

100 seconds



75 years and counting

Bulletin of the Atomic Scientists

75 years and counting

The Mission

At our core, the Bulletin of the Atomic Scientists is a media organization, publishing a free-access website and a bimonthly magazine. But we are much more. The Bulletin's website, iconic Doomsday Clock, and regular events equip the public, policymakers, and scientists with the information needed to reduce manmade threats to our existence.

The Bulletin focuses on three main areas: nuclear risk, climate change, and disruptive technologies. What connects these topics is a driving belief that because humans created them, we can control them.

The Bulletin is an independent, nonprofit 501(c)(3) organization. We gather the most informed and influential voices tracking man-made threats and bring their innovative thinking to a global audience. We apply intellectual rigor to the conversation and do not shrink from alarming truths.

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From the Executive Chair

Edmund G. Brown Jr.

Time to make the world safer

Ominously, the Bulletin this year has again set the Doomsday Clock at 100 seconds to midnight. This should not be comforting.

Here we are, more than 75 years after the bombing of Hiroshima and Nagasaki, and we still have not freed ourselves from the danger of nuclear holocaust. In fact, Russia and the US, together with other nuclear powers, are blatantly ignoring Article VI of the Treaty on the Nonproliferation of Nuclear Weapons, which calls for an end to the nuclear arms buildup and negotiations for full nuclear disarmament. Worse, the three biggest nuclear powers are locked into escalating conflict over territory, policies, or what is now being called “core values.”

Whether the solemn pledge of Ronald Reagan and Mikhail Gorbachev that “a nuclear war cannot be won and must never be fought” still holds is open to some doubt because our current leaders so far have failed to publicly endorse it. Extending New Start and discussing ways to reinvigorate the Iran nuclear deal are positive steps. However, they are clearly counterbalanced by a lack of serious dialogue about the overall nuclear danger, punctuated by increasingly shrill rhetoric. Compounding the risk is the growing power of cyber technology and artificial intelligence joined to the ever expanding use of space for military purposes.

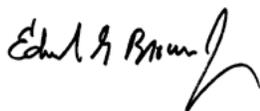
We know from past history that mistake, or miscalculation, can take us to the brink. All the more reason why dialogue—frequent and extensive—should be the order of the day. Tragically, it is not.

The Bulletin continues its vital work of disseminating sound and scientific information and analysis about the nuclear threat as well as the other growing existential dangers, including the climate crisis. This work has never been more important.

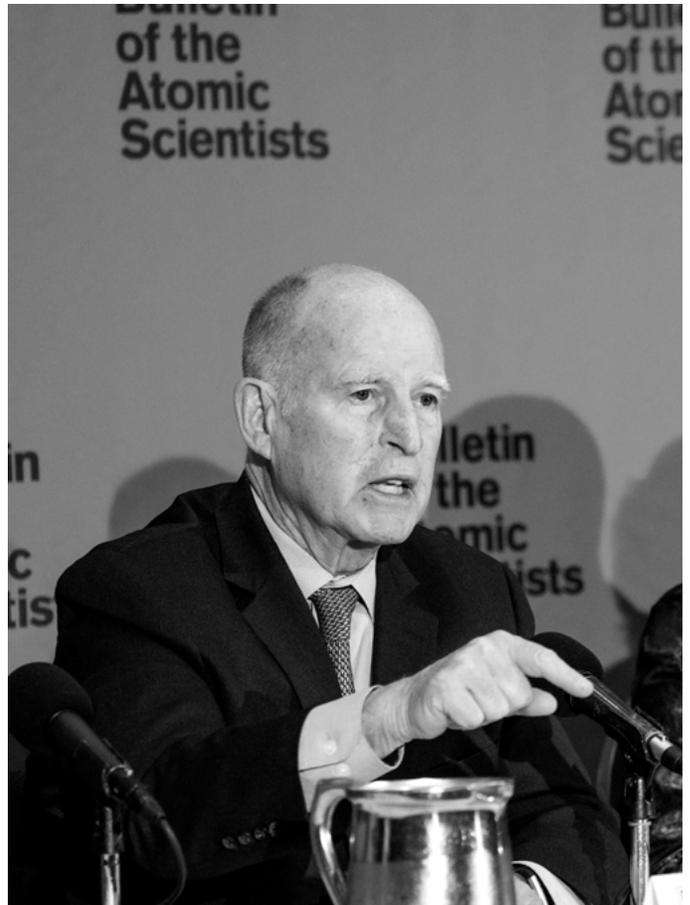
During this period of worldwide pandemic, it is clearer than ever that world leaders must get serious about existential issues—and come together to confront them. Sadly, national competition is holding back what needs to be an all-hands-on-deck approach by the major countries.

We can learn from the scientists whose collaboration has resulted in vaccines produced at unprecedented speed. This is a sign of what can be done—and must be done—if the world is to reduce the global threats that we all face.

So as we reflect on the challenges and the work of the past year, let us renew our resolve and commitment to wake people up and to find more enlightened paths forward. The hour is late. Yes, it’s 100 seconds to midnight. But there is still time to make the world safer.



Edmund G. Brown Jr.
Executive Chair
Bulletin of the Atomic Scientists



We know from past history that mistake, or miscalculation, can take us to the brink. All the more reason why dialogue—frequent and extensive — should be the order of the day. Tragically, it is not.

From the President & CEO

Rachel Bronson



In short, the world needs small but mighty organizations, like the Bulletin, that relentlessly support the advancement of science and demand that science be used to further the cause of humanity and not to undermine it.

Time to get real

In January 2020 I stood before a bank of global news organizations at the Bulletin's annual Clock announcement, and moved the hands of the Doomsday Clock to 100 seconds to midnight, the closest it has ever been to midnight. Although our message was discussed in thousands of newspaper articles and television shows, and watched by millions around the world, there were, as always, skeptics. Was it really that dangerous? Did we really need to focus global attention on solving global problems? Why so urgent? In light of what 2020 wrought, those criticisms now seem seriously misplaced.

While concerns about climate change and nuclear war were the major drivers in moving the hands of the Doomsday Clock, the Bulletin's 2020 statement had returned repeatedly to the same underlying problem: the deliberate erosion by politicians of science and core institutions of global cooperation and verification.

That statement anticipated the early denial in the US of the coronavirus pandemic threat, the downplaying and delaying of needed public health responses, and the vilifying of prominent scientists. It has been a disastrous succession of falling dominoes made possible by years of shredding science, mocking experts, and catering to conspiracy theories instead of nurturing our previously most trusted institutions.

COVID-19, the Australian and California wildfires, and the recognition that no one

leader should have the sole authority to launch a nuclear war made the Bulletin more determined to fulfill our four core values: to be understandable and influential, vigilant, solution-oriented, and fair-minded.

As the coronavirus spread globally and the denials of its severity multiplied, the Bulletin delivered high-quality pieces by authoritative public health experts and virologists. Our articles and newly launched monthly program series generated an audience of a million in March and nearly that in April and May. We hosted small expert groups on climate change to determine whether California wildfires were better attributed to poor forest management or climate change—and confirmed the latter.

Over the summer, we published important pieces in response to the George Floyd murder and protests, grappling publicly with how best to respond to the profound social and racial injustices that exist not only in the US more generally, but within the nuclear, climate, and technology spaces specifically. We pledged to build campaigns in our own communities to dismantle structural racism.

More recently, we have been publishing important work on the SolarWinds hack, and tied the January 6th assault on Capitol Hill to science denialism and conspiracy theories that we've been covering intensely for some time.

Our 2021 Doomsday Clock statement, found in the pages that follow, details many of the challenges that we face, but also identifies real opportunities for progress.

Achieving positive change will not be easy. The United States and China are increasingly engaged in what some are calling a technological Cold War. The US-Russian relationship is at its lowest point, a dangerous reality highlighted in a mid-January Bulletin article by our Executive Chair, Jerry Brown. Every nuclear state seems determined to bolster its arsenal and make nuclear weapons more, rather than less, usable. The pandemic remains a menacing global danger, and future ones seem likely, notwithstanding the unprecedented speed at which vaccines are being developed. The Bulletin is committed to helping navigate these tough challenges and offering policy solutions for moving forward.

In short, the world needs small but mighty organizations, like the Bulletin, that relentlessly support the advancement of science and demand that science be used to further the cause of humanity and not to undermine it.

Your steadfast and generous support ensures that our staff, writers, and expert contributors have the resources to provide vital coverage on today's most important issues. And for that, we couldn't be more thankful.

Rachel Bronson

Our values

To be understandable and influential.

To be vigilant.

To be solution-oriented.

To be fair-minded.

From the Editor-in-Chief

John Mecklin

Looming threats and pandemic reality

Traffic to the Bulletin's website increased by 95 percent in 2020, with 2.1 million more unique visitors than in the same time period of 2019. This enormous growth was driven by many factors, but most prominently by a continuous stream of timely, high-quality content.

Through much of 2020, Bulletin editorial efforts appropriately focused on the coronavirus pandemic and how it intersects with the nuclear, climate, and other global threats that the Bulletin covers. Because of its decades-long history of publishing top experts in the biosecurity field—experts who have long warned of the dangers of zoonotic disease outbreaks—the Bulletin has been looked to globally as a leading source for authoritative information on the pandemic. Our response to COVID-19—from the staff and experts alike—was quick, authoritative, and widely noticed and discussed.

For example, associate editor Matt Field, who leads our biosecurity coverage, wrote a story—"Experts know the new coronavirus is not a bioweapon. They disagree on whether it could have leaked from a research lab"—that has garnered more than 360,000 pageviews. Meanwhile, Bulletin columnists who deal with public health and biosecurity—Princeton's Laura Kahn and Filippa Lentzos of Kings College London—weighed in with multiple strong and widely read pieces, including "Natural spillover or research lab leak? Why a credible investigation is needed to determine the origin of the coronavirus pandemic."

In March of last year, in a new journalistic partnership, the Bulletin and *The New Yorker* magazine co-published Bulletin contributing editor Elisabeth Eaves's in-depth look at the safety of American biodefense laboratories, "Hot zone in the heartland?" The timing of the article's publication was apt, coming as experts were raising questions about whether the coronavirus outbreak had begun as a natural spillover from animals to humans, or from a leak from a Chinese biosafety lab—a lab of the very type Eaves's article explored.

Through these (and many, many other) articles on the pandemic and its overlap with other existential risks, the Bulletin was able to carve out its own authoritative space amid voluminous news coverage of the pandemic by media organizations with many times our resources. A collection of our coronavirus pandemic articles is available on the website. I am proud of it.

As our pandemic coverage continued, in April we also debuted our interactive version of the "Turn Back the Clock" exhibit initially displayed at the Museum of Science and Industry in Chicago. Spearheaded by multimedia editor Thomas Gaulkin and chief digital officer Rob Elder, this interactive installation allows anyone with an internet connection and a web browser to "walk through" and examine the MSI exhibit.

Early in August, the Bulletin staff marshalled voluminous and authoritative coverage of the 75th anniversary of the atomic bombings of Hiroshima and Nagasaki. These analyses (and much distinguished past coverage of the atomic bombings) can be found in our Hiroshima & Nagasaki collection.

The September issue of our bimonthly subscription magazine had the cover headline "Managing the transition away from fossil fuels" and marked the relaunch of the magazine, with a new design and new software that allows the Bulletin to solicit and accept individual subscriptions in a reader-friendly way.

