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A Chronotope of Expansion: Resisting Spatio-temporal Limits in a Kazakh Nuclear Town

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ABSTRACT

This article starts by anatomising the various strategies used by the Soviet regime to contain and ‘disappear’ the nuclear weapon test site in Kazakhstan before moving on to outline attempts by the independent Republic of Kazakhstan’s National Nuclear Centre (NNC) to be more open—including making much of the site available for commercial and agricultural use, after 25 years of remediation and monitoring. Juxtaposing these strategies with accounts from residents living in the town that hosts the NNC provides far more ambivalent engagements with both town and site. Thus, in what I call a chronotope of expansion, what appears is a resistance to any kind of spatial or temporal containment, a denial of progress and the possibility of moving to a brighter nuclear future by leaving behind the Soviet period and its entailments. I end by discussing the consequences of assumptions that the site can be limited and bounded in terms of radioactive contamination.

KEYWORDS Nuclear; Soviet; post-Soviet; Kazakhstan; secrecy; containment

Introduction

On my third visit to Kurchatov, a small township in northeast Kazakhstan, I took an unfamiliar turning and found myself in a dusty, tree-lined road, bordered by the Irtysh riverbank. Five small boys were excitedly playing football up and down the street. A little further on, two teenage girls were sitting on a bench disconsolately swinging their legs and chattering. I asked them what it was like living in Kurchatov; after all it was quite isolated, a long, bumpy bus-ride to the next town. ‘Oh!’ they cried, ‘it’s so *boring*! There’s nothing to *do*’. Their proposed solution was surprising. ‘What we need here is an AquaPark! That would really change this place. That would put us on the map.’ Aruzhan, one of the girls, went on to say that Kurchatov was ‘spooky’ and had a large, secret, underground city, at which her friend thumped her and told her not to be silly. Later, a 17-year old who had grown up in Kurchatov in the late

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1980s initially shrugged off his childhood as ‘just the same as everywhere. We played in the courtyard. My life centred round my family and friends,’ and then solemnly told me, with a curious Churchillian echo, that the town’s small museum was ‘a secret wrapped in great darkness that no-one could ever see’. A young man who had arrived with his family in 1994 from a nearby village insisted, with a mischievous grin, on only talking outside or in his car, adding darkly one day that the last person who had asked questions had been found shot dead, which did not exactly fill me with confidence. As the weeks went by and I settled into the residential quarter, I heard several times that an AquaPark was sorely desired. I also stopped noticing the ruins that punctuated the town.

Arguably, such an opening is risky. Introductions to Kurchatov, particularly in the media, typically either plunge into the horror of the Soviet nuclear weapon testing programme on what is called ‘the polygon’ or Semipalatinsk Test Site (STS) next to the town, or emphasise Kurchatov’s dramatic ruins. While compelling, such strategies recapitulate the invisibility of Kurchatov’s residents and the thousands of people who laboured on the polygon. My aim here, in part, is to recover those unheard voices and examine how they interweave with official and other accounts of the tests and contemporary nuclear enterprise in Kazakhstan. How do such lives among the ruins fit with the government’s hopes to leave awkward nuclear histories behind and move on to radiant atomic futures, when the past continually insists itself into the present in multiple ways, just as the children’s reactions, from boredom to playfulness or frisson suggest profoundly ambivalent or even contradictory affects?

