

**It is
five
minutes
to
midnight
2011**



How close are we to catastrophic destruction? The Bulletin monitors “minutes to midnight” on the Doomsday Clock, and publishes information and analysis about trends and technologies that threaten the survival of humanity. First and foremost, these include nuclear weapons, but they also encompass climate-changing technologies and new developments in the life sciences that could inflict irrevocable harm.

1

Nuclear Weapons

The nuclear age dawned in the 1940s when scientists learned how to release the energy stored within the atom. Immediately, they thought of two potential uses—an unparalleled weapon and a new energy source. The United States built the first atomic bombs during World War II, which they used on Hiroshima and Nagasaki, Japan in August 1945. Within two decades, Britain, the Soviet Union, China, and France had also established nuclear weapon programs. Since then, Israel, India, Pakistan, and North Korea have built nuclear weapons as well.

For most of the Cold War, overt hostility between the United States and Soviet Union, coupled with their enormous nuclear arsenals, defined the nuclear threat. The U.S. arsenal peaked at about 30,000 warheads in the mid-1960s and the Soviet arsenal at 40,000 warheads in the 1980s, dwarfing all other nuclear weapon states.

Unfortunately, however, in a globalized world with porous national borders, rapid communications, and expanded commerce in dual-use technologies, nuclear know-how and materials travel more widely and easily than before—raising the possibility that terrorists could obtain such materials and construct a nuclear device of their own. The materials necessary to construct a bomb pervade the world.

As a result, according to the International Panel on Fissile Materials, substantial quantities of highly enriched uranium, one of the materials necessary for a bomb, remain in more than 40 non-weapon states. Save for Antarctica, every continent contains at least one country with civilian highly enriched uranium. Even with the improvement of nuclear reactor design and international controls provided by the International Atomic Energy Agency (IAEA), proliferation concerns persist, as the components and infrastructure for a civilian nuclear power program can also be used to construct nuclear weapons.

2011 Updates

US tactical nuclear weapons in Europe, 2011
January/February 2011
Hans M. Kristensen and Robert S. Norris write about US tactical nuclear weapons in Europe, and how NATO's new Strategic Concept, adopted in November 2010, places less importance on these weapons.

A new way to detect secret nuclear tests: GPS
August 18, 2011
Jihye Park, Dorota A. Grejner-Brzezinska, and Ralph von Frese look at how GPS could complement other nuclear test detection methods and give the US more reason to ratify the Comprehensive Test Ban Treaty.

Fatwas for fission: Assessing the terrorist threat to Pakistan's nuclear assets
November/December 2011
Charles Blair maintains that the real threat assessment is yet to be made—one that goes beyond merely considering assumed terrorist capability and putative vulnerabilities.

2

Climate & Energy

Fossil-fuel technologies such as coal-burning plants powered the industrial revolution, bringing unparalleled economic prosperity to many parts of the world. But in the 1950s, scientists began measuring year-to-year changes in the carbon-dioxide concentration in the atmosphere that they could relate to fossil-fuel combustion, and they began to see the implications for Earth's temperature and for climate change.

Today, the concentration of carbon dioxide is higher than at any time during the last 650,000 years. These gases warm Earth's continents and oceans by acting like a giant blanket that keeps the sun's heat from leaving the atmosphere, melting ice and triggering a number of ecological changes that cause an increase in global temperature. Even if carbon-dioxide emissions were to cease immediately, the extra gases already added to the atmosphere, which linger for centuries, would continue to raise sea levels and change other characteristics of the Earth for hundreds of years.

The most authoritative scientific group on the issue, the Intergovernmental Panel on Climate Change (IPCC), suggests that warming on the order of 2–10 degrees Fahrenheit over the next 100 years is a distinct possibility.

Inland, the IPCC predicts that another century of temperature increases could place severe stress on forests, alpine regions, and other ecosystems, threaten human health as mosquitoes and other disease-carrying insects and rodents spread lethal viruses and bacteria over larger geographical regions, and harm agriculture by reducing rainfall in many food-producing areas while at the same time increasing flooding in others—any of which could contribute to mass migrations and wars over arable land, water, and other natural resources.

Chernobyl 25 years later: Many lessons learned
March/April 2011
Mikhail Gorbachev discusses how to prevent, manage, and recover from such an event, and offers specific lessons for the further development of nuclear power.

