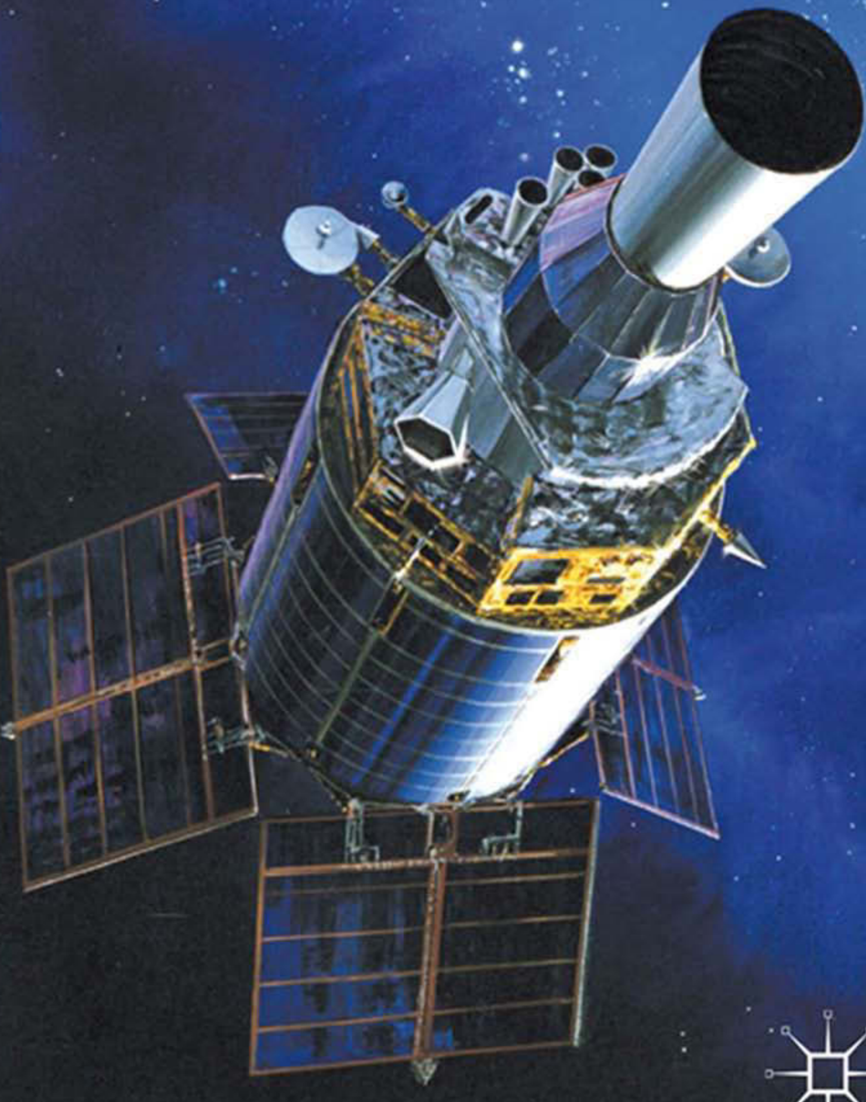
EDITED BY
SIMONE TURCHETTI & PEDER ROBERTS

THE SURVEILLANCE IMPERATIVE

Geosciences during the Cold War and Beyond



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Introduction

Knowing the Enemy, Knowing the Earth

Simone Turchetti and Peder Roberts

Surveillance is a subject on many lips. Thanks to Edward Snowden's revelations, commentators around the world have questioned if anything remains undetected by the surveillance networks set up by the world's most powerful nations. Documentation leaked by the former Central Intelligence Agency (CIA) contractor has revealed electronic ears and eyes spreading across the planet, enabling the rapid transfer of massive amounts of data to an army of intelligence operators, aided by some of the fastest computing machines on earth and their capacious hard drives. While emblematic examples such as German chancellor Angela Merkel's tapped Nokia handset evoke the gadget-oriented espionage of an early 007 movie, the sheer scale and sweep of the operations have caused the greatest concern for most members of the public. Not only has it become apparent how much private information transferred through mobile phones, e-mails, Web portals, and social networking websites can be tapped into by security agencies, but we now also know that intelligence operators do not always discriminate between enemies and allies in tapping operations—something that has come to light in the most embarrassing circumstances for the Obama administration.[1]

While the Snowden case has thus put in plain sight the truly global reach of surveillance operations and networks, the historical provenance of this powerful system of global monitoring continues to be virtually unknown. Watching over enemies (political and otherwise) has been an essential feature in the exercise of power since time immemorial, and knowledge of the earth and its resources has long been useful to statecraft: consider the strategic value possessed by the Map Room of Britain's Royal Geographical Society as late as World War II. But the transformation that took place during the Cold War involved putting the *entire earth* under surveillance, altering the scope, the nature, and above all the extent of scientific interrogation of the planet and its environs.

Both superpowers, especially the US administration, conceived the capacity to monitor the earth within a framework of control through strategic influence, without the need for explicit sovereignty over colonial spaces. This led to the establishment of infrastructures that routed signals from overseas outposts to central homeland units devoted to their analysis. Human communications were—and still are—a miniscule part in this traffic, which includes data from the oceans, the surface and interior of the earth, and the sky (and more recently celestial space) above it. So from the beginning of the Cold War onward, gathering new information on enemies or potential enemies has been intimately linked to gathering information about the earth.

Despite a recent flourish of studies on the relationship between states and the scientific research they patronized during the Cold War, especially in the United States,[2] surveillance is too often regarded as a discrete activity linked to concrete state aims rather than a more general imperative to understand and control both the earth and its inhabitants. Surveillance networks owe their existence, or at least their sophistication and extent, to the dramatic expansion of funding to the geosciences after 1945. Their contribution was decisive not only in making it possible to analyze the activities of potential enemies through traces upon the earth's environment, but also to understand that environment as an end in itself. In this light we might fruitfully think of environmental surveillance as a means to detect signals, packets of data that could be unpacked to reveal intelligence with value in multiple contexts.