Between 1949 and 1989, a huge area in Kazakhstan, half the size of Belgium (18,000km²) was used to test nuclear bombs. In 1991, independent Kazakhstan inherited contaminated land and bodies, as well as nuclear scientists and engineers, plus three experimental reactors on the polygon. Unlike other such sites around the world (Johnston 2007), the sovereign power that had carried out the tests no longer existed; the fledgling nation-state of Kazakhstan was left to deal with the legacy. The post-Soviet economic decline in the years that followed led many, including scientists, to leave poorly or unpaid jobs for work in bazaars or to move elsewhere (Ninetto 2001, 2005). Fearful of nuclear expertise moving to ‘states of concern’, Russia and Britain established The Closed Nuclear Cities Partnership (CNCP)¹ to provide sustainable employment in formerly-closed, nuclear towns like Kurchatov and keep such expertise in place. This supported both President Nazarbayev’s claims to legitimacy and his ambitions for Kazakhstan. As Cynthia Werner and Kathleen Purvis-Roberts note, the former was partly grounded on pursuing peaceful nuclear objectives (2014, 2007, 2006; Purvis Roberts *et al.* 2007, Werner *et al.* 2003; see also Kadyrzhanov 2011), to which I would add an emphasis on Soviet tyranny and the suffering of Kazakhstan’s people and land (see Grant 2001; Alexander 2019). Kazakhstan’s uranium resource wealth—it was the world’s largest producer in 2009 (World Nuclear Association 2014²)—contributed to the pursuit of economic opportunity via nuclear skills, infrastructure and resources (World Nuclear News 2014). All three are key in moves towards what has been dubbed Kazakhstan’s ‘nuclear renaissance’ (Bennett 2011:112–6; see also Shkolnik 2011) that leave behind, or at any rate, limit or ‘manage’ the damage of the Soviet

programme. Management here has a Strathernian inflection (2010), where ‘manage’ implies shutting down and containment as opposed to open-ended questions.

My first two visits to Kurchatov in 2007 and 2009 were formally arranged by the National Nuclear Centre (NNC), the local administration (Akimat), security service and police. I was shown around laboratories, allowed to interview scientists and civic worthies and taken to visit the STS.³ It took several hours to reach Kurchatov from Semey, formerly Semipalatinsk, some 143 km away. Twice our tyres needed changing, ripped by the sharply-rutted road that bakes hard in the intense summer heat and freezes to razor edges in the winter. A better road also features in residents’ wishes for improved infrastructure. It is easy to spot Kurchatov from afar, a small, green spot where apartment blocks and trees rise up from the plain. But the first closer glimpse can be disconcerting. Coils of rusting barbed wire next to a tumbledown hut are easily missed, but signal the earlier KGB checkpoint and fence that encircled the town and STS. The road potters along with scrubland either side and the occasional building in poor repair. In 2009, a half-built construction appeared where building work seemed to have been arrested. Finally, the road arrives at the main square, bounded on three sides by the smartly refurbished NNC headquarters, the Akimat and a dilapidated former Palace of Culture. Guests are taken to the 1970s guesthouse ‘Mayak’ opposite the colossal ruins of two 1950s hotels built in the grandiose ‘Stalinist imperial’ style, sometimes dubbed Stalin-Gothic. Windowless, roofless, scarred with fire and graffiti, they back onto overgrown paths, tree stumps and gutted, low residential buildings, and face a huge, bare field. Nothing suggests that until 1994 this scrubby expanse housed around 6,000 soldiers.

It would be easy to take away a picture of an isolated, ruined settlement. Indeed, this is how it is commonly represented in reports (Gudowski 2001; Greenall 2005) and undoubtedly much of it appears abandoned,⁴ derelict or has simply disappeared, like the soldiers’ barracks. My guide on that first visit, a young scientist, confided that the place gave her the creeps. ‘I love my work,’ she said, ‘but I can’t bear the wild dogs that howl in the streets at night, the emptiness and the isolation.’ Two years later she moved to Novosibirsk. Ethnographic accounts of the area have focused on the surrounding villages, particularly legacy health concerns (Stawkowski 2014, 2016, 2017; Werner and Purvis-Roberts 2006, 2007, 2014; Purvis-Roberts *et al.* 2007). These have been complemented by a series of collaborative publications, again focusing on health and risk, which draw on the expertise of Semey’s Institute of Radiation Medicine and Ecology, including those who were directly and indirectly part of the Soviet programme (e.g. Bauer *et al.* 2013; Bauer 2005; Balmukhanov *et al.* 2006). Historical studies (e.g. Holloway 1994; Shkolnik and Littlefield 2002; Boztaev 1997; Rhodes 1986, 1995; Balmukhanov *et al.* 2002) typically concentrate on the technical aspects and important figures of the Soviet nuclear bomb project who visited the town and STS: Lavrentiy Beria, (political director), Igor Kurchatov (Scientific Director), Yulii Khariton, and Andrei Sakharov (bomb designers). The town itself, and the people who had lived and worked there since 1947, are typically either eclipsed or have not been the main focus of attention.⁵

