POPULAR MECHANICS

DEATH

THE ULTIMATE HOAX

PM

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This scientific discovery proves we can reverse death. Plus: A disastrous flood killed thousands when a dam broke. Will it happen again? And the Navy's newest secret weapon. Cover motion: Pat Heine

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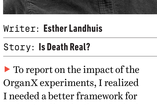
Nuclear Fusion May Power Future Naval Aircraft Carriers

Plus more uncanny discoveries, insightful observations, and ingenious ideas from *PopMech* experts, contributors, and staff.

Writer: **David Hambling**

Story: **China and Russia Are Dominating the Hypersonic Arms Race—And It's Not Even Close**

▶ Plans for hypersonic weapons go back to WWII, when the Nazis dreamed of a bomber capable of attacking the United States from Germany. Engineering couple Eugen Sänger and Irene Bredt drew up plans for a suborbital rocket plane that became known as the Silbervogel, or Silver Bird. Launched from a sled powered by V2 rockets, the Silver Bird would accelerate to 1,200 miles per hour before it took off. Once in the air, it would climb to an altitude of 90 miles, reaching speeds above Mach 15. Of course this fantastic craft was never built. But after the war, Sanger began working on ramjet engines—the descendants of which now power the first generation of hypersonic weapons.



Writer: **Esther Landhuis**

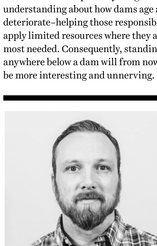
Story: **Is Death Real?**

▶ To report on the impact of the OrganX experiments, I realized I needed a better framework for understanding death, so I asked bioethicist Seema Shah to clarify the basics: In medical and legal terms, how is an organism pronounced dead? Shah had contributed to a 2019 report from the Hastings Center, a bioethics think tank, which asked: "Can death be declared on the basis of severe neurological injury…or is it essentially a social construct that can be defined in different ways?" Her answer made me realize that death is multidimensional and may ultimately be defined more by what people in power agree on rather than by hard-and-fast medical parameters.

Writer: **Dylan Taylor-Lehman**

Story: **When the South Fork Dam Broke, a Pennsylvania Town Washed Away. Which Town Is Next?**

▶ In researching one of the worst floods in US history, one fact that made an impression was the sheer number of dams in the US—90,000. This was much higher than I would have guessed; dams are a kind of infrastructure we don't often think about. Also surprising: The number of experts I interviewed who spoke alarmingly about the poor condition of many those dams and the potential risk they pose. Those fears are somewhat tempered by the growing understanding about how dams age and deteriorate–helping those responsible to apply limited resources where they are most needed. Consequently, standing anywhere below a dam will from now on be more interesting and unnerving.



Writer: **Alex Hollings**

Story: **The Navy's New, $13 Billion Aircraft Carrier Is Already Obsolete–But This High-Tech Weapon Can Save It**

▶ In its drive to install high-powered lasers aboard its warships, the Navy is also seeking more powerful fuel sources. One recent Navy patent for a "Plasma Compression Fusion Device," hints at a nuclear fusion—not fission—powerplant. Scientists believe fusion can produce three or four times as much energy as current fission reactors used on the Navy's largest ships. Fusion reactors also eliminate radioactive waste. In fact, they are fueled by hydrogen isotopes deuterium and tritium—the former of which is so common in seawater that the Department of Energy estimates one gallon of ocean water could produce as much power as 300 gallons of gasoline.

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China and Russia Are Dominating the Hypersonic Arms Race— And It's Not Even Close

The U.S. has deployed hypersonic missiles. Russia and China are ahead. They also are sitting years from completion.

BY ARMS WORK NEW

EVERYONE THINKS, Russia used to invent and China to copy. Today, the roles are flipped. Both are far lighter. When Russian engineers tested the first hypersonic glide vehicle and engines and ordered a new day of work, Chinese factories had already copied the prototype. A month later the first Russian hypersonic weapon has been used in Ukraine.