The intimate connection between science and surveillance was neatly captured through *Sputnik*, the first artificial satellite to enter the earth's orbit and a powerful symbol of the central role of science and technology in Cold War strategies.[3] Artificial satellites had long been discussed as part of the International Geophysical Year (IGY, 1957–58), an event that simultaneously demonstrated the power of the geosciences to understand the whole earth (and its environs) and showcased competition as well as cooperation between the superpowers.[4] *Sputnik* not only provided a platform for observing the earth, but also created a new category of objects that themselves required surveillance as potential threats, in terms of both data collection and military strikes. This in turn stimulated the field of upper atmospheric research and the development of tracking technologies, in addition to sparking significant political debate and strategic deliberation.

Yet the *Sputnik* launch was only one aspect of a pervasive concern for understanding the earth, its ocean, and its atmosphere within the context of state security. How could the Cold War West establish an effective detection system for enemy missiles, having already invested massively in early warning systems for conventional aircraft? Could satellites detect sensitive military systems on the earth's surface and even in its oceans? Could the extent of sea ice be reliably forecast in order to supply Arctic bases? How could foreign nuclear tests be reliably located and identified? As this volume demonstrates, addressing these questions led chiefs of government and their scientific advisers to envisage modern forms of global surveillance and helped to establish the geosciences in Cold War strategic planning. Knowledge about the circulation of jet streams and ocean currents assisted in the improvement of antiaircraft defense and antisubmarine warfare measures. A major injection of funds into the study of earthquakes was premised explicitly upon the need to monitor underground nuclear tests.

Studies of the atmosphere, the oceans, and the inner earth thus coupled the desire of scientists to acquire new knowledge of the earth's features with the need to better know the enemy. As this knowledge had the potential to transform more traditional methods of surveillance, detection, and intelligence-gathering, the enormous influx of state funding for the geosciences during the 1950s and 1960s helped researchers to accumulate vast data sets and derive important new insights that furthered research agendas within specific disciplines, while also providing benefits—either directly or indirectly—for states. The chapters in this volume examine the rise of the geosciences during the second half of the twentieth century through the lens of this "surveillance imperative." Using surveillance as the central analytic concept and shifting the focus beyond American borders, the set of chapters that follow explain how a constellation of disciplines, namely the geosciences, benefitted from this search for novel means to monitor the enemy instigated by the confrontation between superpowers. Disciplines that eventually became imbued with "green" values—especially through environmental monitoring—flourished within a geopolitical context in which watching over enemy states and alliances was at least as important as the "assault on the unknown."[5]

The Surveillance Imperative

Surveillance has long been an important concept in historical and sociological analyses of science, technology, and society, from the philosopher and historian Michel Foucault's early study of penitentiaries to the historian and activist Mike Davis's more recent portrayal of CCTV-controlled Los Angeles.[6] The field of surveillance studies now has many of the trappings of disciplinary success, including university centers and departments, an international research network, and a burgeoning literature. The great majority of these works are concerned with the relationship between individuals and the states, armed forces, and corporations that desire to know, predict, and, perhaps most worryingly, control their actions.[7]

Yet in the earth and environmental sciences, surveillance typically does not connote the same sense of malevolent intent. A quick scan (we nearly wrote a survey) of recent literature reveals reference to the surveillance of coral reef fauna, the monitoring of marine conditions to assist navigation and quickly detect pollution, and the reconnaissance of territories potentially infested by disease-vector mosquitoes in the context of biomonitoring operations.[8] Observing a person, a citizen, or a politician carries a set of legal and moral concerns that do not exist for an iceberg or for the composition of the earth's mantle, despite the fact that each can produce information with relevance to statecraft. The uneasy relationship between technologies designed to ascertain facts about individuals and organizations of governance seems to fade when the targets of surveillance are objects rather than subjects, phenomena to be ordered through science rather than citizens within a polity. This distinction hinges upon the separation of the natural and the human, a distinction grounded in the possession of political agency, but which implicitly supposes that surveillance of objects is unproblematic because the consequences of that action are limited to the target. The interdependence of the human and the natural, and between the observer and the observed, is a reminder that putting a thing rather than a person under surveillance does not render the action politically neutral.[9]

The bifurcation between surveillance as the stereotypical Orwellian challenge to free society and as a set of seemingly innocent scientific practices that have to do with the gathering of environmental knowledge draws a moral distinction that obscures common origins. Since the Cold War, intelligence ambitions have been embedded in novel methods of scientific inquiry targeting the earth and its features rather than using human agents alone. The coupling of intelligence and scientific goals has also created the opportunity to pioneer new forms of environmental monitoring, as some of the chapters in this volume show.

Surveillance also remains an underutilized concept in analyses of the Cold War from both international relations and history of science perspectives. In 2001, international relations scholar Robert Jervis correctly identified the "security dilemma" as a key tenet of Cold War geopolitics, suggesting that "as each state seeks to be able to protect itself, it is likely to gain the ability to menace others."[10] Jervis has understood the ways in which security challenges were met mainly in terms of the expansion of military and nuclear capability rather than through the growth of information-gathering structures, but these too exemplify his point: competition for supremacy spread far beyond the confines of missile silos and armaments depots. Cold War policymakers and science planners devoted enormous resources to developing early warning and monitoring systems, and to developing the careers of scientists within disciplines from seismology[11] to physical oceanography[12]—many of whom relished the leverage they obtained over state patrons through the perceived strategic relevance of their own disciplines and the specter of other states leaping ahead within them due to greater resources.