Yet 10,000 people live in between the wrecks. Four-storey apartment blocks at the other end of town are filled with families, interspersed with empty blocks stripped of windows and doors, where children delightedly ignore the prohibition on playing. As with most post-Soviet settlements, small shops have been carved from ground-floor flats and residents bustle between them exchanging gossip and comparing prices. A neighbour in Olimpiskaya, the quarter where I lived, wryly commented, ‘When people first come here, they only see ruins. But we don’t see them any more. This is our home’.

This article contributes to anthropological interventions on varieties of unknowing that typically highlight the strategic cultivation of ignorance either by authorities, individuals or communities. In the first case, this may involve discrediting other knowledge forms, withholding information or actively choosing not to recognise certain ways of knowing, often in colonial or development contexts (Gershon and Sarhadi Raj 2002; Dilley and Kirsch 2015). Elsewhere, from Fredrik Barth (2002) onwards, there is a long ethnographic record of the political invocation of other people’s ignorance of secrets as a demonstration of power within communities, or individuals’ self-preservation through claims not to know (Gershon and Sarhadi Raj 2002; Mair *et al.* 2015). In the ethnography below, most of these versions are entangled in ways that resist a simple attribution of singular modes to one group or person. As one example, formal Soviet military modes of deflecting attention through codification were not only domesticated through diminutives (thus being even further removed from the signified object) by workers and their families, but this practice has persisted into a post-Soviet era of purported openness by the authorities. Kurchatov’s residents craft a life by moving between a habitus of silence, familiar to many military families, and active recognition of the ruins and ‘bad ecology’ of their town; by turn mocking the authorities and then retelling official histories that sometimes occlude their own lives. Inspired by Mikhail Bakhtin’s idea of literary genres being characterised by specific time–space conventions or chronotopes (1981), I suggest that the neat partitioning of temporal periods by the post-Soviet powers is countered by residents’ experience of temporal conflation, where present and future are ensnared by the past and where the boundaries of the town and site seem to be constantly on the move. Such a chronotope of expansion and mobility thus refuses either spatial or temporal limits. This then subverts the present government’s attempts to lock wastes in place and time and move on to nuclear futures.

This account also contributes to post-Cold War scholarship (e.g. Chari and Verdery 2009) that excavates continuing legacies in peripheral theatres of erstwhile hot war (e.g. Kwon 2008, 2010). It further offers an ethnographic restoration of the people otherwise routinely silenced in accounts of the Soviet nuclear programme. Banal as yearning for an AquaPark, or the restoration of the children’s playground ‘Buratino’ might seem, it speaks to a desire to be known, to be on the map, for reasons unconnected to nuclear weapon experimentation. ‘I never tell people where I’m from,’ Aruzhan’s friend sadly added, ‘or they look at you as if you’ve got two heads.’ Such desires also index the social infrastructure needed to sustain ordinary lives, which is not mentioned in the government and local media’s encomia of Kurchatov’s

scientific enterprise, and which contributes to difficulties in keeping hold of skilled professionals who are concerned about their families. Finally, consideration of the act of limitation, contributes to studies of pollution disasters, refutations of liability and cover-ups by the industrial-military complex (Spears 2014), and what Kim Fortun describes, in research on the fallout from Bhopal's Union Carbide disaster (2001), as the impossibility of bounding fieldwork or the ethnographic site in such circumstances.

