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Closer than Ever: It Is 100 Seconds to Midnight. The Dangers of Nuclear War

2020 Doomsday Clock Statement

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To: Leaders and citizens of the world

Humanity continues to face two simultaneous existential dangers—nuclear war and climate change—that are compounded by a threat multiplier, cyber-enabled information warfare, that undercuts society's ability to respond. The international security situation is dire, not just because these threats exist, but because world leaders have allowed the international political infrastructure for managing them to erode.

In the nuclear realm, national leaders have ended or undermined several major arms control treaties and negotiations during the last year, creating an environment conducive to a renewed nuclear arms race, to the proliferation of nuclear weapons, and to lowered barriers to nuclear war. Political conflicts regarding nuclear programs in Iran and North Korea remain unresolved and are, if anything, worsening. US-Russia cooperation on arms control and disarmament is all but nonexistent.

Public awareness of the climate crisis grew over the course of 2019, largely because of mass protests by young people around the world. Just the same, governmental action on climate change still falls far short of meeting the challenge at hand. At UN climate meetings last year, national delegates made fine speeches but put forward few concrete plans to further limit the carbon dioxide emissions that are disrupting Earth's climate. This limited political response came during a year when the effects of manmade climate change were manifested by one of the warmest years on record, extensive wildfires, and quicker-than-expected melting of glacial ice.

Continued corruption of the information ecosphere on which democracy and public decision making depend has heightened the nuclear and climate threats. In the last year, many governments used cyber-enabled disinformation campaigns to sow distrust in institutions and among nations, undermining domestic and international efforts to foster peace and protect the planet.

This situation—two major threats to human civilization, amplified by sophisticated, technology-propelled propaganda—would be serious enough if leaders around the world were focused on managing the danger and reducing the risk of catastrophe. Instead, over the last two years, we have seen influential leaders denigrate and discard the most effective methods for addressing complex threats—international agreements with strong verification regimes—in favor of their own narrow interests and domestic political gain. By undermining

cooperative, science- and law-based approaches to managing the most urgent threats to humanity, these leaders have helped to create a situation that will, if unaddressed, lead to catastrophe, sooner rather than later.

Faced with this daunting threat landscape and a new willingness of political leaders to reject the negotiations and institutions that can protect civilization over the long term, the Bulletin of the Atomic Scientists Science and Security Board today moves the Doomsday Clock 20 seconds closer to midnight—closer to apocalypse than ever. In so doing, board members are explicitly warning leaders and citizens around the world that the international security situation is now more dangerous than it has ever been, even at the height of the Cold War.

Civilization-ending nuclear war—whether started by design, blunder, or simple miscommunication—is a genuine possibility. Climate change that could devastate the planet is undeniably happening. And for a variety of reasons that include a corrupted and manipulated media environment, democratic governments and other institutions that should be working to address these threats have failed to rise to the challenge.

The Bulletin believes that human beings can manage the dangers posed by the technology that humans create. Indeed, in the 1990s leaders in the United States and the Soviet Union took bold actions that made nuclear war markedly less likely—and as a result the Bulletin moved the minute hand of the Doomsday Clock the farthest it has been from midnight.

But given the inaction—and in too many cases counterproductive actions—of international leaders, the members of the Science and Security Board are compelled to declare a state of emergency that requires the immediate, focused, and unrelenting attention of the entire world. It is 100 seconds to midnight. The Clock continues to tick. Immediate action is required.

A retreat from arms control creates a dangerous nuclear reality

The world is sleepwalking its way through a newly unstable nuclear landscape. The arms control boundaries that have helped prevent nuclear catastrophe for the last half century are being steadily dismantled.

In several areas, a bad situation continues to worsen. Throughout 2019, Iran increased its stockpile of low-enriched uranium, increased its uranium enrichment levels, and added new and improved centrifuges—all to express its frustration that the United States had withdrawn from the Iran nuclear deal (formally known as the Joint Comprehensive Plan of Action, or JCPOA), re-imposed economic sanctions on Iran, and pressured other parties to the Iran nuclear agreement to stop their compliance with the agreement. Early this year, amid high US-Iranian tensions, the US military conducted a drone air strike that killed a prominent Iranian general in Iraq. Iranian leaders vowed to exact “severe revenge” on US military forces, and the Iranian government announced it would no longer observe limits, imposed by the JCPOA, on the number of centrifuges that it uses to enrich uranium.

Although Iran has not formally exited the nuclear deal, its actions appear likely to reduce the “breakout time” it would need to build a nuclear weapon, to less than the 12 months envisioned by parties to the JCPOA. At that point, other parties to the nuclear agreement—including the European Union and possibly Russia and China—may be compelled to acknowledge that Iran is not complying. What little is left of the agreement could crumble, reducing constraints on the Iranian nuclear program and increasing the

likelihood of military conflict with the United States.