The IGY was the preeminent example of a wider phenomenon. Surveillance of the planet through the lens of the geosciences involved prospecting foreign territories to determine the availability of strategic natural resources; reconnaissance overflights to chart military facilities and the geomorphology of potential combat sites; surveys and satellite programs to gather atmospheric, terrestrial, and oceanographic data; seismic observatories and atmospheric monitoring stations to detect nuclear tests; deep-ocean studies to facilitate submarine detection; and much more. Investment in such projects increased the amount (and diversity) of new knowledge about the earth as a whole, establishing an infrastructure for ongoing research and on occasion pushing rivals to counter with their own initiatives.

Several authors have related espionage and reconnaissance to the development of the Cold War earth sciences from different scholarly perspectives and these perspectives certainly have informed studies in the history of contemporary science and technology.[13] David van Keuren was correct to draw attention to the relationship between "science in black" (the world of classified knowledge production) and its open cousin, "science in white," citing the dual value of the abortive 600-foot diameter "big dish" in West Virginia for both radioastronomy and intelligence-gathering.[14] John Krige has highlighted the importance of international scientific meetings during the 1950s to assessing the state of science behind the Iron Curtain, not least in the field of atomic energy.[15] Our claim in this volume is that while specific incidents such as these cast valuable spotlights, the coexistence of scientific and intelligence ambitions should be regarded as ubiquitous rather than episodic. State support for the earth sciences recognized the value of the earth itself to Cold War strategy—that the quest to obtain information for state advantage involved interrogating the planet in addition to spying on those who inhabited its surface.

As the earth was placed under surveillance through the gaze of the geosciences, state strategy provided both context and motivation.[16] Competition between states, as much as collaboration between them, provided the fuel for research. Alan Needell has shown that during the 1950s, the American physicist and science administrator Lloyd Berkner vigorously advocated for improved US surveillance of its military rivals while acting as a key organizer of international geophysical research.[17] Berkner insisted that his country respond to the Soviet nuclear threat through aggressive stances based on intelligence gathering, monitoring, and reconnaissance, materialized for instance in new radar-based interception systems such as the Distant Early Warning (DEW) Line (see Figure 6.2, p. 130).[18] Such concerns also shaped Berkner's vision for the IGY: international scientific endeavors of such a magnitude offered a wealth of new data on foreign environments and scientific activities.

The chapters in this volume demonstrate that the growth of the geosciences in Western Europe, in addition to North America, was to a considerable extent driven by a security dilemma in ways beyond those described by Jervis. State demands for increased vigilance were manifested through a range of research programs from covert national missions to open international collaborations. A new perspective may thus be gained upon the history of the earth and environmental sciences during the Cold War—and beyond—by using surveillance as a conceptual linchpin, and by foregrounding the international and transnational dimensions of the geosciences during these years.

Beyond the National

The term "transnational" emphasizes flows across borders, connecting simultaneous, often coproduced developments in different national contexts.[19] Natural resource extraction frequently involved state or multinational actors operating in territory far from corporate headquarters, feeding markets around the world. Events such as the IGY were international in the sense that individuals and groups acted on behalf of state sponsors within the overall frame of a larger collaboration, but also transnational in the sense that such events helped furthering research in certain areas of the earth, notably Antarctica, as targets for investigation uniting different national groups, regardless of sovereignty claims. Secrecy nevertheless occupied a central role in practices across the spectrum of the geosciences. As Michael A. Dennis has argued, secrecy shapes research environments across academic and industrial domains, structuring the process as well as the dissemination.[20] A transnational perspective captures the cross-border nature of the surveillance imperative and its role in sparking activity in different states: developments within one national context were often directly related to developments in another, for reasons of political as much as intellectual rivalry.[21] While the superpower face-off was the most prominent example, we emphasize that such rivalries involving European states—and their former imperial territories—could also be powerful drivers for the Cold War geosciences. Despite this fact, existing work on North American–Western European scientific relations during this period has focused only briefly on the geosciences, and far less has been written on Western Europe and its crumbling empires than about the superpowers.[22]

A transnational approach also enables us to revisit the role of science as an instrument of political power through the tail end of the long history of European imperialism, bringing the years of decolonization into the same historiographic conversation as the heyday of science as a handmaiden of empire.[23] The function of science as an instrument of European imperial authority, like the structures of early twentieth-century international science with their focus on national delegations, reflected a "realist" view that recognized the nation and its interests as the fundamental frame for political action.[24] After 1945 it quickly became clear that the pre-1939 status quo, with its inscription of European nationality upon global political geography, no longer corresponded to the emerging superpower-dominated world order. US policymakers, diplomats, and scientists alike regarded geophysical knowledge as a powerful tool to gain knowledge of foreign environments in order to facilitate their control, without necessarily involving territorial annexation.

The growth of the geosciences and the pursuit of global surveillance not only overlapped, but were also mutually reinforcing. The establishment of scientific outposts in far-flung lands, the collection of data from satellites, and the intensification of research on the high seas led to the collection of geophysical data on a truly global basis. In some cases, such as the monitoring of foreign nuclear tests, establishing friendly relations with foreign governments made it possible to covertly foster monitoring projects. Of course, the covert ambitions of earth data collection programs were not distinctive of the US intelligence community alone: most notably, Soviet and British intelligence had similar ambitions. Yet no other state could afford to promote these programs to the same extent. By contrast, despite the continued assertion by many European politicians (especially Charles de Gaulle)[25] that the nation-state remained the natural unit of political authority, the years after 1945 saw a decline of formal European imperialism. Intra–Western European integration through political-economic organizations such as the European Coal and Steel Community and Euratom was also manifested through scientific bodies such as CERN (the European Organization for Nuclear Research).[26] Successive US administrations encouraged these integration projects and sought to align them with the United States's own national interests, as integration in broader alliances strengthened its role as the Machiavellian Prince of the Cold War world.[27] John Krige has famously argued that during the Cold War, the funding of new research programs in Europe helped American patrons to forge cultural synergies across the Atlantic and spread American values, thus setting the conditions for alliances that embedded political and military goals within a common cultural and economic stratum.[28]

The goal of fostering European integration did not preclude the United States from acquiring classified data from these allies with direct relevance to military or economic goals, either in the 1950s and 1960s or indeed the present—as the Snowden revelations demonstrate. Interactions with European partners were often informed by such knowledge. We learn in this volume that a number of undercover US agents were dispatched to European territories to monitor deposits of strategically important natural resources such as oil and uranium, and to gain information on the intentions of corporations and governments. These activities blurred the distinction between scientific experts, diplomats, and intelligence agents as their roles became contiguous and, at times, overlapping. Such data helped the US government evaluate requests for assistance or collaboration from European partners in fields where the United States often competed with European states for access to resources and profits. US science administrators quarantined more sensitive scientific data (for instance, on nuclear weapons and Soviet nuclear tests), making them accessible only to a few allies. Data from the geosciences thus functioned as valuable commodities in terms of building American political and economic strength, and in turn validated the importance of the geosciences more generally.