In what follows, I explore, through Kurchatov's histories and its residents, how wasted lands, bodies, buildings and knowledges are variously invoked, concealed, and revealed, and the effects of these different ways of knowing and unknowing.⁶ For this, I deploy the heuristic and structuring device of two juxtapositions. The first pair is simultaneously temporal and spatial: before December 1991, Kazakhstan was part of the Soviet Union, afterwards it was independent. Nuclear legacies, however, query both distinctions. The second pair is broadly between 'formal' or state-sponsored ways of knowing, and recollections or narratives by long-standing residents of the town, including those who worked on the STS and more recent arrivals. In the final section, I move from the town and its residents to the STS to examine different ways of knowing the site and their consequences. As I discuss, following Kenneth Burke (1969), representations, whether narrative or cartographic, create their object by selecting some elements and deflecting or ignoring others (see also Harley 1989). When such abstractions are applied to a world of infinite possibility, the consequences can be profound.

While these distinctions between then and now, Kazakhstan and the Soviet Union, formal and informal are used emically to configure narratives, they also leak into one another. The following sections move from the Soviet period to the present, examining continuities and changes in how the STS is managed and how wasteful activities and their consequences have been obscured or selectively revealed. This is then contrasted with accounts from residents. The conclusion returns to the implications of two different stances towards knowledge: management and open-endedness. Although the context is specific, the questions it raises are of broad application. What does it mean to be 'on the map' as Aruzhan and many others so earnestly desired?

Cold War Isomorphic Secrecy

The Soviet atomic weapon project was shrouded in secrecy but, just as Soviet designs repeated American ones secured through espionage (Rhodes 1986, 1995; Brown 2013), so too were many of the technologies of unknowing common or isomorphic across the two powers.⁷ From the beginning, accounts were contested. In 1947, Beria selected an area in Kazakhstan to be the test ground. Many reasons are given for choosing this location. Logistically it made sense: it was close to the TurkSib railway, an airport in Semipalatinsk, the Irtysh for river transport and other parts of the Soviet nuclear complex⁸ in the Urals (Sergazina and Balmukhanov 1999:13). Some say Beria claimed the lands were uninhabited (Kassymova *et al.* 2012:237), or practically so (Shkolnik and Littlefield 2002), thus echoing the colonial discourse of *terra nullius*, denying recognition of indigenous peoples by declaring their land empty (see Buchli

2007). This reappeared in a trope, used by Alexander Chaikovsky,⁹ former lead civil scientist and mayor, amongst others who described the polygon's establishment on the naked steppe (*golaya steppe*). Others speak of deliberate genocide of Kazakhs from the outset (Brummell 2011:241) while the NNC suggests the effects of nuclear tests were unknown at the start (Panov and Shalemetov 2008:21–22; Shkolnik and Littlefield 2002) and therefore logically could not have been genocidal. Arguably, this is disingenuous. Even if the effects were initially unknown, they rapidly became clear. In 1957, 8 years after the first detonation, the military established a clinic in Semipalatinsk misleadingly named Anti-Brucellosis Dispensary No. 4. This was to study the effects of nuclear tests on local residents without informing them of the reason (Kassenova 2009), as the Americans were doing in the Pacific (Barker 2013) and the Southwest (Masco 2006), the French in Polynesia (Barthes 2017) and the British in Australia (McClelland 1985). Boris Gusev, one of the doctors employed at the clinic has written about its work (e.g. Bauer *et al.* 2013; Bauer 2005). Those of my informants who were originally from neighbouring villages described being ordered to stand outside during surface detonations, sometimes 'shielded' by a sheet. They interpreted this variously as deliberately using local inhabitants as guinea pigs or protecting them from the possibility of collapsed houses. Thus while it is possible that the effect of fallout and blasts was unknown at the start, a trope of emptiness persists that eradicates people living on or nearby the site. Such deflective strategies were coupled with other methods for disabling knowledge about the programme.

