"They are alive. The workers know that they didn’t die. But they don’t know how they survived.” These words were spoken to me by a biochemist in Kiev, Ukraine, in 1996, a decade after the nuclear disaster at Chernobyl. This scientist, along with colleagues at the country’s Academy of Medical Sciences, pioneered a way of analyzing the tooth enamel of Chernobyl cleanup workers and evacuees for clues to past levels of radiation exposure. Affected populations included roughly 600,000 cleanup workers and 5 million people either resettled from contaminated territories or continuing to live there. Their actual doses were uncertain or unknown owing to a lack of monitoring, and this made long-term research on Chernobyl’s health effects difficult, but not impossible. Tooth enamel, scrubbed of organic rot and crushed into microfine mineral components, provides a reliable measurement of an absorbed dose. More than four thousand samples were gathered in an established countrywide tooth acquisition network. Dr. Vadim Chumak and his colleagues, supported partly by the U.S. Armed Forces Radiobiology Research Institute, worked tirelessly, analyzing the dosimetric signals of the prepared samples so that a large-scale epidemiological study could soon take place. At least that was the plan.

Dr. Chumak expressed surprise, even bewilderment, at some of his research subjects even being alive. Samples from some Chernobyl cleanup workers showed that they had absorbed six to eight times the textbook definition of a lethal dose of radiation. Their teeth evidenced the unthink-
able: improbable lives for whom the textbook of survival was not yet written.

Twenty-five years later, that textbook still does not exist. The research networks required to translate Chernobyl survivors’ reconstructed doses into an internationally recognized gold standard of clinical data have all but disintegrated. Populations affected by Chernobyl have by and large become vestiges of larger—and mostly unsystematized—bodies of fragmented studies. The heterogenous facts of living that make up their stories of death and recovery have nowhere to live under dominant systems of knowledge. How they survived has become an inexplicable fluke.

Because of their durability, teeth have a special capacity to resist the pressure of disappearance. Remaining after everything else decays, fossils, like teeth, are also flukes, pointing to assemblages of life and matter and larger living environments that no longer exist; they dog the certainties of knowledge systems and the authority we attribute to them. Fossils, like the teeth, can be serendipitous too—a starting point for newer, more complete truths. Or they can signal a lost chance, in which the potential for newer, more complete truths precipitously falls away.

There is a term in science that captures this instability of what fossils mean. Introduced in 1940 by Soviet paleontologist and science fiction writer Ivan Yefremov, “taphonomy” (from the Greek taphos, burial; nomos, law) refers to the laws governing how biocomposites of whatever sort decay—to the rules that determine how they are put away, so to speak, into the lithic world and, ultimately, cast off into geological deep time. Taphonomy also charts the circuitous paths by which fossils come back to us, how their weatherings and modifications and very “depositional environments” confound what they are. Fossils, ancient artifacts, ammonites, seashells, or rodent teeth, are transfigured, bored into, weathered, and altered by heat—they are never just pure samples.

Life Exposed applies this taphonomic sensibility to call for a more complete record of what happened to the cleanup workers, resettled families, and children and parents of exposed children in the decade after the Chernobyl disaster. What is the moral and epistemological system in which knowledge of Chernobyl survivors fits or precipitously drops off? Are the survivors castoffs or flukes to be discounted or filtered out—noise in the system of present-day knowledge of human radiogenic risk? Or are they—these possessors of muddled histories and truths—the very thing to be studied? What larger assemblages of truth and disposals of truth do they reference? What is missing but somehow present in what remains? How is it that we remain ignorant about how they survived? What accounts for the incompleteness of the Chernobyl disaster’s “fossil” record?
To be sure, the unraveling of the Soviet system in 1989 contributed to an atmosphere of chaos and left a legacy in Ukraine of incomplete accounting for Chernobyl’s full public health and human consequences. Moreover, the difficulty of independent long-term study of the disaster’s human health effects has been exacerbated by fragmented research efforts and misplaced priorities, a lack of cooperation between international organizations, inconsistent funding or inappropriate allocation and misuse of funds, and the incompleteness of information and data collection.1