And in December, we published a special double-issue of the magazine, commemorating the start of the Bulletin's 75th year of serving the global public interest. To avoid wallowing in the past, I quite purposely aimed the opening section of the issue at 21st-century challenges, asking a diverse cast of respected strategic thinkers and doers of this era to look forward a decade or two, and suggest where the Bulletin and its readers might profitably focus their attention to keep the Doomsday Clock from striking midnight.



The latter portion of the 75th anniversary issue consists of republications of noteworthy pieces that appeared in the Bulletin over the last seven-and-a-half decades. I make no representation that this retrospective is comprehensive. Still, the names Einstein, Oppenheimer, Gorbachev, Rabinowitch, Nixon, and Kennedy do at least suggest the level of famous and accomplished authors the magazine has ushered into print and (as the magazine turned digital) pixels since 1945.

As the staff and I prepared the 75th anniversary issue, I became more convinced than ever that humans can manage the technologies we create, and that the collective will to extend the human experiment should not be underestimated. But the present and future never belong to those who live in the past. Each era needs its own narratives, and today those narratives will be offered by a new generation of thinkers who come from diverse backgrounds and who create effective 21st-century solutions for the world's largest challenges. The Bulletin has long been ahead of the curve in explaining existential threats to humanity in a way that is useful to experts, a general audience, and those world leaders who are willing to pay attention. With your support, we will continue to find new and powerful ways to tell the story of humanity's most important mission: to survive.

A handwritten signature of John Mecklin in black ink. The signature is cursive and reads "John Mecklin".

John Mecklin

Providing accessible facts and commentary

Seventy-five years after the Bulletin's founding, the convergence of cyber, artificial intelligence, biological threats, nuclear risk, and climate change requires serious and intense attention. The Bulletin is the only outlet devoted to the study of existential threats that was specifically established to engage the public.

Today, at a moment of renewed civic activism, engagement requires strong content, and technology equips us to invite the increasing number of our followers to engage directly with our experts and contributors—adding substantial support to their local advocacy efforts for a safer, more secure future.

This year we worked to make our stories come alive on screens in ways beyond words, using the new capacities built into the redesigned website, launched in 2018. Here are some of the best examples of what we did.

4.5 million website visitors, up 95% from 2019

7.4 million pageviews, up 72% from 2019

Nearly 50% of audience from outside US; half under 35 years of age



30% increase in Twitter followers

Multimedia features

We published articles with a visual dimension not seen since we stopped printing glossy pages in 2009, including **Paul Tullis'** report on the emerging technology, and less clearly emerging ethics of brain-computer interfaces.



In partnership with *The New Yorker* magazine, we presented Bulletin contributing editor **Elisabeth Eaves's** long-form article, "Hot zone in the Heartland?" about the US biodefense facility being built in the heart of Kansas.



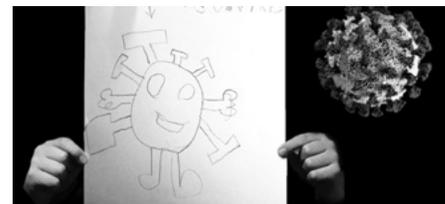
Bulletin Multimedia Editor **Thomas Gaulkin** produced a chronicle of US influence on the World Health Organization titled "Pandemic failure or convenient scapegoat: How did WHO get here?"

Showing and telling. Along with magazine-style features, the Bulletin found nimble ways to illustrate the news. For example, Bulletin editor **John Krzyzaniak** added interactive annotations to an official infographic by US Strategic Command that had grossly misrepresented global nuclear arsenals, demonstrating how it can be more effective to show something rather than simply explain it.

Tracing failure. It's practically impossible to highlight the best of anything in 2020 without talking about the worst thing about 2020—the pandemic that, with any luck, is approaching its apogee after more than one long year.

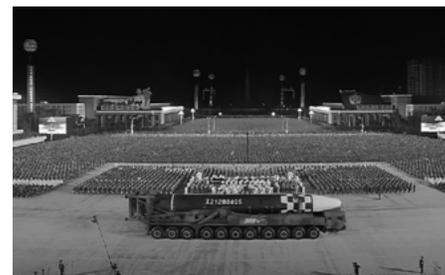
Immediately after then-President Trump announced his positive COVID-19 test on Twitter, Bulletin deputy editor **Dan Drollette** tracked his movements over the previous week. The accompanying 10-part interactive map detailed Trump's extensive travel and unmasked interactions.

Seeing small, seeing big. The coronavirus image from Centers for Disease Control and Prevention (CDC) artists Allisa Eckert and Dan Higgins is burned into the world's collective visual cortex. Young children translated what they were seeing and living into pictures. One of the Bulletin's most widely read pieces in 2020 included samples of children's novel coronavirus art.



The 2020 nuclear landscape

In 2020, we covered the emergence of new nuclear risks and the reemergence of old risks. The United States began deploying a low-yield nuclear warhead on its ballistic missile submarines. In an examination of the many concerns about the low-yield warhead, **Andrew Facini** argued that the dangerous weapon is based on bad strategic thinking.



The 2020 nuclear landscape (cont.)

The Russian military put its first Avngard hypersonic missiles into service atop modified SS-19 intercontinental ballistic missiles. North Korea rolled out some new hardware as well, including a massive new intercontinental ballistic missile and a submarine-launched ballistic missile. A brilliant analysis by **Jenny Town** explains why even though North Korea's new intercontinental ballistic missile stole the show, it wasn't the most important takeaway from the October 2020 parade in Pyongyang.

In a call for antiracist action and accountability in the US nuclear community, **Katlyn M. Turner, Lauren J. Borja, Denia Djokic, and Madicken Munk** presented a roadmap for how individuals and institutions in the nuclear community can begin to take on the true work of becoming antiracist by accepting and rectifying their own complicity in the problem.

The Treaty on the Prohibition of Nuclear Weapons received the 50 ratifications needed to enter force in 2021. Top nuclear policy experts, including **Rebecca Davis Gibbons, Zia Mian, Joellen Pretorius, and Ramesh Thakur**, assessed the impact of the NPT entry into force.

It appears unlikely that President Joe Biden will substantially alter the US nuclear posture or stop US nuclear modernization plans, but he has extended the bilateral New Strategic Arms Reduction Treaty with Russia and rejoined the nuclear agreement with Iran.



Cool your jets: Some perspective on the hyping of hypersonic weapons. Military manufacturing expert **Ivan Oelrich** provided a detailed yet accessible technical analysis that makes clear that many of the claims about the revolutionary nature of hypersonic weapons do not withstand scrutiny, particularly when compared to alternatives.

How the coronavirus outbreak is like a nuclear attack. In an interview, arms control expert **Jeffrey Lewis**, a professor at the Middlebury Institute for International Studies at Monterey, compared the early days of the COVID-19 pandemic to how a nuclear crisis might unfold.



India–China border dispute: The curious incident of a nuclear dog that didn't bark. Nuclear bluster was conspicuously absent during the India–China border clashes. The countries' respective no-first-use policies, authors **Ramesh Thakur** and **Manpreet Sethi** argued, likely played a role.

Worsening climate changes

Comic books explaining climate change. Fight or flight. Antarctic explorers. The New Hampshire presidential primaries.



Each was the topic of a climate story in the Bulletin this year, and each made the short list of our best 2020 climate coverage. Acknowledging that climate change is complex and hard to summarize, **Matteo Farinella** uses comics to make the invisible visible, and to tell human stories.



More fight, less flight. As the climate worsens, affluent Americans are thinking about where to move. That's a privilege many people don't have, argued Bulletin columnist **Dawn Stover**.



British Antarctic Survey documents changes in the Thwaites Glacier. In an interview with the Bulletin, **Peter Davis** described how researchers are discovering what is happening deep under the surface of the ice. How much is melting from below, where the ice comes into contact with warm ocean waters? Is it about to slip off and dramatically raise the world's sea levels? They stay in pyramid tents or Scott tents, capable of withstanding winds of up to 70 miles per hour.

What is happening deep under the surface of the ice? How much is melting from below, where the ice comes into contact with warm ocean waters?

A troubling year for disruptive technology

The year 2020 was largely defined by a presidential election that exposed the fragility of US democracy and a deadly pandemic. The Bulletin provided highly sought-after information about some of the more unsettling issues within the category we call disruptive technology.



Why is tear gas banned in war but not from peaceful protests? Black Lives Matter protesters in the summer of 2020 were often met by authorities who turned to riot-control agents that the US military isn't allowed to use against adversaries on the battlefield. University of Massachusetts Lowell professor **Nicholas Evans**, who researches national security and technology, assessed this development.

How South Korea learned its successful COVID-19 strategy: Both the United States and South Korea announced their first confirmed COVID-19 case on the same January day, but South Korea has fared much better against the pandemic. Biodefense scholar **HyunJung Kim** wrote that South Korea's experience with an outbreak of another coronavirus, MERS-CoV, may have helped the country cope better with COVID-19.

A tale of two Sputniks: Facing a dreary economy and sagging approval ratings, Russian President Vladimir Putin needed a boost over the summer, Bulletin associate editor **Matt Field** discovered. And what better solution than to have your country announce the world's first registered COVID-19 vaccine? One catch: the vaccine, dubbed Sputnik V, had not undergone large-scale clinical testing to ensure safety and efficacy.

Seventy-five years after the Bulletin's founding, the convergence of cyber, artificial intelligence, biological threats, and climate change requires serious and intense attention.



Experts agree the coronavirus is not a bioweapon, but disagree on whether it could have leaked from a research lab. In one of the Bulletin's most top-performing stories, Bulletin associate editor **Matt Field** explored an important retrospective question: Where did SARS-CoV-2, the virus that causes COVID-19, come from in the first place?

Why did the US cut funding to hospitals that deal with lethal disease outbreaks?

As the COVID-19 outbreak began to grow in Wuhan, China, infection prevention and biodefense expert **Saskia Popescu** questioned why preparing for epidemics, which history suggests occur frequently, seemed to be such a low priority for the US government.

How political ideology and governmental incompetence can kill you:

Bulletin editor-in-chief **John Mecklin** wrote in March that the United States's failure to control the COVID-19 pandemic was "reflective of a larger problem—the erosion

of the international infrastructure for dealing with major global threats in general." Mecklin pointed to a problem which, if it continues unabated, bodes poorly for how the world will avert climate catastrophe or even nuclear war.



Old hatreds fuel online misinformation about COVID-19 in South Asia:

A group of students at Princeton University and elsewhere have been working with Princeton professor **Jacob Shapiro** to catalogue the false pandemic narratives that have been spreading online in countries around the world. They've drawn from their database of findings to produce several columns for the Bulletin, including an excellent one on the link between COVID-19 misinformation and long-standing tensions among religious groups in South Asia.



The Magazine

75 Years and counting

Making the most of the new digital magazine format, the December 2020 75th anniversary issue featured an unparalleled collection of past and current contributions, from early Bulletin supporters like Albert Einstein to Jennifer Doudna, co-winner of this year's Nobel prize in chemistry for the discovery of the CRISPR gene editing technique. The anniversary issue cover captured all eight decades of the Bulletin's coverage.

In his introduction to the issue, Bulletin editor-in-chief John Mecklin reflected: "The past can be prologue, but each era needs its own narratives. Today, those narratives will be offered by a new generation of thinkers who come from diverse backgrounds and who create effective 21st-century solutions for the world's largest challenges. The Bulletin has long been ahead of the curve in explaining existential threats to humanity in a way that is useful to experts, a general audience, and those world leaders who are willing to pay attention. With your support, we will continue to find new and powerful ways to tell the story of humanity's most important mission: to survive."

