



Editors' Note

Even before the invention of nuclear weapons, there was concern they would be enormously and indiscriminately destructive to civilian populations. In their pathbreaking secret memorandum to the British government in early 1940, “On the Construction of a Super-bomb, based on a Nuclear Chain Reaction in Uranium” which helped lay the basis for the nuclear weapons program in the UK and later the United States Manhattan Project, Otto Frisch and Rudolf Peierls noted that “some part of the energy set free by the bomb goes to produce radioactive substances, and these will emit very powerful and dangerous radiations.... Some of this radioactivity will be carried along with the wind and will spread the contamination; several miles downwind this may kill people.... Owing to the spreading of radioactive substances with the wind, the bomb could probably not be used without killing large numbers of civilians, and this may make it unsuitable as a weapon for use by this country.” During the Cold War, it was well understood that any nuclear attack aimed at destroying an adversary’s nuclear or conventional forces could result in very large numbers of civilian casualties in the targeted country, perhaps regionally, and possibly even globally for a large enough attack with high-yield weapons. This remains true today.

In the opening article of the issue, “Radioactive Fallout and Potential Fatalities from Nuclear Attacks on China’s New Missile Silo Fields,” Sébastien Philippe and Ivan Stepanov present an analysis of the consequences of a nuclear attack on three relatively remote areas where China is believed to be constructing hundreds of silos for deploying intercontinental ballistic missiles. The authors model a possible attack on these silos, assuming that to achieve an acceptable kill probability the attacker uses two warheads against a silo and detonates them very close to the ground (which is consistent with public information about U.S. nuclear war plans).

The analysis models the significant radioactive fallout from these near-surface nuclear explosions, using advanced atmospheric particle transport software and weather data to evaluate the dispersion of the fallout and population exposure in cities at long distances. Estimates of casualties depend on the specifics of the scenario, but as the authors demonstrate, an attack on the alleged silo fields in China is likely to result in tens of millions of unintended but to be expected civilian deaths from acute radiation sickness. The authors note “Many more would suffer from long-term effects of radiation exposure and die prematurely.” They suggest that such dire humanitarian outcomes should compel policymakers to revisit decisions about siting and attacking missile silo fields.

The second article in the issue, “Simulating the Passive Neutron and Gamma Signatures of Containerized Nuclear Warheads for Disarmament Verification,” deals with a completely different side of nuclear weapons. Svenja Sonder, Carina Prunte, Yannick Fischer, Manuel Kreutle, Jan Scheunemann, and Gerald Kirchner discuss methods for detecting the presence of a plutonium-based weapon in a closed container. The analysis uses numerical simulations with the Geant 4 code to consider the cases of a simplified fission weapon and of a two-stage thermonuclear warhead, as well as a small amount of plutonium in a scrap container with different assumptions about

shielding materials and containers. The authors find that gamma-spectrometry of such containerized warheads and scrap could confirm the presence of fission processes and the presence of explosives. This work contributes to a better understanding of the challenges of developing effective tools that can support the verified dismantlement of nuclear warheads and prevent the diversion of nuclear materials.

This issue also includes a response by Cameron L. Tracy and David Wright to the article “Computational Fluid Dynamics Analysis of the Infrared Emission from a Generic Hypersonic Glide Vehicle” by Graham V. Candler and Ivett A. Leyva, published in this journal. Candler and Lavya in their work had addressed some of the findings of the earlier article by Tracy and Wright, “Modelling the Performance of Hypersonic Boost-Glide Missiles.” In their response, Tracy and Wright note that their initial conclusion, based on a simple analytical model, that the heat signature of a hypersonic glider will be visible to early-warning satellites remains valid, despite other differences from the analysis by Candler and Levya. Tracy and Wright highlight the need for resolving discrepancies in computational fluid dynamics models of hypersonic glider flight published so far in the literature and the value of more open-source analysis of hypersonic missile system performance to improve decision-making about these weapons.

The issue is concluded with a review by Leon V. Sigal and Frank N. von Hippel of the book *Hinge Points: An inside Look at North Korea’s Nuclear Program* by Siegfried S. Hecker and Elliot A. Serbin (Stanford University Press, 2023). The book chronicles the efforts of successive U.S. administrations to contain North Korea’s nuclear and missile programs. Siegfried Hecker was an active participant in this process, visiting North Korea several times and providing the U.S. government and the public with detailed technical information about North Korea’s program. This makes his account particularly valuable and insightful. Sigal and von Hippel highlight Hecker’s observation that “Washington’s North Korea policies seldom incorporated sound technical analysis, either because such analysis was not sought out by policy makers or because it was contrary to Washington’s policy assumptions and political priorities.” In the end, perhaps not surprisingly, U.S. efforts to curb North Korea’s nuclear program were unsuccessful; instead, North Korea has built a substantial nuclear arsenal and a range of missiles. In Hecker’s words “The conventional wisdom that I encountered again and again was that good faith American efforts to halt the North’s nuclear program were circumvented by the North’s repeated violations of diplomatic agreements. Over the years, I found this perspective to be neither true nor helpful. It lets Washington off the hook too easily for its own failures and does not tell us why we are in the current predicament.”