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Foreword

Soviet Nuclear Technoscience

Topography of the field and new avenues of research

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FOREWORD

SOVIET NUCLEAR TECHNOSCIENCE

Topography of the field and new avenues of research

In 1904, Frederick Soddy, who would later receive the Nobel Prize for his seminal studies in radiochemistry, speculated that the "new alchemists" who had unlocked the awe-inspiring power of the atom would "turn wastelands green, melt the polar ice caps, and transform the planet into a friendly Garden of Eden." But he also predicted that the state to possess the first viable atomic weapon would achieve world domination.[1] The significance of nuclear technology, at once promising and terrible, shaped the following decades as the Atomic Age dawned. In 1972, the Soviet nuclear physicist and Nobel laureate Petr Kapitsa observed that modern science now had the ability "not only to annihilate but also to stimulate life at a global scale."[2]

The Cold War and nuclear power

The Atomic Age is a popular concept in the periodization of the 20th century.[3] The advent of the Atomic Age is commonly dated to 1938, when Otto Hahn and Lise Meitner succeeded in splitting the uranium atom, or to 1945, when the first atomic bomb was detonated and nuclear physics' age of innocence came to a sudden end.[4] The philosopher Günter Anders, who wrote about the immorality of atomic

1. Quoted in Spencer P. Weart, *The Rise of Nuclear Fear* (Cambridge, MA: Harvard University Press, 2012), 4, 12.

2. Petr L. Kapitsa, *Experiment, Theory, Practice: Articles and Addresses* (Dordrecht: Reidel, 1980), 368.

3. See, for instance, Michael Salewski, ed., *Das nukleare Jahrhundert: Eine Zwischenbilanz* (Stuttgart: Franz Steiner, 1998); Karena Kalmbach, "Revisiting the Nuclear Age. State of the Art Research in Nuclear History," *Neue Politische Literatur,* 62, 1 (2017): 49–70.

4. Roger H. Stuewer, *The Age of Innocence: Nuclear Physics Between the First and Second World Wars* (Oxford: University Press, 2018).

Cahiers du Monde russe, 60/2-3, Avril-septembre 2019, p. 257-280.

weapons, believed that a time was coming "in which at any given moment we have the power to transform any given place on our planet, and even our planet itself, into a Hiroshima."[5] The speculative anticipation of an atomic inferno created an atmosphere in which neither disarmament nor demobilization was possible and the "self-sustained conflict"[6] of the Cold War became a "radical age."[7]

This state of "organized peacelessness"[8] increasingly came to shape research and development. The goal of the nuclear powers was not only to build weapons and disseminate knowledge. By waging a "brain warfare," in which laboratories, lecture halls, and planning institutes were the "first line of defense,"[9] they wanted to anchor Cold War thought and action in technology and science.[10] Andrei Sakharov, the father of the Soviet hydrogen bomb and a later recipient of the Nobel Peace Prize, wrote that many researchers and engineers understood themselves as "soldiers in a war of science and technology." In this war, there "might not have been millions of dead on battlefields" but in its secret engineering offices and production facilities "the tension and in some cases the heroism was no less than during the years of the previous war."[11] As the Soviet rocket scientist Boris Chertok put it, the Cold War took place here "at the speed of a hot war."[12] Experts on both sides of the Iron Curtain justified the development of ever more efficient weapons of mass destruction by clinging to the belief that because of their work, war would carry such a

5. Günther Anders, "Commandments in the Atomic Age," [1957] in Idem, *Burning Conscience* (New York: Monthly Review Press, 1961), 11-20. See also Christian Dries, "'Nukleare Zeitbomben mit unfestgelegtem Explosionstermin': Günther Anders und der Kalte (Atom-)Krieg," in Patrick Bernhard and Holger Nehring, eds., *Den Kalten Krieg denken: Beiträge zur sozialen Ideengeschichte seit 1945* (Essen: Klartext, 2014), 63–87; Elisabeth Roehrlich, "To Make the End Time Endless: Günther Anders' Fight against Nuclear Weapons," in Günter Bischof, Jason Dawsey and Bernhard Fetz, eds., *The Life and Work of Günther Anders: Émigré, Iconoclast, Philosopher, Man of Letters* (Innsbruck: Studien Verlag, 2014), 45–58.

6. Jost Dülffer, "Self-sustained Conflict – Systemerhaltung und Friedensmöglichkeiten im Ost-West-Konflikt," in Corinna Hauswedell, ed., *Deeskalation von Gewaltkonflikten seit 1945* (Essen: Klartext, 2006), 33–60.

7. Bernd Stöver, *Der Kalte Krieg, 1947–1991: Geschichte eines radikalen Zeitalters* (München: C.H. Beck, 2007; reprint 2017).

8. Dieter Senghaas, *Abschreckung und Frieden: Studien zur Kritik organisierter Friedlosigkeit* (Frankfurt am Main: Europa Verlagsanstalt, 1959).

9. Aaron Dennis: "Our First Line of Defense: Two University Laboratories in the Postwar American State," *Isis,* 84 (1994): 427–455; Bernd Greiner, "Macht und Geist im Kalten Krieg: Bilanz und Ausblick," in Tim B. Müller and Claudia Weber, eds., *Macht und Geist im Kalten Krieg* (Hamburg: Hamburger Edition, 2011), 1–30.

10. Matthew W. Dunne, *A Cold War State of Mind: Brainwashing and Postwar American Society* (Amherst: University of Massachusetts Press, 2013); Melissa Feinberg, *Curtain of Lies: The Battle over Truth in Stalinist Eastern Europe* (Oxford: University Press, 2017).

11. Andrej Sacharow, *Mein Leben* (München: Piper, 1991), 122–123. On Sakharov's biography, see Gennady Gorelik, *Andrej Sacharow: Ein Leben für Wissenschaft und Freiheit* (Basel: Birkhäuser, 2013).

12. Boris E. Tschertok, *Raketen und Menschen,* Vol. 1 (Klitzschen: Elbe-Dnjepr-Verlag, 1998), 15 and 344–345.

high price that waging one would become unthinkable.[13] They understood the Cold War first and foremost as a grand game of chess in which players used cunning and mental effort to keep up with the other side.[14]

Nevertheless, science and technology were more than the mere proxy battlefields and intellectual arsenals of two competing systems locked in a seemingly irresolvable conflict. They also represented an "endless frontier"[15] that developed into an important international arena for negotiating ideas about progress, peace, and the future. Once Hiroshima and Nagasaki opened Pandora's box, scientists became diplomats, "communicators in the Cold War" who supported trust-building measures and disarmament initiatives.[16] Moreover, they endeavored to turn the apocalyptic fears that accompanied the overkill capacities of nuclear technologies into utopian hopes and preserve the idea of scientific progress as the savior of the modern era. In this way, they sought to convey the impression of leading humanity away from the abyss and toward paradise.[17]

In 1946, the British journalist Harry Harper (1880–1960) euphorically announced the dawn of the "greatest age of all." He believed that thanks to rocket propulsion technology people would soon explore the vast expanse of space, while nuclear technology would allow them to re-engineer nature and show humanity

13. Hugh Gusterson, *Nuclear Rites: A Weapons Laboratory at the End of the Cold War* (Berkeley: University of California Press, 1996), 53–59. For a detailed account, see Sarah Bridger, *Scientists at War: The Ethics of Cold War Weapons Research* (Cambridge, MA: Harvard University Press, 2015).

14. Robert Bud and Philip Gummett, "Introduction: Don't You Know, There's a War on?," in Idem, eds., *Cold War, Hot Science: Applied Research in Britain's Defence Laboratories* (Amsterdam: Harwood Academic, 1999), 3.

15. Vannevar Bush, *Science: The Endless Frontier* (Washington, D.C.: U.S. Government Printing Office, 1945). For a biography of Bush, an influential American science administrator, see G. Pascal Zachary, *Endless Frontier: Vannevar Bush, Engineer of the American Century* (New York: Schuster & Schuster, 1997; reprint 2019) and Michael Aaron Dennis, "Reconstructing Sociotechnical Order: Vannevar Bush and US Science Policy," in Sheila Jasanoff, ed., *States of Knowledge: The Co-Production of Science and Social Order* (London: Routledge, 2004), 225–253.

16. Matthew Evangelista, *Unarmed Forces: The Transnational Movement to End the Cold War* (Ithaca: Cornell University Press, 1999); Bernd W. Kubbig, *Wissen als Machtfaktor im Kalten Krieg: Naturwissenschaften und die Raketenabwehr der USA* (Frankfurt am Main: Campus, 2004); Kai-Hendrik Barth, "The Catalysts of Change: Scientists as Transnational Arms Control Advocates in the 1980s," *Osiris*, 21, 1 (2006): 182–206; Lawrence Badash, *A Nuclear Winter's Tale: Science and Politics in the 1980s* (Cambridge, MA: MIT Press, 2009); Ulrike Wunderle, *Experten im Kalten Krieg: Kriegserfahrungen und Friedenskonzeptionen US-amerikanischer Kernphysiker* (Paderborn: Schöningh, 2015); Fabian Lüscher, "The Nuclear Spirit of Geneva. Boundary-Crossing Relationships of Soviet Atomic Scientists after 1955," *Jahrbücher für Geschichte Osteuropas*, 66, 1, (2018): 20–44.