It was an altogether banner year for the magazine. In spring 2020, the Bulletin negotiated a first-of-its-kind agreement with its publisher, Taylor and Francis, that gives the Bulletin full control of acquiring and retaining individual subscriptions to its bimonthly digital magazine, while Taylor and Francis continues to publish and market the magazine to more than 10,000 universities and institutions around the globe.

Audience research suggests that, among the more than 4 million annual visitors to our free-access website, there is strong interest in access to the long-form bi-monthly print magazine. Additionally, our 54,000-plus, and growing, newsletter subscribers are highly engaged, and represent a primary target for conversion to individual magazine subscribers.

The Bulletin has licensed new subscription management platforms and developed a new app for an easier reading experience. A broad and growing subscriber base will have a direct effect on the Bulletin's financial stability and its ability to attract the best experts and journalists necessary to strengthen the Bulletin's impact on global peace and security.

To kick off the new year, we published an issue of expert advice for the new president, Joseph R. Biden—bringing back memories of the nuclear challenges that were largely ignored during the tumultuous presidential election. The remaining issues in 2020 continued the restoration of strong visual covers that began in 2019.

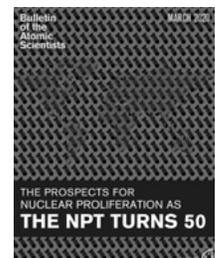
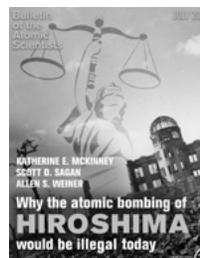
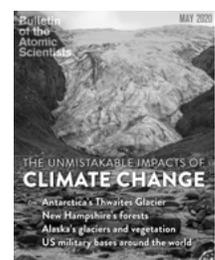
Bulletin
of the
Atomic
Scientists

Now, then, and the future:
The Bulletin turns



DECEMBER 2020

IT IS 100 SECONDS
TO MIDNIGHT



The Next Generation

New leaders step forward

2021 Rieser Award recipient: Jake Tibbetts



Quantum computing will have an impact on national security, just not in the way that some of the policy community claims that it will.

against future decryption techniques. As someone who has had access to encrypted information, I congratulate Mr. Tibbetts and the Bulletin for highlighting a subject that has serious implications for us all and deserves greater attention.”

Rieser Award-winning essay 2021

The Bulletin named Jake Tibbetts as its 2020 Leonard M. Rieser Award recipient for his February essay “Keeping classified information secret in a world of quantum computing.” The article was selected by the Bulletin’s editorial team from its “Voices of Tomorrow” column, which promotes rising experts who write with distinction on topics including nuclear risk, climate change, and disruptive technologies.

Tibbetts is a master’s student at The University of California, Berkeley, where he is studying electrical engineering and computer science and researching the application of machine learning to nuclear safeguards. He is a fellow at the Nuclear Science and Security Consortium and a former research associate at the Center for Global Security Research at Lawrence Livermore National Laboratories.

Tibbetts was also involved in the creation of “SIGNAL,” an online three-player experimental wargame in which three countries, some armed with nuclear weapons, attempt to achieve national goals through diplomacy and conflict. SIGNAL is designed to increase understanding of the impact of emerging technologies on strategic stability and nuclear risk reduction. Tibbetts is interested in cybersecurity and national security from both a technical and a policy perspective.

“In his piece, Jake Tibbetts accomplished the kind of deep, thoughtful, and well-crafted journalism that is the Bulletin’s hallmark,” editor-in-chief John Mecklin said. “Quantum computing is a complex field; many articles about it are full of strange exaggerations and tangled prose. Tibbetts’ piece, on the other hand, is an exemplar of clarity and precision and genuinely worthy of the Rieser Award.”

The Rieser Award is the capstone of the Bulletin’s Next Generation Program, created to ensure that new voices, steeped in science and public policy, have a trusted platform from which to address existential challenges. The award is named for physicist Leonard M. Rieser (1922-1998), board chair at the Bulletin from 1984 to 1998.

“The Leonard Rieser Award is designed to inspire thought-provoking scientific essays that can contribute to advances in public policy,” said Tim Rieser who, along with his brother Len and sister Abby, helped establish the Rieser Award in their father’s honor. “Jake Tibbetts, this year’s awardee, has done us all a service by tackling quantum computing and the so-called ‘race for quantum supremacy.’ The hype surrounding that ‘race,’ he argues, may be obscuring a more serious issue—the need to protect existing encrypted information

Keeping classified information secret in a world of quantum computing

By Jake Tibbetts

Quantum computing is a technology that promises to revolutionize computing by speeding up key computing tasks in areas such as machine learning and solving otherwise intractable problems. Some influential American policy makers, scholars, and analysts are extremely concerned about the effects quantum computing will have on national security. Similar to the way space technology was viewed in the context of the US-Soviet rivalry during the Cold War, scientific advancement in quantum computing is seen as a race with significant national security consequences, particularly in the emerging US-China rivalry. Analysts such as Elsa Kania have written that the winner of this race will be able to overcome all cryptographic efforts and gain access to the state secrets of the losing government. Additionally, the winner will be able to protect its own secrets with a higher level of security than contemporary cryptography guarantees.

The Next Generation

New leaders step forward

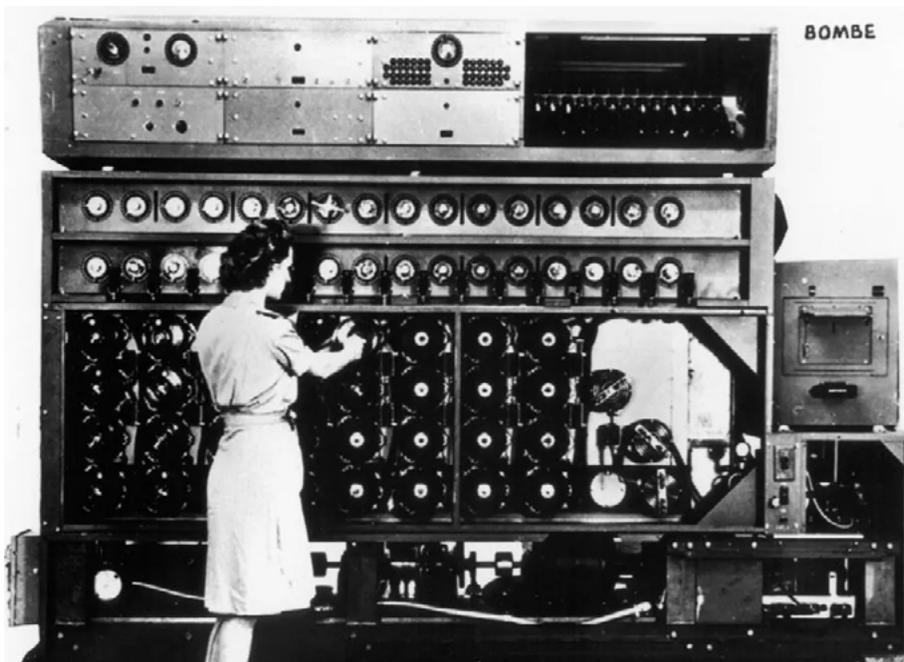
These claims are considerably overstated. Instead of worrying about winning the quantum supremacy race against China, policy makers and scholars should shift their focus to a more urgent national security problem: how to maintain the long-term security of secret information secured by existing cryptographic protections, which will fail against an attack by a future quantum computer.

The race for quantum supremacy.

Quantum supremacy is an artificial scientific goal—one that Google claims to have recently achieved—that marks the moment a quantum computer computes an answer to a well-defined problem more efficiently than a classical computer. Quantum supremacy is possible because quantum computers replace classical bits—representing either a 0 or a 1—with qubits that use the quantum principles of superposition and entanglement to do some types of computations an order of magnitude more efficiently than a classical computer. While quantum supremacy is largely meant as a scientific benchmark, some analysts have co-opted the term and set it as a national security goal for the United States.

These analysts draw a parallel between achieving quantum supremacy and the historical competition for supremacy in space and missile technology between the United States and the Soviet Union. As with the widely shared assessment in the 1950s and 1960s that the United States was playing catchup, *Foreign Policy* has reported on a “quantum gap” between the United States and China that gives China a “first mover advantage.” US policy experts such as Kania, John Costello, and Congressman Will Hurd (R-TX) fear that if China achieves quantum supremacy first, that will have a direct negative impact on US national security.

Some analysts who have reviewed technical literature have found that quantum computers will be able to run algorithms that allow for the decryption of encrypted messages without access to a decryption key. If encryption schemes can be broken, message senders will be exposed to significant strategic and security risks, and adversaries may be able to read US military communications, diplomatic cables, and



other sensitive information. Some of the policy discussion around this issue is influenced by suggestions that the United States could itself become the victim of a *fait accompli* in code-breaking after quantum supremacy is achieved by an adversary such as China. Such an advantage would be similar to the Allies' advantage in World War II, when they were able to decrypt German radio traffic in near-real time, using US and British Bombe machines.

The analysts who have reviewed the technical literature have also found that quantum technologies will enable the use of cryptographic schemes that do not rely on mathematical assumptions, specifically a scheme called quantum key distribution. This has led to the notion in the policy community that quantum communications will be significantly more secure than classical cryptography. Computer scientist James Kurose of the National Science Foundation has presented this view before the US Congress, for example.

Inconsistencies between policy concerns and technical realities.

It is true that quantum computing threatens the viability of current encryption systems, but that does not mean quantum computing will make the concept of encryption

obsolete. There are solutions to this impending problem. In fact, there is an entire movement in the field to investigate post-quantum cryptography. The aims of this movement are to find efficient encryption schemes to replace current methods with new, quantum-secure encryption.

When communicating parties use quantum key distribution, an eavesdropper cannot get ciphertext (encrypted text) and therefore cannot get any corresponding plaintext (unencrypted text). When the communicating parties use classical cryptography, the eavesdropper can get ciphertext but cannot decrypt it, so the level of security provided to the communicating parties is indistinguishable from quantum key distribution.

The Next Generation

New leaders step forward

The more pressing national security problem. While the technical realities of quantum computing demonstrate that there are no permanent security implications of quantum computing, there is a notable longer-term national security problem: Classified information with long-term intelligence value that is secured by contemporary encryption schemes can be compromised in the future by a quantum computer.

The most important aspect of the executive order that gives the US government the power to classify information, as it relates to the discussion of quantum computing and cryptography, is that this order allows for the classification of all types of information for as long as 25 years. Similarly, the National Security Agency provides guidelines to its contractors that classified information has a potential “intelligence life” of up to 30 years. This means that classified information currently being secured by contemporary encryption schemes could be relevant to national security through at least 2049—and will not be secure in the future against cryptanalysis enabled by a quantum computer.

In the past, the United States has intercepted and stored encrypted information for later cryptanalysis. Toward the end of World War II, for example, the United States became suspicious of Soviet intentions and began to intercept encrypted Soviet messages. Because of operator error, some of the messages were partially decryptable. When the United States realized this, the government began a program called the Venona Project to decrypt these messages.

It is likely that both the United States and its adversaries will have Venona-style projects in the future. A few scholars and individuals in the policy community have recognized this problem. Security experts Richard Clarke and Robert Knake have stated that “governments have been rumored for years to be collecting and storing other nations’ encrypted messages that they now cannot crack,” with the hope of cracking them in the future with a quantum computer.