During the bitter winter of 1947, a small garrison was set up 30km from the STS with drivers described as valiantly battling snow storms and icy temperatures to bring supplies across the trackless wastes from Semipalatinsk. This settlement eventually became Kurchatov (Anon 2007:4). Standard narratives (e.g. Akchurin 2007; Shkolnik and Littlefield 2002) repeated in the NNC's official histories, are structured around heroic figures of valour and self-sacrifice for the Soviet fatherland, where suffering from extreme frostbite is matched by a Stakhanovian capacity for work and exemplary moral character. By the 1950s, the garrison had developed into a sizeable town for officers, civilians and their families abutted by a similar complex for soldiers, each well-equipped with libraries, schools, medical facilities and Palaces of Culture (Akchurin 2007:49). The population size was known only by the military commander,¹⁰ but the highest likeliest number is 23,000 adults plus children.¹¹ In common with most nuclear towns in the eastern bloc (Brown 2013; Šliavaitė 2005; Baločkaitė 2010; Sagdeev 1994) it was characterised by secrecy, isolation, and the relative luxury in which the constrained residents lived. Kurchatov's isolation was threefold: it was far from other settlements, ringed by barbed wire and heavily guarded.

Kurchatov and the STS were constructed as places that defied conventional methods for knowing. As with other secret atomic installations, they were unmapped and had several 'official' names intended to deflect attention elsewhere. A double cartographic absence thus denied first the presence of Kazakhs and then that of the town and STS. At the start the town was simply called Moscow-400. Naming such installations as postcodes for distant places was a standard technique; so much so that, somewhat ironically, young engineers rapidly came to know that being recruited for a 'postcode

address' meant work for the atomic programme (Sagdeev 1994). A nearby farm, Moldary, briefly lent its name to the garrison. After a railway link was built, it was also called Konechnaya (Terminus). The whole complex was further divided and codified as letters; thus the town was also Ploshad M (site M).¹² Finally, in 1974, it was given the status of a civil town and renamed Kurchatov, after Igor Kurchatov. Semi-palatinsk-21 was the most commonly known and used 'postcode address'.

Departments were also coded. As Valeriya, wife of a retired senior engineer, spelled out: the Institute of Atomic Energy, where her husband still worked, had been called 'The United Expedition'; the Institute of Geophysics was 'The Central Expedition' while the seismic station had only ever been Object-905. Perhaps more famously, the department in overall charge of the Soviet nuclear programme was called the Ministry of Middle Machine Construction, Minsredmash.¹³ Roald Sagdeev, a Soviet physicist, observed in his autobiography that the deliberate banality of the names was so successful that he was initially put off from applying to work in Kurchatov's laboratory, named the Laboratory for Measuring Instruments (1994:46).

Another technique of unknowing was the compartmentalisation of the nuclear programme such that, in theory, as the Director of Almaty's Institute of Nuclear Physics explained, 'everyone knew their precise task and no more. Nor did they ask. Only a very few people at the very top were able to see the whole picture'. Chaikovsky was quick to highlight the problems this could engender, suggesting that had it been easier to communicate laterally, the safety protocols developed in Kurchatov's civil research reactors would have prevented the disaster at Chernobyl. Quietly, he added that such separation also meant that almost no-one could be held responsible for what they did.

The IAEA (1998:6) suggests that 456 tests were carried out on this territory: 116 of which were atmospheric until the 1963 Limited Test Ban Treaty ended surface explosions. The numbers are approximate; there are different ways of counting. It is difficult to be precise as some tests did not go as planned. There were accidents,¹⁴ failed detonations, unforeseen changes of wind direction; coal seams that caught fire from underground tests and burned for five years (Mustovya 1992; IRES 2009). The IAEA (1998) notes that details of failed tests are needed to determine fully any residual effects but, as described below, test documents were either destroyed or taken to Russia.