The Kinzhal and Avangard are two of the top of a technological revolution in weapons that the U.S. Navy, Air Force, and Army are racing to field. Hypersonic weapons are defined as those flying faster than five times the speed of sound, or Mach 5. Existing ballistic missiles travel faster, but they follow a fixed path. Hypersonic weapons can change direction, doesn't lose drag on dive, then dash to a different target. Hypersonic weapons are different from cruise missiles, like a nonmanned, which make their way to a fixed target at a slow speed, usually between Mach 0.7 and Mach 1.0 (600-800 feet, adjust cruise ballistic missiles, which are fast but follow predictable paths, and hypersonic glides, "unstoppable." Hypersonic weapons are expensive, but most significant is their ability to remake technology, since hypersonic weapons are

rocket launchers that the U.S. has been supplying to Ukraine. While HIMARS systems conventionally carry six rockets, a reconfigured version holds just one of the jumbo-size ATACMS rockets, which has five times the range. The army initially armed the larger missile with a cluster-bomb warhead to take out concentrations of tanks, but most ATACMS now carry a 500-pound, GPS-guided blast/fragmentation warhead developed to destroy enemy command centers, radar installations, ammunition dumps, and air bases.

Ukraine is pressing the U.S. to deliver ATACMS systems to further aid its defense—especially to hit longer-range targets, like Russian drone bases in Crimea. So far, the U.S. has resisted; officials cite concerns that the missiles could be used to attack positions inside Russia that would escalate the war.

11. JL-2 Giant Wave-2

Nation: China | **Length:** 42.5 ft. **Weight:** 93,000 lb. | **Range:** 4,500+ miles | **Speed:** Mach 20

Like the U.S. and Russia (and France, the U.K., and India), China operates a fleet of nuclear subs armed with submarine-launched ballistic missiles (SLBMs) as a retaliatory option against nuclear attacks. While land- and air-based nuclear weapons might be destroyed in a surprise nuclear attack, submarines remain safely hidden underwater. Their ability to counterpunch creates a strong deterrent.

Part of China's rapid naval expansion includes plans to grow its submarine fleet from four Jin-class subs to 12. Each of them will carry 12 JL-2 nuclear-armed SLBMs. And each missile will carry up to eight warheads, the most allowed by international nuclear treaties. Although smaller than the U.S.'s Trident D-5 SLBM, the JL-2 is still potent, with a range of more than 4,500 miles and capable of reaching speeds of Mach 20.

China is already working on the JL-3, a much larger missile with a range of over 7,500 miles. That missile will be carried on the country's new supersize nuclear submarine, which it expects to be ready by 2030.

12. KN-22/Hwasong-15

Nation: North Korea | **Length:** 72 ft. [est.] | **Weight:** 160,000 lb. [est.] | **Range:** 6,000+ miles [est.] **Speed:** Mach 11

While Russia and China push ahead with hypersonics and other advanced concepts, conventional weapons still pose the most immediate threat. North Korea has been steadily developing its ballistic missiles with the range needed to attack the U.S.

The Hwasong-15 (Mars-15), transported on a mobile, 18-wheel launcher, is North Korea's most powerful weapon. Analysis of a test firing in 2017 suggested that it can hit targets more than 6,000 miles away, putting mainland America within North Korea's range for the first time. This is a larger version of the Hwasong-12 that North Korea test-fired over Japan this past October. The missiles, although generations behind what the U.S., China, and Russia possess, are now capable of delivering a nuclear warhead to almost any spot on the globe.

13. 3M-54 Kalibr

Nation: Russia | **Length:** 26.9 ft. | **Weight:** 4,000-5,000 lb., depending on version | **Range:** 200+ miles | **Speed:** Mach 0.8

The Russian Kalibr has likely caused more destruction and civilian deaths in Ukraine than any other weapon. One month into the war, Russia had launched at least 183 Kalibrs at Ukraine, making it the most frequently used missile in the conflict. And that pace of bombardment has not slowed. According to Ukraine's ministry of defense, 70 percent of Russian missiles hit nonmilitary targets. The size of Russia's Kalibr stockpile remains secret, but the country reportedly has produced at least 100 of them per year since the early 2000s. Russia initially used Kalibrs as anti-ship cruise missile, but more recently has fired dozens of them from ships and submarines in its Black Sea Fleet against land targets.