As long as the United States continues to use encryption algorithms that are not quantum-resistant, sensitive information will be exposed to this long-term risk. The National Institute of Standards and Technology’s quantum-resistant algorithm might not be completed—and reflected in the National Security Agency’s own standard—until 2024. The National Security Agency has stated that “algorithms often require 20 years to be fully deployed on NSS [National Security Systems].” Because of this, some parts of the US national security apparatus may be using encryption algorithms that are not quantum-resistant as late as 2044. Any information secured by these algorithms is at risk of long-term decryption by US adversaries.

Recommendations for securing information. While the United States cannot take back any encrypted data already in the possession of adversaries, short-term reforms can reduce the security impacts of this reality. Taking 20 years to fully deploy any cryptographic algorithm should be considered unacceptable in light of the threat to long-lived classified information. The amount of time required to fully deploy a cryptographic algorithm should be lowered to the smallest time frame feasible. Even if this time period cannot be significantly reduced, the National Security Agency should take steps to triage modernization efforts and ensure that the most sensitive systems and information are updated first.

Luckily for the defenders of classified information, existing encryption isn’t completely defenseless against quantum computing. While attackers with quantum computers could break a significant number of classical encryption schemes, it still may take an extremely large amount of time and resources to carry out such attacks. While the encryption schemes being used today can eventually be broken, risk mitigation efforts can increase the time it takes to decrypt information.

This can be done by setting up honeypots—systems disguised as vulnerable classified networks that contain useless encrypted data—and allowing them to be attacked by US adversaries. This would force adversaries to waste substantial amounts

of time and valuable computer resources decrypting useless information. Such an operation is known as defense by deception, a well-proven strategy to stymie hackers looking to steal sensitive information. This strategy is simply an application of an old risk mitigation strategy to deal with a new problem.

Quantum computing will have an impact on national security, just not in the way that some of the policy community claims that it will. Quantum computing will not significantly reduce or enhance the inherent utility of cryptography, and the outcome of the race for quantum supremacy will not fundamentally change the distribution of military and intelligence advantages between the great powers.

Still, the United States needs to be wary of long-term threats to the secrecy of sensitive information. These threats can be mitigated by reducing the deployment timeline for new encryption schemes to something significantly less than 20 years, triaging cryptographic updates to systems that communicate and store sensitive and classified information, and taking countermeasures that significantly increase the amount of time and resources it takes for adversaries to exploit stolen encrypted information. The threats of quantum computing are manageable, as long as the US government implements these common-sense reforms.

Whereas some believe that quantum computing poses an existential threat to secrecy, in reality the threats of quantum computing are manageable as long as the governing institutions of the US implement a few simple, common sense reforms.

The Next Generation

New leaders step forward



Bulletin partnership with the Medill School at Northwestern

Early in 2020, the Bulletin announced a new collaboration with the Northwestern University Medill School of Journalism, Media, Integrated Marketing Communications, one of the premier journalism programs in the world.

Through this initiative, the Bulletin is partnering with students in Medill's graduate journalism Health, Environment and Science specialization and Medill on the Hill, the school's program in Washington, D.C., to provide an outlet for aspiring journalists focused on the Bulletin's coverage areas of nuclear weapons, climate change, and disruptive technologies.

How boulders in Mongolian mountains reveal the pace of climate change:

With vivid prose and an adventurer's heart, Medill alumna Stephanie Fox chronicled her trip to the Mongolian mountains with two glacial geologists, a high school teacher, three undergraduate science majors, and a collection of Mongolian guides to show how boulders there reveal the pace of the climate crisis.

The disturbing and under-researched legacy of uranium weapons:

Elena Bruess, Joe Snell, and Madhurita Goswami found that there has been a lack of research and education into the effects of depleted uranium munitions on post-conflict communities in Iraq and Syria. Cleanup efforts by both UN member countries and affected communities have failed.



2020 Voices of Tomorrow Authors

Bulat Aytbaev, Dmitry Grigoriev, Vladislav Lavrenchuk, Noah Mayhew

Lisa A. Bergstrom

Daine L. Danielson, Vladimir Kobezskii, Anna Kudriavtseva, Ariel Petrovics

Cecilia Eiroa-Lledo, Maria Kolomiets, Masha Levon, Nikita Karpov, Elliot Serbin, Yulia Katsenko

Jake Hecla, Gabriela Levikow, Ksenia Pirnavskaia

Dahyun Kang

Jaroslav Krasny

Monica Montgomery

Maxime Polleri, Cameron Tracy, Elizaveta Likhacheva, Evgenia Stepanykh

Halley Posner

Jake Tippetts (Rieser Award recipient)

The Doomsday Clock Announcement: It is 100 seconds to midnight

As COVID-19, nuclear tensions, and climate change dominated the world stage, the Bulletin conducted its first-ever virtual Doomsday Clock announcement on January 27, 2021, one week after the inauguration of President Joseph R. Biden.

At the media event, CEO President and CEO Rachel Bronson concluded her opening remarks by stating: "It would be a privilege and an honor to move the hands of the Doomsday Clock away from Midnight. Although there are important bright spots that we articulate in our report, bright spots that we hope will continue to extend and evolve and allow us to push it back next year at this time, the current situation does not warrant it."

With that, she asked Science and Security Board members Suzet McKinney and Robert Rosner to reveal the Clock, which remained at 100 seconds to midnight, unchanged from 2020.

Two respected international leaders then offered their insights, starting with Former Liberian President Ellen Johnson Sirleaf, who is co-chair of the World Health Organization Independent Panel for Pandemic Preparedness and Response, member of the Elders, and recipient of the Nobel Peace Prize in 2011. President Sirleaf was followed by the Governor of the Hiroshima Prefecture in Japan, Hidehiko Yuzaki.

Former California Governor Jerry Brown, who serves as the Bulletin's executive chair, closed out that segment of the Clock Announcement.



From left: Jerry Brown, Ellen Johnson Sirleaf, and Hidehiko Yuzaki

The past twelve months have served to reinforce the messages that the Bulletin of the Atomic Scientists has been saying for decades: that it is only through collective action and responsible leadership that we can secure a peaceful and habitable planet for future generations. The new Presidency of Joe Biden has a chance to reassert US commitments to the values and institutions of multilateralism; there is no other way for humanity to overcome the dangers posed by pandemics, climate change, and the risk of nuclear war.

Former President of Liberia Ellen Johnson Sirleaf

The US, Russia, and the world's nuclear powers must stop shouting at each other. It's time to eliminate nuclear weapons, not build more of them. Likewise, with climate change.
Edmund G. Brown Jr
Executive Chair

The hands of the Doomsday Clock remain at 100 seconds to midnight, as close to midnight as ever. The lethal and fear-inspiring COVID-19 pandemic serves as a historic 'wake-up call,' a vivid illustration that national governments and international organizations are unprepared to manage the truly civilization-ending threats of nuclear weapons and climate change.
Rachel Bronson, President and CEO

The Doomsday Clock Announcement: It is 100 seconds to midnight

Three members of the science board, all of whom had helped to write the Clock Statement, then presented statements from their respective disciplines:

- Asha George, executive director, Bipartisan Commission on Biodefense
- Susan Solomon, Lee and Geraldine Martin Professor of Environmental Studies at the Massachusetts Institute of Technology (MIT) and founding director of the MIT Environmental Solutions Initiative
- Steve Fetter, associate provost, dean of the graduate school, and professor of public policy, University of Maryland

Media representatives at the announcement were then invited to ask questions.

Media coverage grows

The 2021 Doomsday Clock announcement generated a total of 14,700 social media mentions, with an estimated reach of 841.6 million readers. The Clock live stream was fed on 31 platforms with an estimated viewership of approximately 2,000,000.

The Doomsday Clock news event itself resulted in 2,465 earned-media stories of all kinds:

- 2,017 print/online stories
- 448 TV and broadcast stories

Highlights include:

- *The Honorable Gro Harlem Brundtland of Norway's op-ed at Inquirer.net*
- *CNN op-ed "The most dangerous situation humanity has ever faced," by Jerry Brown and Bob Rosner.*
- *The Nation*
- *The New York Times*
- *The Washington Post*
- *Forbes*
- *The Conversation*



Robert Rosner and Suzette McKinney reveal the time on the Doomsday Clock.



From left: Steve Fetter, Asha George, and Susan Solomon.

Despite nuclear abolition being the long-awaited wish of all A-Bomb survivors, there are still more than 13,000 nuclear weapons in the world, with nuclear states continuing to modernize their nuclear forces. Moreover, nuclear disarmament continues to stagnate, further exacerbating global tensions.

Hiroshima Prefecture Governor Hidehiko Yuzaki



The 2021 Clock Statement

This is your COVID wake-up call: It is 100 seconds to midnight

To: Leaders and citizens of the world

Humanity continues to suffer as the COVID-19 pandemic spreads around the world. In 2020 alone, this novel disease killed 1.7 million people and sickened at least 70 million more. The pandemic revealed just how unprepared and unwilling countries and the international system are to handle global emergencies properly. In this time of genuine crisis, governments too often abdicated responsibility, ignored scientific advice, did not cooperate or communicate effectively, and consequently failed to protect the health and welfare of their citizens.

As a result, many hundreds of thousands of human beings died needlessly.

Though lethal on a massive scale, this particular pandemic is not an existential threat. Its consequences are grave and will be lasting. But COVID-19 will not obliterate civilization, and we expect the disease to recede eventually. Still, the pandemic serves as a historic wake-up call, a vivid illustration that national governments and international organizations are unprepared to manage nuclear weapons and climate change, which currently pose existential threats to humanity, or the other dangers—including more virulent pandemics and next-generation warfare—that could threaten civilization in the near future.

Accelerating nuclear programs in multiple countries moved the world into less stable and manageable territory last year. Development of hypersonic glide vehicles, ballistic missile defenses, and weapons-delivery systems that can flexibly use conventional or nuclear warheads may raise the probability of miscalculation in times of tension. Events like the deadly assault earlier this month on the US Capitol renewed legitimate concerns about national leaders who have sole control of the use of nuclear weapons. Nuclear nations, however, have ignored or undermined practical and available diplomatic and security tools for managing nuclear risks. By our estimation, the potential for the world to stumble into nuclear war—an ever-present danger over the last 75 years—increased in 2020. An extremely dangerous global failure to address existential threats—what we called “the new abnormal” in 2019—tightened its grip in the nuclear realm in the past year, increasing the likelihood of catastrophe.

Governments have also failed to sufficiently address climate change. A pandemic-related economic slowdown temporarily reduced the carbon dioxide emissions that cause global warming. But over the

coming decade fossil fuel use needs to decline precipitously if the worst effects of climate change are to be avoided. Instead, fossil fuel development and production are projected to increase. Atmospheric greenhouse gas concentrations hit a record high in 2020, one of the two warmest years on record. The massive wildfires and catastrophic cyclones of 2020 are illustrations of the major devastation that will only increase if governments do not significantly and quickly amplify their efforts to bring greenhouse gas emissions essentially to zero.

As we noted in our last Doomsday Clock statement, the existential threats of nuclear weapons and climate change have intensified in recent years because of a threat multiplier: the continuing corruption of the information ecosphere on which democracy and public decision-making depend. Here, again, the COVID-19 pandemic is a wake-up call. False and misleading information disseminated over the internet—including misrepresentation of COVID-19’s seriousness, promotion of false cures, and politicization of low-cost protective measures such as face masks—created social chaos in many countries and led to unnecessary death. This wanton disregard for science and the large-scale embrace of conspiratorial nonsense—often driven by political figures and partisan media—undermined the ability of responsible national and global leaders to protect the security of their citizens. False conspiracy theories about a “stolen” presidential election led to rioting that resulted in the death of five people and the first hostile occupation of the US Capitol since 1814.