Secrecy is an odd concept in the case of something as spectacular as atomic explosions that are explicitly demonstrative of power in all senses. The unexpected element is that the spectacular secrecy of the weapon tests served to conceal or at least deflect attention from the civil research that began on the site in the early 1960s into nuclear-fuelled space rockets. Much of this took place in a 7 km square underground complex; not quite the secret underground city Aruzhan mentioned but still, as Chaikovsky said, 'our work was hidden by the weapon tests so we could peacefully get on with our work'. What are rarely discussed are the radioactive wastes produced by the research reactors in the 1970s and 80s (Lukashenko 2008:16), the 'dirty' bombs or 'Combatant Radioactive Substances' tested on site 1953–1957 (Lukashenko 2008:16), and the burial of highly-toxic chemical wastes from nearby industrial cities. What then appears is a 'sacrifice zone', a site selected to be wasted for the greater good, in this case defense. Steve Lerner (2010), amongst others, charts how such

North American ‘national sacrifice zones’ are typically co-located with minority, economically-disadvantaged groups, are linked to military and industrial wastes and may be repeatedly used for different kinds of wastes, once the initial act of wasting has been made. To this we can add Cold War nuclear test sites that were usually in distant colonies of former empires.¹⁵ In Kazakhstan’s case, as the next section details, we find attempts to reframe one such national sacrifice zone as an area of potential national enterprise, but for a different geopolitical formation altogether.

In the late 1980s, the Nevada-Semipalatinsk Campaign to stop nuclear weapon testing was successful. The last test was performed in 1989 and testing officially stopped on August 29th 1991. Four months later the Soviet Union was dissolved. The campaign carefully talked about the land and people of Kazakhstan—thus implicitly including the many ethnic groups in the country—but was often seen as a protest only by and on behalf of indigenous Kazakhs.¹⁶ Indeed, in 2002, I visited an art exhibition in Semipalatinsk where huge, black canvases depicted monumental, weeping, elderly Kazakh women, in traditional dress, rising from the land as though part of it, in a bleak landscape of bones and skulls.

In sum therefore, the Soviets could be said to have constructed a national sacrifice zone by declaring lands to be empty, then repeatedly wasting the territory. The lives of those who lived on or near the land were thereby eclipsed alongside the many kinds of waste on the STS. Such ‘sacrifice’ is amplified by the heroic narratives of suffering that overwrite the bodies wrecked by the testing programme itself. In theory, the destructiveness of the testing was hidden from outsiders by the complex’s isolation and cartographic absence. The chaos that followed independent Kazakhstan’s emergence, however, meant that the human and financial infrastructure for continuing the kind of secrecy that Masco traces from the US Cold War to contemporary counter terrorism practices (2010) was simply impossible. Thus while there are certain continuities from Cold War modes of secrecy, these follow a distinct path.

Post Soviet Imaginary Fractals

In 1991, the Soviet Union collapsed. But time and space took on peculiar qualities in Kurchatov and the STS. The Soviet-turned-Russian army remained alongside the Kazakh civil administration for two years. Nearby Chagan, a Soviet reconnaissance aircraft base, equally secret, was instantly vacated and rapidly crumbled under the combined onslaught of the harsh steppe climate and scavengers or ‘harvesters’ after metal and bricks.¹⁷ It was a daily reminder of what might happen to Kurchatov.

Then, suddenly, in the winter of 1993/4, the army left. Gennadi, then a civilian engineer, said ‘I was in one of the offices and saw documents being stuffed into the stoves and burnt, other papers were being ripped up or stuffed into bags and taken back to Russia.’ This destruction and removal of test documentation has hampered attempts to monitor the site ever since, a simple but effective method of impeding complete knowledge.

Convoys of lorries took military families back to Russia, with many Russian civilian engineers and scientists following suit. As the army left, the officer’s mess was engulfed

in a conflagration. With military technical expertise gone, the heating plant broke down and the little town rapidly buckled in the extreme cold, temperatures reaching -50 Celsius. Many residents say the Russian army deliberately tried to wreck the town, leaving nothing for the Kazakhs, although its near collapse was more likely to be caused by a concatenation of other factors. My neighbours showed me photographs of enormous stalagmites stabbing down from roofs, windows sheeted in thick ice, frozen snow piles blocking doorways. If they had not described families huddling together wearing all their clothes, crouched around stoves, the place would have seemed already deserted. At this crucial point, as formal and informal narratives alike recite, a *deus ex machina* arrived: Nazarbayev, the First Secretary turned President of Kazakhstan, flew in and said, 'hey guys, don't leave! Kazakhstan needs you and your skills. We will build the National Nuclear Centre here!'