It is worth dwelling further on the dual role of data from the geosciences as sources of privileged information and avenues for collaboration across national borders. Monolithic interpretations focused on superpower decision making miss the often-messy relations within (and occasionally across) Cold War geopolitical alliances.[29] As recent revelations of American spying upon the leaders of friendly states reminds us, surveillance of the political world is almost as pervasive as surveillance of the natural world. New security challenges could be catered for and collaborative deals offered that might provide mutual benefit—though the stronger party inevitably set the terms for exchange.[30] Secretive transfers of environmental knowledge stirred tensions in Europe, as described by Roberto Cantoni and Leucha Veneerin in this volume (Chapter 2), exacerbated by the ongoing process of decolonization and its attendant challenges to established political and economic systems. While bonds with research communities in the United States enabled European scientists to access additional support (intellectual and material), erstwhile imperial powers maintained or even sought to expand their scientific presence in many former colonies.

As newly decolonized states joined bodies such as the United Nations Educational, Cultural and Scientific Organization (UNESCO) and the International Council of Scientific Unions (ICSU), the quest to know and control regions from the poles to Africa and Asia continued apace.[31] The bonds of empire continued to be relevant, as in the case of geological prospecting in Africa, but claims to national authority were complicated both by the global ambitions of the superpowers and rivalries between European states. Italy undermined France's control in North Africa by letting Italian firms offer scientific information on oil deposits to Algerian rebels, for instance, while cooperative uranium prospecting in Europe and Africa alternated between uniting and dividing the atomic research organizations of France, Italy, Spain, and the United States.[32]

Equally, the existence of internationally structured scientific events was often (perhaps invariably) consistent with the military-strategic goals of states in addition to the research agendas of scientists. Propagandized as an enlightened event that bucked the confrontational atmosphere of the early Cold War, the IGY nonetheless straddled the military/civilian domains by instigating studies coupling science with intelligence work.[33] When Soviet research groups began transmitting reports to international IGY organizations from 1955, the United States IGY Committee promptly forwarded this information to State Department and the CIA's Office of Scientific Intelligence. Intelligence reports on Soviet advances in oceanography, meteorology, and rocketry were subsequently shared with other states, enhancing policymaking but also helping scientists in the Cold War West to demand increased expenditures premised on the need to compete.[34] Nor did the accumulation of vast, openly accessible data sets at the official World Data Centers mean the data within held equal value to all states. As Jacob

Hamblin has pointed out in the case of oceanography, the United States recognized that because global data sets were so much more valuable than the partial sets it could acquire through its own resources, international data sharing was to its military advantage—even if this meant providing data to rivals.[35] Global data held greatest value to states with ambitions to global power.

The most notable event of the IGY—the *Sputnik* launch—renewed fears among scientists and politicians alike in the Western bloc that the Soviet Union had achieved supremacy in key fields of science and technology. The crisis that *Sputnik* precipitated focused American minds on the importance of science and ensured new funding opportunities for the geosciences—not least through the North Atlantic Treaty Organization (NATO), which could mobilize European scientific cooperation in addition to boosting capacity in strategically useful fields. A good example was, again, oceanography. NATO entrusted European experts with conducting surveys in the Atlantic and the Mediterranean, with a particular focus on areas with direct relevance to antisubmarine warfare strategies, such as the Straits of Gibraltar and the Faroe-Shetland Channel.[36] Cooperation on the acquisition of strategically relevant scientific data took place despite continued disputes between American and British naval officials about how those spaces should be patrolled.

By considering surveillance in both scientific competition and collaboration, and examining in greater detail the flow of scientific knowledge across and beyond national borders, the chapters in this collection thus go beyond the narrative of escalation defined by nuclear deterrence or the "two scorpions in a bottle" scenario.[37] While few could deny that the Cold War was a conflict between two distinct blocs, the historical examples discussed in this volume complicate the picture in interesting ways, providing new perspectives on the strategic value of the earth sciences within the ever-changing historical landscape of the Cold War conflict—and into the present.

From Science in Khaki to Science in Green?

The surveillance imperative contributed to a new image of the earth as a series of systems (and even, some would argue, as a single system). As Robert Poole shows in this volume (chapter 10), by the 1970s space missions had returned a wealth of data, including photographic images that revolutionized our previous understanding of the earth and resonated with an emerging environmental consciousness.[38] Along with important new research in fields such as atmospheric chemistry (such as the Keeling curve), this consciousness contributed to a reassessment of research priorities in the earth sciences, which increasingly came to be associated with the green of modern environmentalism rather than the khaki of military science. Ronald E. Doel has demonstrated that the growth of the geosciences in the United States after 1945 environmental sciences was strongly linked to military strategy, knowledge of the earth's surface an essential prerequisite for controlling it.[39] Manifested also far beyond the borders of the United States, this trend emphasized the power of a global scientific vision.