17. Weart, *Rise of Nuclear Fear*; David Nye, *American Technological Sublime* (Cambridge, MA: MIT Press, 1994; reprint 2007), 225–246; Dick van Lente, ed., *The Nuclear Age in Popular Media: A Transnational History, 1945–1965* (New York: Palgrave, 2012); Mark Lipovetsky, "The Poetics of ITR Discourse in the 1960s and Today," *Ab Imperio*, 14, 1 (2013): 109–131; Stefan Guth, "One Future Only? The Soviet Union in the Age of the Scientific-Technical Revolution," *Journal of Modern European History*, 13, 3 (2015): 355–376; Andreas Renner, "Globale Ikone des Kalten Kriegs? Der Atompilz und die sowjetische Nuklearkultur," *Osteuropa,* 66, 6–7 (2016): 215–236.

the way to its apotheosis.[18] William L. Laurence, the only journalist to witness the Manhattan Project[19] and the atomic bombing of Nagasaki, stated in the same year that atomic energy would bring "within sight the realization of the dream of the ages."[20]

In the mid-1950s, the concept of the Atomic Age, along with that of the Space Age, became a popular term for describing the era.[21] The idea brought with it normative and predictive elements, including a specific vision of modernity based on the unconditional belief in the ability to achieve mastery over nature. In 1953, President Dwight D. Eisenhower formally ushered in the Atomic Age in his "Atoms for Peace" speech before the General Assembly of the United Nations in New York. As the world watched, he proposed the creation of an "atomic energy agency" whose contributing powers would help countries build civilian nuclear programs provided that they agreed to forgo the development of nuclear weapons.[22] Despite initial reservations, the USSR eventually endorsed Eisenhower's proposal and in 1957 became one of the founding members of the International Atomic Energy Agency (IAEA). The path-breaking agency was the institutional manifestation of the new Atomic Age. Brussel's Atomium, built in 1958 as the landmark for the World Fair, was its impressive architectural representation.[23]

This special issue looks at the example of the Soviet Union and its successor states and examines the often ambiguous role of nuclear technology in the mobilization of modernity.[24] To that end, it adopts a concept from recent

18. Harry Harper, *Dawn of the Space Age* (London: S. Low, Marston, 1946), 5.

19. The Manhattan Project was an American research undertaking created in 1942 to build an atomic bomb. See Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1986) and Bruce Cameron Reed, *The History and Science of the Manhattan Project* (Berlin: Springer, 2019).

20. William L. Laurence, *Dawn over Zero: The Story of the Atomic Bomb* (New York: Knopf, 1946), 212.

21. Julia Richers, "Welt-Raum: Die Sowjetunion im Orbit," in Martin Aust, ed., *Globalisierung imperial und sozialistisch: Russland und die Sowjetunion in der Globalgeschichte 1851–1991* (Frankfurt am Main: Campus, 2013), 400–424; Alexander C.T. Geppert, "Die Zeit des Weltraumzeitalters, 1942–1972," in Alexander C.T. Geppert and Till Kössle, eds., *Obsession der Gegenwart: Zeit im 20. Jahrhundert* (Göttingen: Vandenhoeck & Ruprecht, 2015), 218–250.

22. See John Krige, "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence," *Osiris*, 21 (2006): 161–181; Mara Drogan, *Atoms for Peace, US Foreign Policy and the Globalization of Nuclear Technology, 1953–1960* (Albany: University at Albany, 2011); Mara Drogan, "The Nuclear Imperative: Atoms for Peace and the Development of U.S. Policy on Exporting Nuclear Power, 1953–1955," *Diplomatic History,* 40, 5 (2016): 948–974. See also Mara Drogan's article in this volume.

23. On the World Expo in Brussels, see Jochen Hennig, "Das Atomium: Das Symbol des Atomzeitalters," in Gerhard Paul, ed., *Das Jahrhundert der Bilder 1949 bis heute* (Göttingen: Vandenhoeck & Ruprecht, 2008), 210–217; Arthur P. Molella and Scott Gabriel Knowles, eds., *World's Fairs in the Cold War: Science, Technology, and the Culture of Progress* (Pittsburg: University Press, 2019).

24. See Ian Welsh, *Mobilising Modernity: The Nuclear Moment* (London: Routledge, 2015).

scholarship: nuclear modernity.[25] The intention is not to make nuclear energy into an all-encompassing signature of an era or into a certain form of modernity. Rather, the concept of nuclear modernity is meant to foreground the specific interrelationships between the development of nuclear energy, international politics, and societal transformation that characterized the period. Those interrelationships made the Soviet Union a scientific and technological superpower and continue to have an effect on political culture, infrastructure, and everyday life. The forces and processes that accompanied the nuclear era significantly shaped the Soviet version of modernity. Not only did they bring about its rise; they also contributed to its collapse and, in the post-Soviet era, influenced the technology policies of Russia and its neighboring states. This issue will take a closer look at the reciprocal relationships and mutually reinforcing conditions of nuclear modernity at the global, imperial, and local levels. It will also explore how scientific practice related to overarching categories of political and social thought together with the transnational circulation of people, artefacts, and ideas.[26]

Science and technology studies (STS): new impetus, new challenges

This special issue follows the transdisciplinary work of science and technology studies (STS), an object of increasing attention in both academia and society at large for some time now. Amid urgent challenges such as global warming, advancements in biomedical technology, and increasing levels of digitalization, scholars have focused more on the relation of science and technology to societal structures, cultural practices, and normative regimes. STS now represents a diverse, wide-ranging field drawing on a rich spectrum of approaches that have given new impetus to research.[27]

What studies in STS share is the critical re-examination of conventional theoretical models. The objective is to arrive at ways of thinking that focus on

25. See Klaus Gestwa, "Katastrojka und Super-GAU: Die Nuklearmoderne in Zeiten von Tschernobyl und Fukushima," in Katja Kucher et al., eds., *Stille Revolutionen: Die Neuformierung der Welt seit 1989* (Frankfurt am Main: Campus, 2013), 57–68; Yu-Fang Cho, "Remembering Lucky Dragon, Remembering Bikini: Worlding the Anthropocene through Transpacific Nuclear Modernity," *Cultural Studies,* 33 (2018): 122–146; Gustav Cederlof, "The Revolutionary City: Socialist Urbanisation and Nuclear Modernity in Cienfuegos, Cuba," *Journal of Latin American Studies*, 51 (2019): 1–24.

26. Gabrielle Hecht coined the term "nuclearity" to describe this phenomenon. See her *Being Nuclear: Africans and the Global Uranium Trade* (Cambridge, MA: MIT Press, 2012), 3–4.

27. See Sheila Jasanoff et al., eds., *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage Publications, 2010); Sergio Sismondo, *An Introduction in Science and Technology Studies* (Malden, MA: Blackwell Publ., 2010); Stefan Beck, Jörg Niewöhner and Estrid Sørensen, *Science and Technology Studies: Eine sozialanthropologische Einführung* (Bielefeld: Transcript, 2012); Christophe Bonneuil and Pierre-Benoît Joly, *Sciences, techniques et société* (P.: La Découverte, 2013); Dominique Pestre, ed., *Le gouvernement des technosciences: Gouverner le progrès et ses dégâts depuis 1945* (P.: La Découverte, 2014); Ulrike Felt et al., eds., *Handbook of Science and Technology Studies* (Cambridge, MA: MIT Press, 2017).

interdependence and heterogeneity and that afford adequate space for the analysis of phenomena that are multiple and contingent. These ways of thinking deconstruct the traditional dichotomies of culture and nature, society and technology, life and matter as chimeras of modernity.[28] This new perspective looks at the "social life of things"[29] by "expanding the boundaries of the social."[30] This openness to things paves the way to a new theory of society in which the social world arises not only from discourse but also from the specific materiality of structures and practices. STS scholars call into question established interpretative frameworks and through productive provocation liberate new analytic potential. This new orientation had its beginnings in social constructivist approaches to science and technology studies, in laboratory ethnography, in actor-network theory, in practice theory, and in the new theories of materialism.[31]

Work in these areas offers an alternative understanding of action and agency. It criticizes traditional concept of actors – people, social groups, and institutions – for a blatant "neglect of things."[32] Instead, it looks at the role of the "material participants of action"[33] and the "governance of things."[34] The concepts of "agential realism"[35] and "vibrant matter"[36] stress that human beings are by no means the measure of all things and the only constructors of the social world. The properties of technical devices and other objects affect the actions users can take with them. These properties, known as "affordances," shape social interaction.[37] Things also

28. See Bruno Latour, *Nous n'avons jamais été modernes: Essai d'anthropologie symétrique* (P.: La Découverte, 1991).

29. Arjun Appadurai, *The Social Life of Things: Commodities in Cultural Perspectives*, (Cambridge: University Press, 1986).

30. Georg Kneer et al., eds., *Bruno Latours Kollektive: Kontroversen zur Entgrenzung des Sozialen* (Frankfurt am Main: Suhrkamp, 2008).

31. For a good survey, see Susanne Bauer, Torsten Heinemann, and Thomas Lemke, eds., *Science and Technology Studies: Klassische Positionen und aktuelle Perspektiven* (Suhrkamp: Berlin, 2017).

32. Werner Rammert, "Was ist Technikforschung? Entwicklung und Entfaltung eines sozialwissenschaftlichen Forschungsprogramms," in Idem, ed., *Technik aus soziologischer Perspektive 2: Kultur – Innovation – Virtualität* (Opladen: Westdeutscher Verlag, 2000), 18–19.

33. Stefan Hirschauer, "Praktiken und ihre Körper: Über materielle Partizipanden des Tuns," in Karl H. Hörning and Julia Reuter, eds., *Doing Culture: Neue Positionen zum Verhältnis von Kultur und sozialer Praxis* (Bielefeld: Transcript, 2004), 73–91.

34. Thomas Lemke, "'*Die Regierung der Dinge*': Politik, Diskurs und Materialität," *Zeitschrift für Diskursforschung*, 2, 3 (2014): 250–267; Hans Peter Hahn, ed., *Vom Eigensinn der Dinge: Für eine neue Perspektive auf die Welt des Materiellen* (Berlin: Neofelis, 2015).

35. Karen Barad, *Agential Realism: On the Importance of Material-Discursive Practices* (Durham, NC: Duke University Press, 2006).

36. Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010).

37. On the term affordance, see Richard Fox, Diamantis Panagiotopoulos and Christina Tsouparopoulou, "Affordanz," in Michael R. Ott, Rebecca Sauer and Thomas Meier, eds., *Materiale Textkulturen. Konzepte – Materialien – Praktiken* (Berlin: De Gruyter, 2015), 63–70; Nicole Zillien, "Affordanz," in Kevin Liggier and Oliver Müller, eds., *Mensch-Maschine-Interaktion: Handbuch zu Geschichte, Kultur und Ethik* (Stuttgart: J.B. Metzler, 2019), 226–228.

possess the ability to organize and develop according to their own dynamic. The often differing scripts underlying human actions, technical functions, and natural processes result in unforeseeable events and innovations. The emphasis on "thing power"[38] dissociates the concept of agency from the conscious and the intentional and focuses on effectiveness, i.e. the enactment of action.[39]

Separation is not an essential trait of the social world. Accordingly, the role that humans play among non-human creatures and things can only be meaningfully explained if human agency and the agency of things are studied in the same context. STS scholars remind us that agency dwells in collectives, configurations, or assemblages consisting of people, matter, and artefacts.[40] It is necessary, they claim, that we replace the concept of "interaction," which reflects the cooperation of clearly separate entities, with "intra-action," in which the inextricable entanglement of diverse types of agents is axiomatic.[41] Andrew Pickering speaks of a "dance of agency" in which the lead and the steps constantly change and the further course of the dance remains open.[42]

Bridging the gap: the socio-technical premise and technoscience

Although overly theoretical at times, the metaphors and concepts outlined in the two preceding paragraphs provide a fruitful hotbed of ideas for historical research. The ever more precise focus on the junctures of science, technology, and society in "the seamless web"[43] has recently led to a boom of conceptual bridges that think social practice and historical reality in combination. Sheila Jasanoff's theory of "co-production," avoiding both simplified determinism and an overreaching constructivism, inquires into complex causal chains.[44] Compound adjectives such as "socio-technical" and "socio-natural" act in concert with nouns such

38. Bennett, *Vibrant Matter*, 10.

39. On the concept of "enactment," see Annemarie Mol, *The Body Multiple: Ontology in Medical Practice* (Durham, NC: Duke University Press, 2002).