This marked the switchpoint from the possibility of a devastated, wasted town and wasted skills as professionals sought employment elsewhere. It also signalled a response to the vast stretch of contaminated land. This is where Kazakhstan's post-Soviet story peels away from post-Cold War accounts of nuclear test sites elsewhere (Johnson 2007; Masco 2006; cf. Petryna 2002). The vast and complex Soviet plutonium economy had concentrated most of the technical and scientific design and build installations in Russia. New national borders sliced across this network; Kazakhstan was simply left with the legacy of testing and uranium mines.

The broader economy affected the official response in three ways. First, increasing uranium production, plus mobilising remaining nuclear knowledge and infrastructure, were key drivers in reconfiguring the STS, town and its residents and linking them to a vision of Kazakhstan, championing peaceful nuclear research on the global stage. Second, potential danger on the STS had to be responded to as far as possible.¹⁸ The NNC was clearly central to these projects. With the CNCP, a nuclear technopark was also planned (Gardner 2010) to put Kurchatov on the map as a centre for peaceful nuclear enterprise. This was the unfinished building I had passed on my way into the town, which was intended to provide employment for highly-skilled personnel and keep them in place.

Third, the poverty of the 1990s meant the resource-intensive Soviet security regime was unsustainable. The STS's perimeter fence disappeared, removed, it was said,¹⁹ by locals who sold it on the black market as scrap metal. This in turn meant that remnants of testing equipment and materials were now regularly, illegally mined and sold. Detonation shafts were re-opened to retrieve valuable, but contaminated copper. Daniyar who had been born in Sarzhal, a village on the site's edge, described how a friend had told him in the mid 1990s that there was copper on the STS and wheedled him into joining him in extraction.

We drove there from Semipalatinsk. It was easy. No-one stopped us. We waited until dark then dug through the night where my friend had been told. He went down the hole and came up with copper wire. Then we sat there and smoked. I think we must have inhaled contamination. We sold the copper for a good price but my friend died of cancer 6 months later.

Such stories were relatively commonplace, alongside less dramatic accounts of removing bricks. When I was driven from Kurchatov to the STS, I was startled when the jeep

suddenly braked and the guide announced we had arrived. Unbroken steppe flowed around us, clouds gusting along the vast, open skies above. There was nothing to indicate something different, no start point, or boundary crossing. This was their joke. ‘How do you think we know we’re arrived?’ I spoiled their trick by spotting a tumbledown cabin, which they told me was a former guard hut. It was a vivid illustration of the physicality of the unfenced, unbounded site as opposed to its precise delineation on maps I’d been shown.

The NNC’s Institute for Radioecology and Safety (IRES) grew and began not only monitoring the STS but reconfiguring the town and its people as well as the site as a distinctly Kazakh enterprise. This involved a series of spatial, temporal and relational moves. One intervention was their slogan, ‘From national tragedy to national patrimony’ which is worth unpacking with care. This clearly separates the Soviet past from the Kazakh present, Soviet perpetrators from Kazakh victims echoing similar interventions elsewhere in Kazakhstan’s nation-building exercises (Alexander 2019). The emphasis on national patrimony selectively plucks from a troubled history and lays claim to the achievements of Soviet nuclear science. The wasted bodies and lands of the testing programme are simultaneously recognised and displaced to the past while a bright future is foregrounded that is based on this scientific legacy. Such manoeuvres were reinforced by suggestions from the NNC that the STS should be submitted to UNESCO as a world heritage site²⁰ and could become a tourist destination (Lukashenko 2008), although this has not taken off, except for the occasional dark tourism aficionado. A small museum is occasionally opened for visitors as part of the NNC’s stated aim to be more open, rather than a ‘secret wrapped in darkness’. This contains a diorama of the setup for the first test; maps, a detonation control point, deformed animals in jars of formaldehyde, dazzling psychedelic posters celebrating Soviet nuclear advances and some photographs—including two Soviet Kazakh First Secretaries, including Nazarbayev, warmly shaking hands with Kurchatov’s generals. As Eglė Rindzevičiūtė observes, contemporary museums of Soviet pasts can overflow with meaning, resisting the neat recalculation of history attempted by many post-Soviet national elites (2015).