In spite of these realities, official pronouncements twenty-five years later convey a sense of certainty about Chernobyl’s human health effects.2 Although the World Health Organization (WHO) in 2005 upped the toll of Chernobyl-related deaths—from 31 to about 50 people, mostly highly exposed emergency responders—and stated that up to 4,000 may eventually die as a result of radiation exposure from the accident, the message remains the same: Chernobyl’s public health effects “were not nearly as substantial as had at first been feared.”3 The WHO has suggested focusing health monitoring mainly on highly exposed cleanup workers and children with thyroid cancers.4 As for populations living in roughly five thousand contaminated villages and towns in Belarus, Ukraine, and Russia, the WHO recommended a halt to further studies of mortality. A 2006 analysis states, “Given the lack of statistical power based upon the estimated doses and confounding variables from causes other than radiation exposure, studies of the causes of mortality of the general population or evacuees from highly contaminated zones are unlikely to provide useful scientific information on radiation effects.”5 Most Chernobyl lives, the official story goes, are far too confounded by socio-political realities for any valid science to occur. The UN Scientific Committee on the Effects of Atomic Radiation acknowledged the increase in unusually aggressive thyroid cancers among children living in affected areas, but it continues to characterize most other disorders as products of high levels of stress. UN-agency statements have also gone further to make moral claims about who the survivors are, suggesting that “persistent myths and misperceptions about the threat of radiation have resulted in ‘paralyzing fatalism’” among those living in affected areas.6

Paralyzed by fatalism or overlooked by science? Such invocations can be taken as indexes of how far off the scientific community is from fully understanding and predicting the health consequences from Chernobyl. You do not need this book to tell you how people took all sorts of drastic measures, in the days and months after the disaster, to mitigate the consequences: sending their children by train to relatives living in unaffected
areas, sealing their windows and scouring their floors, desperately scavenging for iodine pills to prevent iodine-131-induced thyroid cancers, searching for “clean” foods for their youngest, and even making their own dosimeters. To call these people fatalistic echoes earlier statements by the International Atomic Energy Agency (IAEA) blaming mental stress on “poor understandings” of scientific principles. It is to deny survivors the attention that their actions are due, and to misstate the record of what actually happened during and after the disaster.

By some curious twist of fate, the people who should be central to knowledge about Chernobyl’s health effects have become peripheral, even pariahs. Somehow, scientific interest in the lessons of the disaster has been “satisfied in isolation from the well-being of those whose lives have been shattered by Chernobyl,” against the intentions of the many scientific experts involved. We still don’t know how workers who absorbed relatively high doses survived, or how those living in contaminated territories have weathered chronic exposure to lower-dose radiation. The fifty or so official deaths from Chernobyl occurred within a week to a few months after exposure. But data on long-term sequelae of high- and low-dose exposures among persons not included in this initial cohort have had difficulty finding their way into the epidemiological record.

Indeed, if the atomic bomb studies provide any guidance, it is far too soon to measure Chernobyl’s full impact. In the words of one report, “In 1965, 20 years after the atomic bombings in Japan, the Atomic Bomb Casualty Commission reported significant increases in the incidence of just two cancers—thyroid cancer and leukemia” among the some eighty thousand Japanese bomb survivors who were monitored. Another decade elapsed before a significant increase in other cancers appeared—and cancer and noncancer diseases continue to be detected today. It is reported that “leukemia and thyroid cancer form only a small fraction of the accepted total radiation-related health detriment”). The lesson is that we still possess only incomplete knowledge of Chernobyl’s individual and human impact, and that understanding the scope of the impact will hinge on what kinds of studies, technologies, and funds we are willing to apply, and over what time frame.

Life Exposed captures a moment in time when a fundamental incompatibility arose between two logics: the shock of survival and the fraught politics of science and the state. These two would compete for the right to establish the terms on which the meaning and scope of the Chernobyl disaster could be determined. On the one hand, government strategies for containing the disaster focused on treating a small cohort of identified victims. Knowledge about the health effects of exposure was limited to these select few. Experts framed Chernobyl’s health aftermath in abstract (mostly psychological) terms; the scope of the disastrous circumstances
and its human toll fell out of the medical narrative of the disaster. The rush to abstraction happened at the expense of the true dimensions of the problem and created egregious holes in Chernobyl’s epidemiological record. In the process of abstraction, an act of political domestication ensued: the story of the human effects and the massive number of workers it actually took to contain Chernobyl-related contamination was relegated to the domestic sphere of Soviet state control. The actual human labor required to inhibit destructive radioactive releases was itself transformed into a hidden reality of suffering—in what we can call a choreography of Chernobyl risk, or the sequence of movements by which domestication of overwhelming risk was achieved.