In 2020, online lying literally killed.

Considered by themselves, these negative events in the nuclear, climate change, and disinformation arenas might justify moving the clock closer to midnight. But amid the gloom, we see some positive developments. The election of a US president who acknowledges climate change as a profound threat and supports international cooperation and science-based policy puts the world on a better footing to address global problems. For example, the United States has already announced it is rejoining the Paris Agreement on climate change and the Biden administration has offered to extend the New START arms control agreement with Russia for five years. In the context of a post-pandemic return to relative stability, more such demonstrations of renewed interest in and respect for science and multilateral cooperation could create the basis for a safer and saner world.

It is one hundred seconds to midnight

Because these developments have not yet yielded substantive progress toward a safer world, they are not sufficient to move the Clock away from midnight. But they are positive and do weigh against the profound dangers of institutional decay, science denialism, aggressive nuclear postures, and disinformation campaigns discussed in our 2020 statement. The members of the Science and Security Board therefore set the Doomsday Clock at 100 seconds to midnight, the closest it has ever been to civilization-ending apocalypse and the same time we set in 2020. It is deeply unfortunate that the global response to the pandemic over the past year has explicitly validated many of the concerns we have voiced for decades.

We continue to believe that human beings can manage the dangers posed by modern technology, even in times of crisis. But if the humanity is to avoid an existential catastrophe—one that would dwarf anything it has yet seen—national leaders must do a far better job of countering disinformation, heeding science, and cooperating to diminish global risks. Citizens around the world can and should organize and demand—through public protests, at ballot boxes, and in other creative ways—that their governments reorder their priorities and cooperate domestically and internationally to reduce the risk of nuclear war, climate change, and other global disasters, including pandemic disease.

We have experienced the consequences of inaction. It is time to respond.

A dark nuclear landscape, with glimmers of hope

In the past year, countries with nuclear weapons continued to spend vast sums on nuclear modernization programs, even as they allowed proven risk-reduction achievements in arms control and diplomacy to wither or die. Nuclear weapons and weapons-delivery platforms capable of carrying either nuclear or conventional warheads continued to proliferate, while destabilizing “advances” in the space and cyber realms, in hypersonic missiles, and in missile defenses continued. Governments in the United States, Russia, and other countries appear to consider nuclear weapons more and more usable, increasing the risks of their actual use. There continues to be an extraordinary disregard for the potential of an accidental nuclear war, even as well-documented examples of frighteningly close calls have emerged.

US and Russian nuclear modernization efforts continued to accelerate, and North Korea, China, India, and Pakistan pursued “improved” and larger nuclear forces. Some of these modernization programs are beginning to field weapons with dangerous enhancements, like Russia’s nuclear-tipped Avangard hypersonic glide vehicles, which are being installed on new SS-29 (Sarmat) missiles designed to replace 1980s-era intercontinental ballistic missiles (ICBMs). Russia continues to field battalions of intermediate-range, ground-launched, nuclear-armed missiles—missiles previously banned by the now-defunct Intermediate-range Nuclear Forces Treaty, from which the United States withdrew in 2019. China, which has historically relied on a small and constrained nuclear arsenal, is expanding its capabilities and deploying multiple

independently retargetable warheads on some of its ICBMs and will likely add more in the coming year.

The heightened interest that the United States and Russia have shown in hypersonic weapons, as demonstrated by a number of tests in 2020, is deeply worrisome. The hypersonics arms race has already led to calls for space-based interceptors to destroy them in flight. This militarization of space is dangerously destabilizing and increases the risk of escalation and accidental conflict.

Several countries are developing weapons-delivery platforms that can carry either nuclear or conventional warheads, introducing greater risks of miscalculation in a crisis or conventional conflict. Some may view this ambiguity as a deterrent to war, but it is not hard to imagine how mistaking a conventionally armed cruise missile for a nuclear-armed missile could complicate decision-making in the fog of crisis or war, potentially leading to preemptive strikes. The potential to stumble into nuclear war—ever present—has grown.

Meanwhile, developments in Northeast Asia, the Middle East, and South Asia further add to nuclear risks.

North Korea continues to develop its missile and nuclear programs. It revealed a new and larger long-range missile (Hwasong-16) in October 2020 at a military parade, but in the absence of flight testing, it’s not clear whether the new missile will add major capabilities to North Korea’s arsenal. There were no high level meetings between North Korea and the United States in 2020, leaving the future of US negotiations with North Korea in doubt.

South Asia remains a potential nuclear hot spot, as both India and Pakistan continue to enlarge their arsenals and increase the sophistication and ranges of their weapons, with Indian ballistic missiles now able to reach Chinese targets. The relatively recent movement of nuclear competition among these countries to sea-based platforms, including submarines, raises the risk—already high—that conventional skirmishes could escalate to the nuclear level.

The continued effort by Iran to enhance its nuclear capabilities is another serious concern. But a bright spot in an otherwise gloomy landscape is the Biden administration’s stated desire to rejoin the Iran nuclear deal, known officially as the Joint Comprehensive Plan of Action (JCPOA). In response to the 2018 US withdrawal, Iran deliberately walked back its commitments under the agreement. Stockpiles of low-enriched uranium have increased, enrichment levels have risen, and new, improved centrifuges have been installed. These actions have reduced the amount of time it would take Iran to put together a nuclear weapon from one year to several months. At the same time, Iran continues to comply with many of the agreement’s requirements, and many of the actions it has taken can easily be reversed. However, Iran’s willingness to remain in the agreement is not a given.

To keep nuclear modernization programs from becoming a full-scale nuclear arms race, it was essential that New START, a treaty that limits US and Russian strategic weapon deployments, be extended for five more years, buying time for a follow-on agreement to be



It is one hundred seconds to midnight

considered, negotiated, and put into force. Russian President Vladimir Putin and new US President Joe Biden agreed to do that on January 26, 2021, and the Russian Duma then ratified the five-year extension.

Other arms control efforts—including the nuclear test ban treaty and negotiations to stop producing fissile materials for weapons—have unraveled or are stalled. Previous cooperation on fissile material control and nuclear proliferation among the United States, Russia, and China has lapsed, and there are no serious efforts aimed at limiting risky developments in cyberweapons, space weapons, missile defenses, and hypersonic missiles.

The tenth review of the Non-Proliferation Treaty (NPT) was postponed in 2020 because of the COVID-19 pandemic. Rescheduled for this year, the review conference will provide an opportunity for nuclear weapons countries to demonstrate the practical steps they have taken or will commit to take to reduce the risks of nuclear weapons use and scale back their reliance on nuclear weapons.

Just a few days ago, the Treaty on the Prohibition of Nuclear Weapons entered into force after 50 countries completed ratification. This treaty was developed by countries that do not have nuclear weapons, with the intention of bringing pressure on the nuclear weapons states to move more forcefully toward nuclear disarmament. The treaty brings much-needed attention to the risks posed by nuclear weapons, especially the enormous humanitarian impacts of the use of nuclear weapons. We hope that the treaty will lead to concrete actions by all states to address the challenges of disarmament and proliferation, including collective security and verification. We call on all states to collaborate and compromise to achieve real disarmament results.

Climate change action after the pandemic

Last year was to have marked a climate change milestone: The parties to the Paris Agreement were expected to increase their pledges to reduce the greenhouse gas emissions that are disrupting Earth's climate. The initial pledges made in 2015 to reduce emissions over this decade were markedly inadequate and meant only to begin an iterative process towards the goal of limiting global warming to well below 2 degrees Celsius, relative to pre-industrial levels. Countries had been expected to raise their pledges at the 2020 meeting, but because of the coronavirus pandemic, the meeting was postponed until this year.

The delay may help. Few countries have been paying much attention to climate action during the pandemic. In 2020, countries whose emissions amounted to barely one-quarter of the global total had submitted improved emissions pledges, and countries responsible for another quarter of global emissions—including Australia, Japan, the United States, Russia, Indonesia, Brazil and New Zealand—simply announced pledges that were effectively identical to or even weaker than their existing commitments. Although the United States formally withdrew from the Paris Agreement late last year, the new administration has begun the process of rejoining and expressed its

intention to submit an improved pledge and to provide additional financial support for climate actions in poor countries. As the pandemic recedes, more countries may step up their pledges over the course of the coming year.

As the COVID-19 pandemic deepened in the early months of 2020, carbon dioxide emissions dropped by an estimated 17 percent compared to the previous year's. Emissions have largely bounced back, however, as the world's fossil fuel-dependent economies have begun to recover, and the year's total emissions were estimated at only four-to-seven percent lower than last year's. Of course, cutting emissions temporarily via disease-induced economic recession is neither desirable nor sustainable. And, as with other economic crises, further recovery will raise energy demand and thus emissions—unless we take deliberate policy steps to reduce fossil-fuel use and accelerate the adoption of alternatives.

Fortunately, renewable energy has been resilient in the turbulent pandemic energy environment. Renewable deployment has slowed, but by less than other sources, and investment remains high. In the US, coal is projected to provide less electricity than renewables for the first time ever, owing to a decline in electricity demand and coal's inability to compete, given the low price of natural gas and near-zero operating costs of renewables. Globally, demand for fossil-based power has declined, while demand for renewable power has risen.

These developments need to be sustained into the recovery from the COVID-19 crisis, but they are not nearly enough to halt warming. Global greenhouse gas concentrations in the atmosphere have hit a record high, and 2020 was essentially tied with 2016 as the warmest year on record. Until global carbon dioxide emissions are reduced to nearly zero, the burden of carbon dioxide in the atmosphere will continue to mount, and the world will continue to warm. The climate is still heading in the wrong direction.

In 2020, the impacts of continuing climate change were underscored in extreme and damaging ways. Portions of North America and Australia suffered massive wildfires, and a clear signal of human-caused climate change was evident in the frequency of powerful tropical cyclones and the heavier rainfall they produced. Meanwhile, evidence mounted that sea level rise is accelerating, and the effects of the oceans growing warmer and more acidic because of carbon dioxide absorption were clear in many marine ecosystems, as was most dramatically illustrated by the ongoing destruction of coral reefs.

In the long term, the answers to two questions related to the pandemic will have important climate change ramifications:

First, to what extent will economic stimulus spending aimed at ending the coronavirus economic slowdown be directed toward efficient green infrastructure and low-carbon industries? Such support will inevitably compete with aid requests from fossil fuel companies and other carbon-intensive industries that are also facing pandemic-related pressures.



It is one hundred seconds to midnight

In the COVID-19 case, a lot of “brown” (fossil-based) stimulus is in the works. The trillions of dollars in stimulus programs that countries have launched are not particularly green. In aggregate, the G20 countries had committed approximately \$240 billion to stimulus spending that supports fossil fuel energy by the end of 2020, versus \$160 billion for clean energy. Likewise, the support packages for developing countries from the World Bank and International Monetary Fund do not favor low-carbon investments. And while China has made strong commitments to the decarbonization of its domestic economy, its Belt and Road Initiative appears poised to fill the niche increasingly being abandoned by developed country finance sectors, pouring investment into fossil-fuel infrastructure around the world.

At present, national plans for fossil fuel development and production are anything but encouraging; they project global growth in carbon dioxide emissions from fossil fuel use of roughly two percent per year over this coming critical decade, whereas emissions would need to decline precipitously if the temperature commitments of the Paris Agreement were to be met. If these plans are indeed pursued, fossil fuel production in 2030 would be around 50 percent higher than is consistent with meeting even the least ambitious goals of the Paris Agreement.