The demise of the Intermediate-Range Nuclear Forces (INF) Treaty became official in 2019, and, as predicted, the United States and Russia have begun a new competition to develop and deploy weapons the treaty had long banned. Meanwhile, the United States continues to suggest that it will not extend New START, the agreement that limits US and Russian deployed strategic nuclear weapons and delivery systems, and that it may withdraw from the Open Skies Treaty, which provides aerial overflights to build confidence and transparency around the world. Russia, meanwhile, continues to support an extension of New START.

The assault on arms control is exacerbated by the decay of great power relations. Despite declaring its intent to bring China into an arms control agreement, the United States has adopted a bullying and derisive tone toward its Chinese and Russian competitors. The three countries disagree on whether to pursue negotiations on outer space, missile defenses, and cyberwarfare. One of the few issues they do agree on: They all oppose the Treaty on the Prohibition of Nuclear Weapons, which opened for signature in 2017. As an alternative, the United States has promoted, within the context of the review conference process of the Nuclear Non-Proliferation Treaty (NPT), an initiative called "Creating the Environment for Nuclear Disarmament." The success of this initiative may depend on its reception at the 2020 NPT Review Conference—a landmark 50th anniversary of the treaty.

US efforts to reach agreement with North Korea made little progress in 2019, despite an early summit in Hanoi and subsequent working-level meetings. After a North Korean deadline for end-of-year progress passed, Kim Jong Un announced he would demonstrate a new "strategic weapon" and indicated that North Korea would forge ahead without sanctions relief. Until now, the willingness of both sides to continue a dialogue was positive, but Chairman Kim seems to have lost faith in President Trump's willingness to come to an agreement.

Without conscious efforts to reinvigorate arms control, the world is headed into an unregulated nuclear environment. Such an outcome could reproduce the intense arms race that was the hallmark of the early decades of the nuclear age. Both the United States and Russia have massive stockpiles of warheads and fissile material in reserve from which to draw, if they choose. Should China decide to build up to US and Russian arsenal levels—a development previously dismissed as unlikely but now being debated—deterrence calculations could become more complicated, making the situation more dangerous. An unconstrained North Korea, coupled with a more assertive China, could further destabilize Northeast Asian security.

As we wrote last year and re-emphasize now, any belief that the threat of nuclear war has been vanquished is a mirage.

An insufficient response to an increasingly threatened climate

In the past year, some countries have taken action to combat climate change, but others—including the United States, which formalized its withdrawal from the Paris Agreement, and Brazil, which dismantled policies that had protected the Amazon rainforest—have taken major steps backward. The highly anticipated UN Climate Action Summit in September fell far short of Secretary General António Guterres' request that

countries come not with “beautiful speeches, but with concrete plans.” The 60 or so countries that have committed (in more or less vague terms) to net zero emissions of carbon dioxide account for just 11 percent of global emissions. The UN climate conference in Madrid similarly disappointed. The countries involved in negotiations there barely reached an agreement, and the result was little more than a weak nudge, asking countries to consider further curbing their emissions. The agreement made no advances in providing further support to poorer countries to cut emissions and deal with increasingly damaging climate impacts.

Lip service continued, with some governments now echoing many scientists’ use of the term “climate emergency.” But the policies and actions that governments proposed were hardly commensurate to an emergency. Exploration and exploitation of fossil fuels continues to grow. A recent UN report finds that global governmental support and private sector investment have put fossil fuels on course to be over-produced at more than twice the level needed to meet the emissions-reduction goals set out in Paris.

Unsurprisingly, these continuing trends are reflected in our atmosphere and environment: Greenhouse gas emissions rose again over the past year, taking both annual emissions and atmospheric concentrations of greenhouse gases to record highs. The world is heading in the opposite direction from the clear demands of climate science and plain arithmetic: Net carbon dioxide emissions need to go down to zero if the world is to stop the continuing buildup of greenhouse gases. World emissions are going in the wrong direction.

The consequences of climate change in the lives of people around the world have been striking and tragic. India was ravaged in 2019 both by record-breaking heat waves and record-breaking floods, each taking a heavy toll on human lives. Wildfires from the Arctic to Australia, and many regions in between, have erupted with a frequency, intensity, extent, and duration that further degrade ecosystems and endanger people. It is not good news when wildfires spring up simultaneously in both the northern and southern hemispheres, making the notion of a limited “fire season” increasingly a thing of the past.