Deconstructing the zero-risk mindset: The lessons and future responsibilities for a post-Fukushima nuclear Japan
September/October 2011
Tatsujiro Suzuki reviews the many technical, social, legal, and economic hurdles remaining months after the accidents.

The “scientization” of Yucca Mountain
October 12, 2011
Dawn Stover suggests that the Yucca Mountain repository for radioactive waste appears to be stone-cold dead—not because scientists determined that the mountain could not safely contain high-level nuclear waste for 10,000 years or more, but rather because politics trumped science.

3

Biosecurity

With greater understanding of genetic material and of how physiological systems interact, biologists can fight disease better and improve overall human health. Scientists already have begun to develop bioengineered vaccines for common diseases such as dengue fever and certain forms of hepatitis. They are using these tools to develop other innovative medical solutions, including cells that have been bioengineered to serve as physiological “pacemakers.” The mapping of the complete human genome in 2001 allows for even greater understanding of human functioning. As a consequence of the Human Genome Project, scientists have already identified more than 1,800 genes associated with particular diseases.

But along with their potential benefits, these technological advances raise the possibility that individuals or non-state actors could create dangerous known or novel pathogens. Additionally, researchers with the best intentions could inadvertently create new pathogens that could harm humans or other species. For example, in 2001, researchers in Australia reported that they had accidentally created a new, virulent strain of the mousepox virus while attempting to genetically engineer a more effective rodent control method.

Unlike the biological weapons of the last century, these new tools could create a limitless variety of threats, from new types of “nonlethal” agents, to viruses that sterilize their hosts, to others that incapacitate whole systems within an organism. The wide availability of bioengineering knowledge and tools, along with the ease with which individuals can obtain specific fragments of genetic material (some can be ordered through the mail or over the internet), could allow these capabilities to find their way into unspecified hands or even those of backyard hobbyists. Such potential dangers are forcing scientists, institutions, and industry to develop self-governing mechanisms.

Special issue on the Biological Weapons Convention Review Conference
May/June 2011
Including articles by Nicholas Sims, Filippa Lentzos, Brian Rappert, Caitriona McLeish, Katherine Bowman, Kathryn Hughes, and Jo L. Husbands

Biosecurity 2.0: Enduring threats in the former Soviet Union
July/August 2011
Marina Voronova-Abrams, on why the international community should not ignore the remaining challenges in the former Soviet Union—such as training a new generation of specialists, strengthening personnel policies to prevent “insider” threats, and improving transparency and multilateral communication.

Amerithrax review: Lessons for future investigations
November 1, 2011
Sonia Ben Ouaghran-Gormley discusses the National Academy of Sciences findings of significant problems in scientific methodology and organization in the FBI's probe of the 2001 anthrax attacks.

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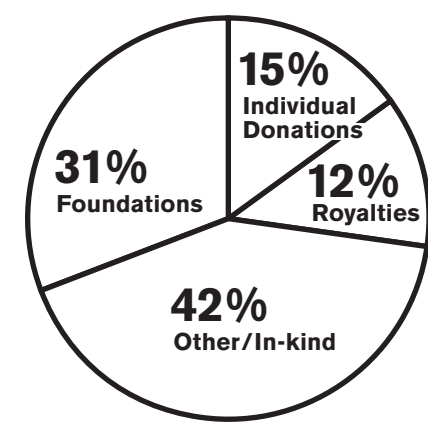
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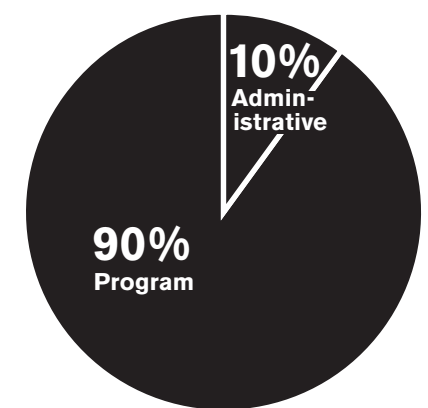
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The Bulletin & Social Media

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“Without such a calm analysis coupled with warnings we could all be drifting down the slippery slope to disaster without realizing it. All we can hope for is that politicians and public continue to wake up to the message before it’s too late.”