A second question: How will the pandemic affect the ability of the international political system to manage global climate change? Like climate change, the COVID-19 pandemic is a global problem that calls for a global solution. How successfully the leaders of the world's nations coordinate their responses to the pandemic affects (or, will affect) their faith and commitment to multilateralism generally. They could become more confident in the value of effective global cooperation and robust international institutions, or they could emerge more mistrustful of multilateralism and discard their remaining commitments to invest in already declining and over-stretched institutions of global cooperation. A positive experience could lead to effective collaborations addressing climate change, the threat of nuclear war, and global challenges yet to emerge.

The COVID-19 infodemic and other disruptive threats

The COVID-19 pandemic has disrupted the planet in many extraordinary and negative ways, one of which involves the internet-driven spread of false or misleading information. As the pandemic emerged, it spawned what the World Health Organization has called a “massive ‘infodemic’—an over-abundance of information ... that makes it hard for people to find trustworthy sources and reliable guidance when they need it.” The COVID-19 infodemic includes deliberate attempts (sometimes by national leaders) to disseminate misinformation and disinformation that harms physical and mental health; threatens public health gains; damages economies; and makes it much more difficult for the nations of the world to stop the pandemic.

The COVID-19 pandemic and its accompanying infodemic have become intertwined with critical uncertainties regarding science, technology, and crisis communications.

First, not all of the science relevant to ending the pandemic was known at its outset. Alas, many loud voices regarded the evolution of scientific knowledge about COVID-19 as reason to ignore and disparage scientific advice about controlling the pandemic.

Also, as new science-based treatments and interventions were developed and tested, experts needed to learn how to maximize their beneficial effects and deliver them to the public. This learning process introduced uncertainty into pandemic discourse around the world.

And finally, governmental communications about COVID-19 included inconsistent and contradictory narratives emerging from political leaders and institutions that should have been cooperating and coordinating.

As these three uncertainties played out last year, the public's response to the coronavirus emergency fractured along ideological lines, with partisanship often replacing science as the justification for public health measures. Unfortunately, the internet-fueled undercutting of rational discourse and policy making is not specific to COVID-19. Efforts to deal with the existential threats of nuclear war and climate change have been similarly undermined.

Social media, search engines, always-on mobile computing technologies, and other technology applications have exploited human cognitive propensities to be misled and enraged and to react impulsively, exacerbating political and ideological differences. Established institutions that have traditionally provided a trusted center that supports societal stability—government agencies, especially those related to public health and climate change, journalism, the judiciary, education—are under attack precisely because they have provided stability.

At the very least, the widespread dysfunction in today's information ecosystem is a threat multiplier that vastly complicates society's ability to address major challenges. Pandemic responses in some countries, including the United States, have provided graphic demonstrations that such concerns are not merely theoretical. Disinformation has led leaders and citizens alike to reject scientific advice about limiting the spread of COVID-19, with tragic results.

Unchecked internet disinformation could have even more drastic consequences in a nuclear crisis, perhaps leading to a nuclear war that ends world civilization. Disinformation efforts across communications systems are at this moment undermining responses to climate change in many countries. The need for deep thinking and careful, effective action to counter the effects of internet-enabled disinformation has never been clearer.

Meanwhile, the COVID-19 pandemic continues to rage. SARS-CoV-2 took advantage of both physiological and societal vulnerabilities and continues to nimbly skirt poorly mustered defenses. Recent mutations have created variants of the virus that are more infectious and sicken children, who were previously thought to be less prone to infection.



It is one hundred seconds to midnight

Scientists around the world have mobilized to create COVID-19 treatments and vaccines, and their work is showing promise in reducing the severity of, and the eventual suppression of, the pandemic. But public officials who have dismissed the value of science during the pandemic now face populations hesitant to take COVID-19 vaccines. Those same public figures also failed to iron out the manufacturing, distribution, and other logistical details needed for efficient immunization programs.

As this pandemic subsides, leaders around the world must come together to create the institutions and surveillance regimes that can identify disease outbreaks and quash them before they become pandemics, quickly develop vaccines and therapeutics for new diseases, and rapidly promulgate preventive measures for public health.

Rapidly advancing biological research and development have produced, and will continue to produce, disruptive technologies that could increase biological risk. In the risk-increasing category are biotechnology applications that could, for example, create super-soldiers or produce biological weapons. Many countries and corporations are investing in the biological sciences as they recognize the immense opportunities to establish and grow bioeconomies. These bio-investment programs raise the new possibility that nations may conduct biological weapons research and development under the guise of building effective responses for naturally occurring pandemics.

Bad actors have surely taken notice of the gaps in national responses to the COVID-19 pandemic. Most nations were unable to meet needs for personal protective equipment, to provide enough hospital beds to treat everyone who became seriously ill with the disease, or to manage international supply chains well enough to deliver medicines and equipment when and where they were most needed. International security requires speedy action to reduce those vulnerabilities. An improved global public health effort to prevent, detect, respond to, and recover from natural pandemics would, as a salutary side-effect, better prepare the world to respond to biological accidents and attacks.

This is your wake-up call

When the world finally emerges from the worst pandemic in a century, everyone will rightly celebrate. It might be tempting to mark the COVID-19 experience as a one-off, a dismal anomaly to be forgotten. We, too, wish the world could return to normal in short order.

But the pandemic is not a unique departure from a secure reality. It is a harbinger, an unmistakable signal that much worse will come if leaders and institutions do not enact wide-ranging reforms to forestall and minimize future pandemics, to restore the primacy of science-based policies, and to reduce the possibility of nuclear war and the impacts of climate change.

We set the Doomsday Clock at 100 seconds to midnight—the closest it has ever been—because the existential risks confronting humanity today call for quick and comprehensive action across the

21st-century's complex threat spectrum. Here are some practical steps that world leaders can and should initiate in 2021 to protect humanity from major global threats that have the potential to end civilization:

- The US and Russian presidents should, upon extension of New START, launch follow-on talks for more ambitious and comprehensive limits of nuclear weapons and delivery systems.
- Now that the United States has announced it will rejoin the Paris climate agreement, it should accelerate its commitment to decarbonization and put policies in place that make the attainment of the commitment feasible.
- US President Joe Biden can show leadership by reducing US reliance on nuclear weapons via limits on their roles, missions, and platforms, and by decreasing budgets accordingly. The United States should declare its commitment to no-first-use of nuclear weapons and persuade allies and rivals to agree that no-first-use is a step toward security and stability.
- President Biden should banish the fear that a single person would have the power to end civilization by eliminating his own and future US presidents' sole authority to launch nuclear weapons. He should work to persuade other countries with nuclear weapons to put in place similar barriers.
- Russia can rejoin the NATO-Russia Council and open serious discussions on risk reduction and on avoiding escalation dangers.
- North Korea can agree to codify and allow verification of its moratorium on nuclear tests and long-range missile tests.
- Iran and the United States can jointly return to full compliance with the Joint Comprehensive Plan of Action, and Iran can agree to new, broader talks about Middle East security and constraints on its missile and other military activities.
- The United States and Russia can renew cooperation on fissile material and nuclear security to make sure that terrorists cannot acquire the means to build a nuclear weapon.
- Banks and other sources of capital can implement policies that limit investment in fossil fuel projects, as indeed some already have done, and redirect it to climate-friendly investments.
- China can reorient its Belt and Road Initiative, so it sets an example for other investors by pursuing sustainable development pathways rather than supporting fossil fuel-intensive development.

It is one hundred seconds to midnight

- All nations can commit to stronger decarbonization goals under the Paris Agreement and implement policies directed toward the realization of these goals. Those policies should address not merely long-term goals but near-term emission reductions and investments in longer-term structural changes. Meanwhile, the world's wealthier countries should enhance their commitments under the Paris Agreement to provide financial support and technology cooperation required by developing countries to undertake strong climate action.
- Leaders in governments and the private sector can emphasize COVID-recovery investments that strongly favor climate mitigation and adaptation objectives across all economic sectors and address the full range of potential greenhouse gas emission reductions. This includes capital investments in urban development, agriculture, transport, heavy industry, buildings and appliances, and electric power.
- The new US administration can fill leadership positions for science-based agencies on the basis of scientific expertise and credentials; prohibit interference with the production or dissemination of executive branch scientific reports; use the best possible science to inform policy considerations; allow government scientists to engage with the public about their work; and provide funding to restore and strengthen international scientific cooperation.
- National leaders and international organizations can create more effective regimes for monitoring biological research and development efforts, so potential benefits can be maximized, and possible negative consequences minimized or eliminated.
- Governments, major communications technology firms, academic experts, and responsible media organizations can cooperate to find practical and ethical ways to combat internet-enabled misinformation and disinformation.

Having now killed more than two million human beings, COVID-19 is an unmistakable global wake-up call. The message is simple and chilling: Next time could be far worse. Given the pandemic experience, no one can reasonably say he or she was not warned. It remains 100 seconds to midnight, the most dangerous situation that humanity has ever faced. It is time for all to take the actions needed to—quite literally—save the world.

Citizens around the world can and should organize and demand—through public protests, at ballot boxes, and in other creative ways—that their governments reorder their priorities and cooperate domestically and internationally to reduce the risk of nuclear war, climate change, and other global disasters, including pandemic disease. We have experienced the consequences of inaction. It is time to respond.



Growing the Bulletin community

With virtual programs, t-shirts, and more



Bulletin helps to unveil Amnesia Atomica

Bulletin president and CEO Rachel Bronson traveled to Mexico City February 13-15 to join renowned artist Pedro Reyes and the Mexican Ministry of Foreign Affairs in unveiling Amnesia Atomica, a three-story inflatable mushroom cloud commissioned to "...raise public awareness, revitalize the once vibrant anti-nuclear community, and most importantly, put pressure on political leaders, policymakers and global citizens by reminding them of the consequences of inaction." The sculpture served as a central component of a three-day commemoration of the 53rd anniversary of the Treaty of Tlatelolco, a historic agreement that created a nuclear weapons free zone for Latin America and the Caribbean.

Connecting virtually

Pivoting to virtual exchanges during a year defined by the COVID-19 crisis, the Bulletin hosted programs online in 2020 for those supporters who want to engage our content at a deeper level. These programs made the Bulletin more accessible, and broadened our impact.

In early February, as the pandemic loomed, Science and Security Board members Asha George, executive director of the Bipartisan Commission on Biodefense, and Suzet McKinney, CEO/executive director of the Illinois

Medical District, discussed the coronavirus at a virtual program, moderated by Bulletin CEO Rachel Bronson.

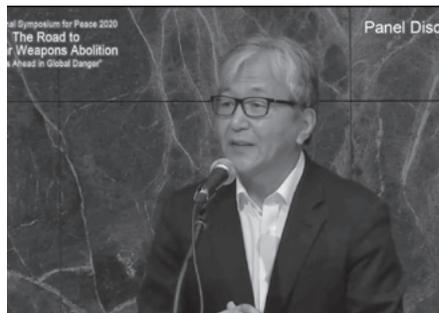
In a March virtual program on "Nuclear Weapons Policy and the U.S. Presidential Election," Bulletin editor-in-chief John Mecklin moderated a conversation between John P. Holdren, former science advisor to President Obama, and Alexandra Bell, senior policy director at the Center for Arms Control & Non-Proliferation.