40. See, for instance, Kneer et al., eds., *Bruno Latours Kollektive*; Manuel DeLanda, *Assemblage Theory* (Edinburgh: University Press, 2016); Naoki Ueno, Rieko Sawyer and Yuji Moro, "Reconstitution of Sociotechnical Arrangements: Agency and the Design of Artifacts," *Mind, Culture, and Activity,* 24, 2 (2017): 95–109.

41. See Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, NC: Duke University Press, 2007); Idem*, Verschränkungen* (Berlin: Merve, 2015).

42. See Andrew Pickering, "Material Culture and the Dance of Agency," in Dan Hicks and Mary C. Beaudry, eds., *The Oxford Handbook of Material Culture Studies* (Oxford: University Press, 2010), 191–208; Idem, "The Robustness of Science and the Dance of Agency," in Léna Soler et al., eds., *Characterizing the Robustness of Science: After the Practice Turn in Philosophy of Science* (Dordrecht: Springer, 2012), 317–327.

43. This concept comes from Thomas P. Hughes, "The Seamless Web: Technology, Science, Etcetera, Etcetera," *Social Studies of Science,* 16 (1986): 281–292.

44. See Sheila Jasanoff and Sang-Hyun Kim, eds., *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (Chicago: University Press, 2015).

as "systems," "change," "transition," "sites," and "imaginaries" to articulate the strong intertwinement of social life and things.[45] Among the popular conceptual bridges is Sara Pritchard's idea of "envirotechnical systems," which describes the confluence of technical, scientific, political, and natural processes.[46]

An especially important conceptual bridge for this issue is technoscience. It addresses (1) the interdependence of academics, economics, and the military in a "military-industrial-academic complex."[47] At the same time, it rejects (2) the distinctions between science and technology or basic research and applied science, respectively. Finally, it stresses (3) the rapidly increasing technologization of science. The production of new knowledge is predicated on increasingly elaborate infrastructures and procedures. As a result, costs for research and development have skyrocketed. At the same time, new arrangements have formed between the organic and the inorganic (through, say, the creation of genetically modified cells and living beings) and the artifacts of technoscience have progressively penetrated social life.[48] For this reason, some have, not without controversy, declared it an epochal phenomenon.[49]

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45. See Wiebe E. Bijker and John Law, *Shaping Technology / Building Society: Studies in Sociotechnical Change* (Cambridge, MA: MIT Press, 1992); Pieter Vermaas et al., *A Philosophy of Technology: From Technical Artefacts to Sociotechnical Systems* (San Rafael, CA: Morgan & Claypool Publishers, 2011); Verena Winiwarter, Martin Schmid and Gert Dressel, "Looking at Half a Millennium of Co-Existence: The Danube in Vienna as a Socio-Natural Site," *Water History*, 5, 2 (2013): 101–119; Simon Marvin et al., eds., *Urban Living Labs: Experimentation and Socio-Technical Transitions* (London: Routledge, 2017).

46. See Sara Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge, MA: Harvard University Press, 2011); Idem, "An Envirotechnical Disaster: Nature, Technology, and Politics at Fukushima," *Environmental History*, 17, 2 (2012): 219–243; Idem, ed., *New Natures: Joining Environmental History with Science and Technology Studies* (Pittsburgh: University Press, 2013).

47. See Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993); Rebecca S. Lowen, *Creating the Cold War University: The Transformation of Stanford* (Berkeley: University of California Press, 1997).

48. The concept of technoscience underlines both Bruno Latour's idea that technology is society made durable and the central role of artifacts in stabilizing heterogeneous arrangements. See Bruno Latour, "Technik ist stabilisierte Gesellschaft," in Andréa Belliger and David J. Krieger, eds., *ANThology: Ein einführendes Handbuch zur Akteur-Netzwerk-Theorie* (Bielefeld: Transcript, 2006), 369–398.

49. See Jutta Weber, *Umkämpfte Bedeutungen: Natur im Zeitalter der Technoscience* (Frankfurt am Main: Campus, 2003); Mikael Hård and Andrew Jamison, *Hubris and Hybrids: A Cultural History of Technology and Science* (New York: Routledge, 2005); Kristin Asdal, Brita Brenna and Ingunn Moser, eds., *Technoscience: The Politics of Interventions* (Oslo: Unipub, 2007); Mike Michael, *Technoscience and Everyday Life: The Complex Simplicities of the Mundane* (Maidenhead: Open University Press, 2010); Bruce Braun and Sarah J. Whatmore, eds., *Political Matter: Technoscience, Democracy, and Public Life* (Minneapolis: University of Minnesota Press, 2010); Alfred Nordmann, Hans Radder and Gregor Schiemann, eds., *Science Transformed?: Debating Claims of an Epochal Break* (Pittsburgh: University Press, 2011). In 2014, Routledged launched its series *History and Philosophy of Technoscience*. It now comprises 20 volumes.

The bourgeoning scholarship on the history of Russian/Soviet technology and science

It was only in the past two decades that studies of Russian and Soviet history began to figure in discussions of the interplay between technology, science, and society.[50] Works have appeared covering a broad range of topics, from celebrated scientists[51] and large-scale projects[52] to individual disciplines[53] and important science towns.[54] Many have also included fruitful analyses of neighboring fields such as agrarian and environmental history.[55] Recently, studies have paid special attention to the

50. This is the view of the editors of *Kritika*. See their "Technopolitics and the Frontier of History," *Kritika: Explorations in Russian and Eurasian History*, 20, 4 (2019): 677–681 (677).

51. See Kendall E. Bailes, *Science and Russian Culture in an Age of Revolutions: V.I. Vernadsky and His Scientific School, 1863–1945* (Bloomington: Indiana University Press, 1990); Torsten Rüting, *Pavlov und der neue Mensch: Diskurse über Disziplinierung in Sowjetrussland* (München: Oldenbourg, 2002); Daniel Todes, *Ivan Pavlov: A Russian Life in Science* (Oxford: University Press, 2014); Michael Gordin, *A Well-Ordered Thing: Dmitrii Mendeleev and the Shadow of the Periodic Table* (New York: Basic Books, 2004); Paul R. Josephson, *Lenin's Laureate: Zhores Alferov's Life in Communist Science* (Cambridge, MA: MIT Press, 2010).

52. See Paul R. Josephson, "'Projects of the Century' in Soviet History: Large-Scale Technologies from Lenin to Gorbachev," *Technology and Culture*, 36 (1995): 519–559; Matthew J. Payne, *Stalin's Railroad: Turksib and the Building of Socialism* (Pittsburgh: University Press, 2001); Scott W. Palmer, *Dictatorship of the Air: Aviation Culture and the Fate of Modern Russia* (Cambridge, MA: University Press, 2006); Christopher J. Ward, *Brezhnev's Folly: The Building of BAM and late Soviet Socialism* (Pittsburgh: University Press, 2009); Klaus Gestwa, *Die Stalinschen Großbauten des Kommunismus: Sowjetische Technik- und Umweltgeschichte, 1948–1967* (München: Oldenbourg, 2010); Johannes Grützmacher, *Die Baikal-Amur-Magistrale: Vom stalinistischen Lager zum Mobilisierungsprojekt unter Brežnev* (München: Oldenbourg, 2010); Frithjof Benjamin Schenk, *Russlands Fahrt in die Moderne: Mobilität und sozialer Raum im Eisenbahnzeitalter* (Stuttgart: Steiner, 2014).

53. Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, MA: MIT Press, 2002); Nikolai Krementsov, *International Science Between the World Wars: The Case of Genetics* (New York: Routledge, 2004); Nils Roll-Hansen, *The Lysenko Effect: The Politics of Science* (New York: Humanity Books, 2005); Eglė Rindzevičiūtė, *The Power of Systems: How Policy Sciences Opened up the Cold War World* (Ithaca: Cornell University Press, 2016); Jan Arend, *Russlands Bodenkunde in der Welt: Eine ost-westliche Transfergeschichte 1880–1945* (Göttingen: Vandenhoeck & Ruprecht, 2017).

54. See Paul R. Josephson, *New Atlantis Revisited: Akademgorodok, the Siberian City of Science* (Princeton: University Press, 1997); Ksenia Tatarchenko, "Calculating a Showcase: Mikhail Lavrentiev, the Politics of Expertise, and the International Life of the Siberian Science-City," *Historical Studies in the Natural Sciences*, 46, 5 (2016): 592–632.