On the other hand, the words “they don’t know how they survived” point to an agonizing lack of knowledge about the actual physical states of those who survived, and where their survival ought to fit within larger schemes of knowledge about the biological effects of Chernobyl—how they were doing, what kind of medical care they needed to go on living, and how long life would last. And when unsystematized biological facts met impersonal bureaucratic systems, all hell broke loose. *Life Exposed* charts this hell, the cut-and-dried or vague formulas of compensation by which survivors’ diseases and lives did or did not gain entry into a “biological citizenship.” Recognizing the deep vulnerabilities left behind by state interventions and failures to intervene, these citizens attempted to remake themselves into recognized sufferers of the state; sickness and citizenship fused together as damaged biologies became the basis for making citizenship claims under changing state and market structures, increasing poverty, and losses of security. I joined patients and families in their protracted interactions with legal and medical bureaucracies and institutions that would acknowledge injury and, at times, compensate for it. Some were able to negotiate a higher disability status or more entitlements. Others were much less successful, or they chose to neglect their symptoms, to be able to keep working in the contaminated zone where salaries were high. In this tangled world of science and bureaucracy, I could document firsthand the dance between strategies for containing the disaster and the bioscientific and social orders of care and disregard that took hold. I analyzed, as unprejudicially as I could, the kinds of human agency that were available to the sufferers, while attending to the political conditions in which their recovery and recoverability were constantly deferred.

The radioactive teeth, as well as Dr. Chumak’s sense of surprise over them, stand at the heart of the two competing logics: the political logic of risk containment and a personal logic of survival. The first, supported by an establishment science, makes all kinds of moral assumptions about who the survivors are. (Interpreting survivors as paralyzed fatalists strikes
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me as a good example of this.) It invokes uncertainties (of doses, of monitoring) as a way of precluding “useful epidemiological radiation studies.”12 It reduces suffering and disease to the idiosyncrasies of individuals, psychology, and culture. It chalks up the disaster to an avoidable error, thus helping to solidify a narrative of Chernobyl as an anomaly in an otherwise technically sound and invulnerable world. In calling the survivors and Chernobyl all but a fluke, this political science of containment suggests that cultures somehow “choose” their own risks13 while attempting to cut its losses from a failure to make any sense of biological impacts beyond the immediate period of intervention. Life Exposed tracks this dubious path, this choreography of Chernobyl’s risk and the science and policies by which closed stories are achieved.

Writing in the wake of 9/11 on the need to decouple prediction from value judgments in the intelligence sphere, psychologists Philip Tetlock and Barbara Mellers write, “The closer scientists come to applying their favorite abstractions to real-world problems, the harder it becomes to keep track of the inevitably numerous […] variables and to resist premature closure on desired conclusions.”14 In juxtaposing vulnerable lives against “favorite abstractions,” this book shows how technopolitical responses themselves aggravated the problems they tried to resolve, and even led to new ones. It tracks premature closure from the standpoint of the inevitably numerous variables and behaviors that were generated by official responses themselves. Understanding these interlinked processes anthropologically is crucial if we are to make sense of the governance of nuclear disasters and their long-term human implications, particularly as they might be unfolding in Japan in the wake of the Fukushima Daiichi plant disaster.

Working against premature closure, many scientists have called for further research into Chernobyl’s health effects. The disaster should have become the touchstone for the human epidemiology of high-dose and chronic low-dose exposures in the context of nuclear accidents. This definitive “laboratory” of human radiation exposure should have yielded medical information at various doses and over various timescales, a better understanding of the uncertainties of available knowledge, and a serviceable way of thinking about and predicting the health consequences of accidental nuclear exposures. According to a UN report published at a time when there was still hope for further study, “If active steps are not taken to resolve the human problems relating to the accident . . . the fate of the communities blighted by Chernobyl will continue to haunt discussions on energy generation for decades to come. In the context of global warming, governments around the world and the international energy industry share an interest in resolving these problems and promoting a
debate on the future of nuclear power based not on emotion but on arguments and facts.”

Let us return to the teeth. After all, they belonged to soldiers, firemen, and other workers who went, voluntarily or involuntarily, to the disaster site to physically remove radiation. These people were sent in because Chernobyl exceeded the logistical competence of states and remediation plans. And, depending on where they stood in the pecking order of Soviet and post-Soviet privilege, some were paid (elite firefighters, Interior Ministry workers, and coal miners); some volunteered; and some were enlisted or shanghaied, because of the great number of people needed to carry out the mission of stabilization and cleanup. In theory, nuclear and military leaders were to closely monitor recruits’ exposure to radiation, and to remove them from the site to control dose exposure. In practice, commanders often deemed it more expedient to overexpose those already in the Zone than to call in more workers, and largely ignored monitoring. Experts gathered by the IAEA in the raft of international “consensus”-building conferences that quickly followed Chernobyl never, in their assessments, acknowledged these stories of unjustified overexposures. They defined—and announced year after year on the disaster’s anniversary—the news of Chernobyl’s limited and controlled aftermath. The teeth are the only hard evidence of substantial involuntary and uncontrolled labor processes.