Paradoxically, the surveillance imperative that thrived in the context of superpower competition helped create an image of the earth as a fragile, complex entity and to highlight the power of human agency to harm the planet. The goals of earth scientists were aligned with those of states during the Cold War—especially in its first two decades—while also providing a conceptual thread to the present, where knowledge of the earth and its systems has become central to debates about climate change. As Naomi Oreskes has put it, military funding contributed to "a period of unprecedented scientific productivity" in the earth sciences that must be located within the context of the times: "military concerns were naturalized, and the extrinsically motivated became the intrinsically interesting."[40] The word "state" might be used with equal effect instead of the word "military." The wide range of relationships that contributed to that burst of productivity in some cases persisted through the later part of the century. In many cases, this took the form of continued active support, but in others new research agendas could be developed upon infrastructure made possible by lavish Cold War funding. Notably, Paul Edwards's comprehensive study of the history of climate science reveals the close relationship between technologies of surveillance and the theories that allowed scientists to make use of them for constructing climate models throughout the twentieth century.[41]

This question of infrastructure invites a reexamination of a hoary question: whether military funding, particularly in the post-1945 United States, distorted science from its "true" trajectory or "generously supplemented pre-existing trajectories."[42] The former position, advocated most notably by Paul Forman and Stuart Leslie, requires proof of deviation from a "natural" research path.[43] The case is at best difficult to prove (though Forman marshaled compelling evidence in the context of quantum electronics research) and at worst nearly impossible, given the reliance upon proving divergence from an inherently hypothetical path. Like Kai-Henrik Barth, Ronald E. Doel, Naomi Oreskes, and (we strongly suspect) the majority of scholars working today, we lean toward a more nuanced position that preserves agency for scientists while emphasizing the importance of patronage in shaping the environments within which research questions are chosen and investigation conducted.[44]

As the term "distortion" implies, arguments about the extent of the military's role in shaping the research it sponsors are inevitably also loaded with claims to moral and intellectual superiority, a question of "who was using who?" accompanied by a whiff of skepticism about how much the science was thus by definition compromised. Links between basic research and specific applications are notoriously difficult to predict, and the post-1945 earth sciences offer particularly strong examples of military funding being used on research that produced immense advances in fundamental scientific understanding, most notably the theory of plate tectonics.[45] Military funding was a topic of contention among scientists from the outset of the Cold War,[46] but the difficulty of determining how research deviated from a hypothetical "natural" trajectory leads us to prefer questions about the trajectory that we *do* know of—the geophysical sciences becoming associated with a form of environmental surveillance that today is widely considered as a force for good.

Whether or not the military distorted the earth sciences, some of its key players sought to harness the tools and training they gained thanks to generous postwar funding to explicitly environmental problems. Partly this was serendipity; as Sebastian Grevsmühl (chapter 8) demonstrates in this volume, satellites designed to address defense research problems could aid in the assessment of meteorological and ice conditions, providing valuable data on warming in the polar regions. The deliberate effort of Cold War planners to train earth scientists produced new generations of scholars who directed the surveillance imperative toward environmental monitoring, most notably of climate change. An independent British scientist, James Lovelock, exchanged views with CIA and MI6 officials on how to find people by covertly labeling them with chemical compounds and then using a device to detect its presence. On his way to the United States, where he was to report on his surveillance gizmo, Lovelock met with NASA's Dian Hitchcock and their collaboration would break new ground in the understanding of the earth as a system also chiming with the environmental discourse (as Poole shows in chapter 10).[47] Individual careers in Europe as well as the United States can reveal such transitions clearly. To take but one example, the Norwegian physical oceanographer Ola M. Johannessen began his studies under Håkon Mosby—a key figure in NATO's oceanographic community—and spent time at the NATO Supreme Allied Command Atlantic Anti-Submarine Warfare Centre at La Spezia in Italy, before leading a number of large-scale environmental monitoring projects and founding the Nansen Environmental and Remote Sensing Center in Bergen, Norway. Johannessen's career path is not particularly unique and indeed mirrors the institutional milieu in Bergen, where NATO money helped reinvigorate a world-renowned hub for geophysical research that suffered with Norway's relative poverty after 1945.[48]

These transitions from "khaki" to "green" do, however, present problematic issues. Naomi Oreskes and Erik Conway have recently documented how a small group of "Cold Warriors" hindered the acceptance of climate change research that they considered politically problematic.[49] Their work is in some ways a rejoinder to accusations by climate change deniers that research into global warming is an attempt to extract money from states under false pretenses—a position taken seriously by a disturbing number of political figures.[50] Yet so much of the infrastructure (material and intellectual) that underpins modern climate research grew out of the Cold War and the strategic decisions made by science administrators such as Lloyd Berkner and Frederick Brundrett and statesmen such as Dwight D. Eisenhower and Charles De Gaulle.[51] Meteorology and atmospheric research, holding the promise of accurate weather prediction but potentially also control of weather systems,[52] have come to underpin both our understanding of climate change processes and dreams of geoengineering projects to ameliorate those changes. The hubristic belief that global surveillance could lead to global-scale intervention had great appeal to military planners half a century ago, and a similar faith can be seen today.[53]

Finally, the use of artificial satellites to chart major environmental changes (deforestation, for instance) was the result of lobbying in the US Congress and elsewhere for the release of hitherto classified data.[54] But, as Roger Launius shows in this volume (chapter 7), the question of how far the US surveillance state could develop in the future thanks to spy satellites is yet to be answered. Since an increase in surveillance is often accompanied by the deployment of new weaponry, Launius argues that even space, the last frontier of surveillance, may not escape weaponization. The dual power of satellites to know the enemy and to know the earth is to a significant extent replicated in unpiloted aircraft (drones), which have come to symbolize the new face of warfare while also being touted as flexible and powerful surveillance platforms, for good or ill.[55]