While not technically a hypersonic, the Kalibr does offer some of the same advantages. It is built around a two-stage engine: The first delivers the rocket toward its target at cruising speeds up to Mach 0.8; then a second stage ignites, accelerating it to Mach 3 on its final approach. The rocket remains maneuverable the entire duration, and flies at low altitude—sometimes below 300 feet—making it difficult to detect and intercept. Despite those capabilities, the Kalibr has flaws: U.S. defense officials have claimed that as many as 60 percent of them do not reach their target, and some have been shot down by surface-to-air missile systems. On September 3, Russian forces fired five Kalibrs at Dnipro, Ukraine's fourth-largest city, and Ukrainian air defenses knocked down all of them. PM

ALAMY (KINZHAL, DONGFENG-17, WZ-8, LGM-30 MINUTEMAN III, JL-2 GIANT WAVE-2, KN-22/HWASONG-15); ASSOCIATED PRESS (3M22 ZIRCON, OBJEKT 4202 AVANGARD, ATACMS); DARPA (HAWC); CREATIVE COMMONS (3M-54 KALIBR); GETTY IMAGES (MISSILES LEAD, XINGKONG-2); REUTERS (AGM-183A)

Is Death Real?

A mind blowing scientific discovery could change what it means to be alive

BY ESTHER CAMINITI

O BSESSIONS BEGIN, I'D SAY, AT THE MOMENT WE REALIZE WHAT WE DON'T KNOW.

Mine began with a terrible tonsillectomy. The bad days spent at home recovering were made worse by my inability to eat or sleep, and my relationships with my parents, I felt, had suffered. I was a college junior, but I couldn't shake my girl-like precedence. The vast majority of my classmates were men, and I was not a fortunate woman. Sure I was working from the surgery, she recount ed, but I was also being treated like a fragile, sickly, stupid, emotionally phrasmatized. Medical staff moved around me as if I wasn't there, and I felt that I was being treated like a child. I reported to a shifting AOL Free Order Form, and I felt

When the South Fork Dam Broke, a Pennsylvania City Washed Away. Which Town Is Next?

THE NEW YORK TIMES MAGAZINE

BY JULIA TAYLOR LEWIS

WITH NEARLY 2000 SHOTS fired at the crowd, the gunman ceasing fire only when he had run out of ammunition, the Las Vegas massacre was the worst mass shooting in modern history. Yet it was not the only one that took place in the United States that day. Two hours after the Las Vegas shooting, the Cincinnati Reds game, the Washington Nationals game, and the Los Angeles Dodgers game, the first Amtrak train ever stopped in Scranton, Pennsylvania, since the station closed in 1963. The train was carrying 300 people, including the Democratic nominee for vice president, Tim Kaine, who was scheduled to speak at a rally in the city that night. Kaine's campaign had expected a crowd of 1000 people, but the rally was moved to a larger venue when the crowd ballooned to more than 3000 people. The rally was cut short because of the threat of a mass shooting, and Kaine was whisked back to the train station and out of town.

Unfortunately, 17 minutes after the train collapsed, it was reported that a second gunman had opened fire on the crowd at a country music festival in Las Vegas. Although the Las Vegas shooter was the only one to the past decade have so far been the only one to the past decade to have killed more than 50 people, the Las Vegas massacre was not the only one that day. Two days before the United States had seen the worst mass shooting in its history, the Pulse nightclub massacre in Orlando and the 9/11 terrorist attacks in New York and Washington.

The failure to respond to a crisis in a timely fashion is a pattern in U.S. history. The Great Depression, the Vietnam War, the Iraqi invasion of Kuwait, the Iraqi invasion of Iraq, the Great Recession, and the Ebola outbreak in Africa are all examples of crises that were ignored or underestimated for years before they became full-blown crises

Fire destroyed the Johnstown Flood Museum in the aftermath of the devastation. Entire houses were swept off their foundations and left in the wreckage of the downtown business district.