55. For a good survey of work on agrarian history, see Katja Bruisch and Klaus Gestwa, *Land, Soil and People: Agricultural Expertise and Power*, Special Issue, *Cahiers du Monde russe*, 57, 1 (2016). Subsequent helpful publications include Marc Elie and Carole Ferret, eds., "Verte, la steppe? Agriculture et environnement en Asie centrale," Special Issue, *Études rurales*, 200 (2017): 64–79; Christian Teichmann, *Macht der Unordnung: Stalins Herrschaft in Zentralasien 1920–1950* (Hamburg: Hamburger Edition, 2016); Julia Obertreis, *Imperial Desert Dreams: Cotton Growing and Irrigation in Central Asia, 1860–1991* (Göttingen: V&R unipress, 2017); Maya K. Peterson, *Pipe Dreams: Water and Empire in Central Asia's Aral Sea Basin* (Cambridge: University Press, 2019); Timm Schönfelder, *Roter Fluss auf Schwarzer Erde: Der Kuban und der agromeliorative Komplex, 1929–1991* (Tübingen: unpublished dissertation, 2019).
On environmental history, see Douglas R. Weiner, *A Little Corner of Freedom: Russian Nature Protection from Stalin to Gorbachev* (Berkeley: University of California Press, 1999);

Soviet space program.[56] The history of computing has seen a noticeable upsurge in interest, too.[57]

In many earlier works, the central underlying question had been the extent to which ideology and politics in the Soviet Union determined the development of science and technology. After scholars liberated themselves from the trench wars between the "totalitarian" and "revisionist" schools of thought, they could develop more nuanced historical interpretations. In particular, they found not only that Soviet state power exerted massive influence on science and technology but also that science and technology led to significant changes in politics, society, and economics.[58]

Jonathan D. Oldfield, *Russian Nature: Exploring the Environmental Consequences of Societal Change* (London: Routledge, 2006); Stephen Brain, *Song of the Forest: Russian Forestry and Stalinist Environmentalism*, 1905–1953 (Pittsburgh: University Press, 2011); Paul Josephson et al., *An Environmental History of Russia* (Cambridge: University Press, 2013); Laurent Coumel and Marc Elie, eds., *A Belated and Tragic Ecological Revolution: Nature, Disasters, and Green Activists in the Soviet Union and the Post-Soviet States, 1960s–2010s*, Special Issue, *Soviet and Post-Soviet Review*, 40, 2 (2013); Jonathan Oldfield, Julia Lajus, and Denis J.B. Shaw, eds., *Conceptualizing and Utilizing the Natural Environment: Critical Reflections from Imperial and Soviet Russia*. Special Issue, *Slavonic and Eastern European Review*, 63,1 (2015); Andy Bruno, *The Nature of Soviet Power: An Arctic Environmental History* (Cambridge: University Press, 2016); Nicholas Breyfogle, *Eurasian Environments: Nature and Ecology in Imperial Russia and Soviet History* (Pittsburgh: University Press, 2018); Melanie Arndt and Laurent Coumel, eds., *The Green End of the Red Empire*, Special Issue, *Ab Imperio* 20, 1 (2019).

56. See Asif A. Siddiqi, *The Red Rockets' Glare: Spaceflight and the Soviet Imagination, 1857–1957* (Cambridge: University Press, 2010); Eva Maurer, Julia Richers, Monica Rüthers and Carmen Scheide, eds., *Soviet Space Culture: Cosmic Enthusiasm in Socialist Societies* (Basingstoke, New York: Palgrave Macmillan, 2011); James T. Andrews and Asif A. Siddiqi, eds., *Into the Cosmos: Space Exploration and Soviet Culture* (Pittsburgh: University Press, 2011); Slava Gerovitch, *Voices of the Soviet Space Program: Cosmonauts, Soldiers, and Engineers Who Took the USSR into Space* (New York: Palgrave Macmillan, 2014); Idem, *Soviet Space Mythologies: Public Images, Private Memories, and the Making of a Cultural Identity* (Pittsburgh: University Press, 2015).

57. See Slava Gerovitch, "InterNyet: Why the Soviet Union did not build a nationwide Computer Network," *History and Technology*, 24, 4 (2008): 335–350; Felix Hermann, "Zwischen Planwirtschaft und IBM. Die sowjetische Computerindustrie im Kalten Krieg," *Zeithistorische Forschungen – Studies in Contemporary History*, 9, 2 (2012): 212–230; Benjamin Peters, *How Not to Network a Nation: The Uneasy History of the Soviet Internet* (Cambridge, MA: MIT Press, 2016); Ksenia Tatarchenko, "'The Computer Does Not Believe in Tears': Programming, Professionalization and Gendering of Authority," *Kritika: Explorations in Russian and Eurasian History*, 18, 4 (2017): 709–739; Mario Biagioli and Vincent Lepinay, eds., *From Russia with Code: Russian Computer Scientists Abroad* (Durham: Duke University Press, 2019).

58. See Kendall E. Bailes, *Technology and Society under Lenin and Stalin: Origins of the Soviet Technical Intelligentsia, 1917–1941* (Princeton: University Press, 1978); Alexander Vucinich, *Empire of Knowledge: The Academy of Sciences of the USSR, 1917–1970* (Berkeley: University of California Press, 1984); Nikolai Krementsov, *Stalinist Science* (Princeton: University Press, 1997); Loren Graham, *What Have We Learned about Science and Technology from the Russian Experience?* (Stanford: University Press, 1998); Paul R. Josephson, *Totalitarian Science and Technology* (Atlantic Highlands: Humanities Press, 1996); Alexei B. Kojevnikov, *Stalin's Great Science: The Times and Adventures of Soviet Physicists* (London: Imperial College Press, 2004); Ethan Pollock, *Stalin and the Soviet Science Wars* (Princeton: University Press, 2006).

In an effort to better understand the societal transformation in the Soviet Union induced by science and technology, an increasing number of researchers have turned their attention to technopolitics, a concept pioneered by Gabrielle Hecht in her 1998 study of France's nuclear history.[59] Supplying the missing link between often separate fields of study, technopolitics is "the strategic practice of designing or using technology to constitute, embody, and enact political goals."[60] This practice combines forms of expert knowledge with their materialization in (often impressive) artifacts. Studies investigating technopolitics focus on the researchers, engineers, planners, and inventors that built Czarist Russia and the Soviet Union.

Science and technology has long since stopped being unexplored territory in the expansive map of Russian/Soviet history, and researchers have already announced the discovery of its "technological DNA."[61] A recent issue of *Kritika* edited by Larissa Zakharova and Grégory Dufaud illustrates the richness and diversity that scholarship in this field has attained over the last few years.[62] However, to adequately represent the Russian/Soviet case in the international history of technology, we need additional in-depth and theoretically nuanced studies on how mutually reinforcing constellations of science, technology, and policies enabled the transformation of nature and society in Czarist Russia and the Soviet Union.[63]

The dreams and disasters of Soviet nuclear history

The degree to which technology shaped the history of the Soviet Union was already apparent in the turmoil of the Russian Civil War. Lenin's 1920 announcement that communism was "Soviet power plus electrification" elevated the ambitious plan of the State Commission for the Electrification of Russia (GOELRO) to a "second party program."[64] This energetic worldview continued unaltered throughout the

59. See Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge, MA: MIT Press, 1998; reprint 2009); Gabrielle Hecht and Paul N. Edwards, "The Technopolitics of Cold War: Toward a Transregional Perspective," in Michael Adas, ed., *Essays on Twentieth Century History* (Philadelphia: Temple University Press, 2010), 271–314; Gabrielle Hecht, ed., *Entangled Geographies: Empire and Technopolitics in the Global Cold War* (Cambridge, MA: MIT Press, 2011).

60. Hecht, *Radiance of France*, 15.

61. Gestwa, *Großbauten*, 556.

62. Grégory Dufaud and Larissa Zakharova, eds., *Science, Fiction and Power in the USSR*, Special Issue, *Kritika: Explorations in Russian and Eurasian History*, 20, 4 (2019).

63. The most recent person to call for this was Grégory Dufaud. See his "The History of Science and Technology, or How to Grasp Heterogeneity," ibid.: 813–822.

64. Vladimir I. Lenin, *Polnoe sobranie sochinenii*, vol. 42 (M.: Izdatel´stvo Politicheskoi Literatury, 1970), 159. For a detailed study, see Jonathan Coopersmith, *Electrification of Russia, 1880–1926* (Ithaca: Cornell University Press, 1992).

Cold War.[65] Soviet officials in Moscow confidently announced that the Atomic Age would lead to a second global victory of communism. These nuclear dreams of Soviet modernity have already been surveyed.[66] Researchers have also studied the military branch of the Soviet nuclear program, whose rapid successes ensured a thermonuclear balance of terror between the rival blocs.[67] Moreover, informative studies have appeared on the organizational structures of the Soviet nuclear complex and on Soviet nuclear cities.[68]

The Chernobyl disaster on April 26, 1986, has been the object of much scholarly attention, especially after the events at the Fukushima Daiichi Nuclear Power Plant

65. See Jeronim Perović, ed., *Cold War Energy: A Transnational History of Soviet Oil and Gas* (Cham: Palgrave Macmillan, 2016); Felix Frey, *Arktischer Heizraum: Das Energiesystem Kola zwischen regionaler Autarkie und gesamtstaatlicher Verflechtung, 1928–1974* (Köln: Böhlau, 2019).

66. See Paul R. Josephson, "Atomic-Powered Communism: Nuclear Culture in the Postwar USSR," *Slavic Review*, 55, 2 (1996): 297–324; Idem, *Red Atom: Russia's Nuclear Power Program from Stalin to Today* (New York: W.H. Freeman & Co, 1999); Sonja D. Schmid, "Celebrating Tomorrow Today: The Peaceful Atom on Display in the Soviet Union," *Social Studies of Science*, 36, 3 (2006): 331–365; Idem, "Shaping the Soviet Experience of the Atomic Age: Nuclear Topics in Ogonyok, 1945–1965," in Dick van Lente, ed., *The Nuclear Age in Popular Media: A Transnational History, 1945–1965* (New York: Palgrave Macmillan, 2012), 19–51.

67. See David Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy 1939–1956* (New Haven: Yale University Press, 1994); Thomas B. Cochran, Robert S. Norris and Oleg A. Bukharin, *Making the Russian Bomb from Stalin to Yeltsin* (Boulder: Routledge, 1995); Michael D. Gordin, *Red Cloud at Dawn: Truman, Stalin, and the End of the Atomic Monopoly* (New York: Farrar, Straus and Giroux, 2009).