Perhaps the more difficult question is how the political transitions toward the end of the Cold War connected to the emergence of new political priorities, including the monitoring of environmental changes. While full historical assessment awaits the release of further archival evidence, it seems clear that from the 1970s traditional Cold War urgencies embraced new environmental problems. Following President Richard Nixon's "environmental diplomacy," NATO supported a new program on the Challenges of Modern Society, which sought to offer solution to problems such as air and sea pollution.[56] The scientific shield that the defense alliance wielded seemed now to offer protection to the planet as much as the Cold War West, invoking a discourse of environmental security that remains prominent today. While Nixon's attempt was met with resistance, similar efforts led to the creation of the United Nations Environment Programme (UNEP), which has pushed for global environmental policymaking.[57] As Soraya Boudia shows in this volume (chapter 9), new systems of environmental monitoring adopted in the UNEP context drew on existing surveillance networks, replicating similar attitudes toward scientific and technological prowess and the importance of amassing an arsenal of environmental data. And in the final years of the Soviet Union, Mikhail Gorbachev embraced environmental monitoring as a tool of international cooperation in the Arctic, leading to the Arctic Environmental Protection Strategy and helping prepare the ground for contemporary initiatives in the region such as the Arctic Council.[58]

The surveillance imperative proved equally useful for detecting the enemy and for protecting the planet, either from the threats of military enemies—culminating in the mooted Strategic Defense Initiative (aka the "Star Wars" program)—or from modern industrial civilization more generally. The power of surveillance to know nature, and thus to facilitate its control must not be underestimated, or the technology regarded as unproblematic simply because the cause of environmental monitoring is regarded as enlightened. Just as powerful tools of surveillance such as CCTV cameras in modern cities have rightly been located within discourses of political control,[59] knowing the environment remains a critically underestimated source of power, moral as well as practical, for decisions on the future of the planet and its inhabitants, human and otherwise. The capacity of technologies to furnish information can serve to naturalize political decisions when the uses to which that information is put become reduced to inevitable outcomes of technological development. Critical and historically aware analyses of the origins of modern environmental monitoring technologies are essential to understanding why as well as how such technologies have been adopted, and to ground informed decisions on their usage: as Melvin Kranzberg famously put it, technology is neither good nor bad, but neither is it neutral.[60]

Seen from one perspective, the possibility of truly global environmental monitoring has enabled a problem caused by actors within specific geographic contexts—notably the traditional European empires, but also the Cold War superpowers and new industrial giants such as China—to become regarded as a global political responsibility. This is good inasmuch as it confirms the effect of local actions upon global stages, with potentially catastrophic consequences at the planetary scale, but the history of asymmetric contributions to environmental damage—disproportionately the responsibilities of rich countries and former imperial powers—risks becoming obscured.[61] Pointing to the severity of the current crisis and its potential consequences has failed to produce significant action in the rich world while providing arguments for restraining industrial development elsewhere, and thus potentially entrenching injustice.

Moreover, the disjuncture between acceptance of data indicating climate change and acceptance of the possibility of remedial action has fostered narratives of inevitability, rendering human agency secondary to environmental change. Nowhere is this clearer than in the Arctic, where retreating sea ice and glaciers are painted as necessarily leading to increased shipping and extractive industry, as though the climate has assumed the power of political decision making. Such perspectives reflect the considerable inertia of the hydrocarbon economy but also the frame through which the neoliberal gaze views the global environment. The threat of global environmental catastrophe can be mobilized to justify global restraint, despite the fact that imperial powers exploited global energy resources before, during, and after the Cold War and used them to grow rich while polluting the planet. Asymmetries in power derived from history thus can fade from view, especially when many of the most severe effects of global climate change are likely to be felt by those least able to cope.

The converse problem is even more troubling. If the consequences of climate change are deemed incompatible with the political and economic goals of the rich world, data that might be incorporated into a narrative of inevitable progress becomes an obstacle to be challenged. Spells of cold weather in specific locations still lead individuals to claim that local experience contradicts global warming narratives: oddly enough, such claims tend to be made by those with political views most hostile to global environmental regulation.[62] Others have argued that organized climate change skepticism amounts to disinformation campaigns based on ideology rather than facts—with similarities to tactics used by the tobacco industry.[63] To label this the politicization of a neutral process is simplistic: the political character of *all* research findings is latent, and moments of conflict reveal rather than create this condition. Today perhaps more than ever, understanding the relationship between the geosciences and the global surveillance imperative is crucial to risk perception and thus to informed decision making.

Structure of the Volume

The book is divided into five sections, each focusing on a different aspect of the surveillance imperative and the Cold War earth sciences. The chapters highlight how new surveillance priorities informed the rise of specific disciplines and fields of expertise while also molding new images of the earth.

The first section, Surveillance Strategies to Control Natural Resources, considers how geophysical prospecting methods were enrolled in the shifting geopolitical dynamics of post-1945 Europe. The concept of resource security possessed both domestic and foreign dimensions, posing challenges to existing networks of colonial influence within the overarching shadow of the nuclear-armed superpowers.[64] Oil was critical to domestic stability and national economic prosperity in addition to military capacity. As Roberto Cantoni and Leucha Veneer (chapter 2) demonstrate, ensuring its discovery and delivery was a matter of state interest in both France and Britain. The search for uranium involved even more intensive state surveillance, a topic investigated by Matthew Adamson, Lino Camprubi, and Simone Turchetti (chapter 1). From the late 1940s the US government viewed attempts by other states to locate uranium reserves as a potential threat to its own security, and the United States Atomic Energy Commission sponsored intelligence work to seek and control sources in other countries. As the demand for strategic resources like oil and uranium grew, geoscientists developed new radioactivity-based methods for mapping the earth and its mineral contents.[65] This reinforced the image of the earth as a storehouse of resources, an enduring theme in European geographical and geopolitical thought that developed in concert with the view of the world as a space to be known and then controlled. Deploying ever more sophisticated techniques to interrogate the earth was a central component of state planning for both international conflict and domestic security.