In the end, we have two stories—two competing and incommensurable stories—of Chernobyl. One maintains that “nothing happened here. Nothing happened here . . . and nothing is going to happen here,” to quote a key medical response leader. Life Exposed holds that something did happen here, inside the choreography of Chernobyl containment, and that the larger human dimension of what happened is of paramount significance and should remain firmly fixed at the center of scientific inquiry.

Regrettably, twenty-five years after the disaster, large-scale epidemiologic follow-up of workers and evacuees has barely occurred. Researchers need to systematically link together individuals’ reconstructed histories of exposure and their clinical profiles in order to craft an internationally recognized body of information about Chernobyl’s consequences. But funding and research networks are coming apart. The official accountants of Chernobyl’s toll remain stuck in the “verifiable” facts of the immediate short-term period and reject data on long-term sequelae of high-dose and lower-dose exposures. Independent scientists with significant bodies of research from Ukraine, Belarus, Russia, Spain, France, the United Kingdom, the United States, Finland, and Japan have noted endocrinological, musculoskeletal, respiratory, and circulatory problems and a rise in malignant tumors, especially of the breast and prostate. Many of
these scientists recently came together to design what promised to be a pivotal study of “the lifetime health of more than half a million ‘liquidators’ sent in to clean up the area around Chernobyl, as well as of the general population of the region who were children at the time of the accident.” This crucial, last-ditch effort to study these populations would have covered “more than ten times as many people as the lifetime cohort study set up in Japan after the Hiroshima and Nagasaki atomic bombs, which remains the gold standard for studies on the impact of radiation on a population.”

Funding for this lifetime cohort study was declined because “uncertainties over the doses received by the exposed Chernobyl population potentially weaken the value of such studies.” The European Commission rejected a large-scale life-study approach in favor of a more mechanistic one, said to “deepen understanding of the interaction of radiation with tissue.” Studying the mechanisms of radiation damage in controlled settings is simply easier than “the messier epidemiological work that is needed to gather data and to get a picture of any health effects in the aftermath of a real-life nuclear accident.” This readiness to discount the raw data of real lives in favor of abstractions, this pattern of systematic inattention to “how they survived,” was established very early on in the science of Chernobyl (see chapter 2). Today, the missing human lifetime studies and studies of multigenerational exposures from Chernobyl make projections of risk over time uncertain at best.

To date, a decidedly nonpeopled approach has taken hold of the Chernobyl science establishment. It has left those who survived in a medical and scientific void, in which a lack of knowledge puts them at risk of misclassification. Others have died anonymous and unstudied deaths. The science of human radiogenic complexity post-Chernobyl has been reduced to yes-or-no answers to leading questions that are perhaps not the most compelling ones. For example, the 2005 press release “Chernobyl: The True Scale of the Accident Based on a UN Report” provides the following sorts of questions and answers: How much radiation were people exposed to as a result of the accident? Not enough to cause problems. How many people died and how many more are likely to die in the future? About 50,400 max. Have there been or will there be any inherited or reproductive effects? No. Did the trauma of rapid relocation cause persistent psychological or mental health problems? Yes. What has been the impact on individuals? Largely none, except for mental stress. Crude affirmative messages like these appear mysteriously, as if from a Magic 8-Ball. Shake the ball once: “It is certain.” Shake it again: “It is decidedly so.”

By contrast, there is an almost breathless array of divergent (affirmative, negative, inconclusive) data on how plants, mammals, and amphibians negotiate the surprise of “abrupt fast changes on the environment”
due to Chernobyl. Numerous studies of different species have been ongoing throughout the final decade of the twentieth century and the first decade of the twenty-first. As new data and new kinds of technologies have become available, findings focusing on the short- and long-term aspects of the disaster’s radiogenic impact in the Chernobyl dead zone have been published, debated, revised, and in one case even retracted. And the retraction was a point of pride: “It was an important lesson in admitting error and coming to terms with our mistakes,” according to the retracting authors. In studies of changing terrestrial ecosystems post-Chernobyl, evidence accumulates through repeated observation; it contains a structure of accumulation and apparent self-correction. In this world, science yields different answers depending on how you shake the data, and for how long.

Some studies of biological effects in plants and animals do not conclusively point to reduced “survival fitness,” while other longer-term studies strongly do. Indeed, Hiroshima and Nagasaki human lifetime cohort studies suggest that some effects are delayed in their onset for up to several decades following the exposure. This is not to say that there are one-to-one comparisons between species or different nuclear events. But these studies provide plenty of reason to resist closing the book on Chernobyl prematurely.