68. On the Soviet nuclear complex, see Sonja D. Schmid, *Producing Power: The pre-Chernobyl History of the Soviet Nuclear Industry* (Cambridge, MA: MIT Press, 2015); Idem, "Of Plans and Plants: How Nuclear Power Gained a Foothold in Soviet Energy Policy," *Jahrbücher für Geschichte Osteuropas*, 66, 1 (2018): 124–139.
On nuclear cities, see Kate Brown, *Plutopia: Nuclear Families, Atomic Cities and the Great Soviet and American Plutonium Disasters* (Oxford: University Press, 2013); Anna Storm, *Post-Industrial Landscape Scars* (New York: Palgrave Macmillan, 2014); Anna Veronika Wendland, "Inventing the Atomograd: Nuclear Urbanism as a Way of Life in Eastern Europe, 1970–2011," in Thomas Bohn et al., eds., *The Impact of Disaster: Social and Cultural Approaches to Fukushima and Chernobyl* (Berlin: EB Publishers, 2015), 261–287; Hiroshi Ichikawa, "Obninsk, 1955. The World's First Nuclear Power Plant and 'The Atomic Diplomacy' by Soviet Scientists," *Historia Scientiarum*, 26 (2016): 25–41; Ekaterina Emeliantseva, "Negotiating Coldness: The Natural Environment and Community Cohesion in Cold War Molotovsk-Severodvinsk," in Julia Herzberg, Christian Kehrt, and Franziska Torma, eds., *Ice and Snow in the Cold War: Histories of Extreme Climatic Environments* (New York: Berghahn, 2018), 261–292; Galina Orlova, "The Scientific Shape of a Nuclear City: Obninsk as an Assemblage of Research Institutes," in Felix Ackermann, Benjamin Cope and Siarhei Liubimau, eds., *Mapping Visaginas: Sources of Urbanity in Former Monofunctional Town* (Vilnius: Vilnius Academy of Arts Press, 2016), 63–72; Roman Khandozhko, "Dissidence Behind the Nuclear Shield? The Obninsk Atomic Research Centre and the Infrastructure of Dissent in the Late Soviet Union," *Jahrbücher für Geschichte Osteuropas*, 66, 1 (2018): 65–92; Stefan Guth, "Oasis of the Future: The Nuclear City of Shevchenko/Aktau, 1959–2019," *Jahrbücher für Geschichte Osteuropas*, 66, 1 (2018): 93–123.

in March 2011.[69] Scholars have since looked at other "nuclear landscapes" as well as changes to security regulations and radiation protection.[70]

These studies explicitly address issues of ignorance, lack of knowledge, and surprise as important phenomena of nuclear modernity. Driven by strong socio-economic and political interests, Soviet officials recklessly overlooked technologies' dangers or downplayed the actual risks. Only after the unexpected became bitter reality in the form of unintended consequences did they begin to think more carefully and seek out more knowledge, leading to new social interactions shaping experience and structures.[71]

Most studies of Soviet nuclear history have concentrated either on the late 1940s and 1950s or the period after 1986. The German-Swiss research group "Radiating Future? Nuclear Technopolitics in the Soviet Union" formed several years ago to explore the mostly overlooked interim period.[72] The editors of the first publication

69. See Thomas Bohn et al., eds., *The Impact of Disaster*; Adriana Petryna, *Life Exposed: Biological Citizens after Chernobyl* (Princeton: University Press, 2002); Olga Kuchinskaya, *The Politics of Invisibility: Public Knowledge about Radiation Health Effects after Chernobyl* (Cambridge, MA: MIT Press, 2014); Edward Geist, "Political Fallout: The Failure of Emergency Management at Chernobyl´," *Slavic Review*, 74, 1 (2015): 104–126; Aliaksandr Dalhouski, *Tschernobyl in Belarus: Ökologische Krise und sozialer Kompromiss, 1986–1996* (Wiesbaden: Harrassowitz, 2015); Melanie Arndt, ed., *Politik und Gesellschaft nach Tschernobyl: (Ost-)Europäische Perspektiven* (Berlin: Ch. Links, 2016); Idem, *Tschernobylkinder: Die transnationale Geschichte einer nuklearen Katastrophe* (Göttingen: Vandenhoeck & Ruprecht, 2020); Adam Higginbotham, *Midnight in Chernobyl: The Untold Story of the World's Greatest Nuclear Disaster* (New York: Simon & Schuster, 2019); Serhii Plokhy, *Chernobyl: History of a Tragedy* (London: Penguin, 2019); Kate Brown, *Manual for Survival: A Chernobyl Guide to the Future* (New York: W.W. Norton & Company, 2019).

70. Magdalena Stawkowski, "'I Am a Radioactive Mutant': Emergent Biological Subjectivities at Kazakhstan's Semipalatinsk Nuclear Test Site," *American Ethnologist*, 43, 1 (2016): 144–157; Idem, "Everyday Radioactive Goods? Economic Development at Semipalatinsk, Kazakhstan," *Journal of Asian Studies*, 76, 2 (2017): 423–436; Anna Veronika Wendland, "Reaktorsicherheit als Zukunftskommunikation: Nuklearpolitik, Atomdebatten und kerntechnische Entwicklungen in Westdeutschland und Osteuropa 1970–2015," in Christoph Kampmann, Angela Marciniak and Wencke Meteling, eds., *"Security Turns Its Eye Exclusively to the Future": Zum Verhältnis von Sicherheit und Zukunft in der Geschichte* (Baden-Baden: Nomos, 2018), 305–352; Susanne Bauer, "Radiation Science After the Cold War: The Politics of Measurement, Risk, and Compensation in Kazakhstan," in Olga Zvonareva, Evgeniya Popova and Klasien Horstman, eds., *Health, Technologies and Politics in Post-Soviet Settings: Navigating Uncertainties* (New York: Palgrave Macmillan, 2018), 225–249; Susanne Bauer, Karena Kalmbach and Tatiana Kasperski, "From Pripyat to Paris, from Grassroots Memories to Globalized Knowledge Production: The Politics of Chernobyl Fallout," in Laurel MacDowell, ed., *Nuclear Portraits: Communities, the Environment, and Public Policy* (Toronto: University Press, 2017), 149–189; Laura Sembritzki, "Maiak 1957 and its Aftermath: Radiation Knowledge and Ignorance in the Soviet Union," *Jahrbücher für Geschichte Osteuropas*, 66, 1 (2018): 45–64; and Idem, *Nukleares Naturschutzgebiet im Süd-Ural: Atommüllkatastrophen und Strahlenschutz in der Sowjetunion* (Heidelberg: unpublished dissertation, 2019).

71. Peter Wehling, *Im Schatten des Wissens? Perspektiven der Soziologie des Nichtwissens* (Konstanz: UVK, 2006); Robert P. Proctor and Londa Schiebinger, eds., *Agnotology: The Making and Unmaking of Ignorance* (Stanford: University Press, 2008); Matthias Gross, *Ignorance and Surprise: Science, Society, and Ecological Design* (Cambridge, MA: MIT Press, 2010).

72. Funded by the Germany Research Foundation and the Swiss National Science Foundation, this research group consists of seven researchers, coming from the Universities of Bern, Heidelberg and Tübingen. These include the four editors of this special issue as well as Roman

based on the group's work, an English-language special issue of *Jahrbücher für Geschichte Osteuropa*, have demanded a more in-depth study of the 1960s and 70s, lest it remain a mere epilog to Stalin's bomb projects or a mere prehistory of Chernobyl. Only after this gap in the research is closed will we be able to understand the long-term effects of the Soviet nuclear program.[73]

As the research group's second collective publication, this special issue further explores the topics for which the above-mentioned volume prepared the field. It arose from an international conference organized in March 2018 at the University of Tübingen.[74] The ten articles that make up this issue are arranged thematically into three sections, which we describe in detail below.

Decentered perspectives on Soviet nuclear history

In the 1990s, the first studies on Soviet nuclear history viewed their subjects entirely through the lens of Moscow. This focus was reasonable in view of the Soviet Union's highly centralized nuclear program.[75] More recently, however, scholarship has turned its attention to the periphery of the Soviets' vast nuclear program.[76] This shift was the result of both practical factors – regional archives are generally easier to access than those in the capital – and methodological concerns.

In the past two decades, calls for decentered perspectives have become increasingly frequent in the social sciences, the humanities, and STS. The meaning of "decentered" is both geographical and societal, signaling a shift from the center to the periphery and from elites to subalterns.[77] The nexus between geographical and societal meaning has been especially pronounced in postcolonial studies, where researchers have often combined analytical programs with emancipatory agendas.

New studies of Russian and Soviet history have been particularly receptive to the call for geographical decentering. For one, they regard Russia and the Soviet Union *in toto* as the antithesis and a corrective to Western grand narratives that

Khandozhko (Tübingen), Fabian Lüscher (Bern) and Laura Sembritzki (Heidelberg). For more information on the activities of this working group, see https://nuctechpol.org/ [last accessed on 21.12.2019].

73. Stefan Guth, Fabian Lüscher and Julia Richers, "Nuclear Technopolitics in the Soviet Union: An Introduction," *Jahrbücher für Geschichte Osteuropas*, 66, 1 (2018): 3–19 (5–7). This introduction provides a good survey of the literature on Soviet nuclear modernity. We have thus kept our remarks on the literature brief.

74. A report by Timm Schönfelder on the Tübingen conference can be found at http://www.hsozkult.de/conferencereport/id/tagungsberichte–7659 [last accessed on 21.12.2019].

75. Holloway, *Stalin and the Bomb*; Josephson, *Red Atom*.

76. See the literature cited in n. 68.

77. See Natalie Zemon Davis, "Decentering History: Local Stories and Cultural Crossings in a Global World," *History and Theory*, 50 (2011): 190.

still dominate global history.[78] For another, they have focused their attention on the borderlands of the Russian and Soviet empire, allowing a more comprehensive survey of the historical space while injecting ideas of the spatial and imperial turn in Russian/Soviet history.[79] This change of perspective from the center to the periphery also reflects a shift in interests from structures to contexts.[80] Accordingly, scholars have examined artifacts and practices less in terms of grand designs than in terms of local uses and adaptations.[81]

In the decentered view, the history of science and technology takes on great importance because the Russian/Soviet "conquest" (*osvoenie*) of space primarily took place as part of large-scale energy, water, and transportation infrastructure projects.[82] This issue's first section, therefore, looks at the Soviet nuclear program from the perspective of its peripheries. More than other technologies, nuclear power sheds light on the Soviet "borderlands of industrial modernity."[83] The first strongholds of the Soviet nuclear weapons program were often located in remote areas for reasons of secrecy, resource availability, and environmental impact. Under Brezhnev's leadership, nuclear colonization became a trusted means of incorporating backwater regions into Soviet modernity.

78. See Maxim Waldstein and Sanna Turoma, "Introduction: Empire and Space: Russia and the Soviet Union in Focus," in Idem, eds., *Empire De/Centered: New Spatial Histories of Russia and the Soviet Union* (Farnham: Routledge, 2013), 2. For a general view, see Martin Aust, ed., *Globalisierung imperial und sozialistisch: Russland und die Sowjetunion in der Globalgeschichte 1851–1991* (Frankfurt am Main: Campus, 2013); Idem and Julia Obertreis, eds., *Osteuropäische Geschichte und Globalgeschichte* (Stuttgart: Steiner, 2013); Christof Dejung and Martin Lengwiler, eds., *Ränder der Moderne: Neue Perspektiven auf die Europäische Geschichte, 1800–1930* (Köln: Böhlau, 2016).