The second section, Monitoring the Earth: Nuclear Weapons Programs, examines atmospheric and seismological surveillance of the geophysical traces of nuclear testing. Effective surveillance required both theoretical knowledge and an extensive network of monitoring stations. At the same time, questions that previously held primarily academic interest—from the early uses of radionuclides as tracers to the nature of the earth's interior and ways to transmit seismic waves—became fields in which state strategic interest made intelligence agents of scientists. As Néstor Herran (chapter 3) shows, the recognition that atmospheric radioactivity could have significant public health consequences prompted the creation of international networks devoted to its measurement. But radiological techniques also played a key role in gathering information on foreign nuclear weapons programs, leading to concerns at the highest level of state administration over what could or could not be divulged in scientific meetings without jeopardizing national security. The 1963 Partial Test Ban Treaty banned atmospheric explosions, establishing the importance of underground tests—and the seismic methods that could detect them, as shown by Simone Turchetti (chapter 4).[66] Openly stated goals to ban nuclear tests were thus coupled with more secret ambitions such as knowing, in the context of official meetings, the level of enemy expertise in seismic analysis. The planet came to be perceived as a signals transmission device, with the results of seismic analysis relevant to both intelligence-gathering and the advance of academic research agendas.[67]

The third section, Seeing the Sea—From Above and Below, examines how the surveillance imperative shaped oceanography and sea-ice research during the 1950s. In addition to boosting surveillance of the earth through geophysical research, geoscientists themselves became objects of interest due to their specific expertise, even as events such as the IGY reinforced the advantages to the superpowers of open data sharing. Sam Robinson (chapter 5) reconsiders the problem of relations between "special" allies by examining conflicts between British and US naval leaders over military strategy in the North Atlantic, and the role of oceanographic surveillance in underpinning such strategies. Open collaboration helped produce large-scale data sets, but it did not dictate either shared visions for how that data would be used or even how it should be acquired.

Peder Roberts (chapter 6) explores how charting and forecasting sea ice became a major concern for North American military planners after 1945, as the Arctic became an important potential military theater—and its waters became vital supply lanes for both superpowers. Observations of sea ice across the Northern Hemisphere, both historical and contemporary, became crucial foundations for accurate forecasting, and for the development of predictive techniques. The perceived strength of Soviet researchers in this field made knowledge of their techniques strategically important. Placing the Arctic under surveillance included picking the brains of those who studied it, and assessing the strength of enemy research capacity.

The fourth section, Surveillance Technologies, considers how new technologies were used to produce and establish new images of the earth from space. Roger Launius (chapter 7) reconstructs the history of satellite deployment and its underlying surveillance dimensions, arguing that surveillance was in fact the driver behind technological innovation in the satellite field. Sebastian Grevsmühl (chapter 8) contends that in addition to their initially envisaged uses for espionage and communications, satellites quickly evolved in unexpected ways to become resources for assessing environmental conditions and performing global environmental monitoring. The relationship between satellite imagery and conceptions of global systems is a particularly striking illustration of the surveillance imperative's connection with modern environmental consciousness. No longer just a medium for processing and interpreting otherwise obscure signals providing information about Cold War enemies, the earth became, through the interpretation offered by newly available photographic evidence, the fragile system that we are more familiar with.

The final section, From Surveillance to Environmental Monitoring, takes up the connection between surveillance and environmental consciousness with analyses of new global systems (of both monitoring and thought). Robert Poole (chapter 10) examines the impact of photographs of the earth from space in framing perceptions of the earth as a global system, from the IGY to *Apollo* and beyond. In addition to providing data with application for both civilian and military statecraft, images from space helped create a new mindset toward the earth as a discrete entity, the possibility of surveying it as a whole unit augmenting the fragility revealed by the "blue marble" *Apollo* images. These images fueled the ongoing shift from traditional surveillance monitoring practices adopted at global level to the creation of new systems for environmental monitoring, and to a new set of international organizations, a story picked up by Soraya Boudia (chapter 9). The Global Environmental Monitoring System (GEMS) has come to embrace a range of technological systems across a broad transnational framework, encompassing issues from water quality to biodiversity to atmospheric chemistry. With its roots in the drive to place the earth as a whole under surveillance, GEMS represents both the evolution and culmination of a process that has persisted from the Cold War into the present.

Notes

1. Ian Traynor, Philip Oltermann, and Paul Lewis, "Angela Merkel's Call to Obama: Are You Bugging My Mobile Phone?" *The Guardian*, October 24, 2013.