People in Johnstown took a cautious sigh of relief when it became the water but, as it appeared the floodwaters receded, the Conemaugh River suddenly crested for the second time, the water came crashing straight into the heart of the city. Everything in its path—stores, factories, houses, homes, animals—was swept up in the wave. Debris choked seven, which spread across the city's main thoroughfare and in its wake. There was no escape against the billo surrounding the town, causing backed up water to flow into the city from a second direction and discovered that Johnstown had been hit and escaped the first pass. Newspaper accounts described the wall of water and crested a mountain that was higher than the bridge itself. Though it is unclear who created it (perhaps a real stove set of Brian crazy, the Conemaugh River Bridge was a wall of heat 30 feet high, which ignited houses and buildings that had ended on the Floodwaters had left the aggregate the bridge. A newspaper editor was there to horror as people screamed, "Get out!" "cremation in your town, perhaps." Fire spread through the wreckage, and the Conemaugh River, which ran past, and the some fire pours a moment later." By the end of the day, the center of downtown Johnstown had been turned into a mass grave and funeral pyre. Hundreds of bodies were pulled from the wreckage and burned. The death toll stood at 2,209 with more missing. Nearly 1,000 residents were orphaned. Property damage was in the billions of dollars. The Johnstown Area Heritage Association, it was not until July 30—41 days later—that a grand weekend of funeral services was over. Bodies turned up 100 miles away in Cincinnati, and as late as 1911.

Fire destroyed the Johnstown Flood Museum in the aftermath of the devastation. Entire houses were swept off their foundations and left in the wreckage of the downtown business district.

How Could This Happen?

ACCOUNTS OF THE devastation almost immediately reminded through the world, and every effort were mobilized to provide food, dry clothes, and shelter to the tens of thousands of dazed, and hungry survivors. Wood quickly spread the tragedy of the Johnstown Flood. Fire caused the deluge, and a contingent of firefighters from Pittsburgh arrived in the City Hall to help the worst. The worst, the worst, the worst, the

The Navy's New $13 Billion Aircraft Carrier Is Already Obsolete. This Weapon Can Save It.

By Kyle Mizokami

Defending against hypersonic missiles and swarms of drones won't be easy.

U.S. NAVY'S *Gerald R. Ford* class aircraft carrier, USS *Gerald R. Ford*, is the most expensive and most capable aircraft carrier in the world. The flagship of the Navy's carrier force, the *Ford* is the largest battleship of World War II, the Yamato class, in the sky. Its 100,000-ton displacement, 1,092-foot-long hull, 4 million-pound-thrust nuclear reactor, the ship has nearly three times the electrical generating capacity of any other aircraft carrier, large numbers of CIWS and other self-defense weapons, and a complement of 75 aircraft. The *Ford* class is the most powerful aircraft carrier in the world, and it is the most expensive ship ever built, at a cost of $13 billion.

The *Ford* is more than nine years behind schedule and more than $7 billion over budget. It is the largest battleship of World War II, but it is also the smallest aircraft carrier in the U.S. Navy. For all its size and power

believes it may take a 1-megawatt laser, more than three times the power of HELCAP, to stop them. But megawatt-class lasers may not be too far off either. The Navy awarded a contract to Northrop Grumman to develop such a laser, and in July 2022, the company completed a preliminary design of a high-energy laser that combines several laser beams into one powerful ray. Northrop said it will initially develop a prototype with up to 300 kilowatts of power, but that the technology may allow it to scale up the power to 1 megawatt.

For the Pentagon, which has billions invested in aircraft carriers, that technology can't arrive soon enough. Given the rapid emergence of China's anti-ship weapons, warships like *Ford* are more vulnerable than they have been in 80 years. The fate of the world's most powerful navy could be decided by a single, well-aimed hypersonic shot. To prevent its aircraft carriers from meeting the same fate as World War II battleships, it's going all in on lasers—betting that it can develop the sci-fi tech into a powerful and reliable defense. No matter how fast or powerful anti-ship missiles become, the Navy hopes its futuristic lasers can burn them out of the sky for less than the cost of a cup of coffee. PM

ALAMY (*USS PONCE*); GETTY IMAGES NORTH AMERICA (*USS GERALD FORD*); ALAMY (*DF-21*); PA IMAGES VIA GETTY IMAGES (*HMS REPULSE*); ALAMY (*PHALANX*); ALAMY (*AN/SEQ3*)