The dramatic effects of a changing climate, alongside the glacial progress of government responses, have unsurprisingly led to rising concern and anger among growing numbers of people. Climate change has catalyzed a wave of youth engagement, activism, and protest that seems akin to the mobilization triggered by nuclear disaster and nuclear weapons fears in the 1970s and 1980s. Politicians are taking notice, and, in some cases, starting to propose policies scaled to the urgency and magnitude of the climate problem. We hope that public support for strong climate policies will continue to spread, corporations will accelerate their investments in low-carbon technologies, the price of renewable energy will continue to decline, and politicians will take action. We also hope that these developments will happen rapidly enough to lead to the major transformation that is needed to check climate change.

But the actions of many world leaders continue to increase global risk, at a time when the opposite is urgently needed.

The increased threat of information warfare and other disruptive technologies

Nuclear war and climate change are major threats to the physical world. But information is an essential aspect of human interaction, and threats to the information ecosphere—especially when coupled with the emergence of new destabilizing technologies

in artificial intelligence, space, hypersonics, and biology—portend a dangerous and multifaceted global instability.

In recent years, national leaders have increasingly dismissed information with which they do not agree as fake news, promulgating their own untruths, exaggerations, and misrepresentations in response. Unfortunately, this trend accelerated in 2019. Leaders claimed their lies to be truth, calling into question the integrity of, and creating public distrust in, national institutions that have historically provided societal stability and cohesion.

In the United States, there is active political antagonism toward science and a growing sense of government-sanctioned disdain for expert opinion, creating fear and doubt regarding well-established science about climate change and other urgent challenges. Countries have long attempted to employ propaganda in service of their political agendas. Now, however, the internet provides widespread, inexpensive access to worldwide audiences, facilitating the broadcast of false and manipulative messages to large populations and enabling millions of individuals to indulge in their prejudices, biases, and ideological differences.

The recent emergence of so-called "deepfakes"—audio and video recordings that are essentially undetectable as false—threatens to further undermine the ability of citizens and decision makers to separate truth from fiction. The resulting falsehoods hold the potential to create economic, social, and military chaos, increasing the possibility of misunderstandings or provocations that could lead to war, and fomenting public confusion that leads to inaction on serious issues facing the planet. Agreement on facts is essential to democracy and effective collective action.

Other new technologies, including developments in biological engineering, high-speed (hypersonic) weapons, and space weapons, present further opportunities for disruption.

Genetic engineering and synthetic biology technologies are now increasingly affordable, readily available, and spreading rapidly. Globally, governments and companies are collecting vast amounts of health-related data, including genomic data, ostensibly for the purpose of improving healthcare and increasing profits. But the same data could also be useful in developing highly effective biological weapons, and disagreements regarding verification of the Biological and Toxin Weapons Convention continue to place the world at risk.

Artificial intelligence is progressing at a frenzied pace. In addition to the concern about marginally controlled AI development and its incorporation into weaponry that would make kill decisions without human supervision, AI is now being used in military command and control systems. Research and experience have demonstrated the vulnerability of these systems to hacking and manipulation. Given AI's known shortcomings, it is crucial that the nuclear command and control system remain firmly in the hands of human decision makers.

There is increasing investment in and deployment of hypersonic weapons that will severely limit response times available to targeted nations and create a dangerous degree of ambiguity and uncertainty, at least in part because of their likely ability to carry either nuclear or conventional warheads. This uncertainty could lead to rapid escalation of military conflicts. At a minimum, these weapons are highly destabilizing and presage a new arms race.

Meanwhile, space has become a new arena for weapons development, with multiple countries testing and deploying kinetic, laser, and radiofrequency anti-satellite capabilities, and the United States creating a new military service, the Space Force.

The overall global trend is toward complex, high-tech, highly automated, high-speed warfare. The computerized and increasingly AI-assisted nature of militaries, the sophistication of their weapons, and the new, more aggressive military doctrines asserted by the most heavily armed countries could result in global catastrophe.

How the world should respond

To say the world is nearer to doomsday today than during the Cold War—when the United States and Soviet Union had tens of thousands more nuclear weapons than they now possess—is to make a profound assertion that demands serious explanation. After much deliberation, the members of the Science and Security Board have concluded that the complex technological threats the world faces are at least as dangerous today as they were last year and the year before, when we set the Clock at two minutes to midnight (as close as it had ever been, and the same setting that was announced in 1953, after the United States and the Soviet Union tested their first thermonuclear weapons).