2. See, among others, Ronald E. Doel, "The Earth Sciences and Geophysics," in John Krige and Dominique Pestre (eds), *Companion to Science in the 20th Century* (London: Routledge, 2003), 391–417; Kai-Henrik Barth, "The Politics of Seismology: Nuclear Testing, Arms Control and the Transformation of a Discipline," *Social Studies of Science* 33:5 (2003): 743–781; Jacob Darwin Hamblin, *Oceanographers and the Cold War: Disciples of Marine Science* (Seattle: University of Washington Press, 2005); James Roger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010); Doel and Naomi Oreskes, "The Physics and Chemistry of the Earth," in Mary Jo Nye (ed.), *The Cambridge History of Science*, Vol. 5 (Cambridge: Cambridge University Press, 2012), 538–557.
3. On *Sputnik*, see for instance Rip Bulkeley, *The Sputniks Crisis and Early United States Space Policy: A Critique of the Historiography of Space* (London: Macmillan, 1991); and John M. Logsdon, Roger Launius, and Robert W. Smith (eds), *Reconsidering Sputnik: Forty Years Since the Soviet Satellite* (London: Routledge, 2000).
4. On the IGY, see, for instance, Walter Sullivan, *Assault on the Unknown. The International Geophysical Year* (New York: McGraw-Hill, 1961).
5. This is the term coined by journalist Walter Sullivan to describe the IGY. See ibid.
6. Michel Foucault, *Discipline and Punish* (New York: Pantheon, 1977); Mike Davies, *City of Quartz: Excavating The Future in Los Angeles* (New York: Verso, 1992); and more recently Torin Monahan (ed.), *Surveillance and Security: Technological Politics and Power in Everyday Life* (Abingdon: Routledge, 2006).
7. A general survey is in Kirstie Ball, Kevin Haggerty, and David Lyon (eds), *Routledge Handbook of Surveillance Studies* (Abingdon: Routledge, 2012). A list of relevant centers devoted to surveillance studies is in www.surveillance-studies.net (accessed January 20, 2013). For a thoughtful reflection on the state of the field, see also Kirstie Ball and Kevin Haggerty, "Editorial: Doing Surveillance Studies," *Surveillance & Society* 3 (2005): 129–138 (available at: www.surveillance-and-society.org/Articles3(2)/editorial.pdf, accessed January 20, 2013).
8. M. Dirnwoeber, R. Machan, and J. Herler, "Coral Reef Surveillance: Infrared-Sensitive Video Surveillance Technology as a New Tool for Diurnal and Nocturnal Long-Term Field Observations," *Remote Sensing* 4:11 (2012): 3346–3362; D. G. M. Miller, N. M. Slicer, and Q. Hanich, "Monitoring, Control and Surveillance of Protected Areas and Specially Managed Areas in the Marine Domain," *Marine Policy* 39 (2013): 64–71. On biomonitoring, see for instance: National Research Council, *Human Biomonitoring for Environmental Chemicals* (Washington DC: NRC, 2006).
9. For an analysis of the interdependence between observer and observed in the case of the first photographs of the earth from space, see Robert Poole, *Earthrise: How Man First Saw the Earth* (New Haven, CT: Yale University Press, 2010).
10. Robert Jervis, "Was the Cold War a Security Dilemma," *Journal of Cold War Studies* 3 (2001): 36–60. See also Charles L. Glaser, "The Security Dilemma Revisited," *World Politics* 50 (1997): 171–201; and Alan Collins (ed.), *Contemporary Security Studies* (Oxford: Oxford University Press, 2007), 18.
11. See for instance Turchetti, this volume; Barth, "Politics of Seismology."
12. See, among many others, Ronald E. Doel, Tanya J. Levin, and Mason K. Marker, "Extending Modern Cartography to the Ocean Depths: Military Patronage, Cold War Priorities, and the Heezen–Tharp Mapping Project 1952–1959," *Journal of Historical Geography* 32 (2006): 605–626; Hamblin, *Oceanographers and the Cold War*; Ronald Rainger, "Constructing a Landscape for Postwar

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13. See, for instance, important contributions to science studies such as David H. DeVorkin, *Science with a Vengeance: How the Military Created the US Space Sciences after World War II* (London: Springer, 1993). Other contributions from intelligence studies include: Jeffrey Richelson, *Spying on the Bomb: American Nuclear Intelligence from Nazi Germany to Iran and North Korea* (New York: W.W. Norton & Co., 2006); Charles A. Ziegler and David Jacobson, *Spying Without Spies: Origins of America's Nuclear Surveillance System* (Westport, CT: Praeger, 1995); Michael S. Goodman, *Spying on the Nuclear Bear: Anglo-American Intelligence and the Soviet Bomb* (Stanford: Stanford University Press, 2007). On the transition from human to scientific intelligence see also: Kristie Macrakis, "Technophilic Hubris and Espionage Styles During the Cold War," *Isis* 101 (2010): 378–385.
14. The key reference here is Ronald E. Doel, "Scientists as Policymakers, Advisors, and Intelligence Agents: Linking Contemporary Diplomatic History with the History of Contemporary Science," in Thomas Söderqvist, ed, *The Historiography of Contemporary Science* (Amsterdam: Harwood, 1997), 215–244. See also David Van Keuren, "Cold War Science in Black and White: US Intelligence Gathering and Its Scientific Cover at the Naval Research Laboratory, 1948–1962," *Social Studies of Science*, 31 (2001): 207–229.
15. John Krige, "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence," in Krige and Kai-Henrik Barth (eds), *Global Power Knowledge: Science and Technology in International Affairs*: *Osiris* 21 (2006): 161–181.
16. As the wording makes obvious, this point draws upon Naomi Oreskes, "A Context of Motivation: US Navy Oceanographic Research and the Discovery of Sea-Floor Hydrothermal Vents," *Social Studies of Science* 33 (2003): 697–742.
17. See on this Alan Needell, *Science, Cold War and the American State: Lloyd V. Berkner and the Balance of Professional Ideals* (Amsterdam: Harwood/NASA, 2000).
18. On the history of the DEW Line, see, for instance, P.W. Lackenbauer, Matthew Farish, and Jennifer Arthur-Lackenbauer, *The Distant Early Warning (DEW) Line: A Bibliography and Document Resource List* (Calgary: Arctic Institute of North America, 2005).
19. Key references in the emerging and still contested field of transnational history include (among many others) Akira Iniye, *Global Community: The Role of International Organizations in the Making of the Contemporary World* (Berkeley: University of California Press, 2002); Ian Tyrrell, "American Exceptionalism in an Age of International History," *The American Historical Review* 96 (1991): 1031–1055; Christopher A. Bayly, Sven Beckert, Matthew Connelly, Isabel Hofmeyr, Wendy Kozol, and Patricia Seed, "AHR Conversation: On Transnational History," *American Historical Review* 111 (2006): 1441–1464.
20. Michael A. Dennis, "Secrecy and Science Revisited: From Politics to Historical Practice and Back", in Ronald E. Doel and Thomas Söderqvist, eds. *The Historiography of Contemporary Science, Tecnology and Medicine: Writing Recent Science* (London: Routledge, 2006), 172–184.
21. See the essays in the edited collection Néstor Herran, Soraya Boudia, and Simone Turchetti (eds), *Transnational History of Science: Special Issue of the British Journal for the History of Science* 45 (2012).
22. John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (Cambridge, MA: MIT Press, 2006). There are, of course, works detailing