A July global webinar on the book *The Button*, two days before the 75th anniversary of Trinity, the first ever test of nuclear weapons, featured co-authors William J. Perry, chair of the Board of Sponsors, and Tom Collina, policy director at the Ploughshares Fund, moderated by Bulletin senior advisor Kennette Benedict.

At an International Peace Symposium at the Nagasaki Atomic Bomb Museum, sponsored by *The Asahi Shimbun*, Board of Sponsors chair William Perry and Rachel Bronson were panelists.

Also in August, marking the 75th anniversary of Hiroshima, a global webinar on "Why the Dropping of the Atomic Bomb on Hiroshima Would be Illegal Today," included Science and Security Board member Scott Sagan and Stanford professor Allan Werner, moderated by Bulletin columnist Sara Kutchesfahani.

In December, Bulletin columnist Duyeon Kim invited Ambassadors Robert Gallucci, Christopher Hill, Chun Yung-woo, and Glyn Davies to describe specific challenges the Biden administration faces on the North Korean nuclear problem and the complex regional issues.



Pandemic failure or convenient scapegoat: How did WHO get here?

Bulletin multimedia editor Thomas Gaulkin's deep dive into the history of the World Health Organization (WHO) caught the attention of the producers of *Last Week Tonight with John Oliver*, and inspired a piece that aired on the show October 20, 2020. The global health organization came under relentless criticism during the Trump administration. With scathing humor and authoritative references, Oliver dismantled the validity of most of the criticisms.



Bulletin pride on display

Bulletin supporters are scooping up coffee mugs, dazzling prints, catchy masks, and much more at the Bulletin store, launched in 2020. Two samples of available items appear above, and new options are added often.

Annual Meeting and Dinner

75 years and counting



William J. Perry, Chair, Board of Sponsors

Although a nuclear free world seems like an impossible dream, we must not give up that dream. The future of our children and our grandchildren depend on what we can do to achieve that dream.
 William J. Perry

Plan to be inspired

With these words, the Bulletin invited our community to a virtual 75 Years and Counting Anniversary Dinner on November 12, 2020, just 9 days after the US Presidential Election. William J. Perry, Bulletin Board of Sponsors chair and former US Secretary of Defense, offered a moving toast to the Bulletin's 75 years of bringing evidence-based journalism and actionable ideas around the man-made threats of nuclear weapons, climate change, and disruptive technologies.

Ahead of the event, former Secretary of State Madeleine Albright and former New Jersey governor and EPA administrator Christine Todd Whitman appeared in online messages endorsing the Bulletin's mission and encouraging people to attend the virtual program.

Most exciting were the opportunities for some 350 guests to join small, carefully curated "tables" to connect our global audience with one another and to thought leaders and experts from around the world. Provocateurs and hosts guaranteed spirited, enlightened exchanges, which made the evening a memorable and resounding success.

During the event, donors more than matched a \$25,000 Annual Dinner challenge from long-time benefactors Eleanor and William (Bill) Revelle. Bill Revelle is a former chair and current member of the Governing Board, and Eleanor is Seventh Ward Alderman and civic leader in Evanston, Illinois.



Annual Dinner Sponsors

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Annual Meeting and Dinner

75 years and counting



Program highlights included the Keynote Address from former Japanese Minister of Foreign Affairs and Minister of the Environment Yoriko Kawaguchi (left), and brief remarks from executive chair Jerry Brown, and Governing Board chair John Balkcom.



Governing Board member Dave Kuhlman, top left, hosted a table from Axiom Consulting Partners that also included: top row, from left: Susanna Mlot, Dahlia Radley-Kingsley, Katie Hynan; middle row from left, Charlie Pope, Charlotte Jackson, Kevin Andres, Greg Kuhlman; and bottom row, from left, George Church, Christine Lange, Chelsea Fuller.



Tim Rieser (below, lower right), son of Leonard Rieser, led a stimulating roundtable online with past award winners, and recognized Haven Coleman (below, top right), the 2019 Leonard M. Rieser Award recipient, for a powerful article she co-authored, "Adults won't take climate change seriously. So we, the youth, are forced to strike." Also included in the roundtable were (top row) 2018 Rieser Awardees Kate Hewitt and Erin Connolly, and (bottom row) 2017 Rieser Award recipient Yangyang Chang.

Dinner Provocateurs

- Pedro Alonzo, nuclear risk/ science communication
- Lesley Blume, nuclear risk
- Jerry Brown, government and leadership
- George Church, disruptive technology/ genetics
- Lynn Eden, nuclear risk
- Gareth Evans, nuclear risk
- Rodney Ewing, nuclear risk
- Steve Fetter, disruptive technology
- Beatrice Fihn, nuclear risk
- Asha M. George, disruptive technology/biosecurity
- Laura Holgate, nuclear risk
- Daniel Holz, disruptive technology/ gravitational waves
- Laura Kahn, disruptive technology/ biosecurity
- Sivan Kartha, climate change
- Duyeon Kim, nuclear risk
- Robert Latiff, disruptive technology/the ethics of AI in warfare
- Filippa Lentzos, disruptive technology/ biosecurity
- Herbert Lin/disruptive technology/ cybersecurity
- Giorgia Lupi, disruptive technology/ science communication
- Suzet McKinney, disruptive technology/ biosecurity
- Sunshine Menezes, climate change/ science communication
- Zia Mian, nuclear risk
- Steven Miller, nuclear risk
- Raymond Pierrehumbert, climate change
- Lisa Randall, disruptive technology
- Harper Reed, disruptive technology/ cyber security
- Pedro Reyes, nuclear risk/science communications
- Mareena Robinson, nuclear risk
- Robert Rosner, nuclear risk
- Scott Sagan, nuclear risk
- Robert Socolow, climate change
- Susan Solomon, climate change
- Sharon Squassoni, nuclear risk
- Jon Wolfsthal, nuclear risk

With gratitude

Recognizing generous philanthropy

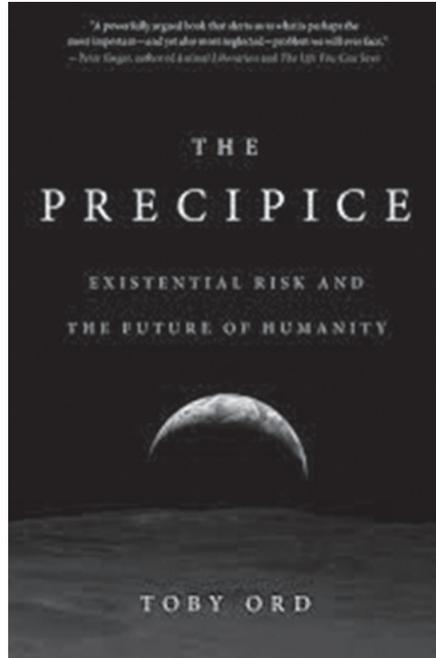


Toby Ord is a Senior Research Fellow in Philosophy at Oxford University (See photo above.) He has advised the World Health Organization, the World Economic Forum, and the UK Prime Minister's Office and Cabinet Office. His work has been featured hundreds of times in the national and international media.

Ord's work focuses on the big picture questions facing humanity. What are the most important issues of our time? How can we best address them? His earlier work explored the ethics of global poverty, leading him to make a lifelong pledge to donate 10% of his income to the most effective charities helping improve the world.

Ord's current research is on the long-term future of humanity, and the risks which threaten to destroy our entire potential. His new book, *The Precipice*, explores these topics and concludes that safeguarding our future is among the most pressing and neglected issues we face.

Ord generously donated a portion of the proceeds from the sale of his book, *The Precipice*, to the Bulletin. With his help, the Bulletin continues to elevate expert voices above the noise, providing a platform for fact-based, solution-oriented coverage of issues that pose the greatest threats to our existence.



I've long been an admirer of the Bulletin, both from its early years as a landmark change in the responsibility and role of scientists, and in its recent years with its shift towards a wider set of existential risks. When I wrote *The Precipice*, I decided to donate the entire advance and royalties to excellent organisations working on fighting existential risk, and the Bulletin is certainly one of them.
Toby Ord

The Legacy Society

The Bulletin is grateful for the confidence and generous support provided by our Legacy Society members. The Society was established to recognize and honor Bulletin friends who have thoughtfully provided for the Bulletin through their estate plans. Society members can make a significant impact that costs nothing in their lifetime-- including a charitable bequest under a will or by designating the Bulletin of the Atomic Scientists as a beneficiary of a life insurance policy, retirement plan, or other instrument.

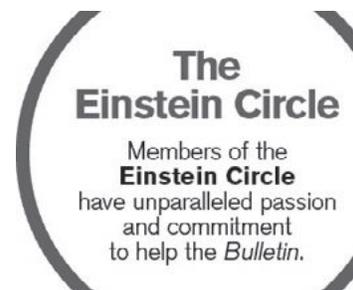
These meaningful gifts inspire confidence while ensuring that the Bulletin will be here for the next generation and beyond.



Einstein Circle

The Bulletin recognizes leadership gifts of \$1000 or more with membership in the Einstein Circle, which celebrates and honors those who offer their financial support at the highest level.

Einstein Circle members make a personal statement about their belief in the inherent value of evidence-based research and education to address the most pressing challenges facing our planet and its inhabitants.



Financial Overview

Management Discussion and Analysis

This Management Discussion and Analysis (MD&A) aims to help readers of our financial statements make reasonable inferences about the Bulletin's progress in accomplishing our mission in a financially responsible way. This narrative supplements the financial statements on pages 26 and 27.

As you will see, individual and foundation giving fueled the Bulletin's mission-critical work in 2020. Examples of our efforts are presented throughout the pages of this annual report. I am pleased to share that contributions to the Bulletin grew by 35% between 2019 and 2020, providing nearly one million dollars to support our mission critical work. The chart on the next page labeled "New Individual and Corporate Gifts 2016-2020" shows the growth in our support over time. The spike in 2017 includes a major gift from Mary Patricia Dougherty, the largest gift from an individual ever received by the Bulletin. Readers will note a \$431K increase in expenses 2019 over 2020. The Bulletin has continued to make significant investments in human capital, programmatic activities, and infrastructure, while still ending the year with a positive net income from operations.

The medium- and long-term impact of the current COVID-19 outbreak on the Bulletin's investments, donors, and operations remains uncertain. In light of the pandemic the Bulletin suspended certain programs and in-person events. However, many of these programs and events moved to a virtual environment. The Bulletin continues to stay in regular communication with our stakeholders and closely monitor our investment portfolio and its liquidity. Management is currently unable to quantify the effects that the pandemic will have on its operations and financial position; however, they may be significant.

In April 2020, the Bulletin entered into a Payroll Protection Program (PPP) loan agreement that totaled \$194K, bore interest at 1.0%, was set to mature in April 2022, was not collateralized, and was eligible for forgiveness subject to provisions of the Coronavirus Aid, Relief, and Economic Security Act ("CARES Act"). During the year ending December 31, 2020, the loan was forgiven in full by the Small Business Administration (SBA), and the Bulletin was legally released from repaying the loan. The full forgiveness of the loan has been included as grant revenue on the statement of activities during the year ended December 31, 2020.

The Bulletin was also fortunate to have the support of multiyear grants from several major foundations that were renewed in 2019. The requirements of Generally Accepted Accounting Principles (GAAP) make the annual presentation challenging. We—like our counterparts—are required by GAAP to recognize a full multi-year gift in the first year in which it is awarded even though the funds may not be received or used until later years of the grant's disbursement.