The local media are regularly invited in to emphasise this temporal shift. Kurchatov, still half-ruined but home to the NNC, has been variously hailed as ‘a phoenix’, ‘the most intellectual town in Kazakhstan’, a ‘town of science’ (Bidanova 2009), and ‘the pearl of Kazakhstan’ (Vikhrev 2002). The site itself; the local environmental and medical history and their present consequences; and the town’s ruins are typically briefly mentioned only to be displaced by paeans to a glittering research future for ‘the only one-company town whose product is scientific knowledge’ as a Kurchatovits proudly described his city in 2014. The fact that the STS was one part of a vast complex is similarly eclipsed. It is as though the logic of fractals insists on seeing the whole in the part. Kazakhstan is still heavily dependent on Tomsk University in Russia for training nuclear specialists and, despite claims to scientific achievements, most of these occurred in Russian institutes which designed test protocols and infrastructure, and analysed results. Kurchatov’s contribution was the study of radioactivity on animals as well as material science. The IRES has also become expert in radioecology, taking part in international collaborations to neutralise or remove dangerous materials (Stone

2003; Harrell and Hoffman 2013), monitoring on-site contamination²¹ and, where possible, carrying out remediation activities.²²

Post-Soviet interventions to deflect or manage potential and actual wastes thus took two main forms: the displacement of wastes to the past while yoking the town, qua scientific enterprise, to national futures and keeping nuclear knowledge, people and material in place. This requires not only reimagining once separated knowledge as co-located and adequate for a national nuclear enterprise but also that the vast network, of which the test site was just one node, were somehow replicated in each part.

Living with Wastes

My neighbours in Kurchatov did not appear in the grand histories of great scientists and heroic pioneers, histories that some regularly cited as ‘having said everything there is to say’. In turn, their perspectives variously undercut, recapitulated or presented quite different takes on the official narratives above. Notably, most people’s reminiscences included fond memories, cynicism and terrifying moments depending on context. What appear, *inter alia*, are narratives that undermine the new nationalist drive to contain the past and keep it and associated wastes in place. These are stories of yardward movement.

Although 1991 marked a spatio-temporal geopolitical break, this is not how it was experienced by many Kurchatov residents. Minoushka, a frail woman who now helps in a kindergarten, had been sent from her Russian orphanage to work as an army sempstress in Kurchatov when she was 16. Her entire adult life had been spent in the town. When the new Republic was declared, she said, ‘We held our breath. We felt as though we were caught between heaven and earth. No-one knew what would happen’. There is no map that can convey the sense of being ‘between heaven and earth’ or indeed ‘a little bit of Russia in Central Asia’, or even ‘a corner of the Soviet Union’, all of which are regularly said, either despairingly or delightedly, about Kurchatov, depending on the speaker. This seepage between times and places is a constant undertow dragging against official attempts to present clearly delimited temporal periods.

Many younger, second-generation Kurchatov residents described how they had repeatedly left and returned to ‘their homeland’ (*rodina*); pushed by a desire to leave an isolated, crumbling town with ‘bad ecology’, and poor infrastructure for children but pulled back by the comfort of family and friends. Thus Sasha had joined the army, returned to his family, left to marry, then returned with another girlfriend and set up a children’s club, still wondering if he would finally settle. Others, who seemed content to stay, described the periodic anxiety over whether or not this was the right decision. The daughter of an army driver, married to an IT specialist in the NNC, Anna had been born in Kurchatov in the late 1970s and now lived with her family in a large apartment. