy tests and a high school experiment. While the composition of the biofuel has not been disclosed, bluShift CEO Sascha Deri divulged that its material can be acquired globally from farms, is non-toxic and "actually costs less per kilogram than traditional rocket fuel" while being carbon-neutral. Deri also noted that, while large rockets from companies such as SpaceX dominate the market, there is currently a lack of smaller space launch services and bluShift Aerospace aims to fill this void and "be the Uber service to space." (*BBC News*, February 1, 2021)

THE TECH PROMISE OF PLANTS
Plant nanobionic technology, which involves fusing nanoparticles into plants, can be used for a variety of novel purposes... bomb detection among them. MIT engineers previously demonstrated that nanobionic spinach plants can detect explosive materials. The roots of nanobionic spinach plants are capable of detecting nitroaromatic compounds, which are often used in explosives, in groundwater. Once the roots detect this compound, the spinach plants' carbon nanotubes transmit signals to infrared cameras, which proceed to send email notifications to the engineers. Scientists believe nanobionic spinach plants could also be harnessed to monitor environmental conditions in order to detect climate change. Additionally, American University scientists have found that spinach-based carbon nanosheets can be used to increase the energy efficiency of fuel cells and metal-air batteries. Metal-air batteries are an environmentally friendly alternative to lithium-ion batteries, which currently power many commonly-used electronics. (*Euro News*, February 2, 2021)

SIMULATING THE HUMAN BRAIN WITH COBALT
Quantum technology is a key enabler of advanced artificial intelligence, and one way to speed the development of AI is to mimic the human brain. A major limitation to modern computers is having to store data in one place (memory), and process it an another (in the CPU or GPU), rather than combining the functions in one place as the brain does. However, a recent study led by Dr. Alexander Khajetoorians of Radboud University in the Netherlands leveraged the quantum properties of cobalt atoms to develop a system that resembles the internal processes of the human brain. Researchers were able to transmit binary data into a network of cobalt atoms, which acted as brain neurons, and added a small voltage change to demonstrate synaptic activity. The next step will be to show that the system is capable of scaling and processing real-world data. According to Dr. Khajetoorians, "our new idea of building a 'quantum brain' based on the quantum properties of materials could be the basis for a future solution for applications in AI." (*Singularity Hub*, February 9, 2021)

RESILIENT, REGENERATIVE MATERIALS
Engineering materials for military affairs have witnessed several enhancements recently, but it remains a rare feat to develop materials that are exceptionally strong, do not fracture easily, and can dissipate energy efficiently. However, researchers at USC's Viterbi School of Engineering may have accomplished this feat, and even incorporated self-healing, by fusing a biological material (*S. pasteurii* bacteria) with synthetic ones. As part of the experiment, the researchers 3-D printed a lattice structure containing empty squares. The *S. pasteurii* was then inserted, leading to the production of calcium carbonate structures that filled in the squares. The structures could potentially be used to strengthen vehicle frames and aerospace panels, or for defense purposes, including to develop vehicles or body armor. Nature has long been an inspiration in the development of advanced body armor (see *Defense Technology Monitor* nos. 62, 47, and 46). (*Newswise*, February 22, 2021)

U.S. ARMY DEVELOPS PULSED LASER WEAPON

The Pentagon has numerous high energy laser weapon systems in various phases of development and deployed across ground and sea platforms. While chemical and fiber-based kilowatt class lasers are constantly improving, they remain limited in effectiveness due to the amount of dwell time it takes to melt a target drone or missile. However, the U.S. Army's newly designed Tactical Ultrashort Pulsed Laser (UPSL) does not rely on a constant beam or compilation of smaller constant beams of energy to destroy a target. Rather, the UPSL emits short low energy pulses that reach a terawatt of power in a quadrillionth of a second, which make it capable of incinerating a drone or missile casing instantly. Additionally, the UPSL system is able to project an electromagnetic pulse in order to disrupt adversary electronics. The military hopes to have a working prototype weapon available by 2022. (*Interesting Engineering*, February 23, 2021)