But this year, we move the Clock 20 seconds closer to midnight not just because trends in our major areas of concern—nuclear weapons and climate change—have failed to improve significantly over the last two years. We move the Clock toward midnight because the means by which political leaders had previously managed these potentially civilization-ending dangers are themselves being dismantled or undermined, without a realistic effort to replace them with new or better management regimes. In effect, the international political infrastructure for controlling existential risk is degrading, leaving the world in a situation of high and rising threat. Global leaders are not responding appropriately to reduce this threat level and counteract the hollowing-out of international political institutions, negotiations, and agreements that aim to contain it. The result is a heightened and growing risk of disaster.

To be sure, some of these negative trends have been long in development. That they could be seen coming miles in the distance but still were allowed to occur is not just disheartening but also a sign of fundamental dysfunction in the world's efforts to manage and reduce existential risk.

Last year, we called the extremely troubling state of world security an untenable "new abnormal."

"In this extraordinarily dangerous state of affairs, nuclear war and climate change pose severe threats to humanity, yet go largely unaddressed," we wrote. "Meanwhile, the use of cyber-enabled information warfare by countries, leaders, and subnational groups of many stripes around the world exacerbates these enormous threats and endangers the information ecosystem that underpins democracy and civilization as we know it. At the same time, other disruptive technologies complicate and further darken the world security situation."

This dangerous situation remains—and continues to deteriorate. Compounding the nuclear, climate, and information warfare threats, the world's institutional and political capacity for dealing with these threats and reducing the possibility of civilization-scale catastrophe has

been diminished. Because of the worldwide governmental trend toward dysfunction in dealing with global threats, we feel compelled to move the Doomsday Clock forward. The need for emergency action is urgent.

There are many practical, concrete steps that leaders could take—and citizens should demand—to improve the current, absolutely unacceptable state of world security affairs. Among them:

- US and Russian leaders can return to the negotiating table to: reinstate the INF Treaty or take other action to restrain an unnecessary arms race in medium-range missiles; extend the limits of New START beyond 2021; seek further reductions in nuclear arms; discuss a lowering of the alert status of the nuclear arsenals of both countries; limit nuclear modernization programs that threaten to create a new nuclear arms race; and start talks on cyber warfare, missile defenses, the militarization of space, hypersonic technology, and the elimination of battlefield nuclear weapons.
- The countries of the world should publicly rededicate themselves to the temperature goal of the Paris climate agreement, which is restricting warming "well below" 2 degrees Celsius higher than the preindustrial level. That goal is consistent with consensus views on climate science, and, notwithstanding the inadequate climate action to date, it may well remain within reach if major changes in the worldwide energy system and land use are undertaken promptly. If that goal is to be attained, industrialized countries will need to curb emissions rapidly, going beyond their initial, inadequate pledges and supporting developing countries so they can leapfrog the entrenched, fossil fuel-intensive patterns previously pursued by industrialized countries.
- US citizens should demand climate action from their government. Climate change is a serious and worsening threat to humanity. Citizens should insist that their government acknowledge it and act accordingly. President Trump's decision to withdraw the United States from the Paris climate change agreement was a dire mistake. Whoever wins the 2020 US presidential election should reverse that decision.
- The United States and other signatories of the Iran nuclear deal can work together to restrain nuclear proliferation in the Middle East. Iran is poised to violate key thresholds of the deal. Whoever wins the United States' 2020 presidential election must prioritize dealing with this problem, whether through a return to the original nuclear agreement or via negotiation of a new and broader accord.
- The international community should begin multilateral discussions aimed at establishing norms of behavior, both domestic and international, that discourage and penalize the misuse of science. Science provides the world's searchlight in times of fog and confusion. Furthermore, focused attention is needed to prevent information technology from undermining public trust in political institutions, in the media, and in the existence of objective reality itself. Cyber-enabled information warfare is a threat to the common good. Deception campaigns—and leaders intent on blurring the line between fact and politically motivated fantasy—are a profound threat to effective democracies, reducing their ability to address nuclear weapons, climate change, and other existential dangers.

The global security situation is unsustainable and extremely dangerous, but that situation

can be improved, if leaders seek change and citizens demand it. There is no reason the Doomsday Clock cannot move away from midnight. It has done so in the past when wise leaders acted, under pressure from informed and engaged citizens around the world. We believe that mass civic engagement will be necessary to compel the change the world needs.

Citizens around the world have the power to unmask social media disinformation and improve the long-term prospects of their children and grandchildren. They can insist on facts, and discount nonsense. They can demand—through public protest, at the ballot box, and in many other creative ways—that their leaders take immediate steps to reduce the existential threats of nuclear war and climate change. It is now 100 seconds to midnight, the most dangerous situation that humanity has ever faced. Now is the time to unite—and act.

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