A year after the catastrophe at the Fukushima Daichii nuclear plant in Japan, citizens worldwide require a reliable measure of the human consequences of chronic exposure to low-dose radiation from nuclear accidents. Chernobyl could have provided that measure. But it has not. Finnish radiation specialist Keith Baverstock led the WHO’s radiation protection program from 1991 to 2003; he noted in 2011, “There have not been any serious and large enough studies done on the appearance of solid tumors, like breast cancer, gastric cancer or lung cancer.” There is no long-term plan of research. Absent lifetime studies—of the kind to which we have subjected Holstein cattle, voles, and mice—we still don’t know how those exposed at Chernobyl survived. This path in science leaves the public ill-equipped to handle current and future disasters.

Being accountable to the people affected is a key challenge of our time. The workers and evacuees who appeared in the clinics and administrative offices where I did fieldwork do not constitute clear-cut and well-defined cohorts now. They are not pure samples in any sense. But this fact alone does not justify their exclusion from robust scientific inquiry. It is critical to recognize that these claimants showed up because of unanswered health questions. Those unanswered questions are symptoms of a fraught politics of science and a state that made their bearers’ complaints idiosyncratic and unreal. Yet the reality of the claimants’ health burdens should not be ignored in analyses of the disaster’s effects, including those that
address how they survived. Biomedical truths are complex, but they must be understood in all their complexity if we are to lay the groundwork for a better response in the future.

The Unlikely Happened Again: Some Comparative Notes for the Present and Future

In 2011, the Bulletin of the Atomic Scientists, a journal covering global security and public policy issues, invited a group of Chernobyl experts to write essays for a themed issue dedicated to the disaster’s twenty-fifth anniversary. Mikhail Gorbachev wrote the lead essay. The head of an influential former U.S.-Soviet medical team coauthored an article entitled “If the Unlikely Becomes Likely: Medical Response to Nuclear Accidents.” In it, the authors expressed confidence in the nuclear industry’s “extensive guidelines for dealing with these incidents that work reasonably well” to prevent runaway disasters. Chernobyl, they wrote, was unlikely and unmanageable not because of its scale, but because of the incompetence of the plant’s operators, who could not properly adhere to guidelines. Such reasoning reinforces the narrative of Chernobyl as unique, a one-off event with no comparability with other disasters.

Precisely on the twenty-fifth anniversary of Chernobyl, “the unlikely” happened again. Reactors at the Fukushima Daichii plant exploded, exposing the serious lapses that blind overconfidence in guidelines conceals. Today, a theater of moral calculus is staging itself not behind an iron curtain, but before our very eyes.

At first, various experts and observers went to great lengths to refrain from making comparisons between Chernobyl and the nuclear disaster at the Fukushima plant. Chernobyl was arguably history’s worst peacetime nuclear disaster; the reactor was of poor Soviet quality and design; the nuclear explosion and meltdown were unparalleled; and the aftermath was mishandled by a corrupt government that tried to cover up the disaster’s scope. The stricken Fukushima plant, it was stated repeatedly, was better designed, and the catastrophe would be dealt with in a “Japanese” way—as embodied in the brave Fukushima 50, also called a “suicide corps” for their utter devotion to the task of containing radiation at all costs. Many of these workers’ lives have been devastated by the triple catastrophes of March 2011, their villages swept away and loved ones gone.

While a proper comparison with Fukushima may prove a limited endeavor at present, I hope that Life Exposed provides a critical template for moral inquiry into Fukushima and into the choices that policymakers and citizens are facing today. And if this book sheds any comparative light, the comparison illuminates how limits of accountability can be
built into interventions themselves, confounding truths about the health consequences of widespread radiation release. The brave fifty of Fukushima were called upon to do superhuman tasks, and they toiled in relative obscurity, clearing rubble and debris. As they attempted to cool the reactors and fuel pools and to avert meltdown, they reportedly saw the same ethereal blue flashes, symptomatic of the meltdown of nuclear fuel and uncontrolled chain reactions, that were witnessed by the many Chernobyl cleanup workers I interviewed for this book. Today, new cohorts of fifty toil feverishly—removing highly radioactive roof concrete and ducts, shielding floors and windows, sticking lead boards onto inside walls—as they work to shift areas of the plant from highly contaminated to less contaminated status. And this is all just in aid of creating a safe working environment for the decommissioning of the plant, itself a separate long process.