John Bynner, Emeritus Professor at the Faculty of Policy and Society Institute of Education, University of London, May 2011

“At a minimum, I regard it as my personal responsibility to know where our exposure remains the greatest to nuclear weapons accidents and potential attacks. The *Bulletin* provides uniquely insightful coverage of the circumstances that affect these risks, in addition to the existential risks of climate change and bioterrorism. I support the *Bulletin* so that its capability to keep the public and policy makers informed will grow in the era of shrinking degrees of separation across the globe.”

John Balkcom, Governing Board member, former president of St. John’s College

“Most of us in the community of counterterrorism experts consider the *Bulletin* as the preeminent publication on these issues. For example, law enforcement officers who work every day to counter nuclear trafficking in Eastern and Central Europe and the Black Sea need access to current, authoritative analysis of the conditions they face. Keep it up.”

Joshua Sinai, VT Research Center, Arlington, Virginia, Virginia Polytechnic Institute and State University, July 2011

“With over 100 deployed nuclear warheads now at its disposal, Pakistan has in the past few years more than doubled its nuclear arsenal, which now exceeds that of neighboring India, says a report carried by the latest issue of the *Bulletin of Atomic Scientists*. Pakistan is the only country blocking US efforts to prepare an international agreement banning the production of fissionable materials.”

Moscow Times, February 1, 2011

“Without the *Bulletin of Atomic Scientists* I never would find access to these indeed complicated issues. I’m reading your newsletter regularly.”

Andrea Rehmsmeier, German Radio Deutschlandfunk, dradio.de, November 26, 2011

From the archives

“The *Bulletin* brings substance and clarity to public debates. We need it.”
Stephen Hawking, theoretical physicist and member of the *Bulletin’s* Board of Sponsors

“Few things are more important in these days in which we live, than the search for those truths to which the *Bulletin of the Atomic Scientists* is dedicated.”

Albert Einstein, founding co-chair of the Board of Sponsors

“This is according to the *Bulletin of Atomic Scientists*. We estimate they [Russians] have a large inventory of operational nonstrategic warheads—5,390 is the number of tactical warheads, air defense tactical, et cetera. So they do still have more, and it still is a very legitimate concern to us.”

Senator John Kerry (D-MA) during hearings on the New START Treaty, December 2010

And just two samples from early 2012

“Last month, the Doomsday Clock’s hands were moved a minute closer to midnight by the *Bulletin of the Atomic Scientists*, the respected global organization that for decades has tracked the risk of a nuclear-weapons catastrophe, whether caused by accident or design, state or terrorist, fission bomb or dirty radiological bomb. Few around the world seemed to be listening.... But the Scientists’ argument was sobering, and demands attention.”

The Daily News Egypt (online journal, printing an Australian editorial), February 29, 2012

“The board of the *Bulletin of Atomic Scientists* recently announced in its magazine it had moved its notorious Doomsday Clock one minute closer to, well, doomsday.... But the biggest surprise of this year’s announcement that we are a tick-tock closer toward obliteration is the *Bulletin’s* unprecedented appeal for grass-roots backers.... Even those scientists watching for the end think it’s up to us, and not the government, to stop the clock before it hits midnight. Their desperate hope is that ‘the people’ are listening.”

The Miami Herald, January 22, 2012

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The *Bulletin of the Atomic Scientists* is an essential source of independent news and analysis about issues of ultimate urgency. For 67 years we have amplified the voices of scientists, bridging the gap between experts and the public with accurate information and in-depth analysis.

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- builds an online community of *Bulletin* readers and supporters
- complements the subscription-access digital journal published through SAGE
- showcases the Doomsday Clock and draws attention to current challenges to humanity
- provides access to the *Bulletin’s* archival and expert assets

Focused coverage of nuclear security, energy policy, biotechnology safety, and Nuclear Notebook

Expansion of editorial capacity to deepen coverage, widen author network, and manage independent editorial contributors and interactions with experts, and sustain and expand the *Bulletin’s* signature Nuclear Notebook, which is available without charge on the SAGE platform

2012 Doomsday Clock Symposium
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Multi-media tutorials about *Bulletin* topics (Doomsday Clock, Nuclear Weapons, Nuclear Energy, Climate Change, and Biosecurity), residing permanently in Clock section of the website for background, presentations, and links to *Bulletin* and external resources.

It is 5 minutes to midnight.

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