In 2019, for example, the Bulletin received two two-year foundation grants of \$550K and \$700K respectively. These were reported in accordance with GAAP as \$1.25M of revenue in 2019, although the Bulletin did not receive some of these funds until 2020 and does not intend to use a portion of these funds until 2021, spanning a 24-month period.

To manage the cyclical nature of GAAP's required revenue recognition, the Bulletin temporarily restricts revenue in the first year of a multi-year grant, in anticipation of planned expenses in the following years, as can be seen under "Net assets with donor restrictions" in our Statement of Financial Position, and in "Revenue released from restrictions" in our Statement of Activities. The chart of "Foundation Support 2016-2020" on the next page shows both the cyclical nature of our Foundation Support (Foundation grants, new, represented by the solid vertical bars), as well as how we manage it (Foundation grants after restriction adjustments, represented by the grey line). The chart's grey line shows a decline in our foundation grants after restriction adjustment in 2019, in anticipation of our higher than usual programmatic spending in 2020 and 2021 during the Bulletin's historic 75th anniversary year.

Our ability to secure multiyear support is a strong endorsement of our efforts, notwithstanding the required accounting treatment. In making multiyear commitments, our supporters are providing external validation of our strategy, governance, and impact.

Readers will notice a decline in our assets 2019 over 2020. As noted above, the Bulletin temporarily restricts assets to support multiple years of operations. As can be seen in the table "Change in Net Assets," in 2019 we temporarily restricted \$700K in donor and foundation giving to be used in future years. In 2020, we utilized \$550K of those assets to support operations. In addition to temporarily restricting contributions, the Bulletin continues to support future operations when results end positively. The Bulletin ended 2020 with a surplus that was added to our unrestricted net assets at the end of the year.

As approved by the Bulletin's Board of Directors on June 9, 2020, the Bulletin of the Atomic Scientists' fiscal year, that formerly ran from January 1 - December 31, has changed, effective January 2021. Moving forward, the Bulletin will transition to a July 1 - June 30 fiscal year that is in keeping with best practices that align programmatic activities with budget cycles. As part of this change, we will not publish financials in the 2021 Annual Report, as there will be only 6 months of results on which to report. Readers of this report can expect that the Bulletin will present financials for the short fiscal year January 1 - June 30, 2021 and the full fiscal year July 1, 2021 - June 30, 2022 in its 2022 Annual Report. We will be pleased, of course, to discuss the background for this move and provide financials to any individual, foundation, or corporation seeking them.

Our financial reporting is designed to provide donors and the public with a transparent overview of our finances. The Bulletin's financial statements were audited by Miller Cooper LLP. The complete audited financial statements for calendar year 2020 are available by request or on GuideStar. If you have any questions about this report or need additional financial information, please do not hesitate to contact the Bulletin at finance@thebulletin.org.

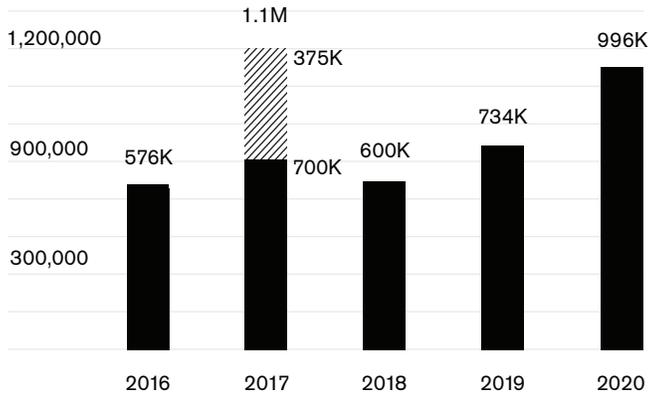
Thank you for your generous and sustained support.



Rachel Bronson, PhD
President and CEO

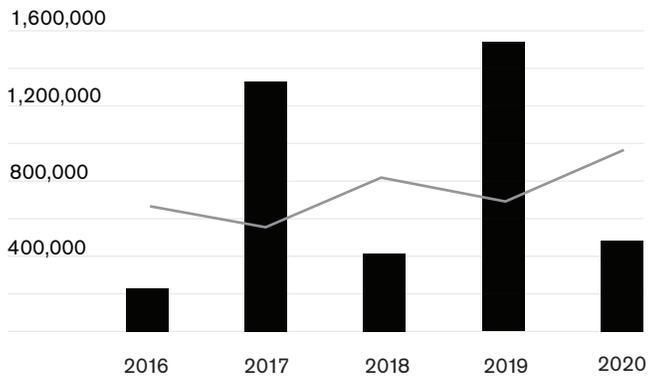
Charts

NEW DONOR AND CORPORATE SUPPORT 2016-2020

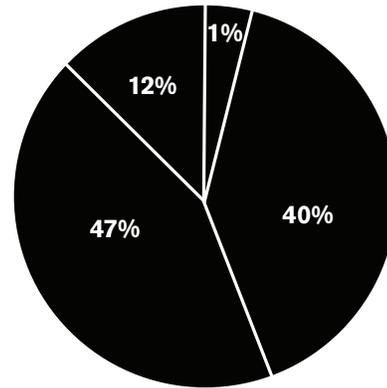


//// Single individual major gift of \$375K

FOUNDATION SUPPORT 2016-2020



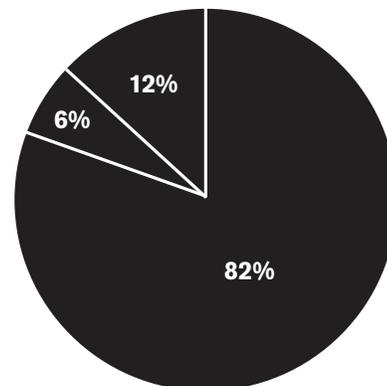
- Foundation Grants New
- Foundation Grants After Restriction Adjustments



Operating Revenue

Donor Support*	40%
Foundation Grants*	47%
Magazine	12%
Other Revenue	1%

* After restriction adjustments



Operating Expenses

Publication and Website Program	82%
Fundraising	12%
Management and General	6%

Statements

STATEMENT OF FINANCIAL POSITION

For the year ended December 31, 2020

	2020	2019
Assets		
Cash/certificates of deposit	1,331,682	1,153,870
Accounts receivable, net of allowance	109,188	82,240
Pledges receivable	127,079	698,837
Prepaid expenses	34,419	26,793
Total current assets	1,602,368	1,961,740
Pledges receivable, less current portion	30,000	-
Property and equipment	75,443	95,074
Total assets	1,707,811	2,056,814
Liabilities and net assets		
Accounts payable	25,500	57,104
Accrued expenses	30,390	15,366
Deferred subscription revenue	8,744	1,690
Retirement payable	-	35,458
Total liabilities	64,633	109,618
Net assets		
Without donor restrictions	1,064,491	818,484
With donor restrictions	578,687	1,128,712
Total net assets	1,643,178	1,947,196
Total liabilities and net assets	1,707,811	2,056,814

STATEMENT OF ACTIVITIES

For the year ended December 31, 2020

	2020	2019
Revenue and other support		
Magazine	279,086	213,535
Individual gifts and corporate support	936,484	732,184
Foundation grants	322,548	43,000
Other revenue	19,443	25,990
In-kind*	845,497	634,321
Total revenues and gains without donor restrictions	2,403,058	1,649,030
Revenue released from restrictions	771,692	734,225
Total revenues, gains and support without donor restrictions	3,174,750	2,383,255
Operating expenses by function		
Publication and website program	1,595,170	1,391,252
Fundraising	344,346	339,276
Management and general	143,730	132,913
In-kind*	845,497	634,321
Total operating expenses	2,928,743	2,497,762
Net income	246,008	(114,507)
Board designated transfer (transfer into reserves)/utilization of reserves	(239,639)	120,000
Net income from ordinary operations	6,369	5,493

CHANGE IN NET ASSETS

	2020	2019
Net assets, beginning of the year	1,947,196	1,359,328
Revenues with donor restrictions	(550,025)	702,375
Net income	246,008	(114,507)
Net assets, end of the year	1,643,179	1,947,196

* In-Kind is further categorized as follows: \$623K for writers contributions to our publications \$222K for professional services

In Memoriam

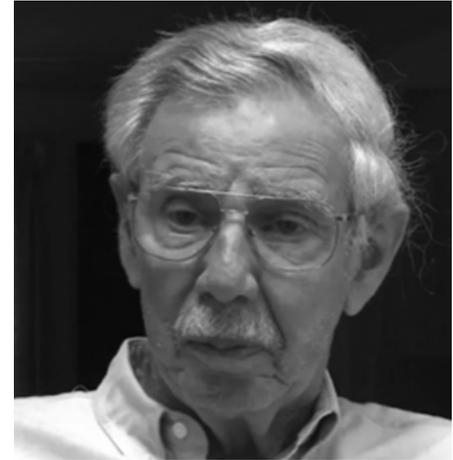
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Freeman Dyson, longtime Bulletin author and professor of physics at the Institute for Advanced Study in Princeton, was born in England and worked as a civilian scientist for the Royal Air Force in World War II. He graduated from Cambridge University in 1945 with a B.A. degree in mathematics. He went on to Cornell University as a graduate student in 1947. He worked on nuclear reactors, solid state physics, ferromagnetism, astrophysics and biology, looking for problems where elegant mathematics could be applied, and he wrote a number of books about science for the general public.



Reimar Lüst was a German astrophysicist who worked in European space science from its beginning, as the scientific director of the European Space Research Organisation (ESRO) from 1962 and as Director General of the European Space Agency (ESA) from 1984 until 1990. Lüst taught internationally and influenced German politics as chairman of the Wissenschaftsrat from 1969 to 1972. He was the president of the German Max Planck Society from 1972 to 1984.



Kosta Tsipis was a native of Greece who emigrated to the United States in 1954 to study electrical engineering and physics at Rutgers University. After earning a doctorate at Columbia University, in 1966 he joined the physics department at the Massachusetts Institute of Technology. A little more than 10 years later, he co-founded the Program in Science & Technology for International Security at MIT. Tsipis was committed to disarmament and was generous with his time, serving many international organizations including the Bulletin, where he was a highly respected author.

Friends of the Bulletin

R. Stephen Berry was a former Bulletin board member and a pioneering University of Chicago scientist who spent his life making fundamental contributions across the fields of chemistry and energy policy. Berry, the James Franck Distinguished Service Professor Emeritus of Chemistry and the James Franck Institute, was known as a “Renaissance scientist.” He made both experimental and theoretical discoveries across a wide range of areas within his discipline and beyond.

Bruce Blair spent his professional life working to expose the dangers from the nuclear Doomsday Machine created by the United States and Soviet Union during their Cold War, and advancing policies to reduce the risk of nuclear use. A leading expert on nuclear command and control, and an author for the Bulletin, he focused especially on the risks of accidental nuclear war implicit in the “hair-trigger” postures of US and Soviet ballistic missiles. During his final 15 years, he led a campaign for the phased and verifiable elimination of all nuclear weapons.

Mario Molina, a brilliant scientist, a tireless advocate for the environment, and an inspiring collaborator, was also a Bulletin author. He shared the 1995 Nobel Prize in Chemistry for discovering the threat that chlorofluorocarbons (CFCs) pose to the stratospheric ozone layer. He also should have received a Nobel Peace Prize for helping create the world’s best environmental treaty to address that threat, the Montreal Protocol on Substances that Deplete the Ozone Layer.

Thank you to our donors and partners

January 1-December 31, 2020

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