79. On the spatial turn, see Manfred Sapper et al., eds., *Der Raum als Wille und Vorstellung: Erkundungen über den Osten Europas*, Special Issue, *Osteuropa* 55, 3 (2005); Mark Bassin, Christopher Ely, and Melissa K. Stockdale, eds., *Space, Place, and Power in Modern Russia: Essays in the New Spatial History* (DeKalb, IL: Northern Illinois University Press, 2010); Karl Schlögel, ed., *Mastering Russian Spaces: Raum und Raumbewältigung als Probleme der russischen Geschichte* (München: Oldenbourg, 2011).
Since 2000, the journal *Ab Imperio* has risen to prominence for its imperial turn in historical studies of Eastern Europe, publishing path-breaking special issues and essays.

80. See Barney Warf and Santa Arias, "Introduction: The Reinsertion of Space in the Humanities and Social Sciences," in Idem, eds., *The Spatial Turn: Interdisciplinary Perspectives* (London: Routledge, 2009), 1–10.

81. See Artemy M. Kalinovsky, "A Most Beautiful City for the World's Tallest Dam: Internationalism, Social Welfare, and Urban Utopia in Nurek," *Cahiers du Monde russe*, 57, 4 (2016), 819–846; Idem, *Laboratory of Socialist Development: Cold War Politics and Decolonization in Soviet Tajikistan* (Ithaca: Cornell University Press, 2018); Idem and Marianne Kamp, *From Industrialization to Extraction: Visions and Practices of Development in Soviet Central Asia*, Forum, *Ab Imperio*, 19, 2 (2018); Patryk Reid, *Managing Nature, Constructing the State: The Material Foundation of Soviet Empire in Tajikistan, 1917–1937* (PhD Dissertation: University of Illinois at Urbana-Champaign, 2016).

82. See the literature cited in n. 52 and 55.

83. Jonas van der Straeten, "Borderlands of Industrial Modernity: Explorations into the History of Technology in Central Asia, 1850–2000," *Technology and Culture*, 60, 3 (2019): 659–687.

In her essay for this issue, Anna Veronika demonstrates that "atomic-powered communism" arose from an imperial program.[84] Similarly, Stefan Guth, in examining the western Kazakh nuclear city of Shevchenko (Aqtau), emphasizes the "frontier" character of nuclear colonization. Against the contrasting backdrop of this backwater desert peninsula, Soviet nuclear modernity could take center stage all the more effectively. Andrei Stsiapanau, writing about the efforts to build a nuclear power plant in Belorussia, observes that nuclear power in the 1980s had become an indispensable sign of participation in Soviet modernity.

These studies of the periphery keep a constant eye on the center in Moscow and its will to shape the Soviet Union. Wendland shows how the construction of a nuclear power plant in western Ukraine furthered Soviet interventionism by industrially reshaping rural areas and bringing thousands of Russian experts into a territory that just two decades earlier was considered an insurgent border region. The same applied, as Stefan Guth argues, for western Kazakhstan, albeit with even less participation from the Soviet republic.

Nuclear development projects in the Soviet Union thus reproduced the discrepancy between an advanced center and a backward periphery that they purported to overcome. In her study on the global division of labor and risk allocation in the atomic age, Gabrielle Hecht describes the hierarchies between imperial elites and subaltern groups that accompanied it. Taking a postcolonial perspective, she points out that many of the most dangerous testing grounds and production sites of nuclear modernity were located in former colonial and quasi-colonial spaces.[85] This was certainly true of the Soviet nuclear testing sites in Semipalatinsk, Kazakhstan, which Susanne Bauer examines in the third section of this issue. In a similar vein, following the nuclear disasters in Kyshtym in 1957 and in Chernobyl in 1986, the protection of local populations enjoyed less priority than that of the technological elite.[86] Accordingly, the resistance to the Soviet overexploitation of social and natural resources came, to no small extent, from the periphery.[87] After the collapse of the USSR, nationally tinged victimhood narratives emerged in Kazakhstan, Belarus, and Ukraine. These narratives interpreted Soviet nuclear colonization as Russian foreign rule and categorized the radioactive sites left by the empire as a colonial legacy.

However, at the beginning of the millennium, nuclear energy began to undergo an astonishing re-evaluation. While contaminated nuclear sites were still "externalized" as an imperial legacy, the political elites of Ukraine, Belarus, and Kazakhstan self-confidently reclaimed the scientific and technological participation of their

84. Josephson, "Atomic-Powered Communism."

85. Hecht, *Being Nuclear*, 8.

86. Sembritzki, "Maiak 1957"; Geist, "Political Fallout."

87. Melanie Arndt and Laurent Coumel, "A Green End to the Red Empire? Ecological Mobilizations in the Soviet Union and Its Successor States, 1950–2000: A Decentralized Approach," *Ab Imperio* 20, 1 (2019): 105–124; Gestwa, *Großbauten*, 500–555; Jane I. Dawson, *Eco-Nationalism: Anti-Nuclear Activism and National Identity in Russia, Lithuania and Ukraine* (Durham: Duke University Press, 1996).

republics in the nuclear modernity acquired during Soviet times as part of their respective national awakening. This strategy was particularly understandable in Ukraine, which as Wendland observes contributed crucial intellectual and personal resources to the Soviet nuclear program and today has an energy system shaped by the nuclear power plants built during the Soviet era. Kazakhstan embraces nuclear energy on account of its status as the world's largest exporter of uranium. For its part, Belarus constructed a new nuclear power plant in an effort to achieve energy autonomy. As with Kazakhstan and Ukraine, however, this strategy was undermined by the country's intense dependence on Russian expertise and technology. Even a quarter of a century after the dissolution of the Soviet Union, its relationships between center and periphery live on.

Interdependencies across the blocs and the imperative of global presence

Several years ago, transnational and global history studies began to include the Cold War. Since then, a number of studies have questioned the metaphor of the "Iron Curtain" and its connotations of isolation, dichotomization and demonization.[88] It is true that the Cold War and its rivaling powers divided humanity after 1945 as rigidly as ever. At the same time, however, interdependencies across the blocs encouraged exchange at the transnational and global levels.[89] The world of the Cold War was, as the title of one study put it, "divided, but not disconnected."[90] In order to better address the resulting web of interrelations, scholarship must be liberated from the Procrustean bed of bipolarity shaped by Washington and Moscow. This means connecting the plotlines of the Cold War with those of modernization, decolonization, and globalization.[91]

The simultaneity of division and interdependence was what made the Cold War so complex. This is especially evident in the development of knowledge and

88. On the history of this term, see Patrick Wright, *Iron Curtain: From Stage to Cold War* (Oxford: University Press, 2007).

89. For an East European perspective, see Yale Richmond, *Cultural Exchange and the Cold War: Raising the Iron Curtain* (University Park, PA: Pennsylvania State University Press, 2003); Patrick Major and Rana Mittler, eds., *Across the Blocs: Cold War Cultural and Social History*, Special Issue, *Cold War History*, 4, 1 (2003); Sari Autio-Sarasmo and Katalin Miklóssy, eds., *Reassessing Cold War Europe* (London: Routledge, 2011); Simo Mikkonen and Pia Koivunen, eds., *Beyond the Divide: Entangled Histories of Cold War Europe* (New York: Berghahn, 2015); Simo Mikkonen et al., eds., *Entangled East and West. Cultural Diplomacy and Artistic Interaction during the Cold War* (Berlin: DeGruyter Oldenbourg, 2019).

90. Tobias Hochscherf, Christoph Laucht and Andrew Plowman, eds., *Divided, but not Disconnected: German Experiences of the Cold War* (New York: Berghahn, 2010).

91. See Akira Iriye, "Historicizing the Cold War", in Richard H. Immerman and Petra Goedde, eds., *The Oxford Handbook of the Cold War* (Oxford: University Press, 2013), 15–31; Akira Iriye, "Introduction," in Idem, ed., *Global Interdependence: The World after 1945* (Cambridge, MA: Harvard University Press, 2014), 3–9.

technology, where confrontation, competition, and cooperation existed side by side.[92] An examination of the constantly shifting balance between these modes of interdependence can provide important insights about the role science and technology played in international relations during the Cold War.[93]

Accordingly, the second section of this issue addresses the transnationalization of nuclear modernity and the imperatives of global presence that arose from it. This development began, as Mara Drogan explains in her essay, with the "Atoms for Peace" program that President Eisenhower announced in 1953. Characterized as an "Atomic Marshall Plan,"[94] the program sought to bring the world's nuclear market under Washington's control. In response, the Soviet Union felt that it too must deploy nuclear diplomacy to create hegemonic relations and new interdependencies. Roman Khandozhko's article on the Joint Institute for Nuclear Research (JINR) in Dubna argues that the Soviet Union established its own "international oasis" in high energy physics in order to keep Eastern Bloc states close. Dubna was also a place in which scientists could exchange ideas with Western colleagues and receive new knowledge through shared research. Proving the saying that "nothing awakens the ambition of the heart more than the trumpets of foreign glory," animosity and aversion as well as partnership and friendship forged ties between states during the Cold War.[95]

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92. Greiner, Müller and Weber, eds., *Macht und Geist*; Klaus Gestwa et al., eds., *Kooperation trotz Konfrontation: Wissenschaft und Technik im Kalten Krieg*, Special Issue, *Osteuropa*, 59, 10 (2009); Jeroen van Dongen, ed., *Cold War Science and the Transatlantic Circulation of Knowledge* (Leiden: Brill, 2015); Jenny Andersson and Eglė Rindzevičiūtė, eds., *The Struggle for the Long-Term in Transnational Science and Politics: Forging the Future* (Abingdon: Routledge 2015); Elena Aronova and Simone Turchetti, eds., *Science Studies During the Cold War and Beyond: Paradigms Defected* (New York: Palgrave Macmillan, 2016). The research group "Cooperation and Competition in the Sciences" at the University of Munich studies the tensions between cooperation and competition. For more, see https://www.kooperation-und-konkurrenz.geschichte.uni-muenchen.de [last accessed on 21.12.2019].