The Fukushima 50 have reportedly been kept largely isolated from the rest of the population, under a government medical surveillance system that is separate from the system used for evacuees and people living in the vicinity of the plant. As authorities invoke their heroism, these anonymous fifty are being swapped out for another fifty, and so on and so on—so much so that, by last count, their numbers have grown to roughly eighteen thousand: “Most of them are not employed by TEPCO [Tokyo Electric Power Company], but by subcontractors, who in turn recruit their workers from temporary employment agencies. Before the tsunami, many of these temporary workers had already done their fair share of the dirty work at other nuclear power plants.” Concerns have been voiced that there are not enough people to carry out the mission of cleaning up and stabilizing the situation. Meanwhile, Japan’s Health and Labor Ministry has continued to focus on containment of contamination, leading officials to increase threshold doses in an attempt to shore up the numbers of eligible laborers. It twice raised the legal limit on the amount of radiation to which each worker could be exposed—up to five times the maximum exposure permitted for American nuclear workers—so that workers could toil longer at the plant.

A U.S. expert in radiation epidemiology who had helped popularize the view that psychological stress trumped any other possible adverse health outcomes among Chernobyl cleanup workers, offered some surprising consolation to Japanese workers who were waiting to be swapped into the Fukushima 50. He stated that the Soviet government had developed a system to limit Chernobyl cleanup workers’ radiation dose exposures: “They sent up to 600,000 people in to clean up the radioactive debris around the plant and build a sarcophagus... The workers were sent into contaminated zones for limited periods” (my italics). This upbeat image—of well-orchestrated altruism working toward a harmoni-
ous reduction of collective risk—is simply inaccurate. It helps to transmute the actual human labor required to halt disaster into a problem of domesticated risk and concealed suffering, comparable to what happened at Chernobyl.

As in Chernobyl, there is in Fukushima nothing obvious about how people come to be engaged in this dangerous work; only ethnographic examination can begin to tease out a moral calculus of risk. Initially experienced workers at the Fukushima plant were to leave when their total dosage exceeded 100 millisieverts (mSv). But many were being kept until their doses reached a high 250 mSv and as long as it was deemed necessary to stop further damage. Back in Ukraine, every village, every housing block, every work collective knew a “bio-robot” who carried out the most dangerous jobs of all, such as shoveling radioactive debris into the mouth of the ruined unit; each one of these workers became part of a very select group through which a morality tale about sacrifice continues to unfold to this day. What is the actual experience of heroism and sacrifice at Fukushima? How will such experience comport with the scientific abstractions that will, perhaps inevitably, diminish biomedical complexities?

Fukushima may not be like Chernobyl in many respects: the reactors are not the same, the designs are not the same, and the political-economic systems of labor exploitation are not the same. Nor do we know yet the political or moral systems of coercion or consent that are keeping workers there overexposed. But Fukushima illustrates that there is more than one way to have a Chernobyl. There are Chernobyl-like aspects of Fukushima in terms of phases of political and societal response.

The first is undoubtedly the heroic phase; it is the only stage of what might be called collective moral confidence (or hope) that existing logistical capacity will prevail against the disaster. Invocations of heroism are seen in headlines reading, “We Are Not Running Away.” In the second phase, the heroes disappear; they become relatively anonymous and are now under the purview of a separately governed reality. This setting-off of a select group as slated for sacrifice sets up a political economy of sacrifice with unique medical and juridical consequences. Discourses of heroism are supplanted by people’s sense of disorientation about actual risk. (Such disorientation ensued, for example, when the U.S. Navy ordered that all of its American personnel evacuate from within a fifty-mile radius of the plant, setting up a contrast with the twenty-kilometer radius specified by Japanese officials.) The sense of duty, cultural or otherwise, that initially kept workers committed to the task is now a palpable form of injury that spreads through the entire social fabric. While some domestic and international experts embark on a series of conferences aimed at “consensus” building, these states of disorientation and desperation esca-
late. Will they also be cordoned off as “problems of risk perception” or “paralyzing fatalism,” to be absorbed by local cultural capacities and beliefs? The burdens of health and how to make sense of their origins fall onto a first generation of biological citizens. Political or medical vulnerabilities are exacerbated for those who do not make the cut.

In Ukraine, a decade after the disaster, waves of citizens poured into medical offices for care and compensation. Their “idiosyncratic” diseases would now encode different kinds of treatment discriminations and different kinds of neglect. In the daily deciphering of what counted and did not count as a disaster-related ailment, of who was and was not on the border with death, a new relationship emerged between a sickened citizenry and a post-Soviet state. Biological citizenship became a complex bureaucratic process by which a population attempts to secure a status as harmfully exposed and deserving of compensation. It entailed populations demanding social welfare based on strict criteria that might acknowledge biological injury and compensate for it. In this labyrinthine world of protection seeking, health was selectively promoted for some, while declines in health hastened for others. People fell in and out of categories or were pigeonholed in ways that they did not choose (or could not escape). It is true that biological citizenship speaks to health as a political project. But more centrally, it speaks to a failure of politics and science to account for human welfare, compounding vulnerability for citizens whose practices of survival have never fit neatly into our efforts to conceptualize them.