93. For more on this field, see Kai-Henrik Barth and John Krige, eds., *Global Power Knowledge: Science and Technology in International Affairs*, Special Issue, *Osiris*, 21 (2006); Naomi Oreskes and John Krige, eds., *Science and Technology in the Global Cold War* (Cambridge, MA: MIT Press, 2014); Maximilian Mayer, Mariana Carpes and Ruth Knoblich, eds., *The Global Politics of Science and Technology, vol. 1 and 2*, (Heidelberg: Springer, 2014); Charles Weiss, "How Do Science and Technology Affect International Affairs," *Minerva*, 53 (2015): 411–430; Birte Fähnrich, "Science Diplomacy: Investigating the Perspective of Scholars on Politics–Science Collaboration in International Affairs," *Public Understanding of Science*, 26, 6 (2017): 688–703; John Krige, ed., *How Knowledge Moves: Writing the Transnational History of Science and Technology* (Chicago: University Press, 2019). Since 2012 the journal *Science & Diplomacy* has investigated diplomacy in science and technology in international relations. In view of the growing interest in this area, some have even spoken of a "diplomatic turn" in the history of science. See Maria Rentetzi, "A Diplomatic Turn in History of Science," *History of Science Society Newsletter*, 47, 1 (2018): 12–14.

94. Stephen Twigge, "The Atomic Marshall Plan: Atoms for Peace, British Diplomacy and Civil Nuclear Power," *Cold War History*, 16, 2 (2016): 213–230.

95. See Jens Niederhut, "'Nichts erweckt den Ehrgeiz im Herzen mehr als die Posaune fremden Ruhmes': Die Wissenschaftsbeziehungen der DDR zum Westen," in Martin Aust and Daniel Schönpflug, eds., *Vom Gegner lernen: Feindschaften und Kulturtransfers im Europa des 19. und 20. Jahrhunderts* (Frankfurt am Main: Campus, 2007), 316–340.

The asymmetries of power arising from nuclear development assistance sometimes had disadvantageous consequences for the superpowers. The export of nuclear technology could lead to political disappointment, because the states supplying the technology often pursued objectives that were incompatible with those of the recipient nations. Mara Drogan illustrates this vividly in her study of the Philippines and Brazil, explaining that at the end of the 1950s the U.S. fundamentally reconsidered its nuclear diplomacy as a result of these divergences.

Individual countries cleverly knew how to manipulate the superpowers as they endeavored to outdo each other. One example was Yugoslavia. As Carla Konta shows in her essay, it leveraged the fact that both Washington and Moscow attached great geopolitical importance to its nuclear program to benefit from the dynamics of global market competition. Thanks to these maneuvers, Yugoslavia got the nuclear facilities and aid it needed from an assortment of countries, including, besides the two superpowers, France, Great Britain, Canada, Norway, and Czechoslovakia.

In his essay on the Romashka reactor, an experimental device developed for space satellites but never used, Fabian Lüscher argues that the project was crucial for the Soviet Union's global "impression management."[96] The Romashka reactor promised Moscow spectacular triumphs on both the nuclear and cosmic frontiers. Alongside these strong competitive motivations, the Romashka project was also shaped by willingness to cooperate. The scientists responsible for the project represented the Soviet Union at international working groups and symposia, such as the 1955 International Conference on the Peaceful Uses of Atomic Energy in Geneva and the Pugwash Conferences on Science and World Affairs, which have taken place regularly since 1957.

In contrast to nuclear diplomacy, which concentrates on relations between states, "nuclear internationalism" describes the process whereby scientists from different ideological systems shared important professional objectives and political values. As Fabian Lüscher, Roman Khandozhko, and Stefan Guth show in their essays, nuclear internationalism generated global epistemic communities whose universally recognized expertise granted them authority. They defined urgent problems and pressured states to develop solutions within global intergovernmental organizations.[97] Agreements such as the 1963 ban on nuclear weapons testing and the 1967 treaty on space exploration showed that despite all the nuclear saber rattling nuclear internationalists on both sides of the Iron Curtain used cooperation and reconciliation to keep the Cold War's potential for confrontation under control.[98]

96. Gestwa, *Großbauten*, 328.

97. Peter M. Haas, ed., *Knowledge, Power and International Policy Coordination* (Columbia, SC: University of South Carolina Press, 1992); Mai´a K. Cross, "Rethinking Epistemic Communities Twenty Years later," *Review of International Studies*, 39, 1 (2013): 137–160; Andrea Schneiker et al., eds., *Transnational Expertise, Internal Cohesion and External Recognition of Expert Groups* (Baden-Baden: Nomos, 2018).

98. Kai-Hendrik Barth, "The Politics of Seismology: Nuclear Testing, Arms Control, and the Transformation of a Discipline," *Social Studies of Science*, 33, 5 (2003): 743–781; Toshihiro Higuchi, "Atmospheric Nuclear Weapons Testing and the Debate on Risk Knowledge in Cold

Secrecy, publicity, and the framing of legacies

To be sure, efforts to see the Cold War less in terms of boundary and distinction and more in terms of the interactions between the blocs are expressions of today's zeitgeist. Studies of the interrelationships between East and West prior to 1989 show that what would merge by the end of the 20th century had already been converging through powerful industrial and societal processes. Nevertheless, phrases such as "the nylon curtain"[99] and "perforating the Iron Curtain"[100] make it easy to forget that the Cold War, for all its moments of opening and transparency, was also characterized by calculated efforts to withhold information and technology, part of what historians have termed the "knowledge control regime."[101] Michael David-Fox has thus described the Iron Curtain as a "semi-permeable" membrane. Understanding the real dynamics of the Cold War, therefore, requires examining the steering power of state security apparatuses along with the interplay of intense publicity and strict secrecy in science and technology.[102]

In Soviet nuclear modernity, the urge to broadcast technological success existed in tension with the need to protect sensitive information.[103] Even in the mid-1970s, the handbook issued by the censorship organ Glavlit forbade almost every unauthorized mention of nuclear technology.[104] Likewise, references to the Soviet ministry supervising nuclear industry were strictly taboo. The ministry, whose official name

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War America, 1945–1963," in John R. McNeill and Corinna R. Unger, eds., *Environmental Histories of the Cold War* (Cambridge: University Press, 2010), 301–322; Susanne Schattenberg, "Les limites du dicible: Les démêlés d'Andrej Saharov avec Hruščev et Brežnev," in *Cahiers du Monde russe* 54, 3–4 (2013): 441–466.

99. György Péteri, "Nylon Curtain: Transnational and Transsystemic Tendencies in the Cultural Life of State-Socialist Russia and East-Central Europa," *Slavonica*, 10 (2004): 113–123.

100. See Poul Villaume and Odd Arne Westad, eds., *Perforating the Iron Curtain: European Détente, Transatlantic Relations, and the Cold War, 1965–1985* (Copenhagen: Museum Tusculanum Press, 2010).

101. On this concept, see Stephen Hilgartner, *Reordering Life: Knowledge and Control in the Genomics Revolution* (Cambridge, MA: MIT Press, 2017). See also Ronald E. Doel, "Scientists, Secrecy, and Scientific Intelligence: The Challenges of International Science in Cold War America," in Jeroen Dongen, ed., *Cold War Science*, 9–35; Simone Turchetti, "A 'Need-to-Know-More' Criterion? Science and Information Security at NATO during the Cold War," in ibid., 36–58; Walter Gellhorn, *Security, Loyalty, and Science* (Ithaca: Cornell University Press, 2019).

102. See Michael David-Fox, "The Iron Curtain as Semipermeable Membrane: Origins and Demise of the Stalinist Superiority Complex," in Babiracki and Zimmer, eds., *Cold War Crossings*, 14–39.

103. See Oleg A. Bukharin, "The Cold War Atomic Intelligence Game, 1945–70," *Studies in Intelligence*, 48, 2 (2004): 1–11. See also the many references to regimes of secrecy in Holloway, *Stalin and the Bomb;* Brown, *Plutopia*; Cochran, Norris and Bukharin, *Making the Russian Bomb*.

104. See Glavnoe upravlenie po okhrane gosudarstvennykh tain v pechati pri Sovete Ministrov SSSR (Glavlit SSSR), ed., *Perechen´ svedenii, zapreshchennykh k opublikovaniiu v otkrytoi pechati, peredachakh po radio i televideniiu* (Moskva 1976), available online at http://novymirjournal.ru/images/cenzura/perechen1976.pdf [last accessed on 23.12.2019].

was the Ministry of Medium Machine Building, remained concealed behind its public fig leaf: the State Committee on the Utilization of Atomic Energy.[105]

In the Soviet Union as elsewhere, the keeping and sharing of secret knowledge satisfied important societal functions besides protecting sensitive information.[106] Secrecy, by establishing an exclusive group of people in the know, generated both social cohesion and segregation.[107] This applied not only to limits on the circulation of knowledge, which authorities regarded early on as an effective means of societal control.[108] Rather, as practices of secrecy expanded ever further into other areas of life in the post-Stalin era, they also developed popular and participative characteristics.[109] In Severodvinsk, all residents, even those who were not involved in the production of nuclear submarines, drew social capital from the aura of secrecy that shrouded the city.[110] In this way, the knowledge and imagination of secrets, along with their communication and concealment, became an indispensable part of the performance of Soviet life.

Galina Orlova, in her article, looks at "practices of simulation and dissimulation, the rhetoric of secretiveness or the strategies of hiding and revealing."[111] Specifically, she examines the secrecy practices of a radiochemical laboratory outside Moscow from the 1940s to the 1970s. She asks how concern about the control of nuclear knowledge both formed and deformed research. By determining how experiments were conducted, assessed, recorded and discussed, secrecy practices strongly influenced the production of scientific results, which in turn shaped the style of Soviet secrecy culture.

The social functions of shared or withheld secret knowledge also operated at the diplomatic level between states. The privileged sharing of expertise between

105. See Schmid, *Producing Power*, 50–51; Maria Vasilieva, *Soleils rouges: l'ambition nucléaire soviétique* (P.: Éditions Rive Droite, 1999), 178–180.

106. The classic study is Georg Simmel, "The Sociology of Secrecy and Secret Societies," *American Journal of Sociology*, 11, 4 (1906): 441–498.

107. See Koen Vermeir and Daniel Margócsy, "States of Secrecy: An Introduction," *British Journal for the History of Science*, 45, 2 (2012), 161.

108. In contrast to the post-Stalin era, much scholarship exists on censorship and secrecy in the early Soviet Union. See Arlen V. Blium, "Forbidden Topics: Early Soviet Censorship Directives," *Book History*, 1, 1 (1998): 268–282; Jonathan Bone, "Soviet Controls on the Circulation of Information in the 1920s and 1930s," *Cahiers du Monde russe*, 40, 1–2 (1999): 65–89; Jan Plamper, "Abolishing Ambiguity: Soviet Censorship Practices in the 1930s," *Russian Review*, 60 (2001): 526–544; Brian Kassoff, "Glavlit, Ideological Censorship, and Russian-Language Book Publishing, 1922–38," *Russian Review*, 74 (2015): 69–96.

109. See Asif A. Siddiqi, "Cosmic Contradictions: Popular Enthusiasm and Secrecy in the Soviet Space Program," in Andrews and Siddiqi, eds., *Into the Cosmos,* 47–76.

110. See Ekaterina Emeliantseva Koller, "The Cult of Secrecy as an Element of Community Cohesion and Commodity on Negotiations: The Case of the Closed City of Severodvinsk during the Cold War," in Xenia Vytuleva, ed., *Soviet Secret Cities During the Cold War* (New York: Harriman Institute Columbia University, 2012), 10–13.

111. Vermeir and Margócsy, "States of Secrecy," 160. See also Koen Vermeir, "Openness Versus Secrecy? Historical and Historiographical Remarks," *British Journal for the History of Science,* 45, 2 (2012): 165–188.

the nuclear powers while excluding other states generated trust during periods of relaxed tension. The paradoxical concept of "secret sharing," which emerged during the 1980s, describes strategies of concealment and revealment in the practices of secrecy.[112] Khandozhko, Lüscher and Guth provide many interesting observations about such cooperation in their contributions to this issue.

Practices of secrecy are not the only vestiges of the Cold War that have awakened scholarly interest in recent years.[113] The radioactive sites that nuclear modernity left behind represent the "radiant future" of a conflict that ended long ago.[114] The environmental pollution of the Cold War, much of which has yet to be cleaned up, makes vividly clear that the conflict produced many losers yet no victor.[115]

For this issue, Tatiana Kasperski takes the examples of the Mayak nuclear fuel plant in the Southern Urals and sites in the Artic to trace how thanks to Glasnost and other new forms of freedom in the 1980s and 90s NGOs such as the Bellona Foundation and Greenpeace began to take stock of the legacy of improperly stored nuclear waste in the Soviet Union. But even as international organizations worked to establish better disposal practices and protect the health of local residents, Russian officials, scientists and military leaders at the beginning of the 21st century began to "reframe" the problem of nuclear waste. As Kasperski explains, they no longer saw it as the horrible *legacy* of a regime that illegally dumped waste, devastating human beings and nature, but as the glorious *heritage* of a superpower. The

112. Raymond Hutchings, *Soviet Secrecy and Non-Secrecy* (Basingstoke – London: Macmillan, 1987), 26.

113. See Shaun Walker, *The Long Hangover: Putin's New Russia and the Ghosts of the Past* (Oxford: University Press, 2018). See also Mark Beissinger and Stephen Kotkin, eds., *Historical Legacies of Communism in Russia and Eastern Europe* (Cambridge: University Press, 2014); Sven Eliaeson, Lyudmila Harutyunyan and Larissa Titarenko, eds., *After the Soviet Empire: Legacies and Pathways* (Leiden – Boston: Brill, 2016); John Beck and Ryan Bishop, eds., *Cold War Legacies: Systems, Theory, Aesthetics* (Edinburgh: University Press, 2016); Konrad H. Jarausch, Christian F. Ostermann and Andreas Etges, eds., *The Cold War: Historiography, Memory, Representation* (Berlin: De Gruyter Oldenbourg, 2017); Karl Schlögel, *Das sowjetische Jahrhundert: Archäologie einer untergegangenen Welt* (München: C.H. Beck, 2017); Ivan Krastev and Stephen Holmes, *The Light that Failed* (London: Penguin, 2019).

114. See Florian Sprenger, "Atomare Hinterlassenschaften: Die strahlende Zukunft des Kalten Krieges," in Patrick Bernhard and Holger Nehring, eds., *Den Kalten Krieg denken: Beiträge zur sozialen Ideengeschichte seit 1945* (Essen: Klartext, 2013), 337–358. See also Michael Blouin, Morgan Shipley and Jack Taylor, eds., *The Silence of Fallout: Nuclear Criticism in a Post-Cold War World* (Newcastle upon Tyne: Cambridge Scholars Publishing, 2012); Barbara Rose Johnston, ed., *Half-Lives and Half-Truths: Confronting the Radioactive Legacies of the Cold War* (Santa Fe, NM: School for Advanced Research Press, 2007); Andrew Blowers, *The Legacy of Nuclear Power* (London – New York: Routledge, 2016); Laurel MacDowell, ed., *Nuclear Portraits: Communities, the Environment, and Public Policy* (Toronto: University Press, 2017); Anna Storm, Fredrik Krohn Andersson and Eglė Rindzevičiūtė, "Urban Nuclear Reactors and the Security Theatre: The Making of Atomic Heritage in Chicago, Moscow, and Stockholm," in Heike Oevermann and Eszter Gantner, eds., *Securing Urban Heritage: Agents, Access, and Securitization* (Abingdon: Routledge 2019), 111–129.

115. See Storm, *Post-Industrial Landscape Scars*; Bernd Greiner, Christian Th. Müller and Claudia Weber, eds., *Ökonomie im Kalten Krieg* (Hamburg: Hamburger Edition, 2010); McNeill and Unger, eds., *Environmental Histories of the Cold War*; J.R. McNeill and Peter Engelke, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge, MA: The Belknap Press of Harvard University Press, 2014).

resulting emphasis on military and industrial strength has rewritten the historical significance of Soviet nuclear modernity and again made it into a resource for authoritarian techno- and geopolitics. This reframing has been to the detriment not only of environmental activists, who have stood accused of espionage by the Russian government, but also, and most of all, local residents who despite all the euphemisms and promises continue to live in radioactive environments. Moreover, the Russian government has reintroduced practices of concealment and secrecy that have significantly rolled back the progress made by nuclear glasnost.

Susanne Bauer is another contributor to address the revealing continuities between the Soviet and post-Soviet eras in her article on the nuclear testing grounds in Semipalatinsk, Kazakhstan, where 118 atmospheric nuclear explosions took place between 1949 and 1989, including the first Soviet hydrogen bomb. Bauer examines four sets of epidemiological studies from the years 1958, 1978, 1992, and 2002 on the health effects of nuclear fallout. By comparing the relationship between knowledge and secrecy in each of those years, she finds that Semipalatinsk produced a form of risk analysis shaped by "Cold War rationality"[116] that to this day has left many in the region exposed to radiation.

Expertise gained from international cooperation, as Bauer also argues, has failed to take into account local knowledge. The scientific authority enjoyed by the epistemic community of nuclear experts has restricted the participation of affected residents. Indeed, the justified concerns of local populations have recently been pathologized as "radiophobia," a term coined by Soviet officials after the Chernobyl disaster.[117]

Although the political regime of the Soviet Union ended in 1991, Soviet nuclear modernity – owing to its powerful lobbyists, expansive infrastructure, and firmly established practices – endured in the Russian Federation. Its diverse manifestations represent more than "the fragments of an empire"[118] and "the ruins of socialism."[119] Both for its advocates and its victims, Soviet nuclear modernity still forms the foundation of their social world – this is the ultimate message conveyed by the essays in this issue's third section, as well as by many of the articles in the preceding two.

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Looking back at the history of Soviet nuclear modernity helps explain the dual strategy that Russia has pursued over the past two decades: on the one hand, it has sought to leverage the threat represented by its newly developed classes of nuclear weapons; on the other, it has sought to gain international influence through the

116. Paul Erickson et al., *How Reason Almost Lost Its Mind: The Strange Career of Cold War Rationality* (Chicago: University Press, 2013).

117. Magdalena E. Stawkowski, "Radiophobia had to be Reinvented," *Theory, Culture, Critique*, 58, 4 (2017): 357–374.

118. Schlögel, *Das sowjetische Jahrhundert*, 27.

119. Swetlana Alexijewitsch, *Secondhand Time: The Last of the Soviets* (New York: Random House, 2016).

construction and export of nuclear power plants.[120] The history of Soviet nuclear modernity also helps account for the controversy surrounding the recently launched *Akademik Lomonosov*, Russia's first floating nuclear power station, which nuclear lobbyists have touted as a technological marvel while nuclear critics have warned of a "floating Chernobyl."[121] From these fundamentally opposed positions we can trace a line back to Frederick Soddy's early-20th-century prediction: nuclear power is still seen as having the potential both to improve the world and to bring about its demise.

The ten essays collected in this volume not only deepen our understanding of the history of Soviet nuclear modernity. They also pave new ways for scholarship to approach the multitude of interrelationships between discourse and material reality, knowledge and power and thus to say more about the heterogeneity of the social world in the Soviet and post-Soviet eras. Grégory Dufaud and Larissa Zakharova's recent coedited issue on the history of Soviet science was dedicated to this task. The following pages continue their work by using the methods of STS to further explore an important "frontier of history."[122]

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120. See Schmid, "Of Plans and Plants," 137–138; Astrid Sahm, "Atomenergie in Ost- und Westeuropa: Reaktionen auf Tschernobyl und Fukushima," *Osteuropa*, 63, 7 (2013): 101–121; Tatiana Kasperski, "Nuclear Dreams and Realities in Contemporary Russia and Ukraine" in *History and Technology*, 31, 1 (2015): 55–80; Stefan Guth, "Atomstaat Russland," *Religion und Gesellschaft in Ost und West*, 44, 4 (2016): 24–27.

121. See, for instance, "Tickende Zeitbombe auf dem Meer," *TAZ*, 26.8.2019 (https://taz.de/Russlands-schwimmendes-AKW-startet/!5617723/); "Russian Floating Nuclear Plant Sets Sail amid a Sea of Concerns," *Bellona*, 18.11.2019 (https://bellona.org/news/nuclear-issues/2019-08-russian-floating-nuclear-plant-sets-sail-amid-a-sea-of-concerns); "World's First Floating Nuclear Plant Goes Online in Russia – Rosatom," *Moscow Times*, 19.12.2019 (https://www.themoscowtimes.com/2019/12/19/worlds-first-floating-nuclear-plant-goes-online-in-russia-rosatom-a68683) [all last accessed on 21.12.2019].

122. See Dufaud and Zakharova, *Science, Fiction and Power in the USSR.*