And this is phase three: this tangled biosocial reality involving people taking stock of those elements in their lives (measures, numbers, symptoms) that could tie to a broader history of the disaster’s mismanagement and risk, and could make them visible and singular in that context. Perhaps the Japanese will fare better than the Ukrainians in how well they “absorb” risk. But a cultural psychiatry is not the point. As the comparison with an already-sterilized version of Chernobyl is used to titrate Fukushima’s health effects down or up, a simultaneous sequestration of local human realities—a domestication of risk—takes place. The troubles of those most affected are undoubtedly already being absorbed in a new sort of normality that desperately requires a concerted anthropological and analytic unpeeling. But I fear that the “radiophobiaologists” who shaped the Chernobyl story may already be shaping the story of who is and is not a true victim in Japan.

In spite of what I have outlined, I hope that Japan will have a different story to tell if it can resist international pressure toward abstraction. It has in fact, in the aftermath of Hiroshima and Nagasaki, previously accomplished a large-scale radiation-effects monitoring program. In contrast, the scientists who are working to piece together new information
and advocating for life span studies are underfunded and still sidelined by science establishments that repeat the same health and mortality statistics over and over again. I hope that the scientific professionals at Fukushima stay close to facts, heed the lessons from Chernobyl, and responsibly build up the gold standard of epidemiological knowledge that scientists of Chernobyl thus far could not attain.

The arc of knowledge building from one nuclear catastrophe to the next is, of course, never linear. There will always be gaps, as every disaster is in some sense idiosyncratic in time and space. Hiroshima, for example, is a story of an intensive, extremely high-dose, short-lived, horrifically deadly radioactive bomb explosion. Chernobyl is a story about an exploding reactor core—its combustive stew of gaseous aerosols, fuel and mineral particles, rare gases, and radioactive hot particles lingered for months and will linger for years and decades in air, water, and the food chain. Extrapolating risks from high-dose, short-lived whole-body exposures to low-dose, long-lived internal ones is a completely uncertain enterprise.

In the presence of long-lived radionuclides, we do not know how people survive, or apparently survive. As human bodies absorb needed minerals, they engage in a troubling biokinetic mimicry. They mistake cesium-137 for potassium and absorb it into muscle tissue. They assume strontium-90 is calcium and build it into bone material. They misread radioactive iodine as a stable regular iodine and absorb that isotope into the thyroid gland. How do mistaken biokinetic judgment calls like these alter histological samples and latencies of disease like cancer? Do radioactive zones occasion evolutionary fitness or a failure to thrive? All remain open questions. Yet there are some worrying trends for those affected by Fukushima. Even in the absence of a definitive model of the impact of chronic low-dose exposures, we see, in just less than a year after Fukushima, definitive pronouncements of that disaster’s limited health toll.26

Closed stories don’t just happen; they are achieved through a science of political containment that preempts public debate. This “PC science” is entangled in classified worlds, to be sure, but it is also part of more general “technologies of hubris.” Such technologies focus “on the known at the expense of the unknown” and display “a peripheral blindness” toward uncertainty and ambiguity.27 The adjustment of Chernobyl’s death toll from 31 to 50 is an example of a superficial refinement that creates no incremental difference in our understanding of what happened.

This sort of PC science has certainly outlived its usefulness for the twenty-first century as it traps Chernobyl-affected groups—and by exten-
sion, everyone else whose lives literally depend on greater scientific objectivity and more nuanced analysis—in at least two undesirable and potentially hazardous moral-conceptual states, neither of which is terribly adaptogenic. The first is denial or amnesia (“nothing happened here”). The second is a state of constant exposure to unpredictable unknowns.

These unwanted scenarios, evolving out of Chernobyl and extending beyond it, are untenable in the twenty-first century. To enhance our capacities to deal with surprise, we need new models of science and politics that take the word “adaptation”—in all its divergent meanings and human practices—seriously. New developments in climate-science modeling and practice may provide clues as to what a science and politics of adaptability could look like. The director of the National Oceanic and Atmospheric Administration (NOAA), charged with tracking atmospheric and oceanic changes (some linked to climate change), has advocated for a “use-inspired science,”28 a strategy that embraces rather than denies the limitations of any scientific account of potential or calamitous environmental disruptions, one that recognizes the complexity of circumstances, such as the new “tipping points” of climate change and the uncertainties of their outcomes for human populations.29 The goal of use-inspired science is to enhance our capacity to negotiate catastrophic surprise, not to control different variables for desired conclusions or containment. It is to craft, however tentatively, a learning curve that can stretch from one disaster (say, a massive hurricane moving up the East Coast of the United States) to another. It is also about being direct with the public concerning what information is available or missing but required to produce a more adequate response the next time. It is about improving templates of data-collection about what happened, and using these to predict and better adapt to the realities of climate change. For example, in 2011 NOAA predicted with 100 percent accuracy the line of transit of Hurricane Irene, but it still cannot predict hurricane intensity (category 1, 2, etc., important for predicting storm surges). Potential victims of potential disasters are framed as consumers and stakeholders. Their value as contributors to the science of game-changing events is fundamental, not negligible.

It is ironic that we have better knowledge about recovering ecosystems of the Chernobyl dead zone—where a herd of rare and ancient Przewalski’s horses now run wild, where the decrease of certain birds’ brain sizes has been observed, and where variability of species’ response to radiation has been gleaned—than we do about recovering people and human conditions on the ground. What makes humans so different from animals and plants when it comes to debating the evidence and research? What makes the “government” of nuclear disasters and its human subjects so qualitatively different from other regimes of twenty-first-century threat,
like hurricanes or climate change? We are learning relatively little about the human health effects from one nuclear disaster to the next. People are missing, or they have been reassigned as flukes or paralyzed fatalists in a judgment-laden history of nuclear catastrophe. Instead of yielding better predictions of the future, a distinctively nonpeopled approach suggests that we are still deeply avoiding it. In the process we are acquiring a steady oversupply of idiosyncratic events with little generalizable or use-inspired science to show for our efforts.

The reality of unrestricted risk, whether it is human or natural or something in between, takes the issue of the unexpected, and what we do with it morally and scientifically, to a new level. *Life Exposed* discerns the morality of what happened as an alternative heuristic to a technocratic monopoly on truth and voice, and makes ethnography’s granularity and sensitivity the record of how they survived. In this record, people on the ground are refusing to be stratified out of existence. They refuse to disappear.

**Notes**

1. Baverstock and Williams 2006; Williams and Baverstock 2006. I thank Fred Appel of Princeton University Press as well as the Koyré Center in Paris for the invitation to reflect on this work in June 2012, especially Jean-Paul Gaudillière, Dominique Pestre, and Sezin Topçu. I am also very grateful to Janet Monge, Michael Joiner, Utpal Sandesara, Beth Hallowell, and Britt Dahlberg for conversation and insightful feedback on this essay.

2. United Nations organizations including the IAEA, WHO, and the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) are main sources of information dissemination regarding the health effects of Chernobyl. They constitute the Chernobyl establishment science and have positioned themselves as authorities of the disaster’s toll.


According to a WHO press release (World Health Organization 2005), “In the health area, the Forum report calls for continued close monitoring of workers who recovered from Acute Radiation Syndrome (ARS) and other highly exposed emergency personnel. The report also calls for focused screening of children exposed to radioactive iodine for thyroid cancer and highly exposed clean-up workers for non-thyroid cancers. However, existing screening programs should be evaluated for cost-effectiveness, since the incidence of spontaneous thyroid cancers is increasing significantly as the target population ages. Moreover, high quality cancer registries need continuing government support.”


9. For critical assessments of the Chernobyl Forum findings (Chernobyl Forum 2003–2005), see Fairlie and Sumner 2006; Williams and Baverstock 2006; Cardis 2007; Geras'kin, Fesenko, and Alexakhin 2008; Mousseau, Nelson, and Shestopalov 2005; among others. For the complete letter referenced by this last article, see http://cricket.biol.sc.edu/chernobyl/nature/letter.pdf.
13. For a critique of this approach see Geertz 2005.
16. For a description of this key lifetime cohort study, see ARCH n.d.
18. Butler 2011. As of this writing, the European Commission may be reconsidering its decision, given the need for such a study; a life span study might be funded on a tripartite basis, that is, the United States, Japan and Europe.
19. Chesser and Baker 2006:546. Their 1996 study published in Nature found that voles living in the Chernobyl zone had a higher rate of genetic mutation. Upon resequencing genes using an automated gene sequencer, they found they could not replicate the initial result.
22. See Gale and Baranov 2011:17.
25. The maximum estimated exposure per worker was 670.4 mSv. See Wada et al. 2012:599. mSv is a unit of ionizing radiation absorbed dose.
26. See Brumfiel 2012.
27. See Sheila Jasanoff’s illuminating essay (Jasanoff 2003).
29. On tipping points, see Guterl 2012. On high-consequence outcomes and internal disagreements about their presentation, see Socolow 2011.

Bibliography

INTRODUCTION TO THE 2013 EDITION


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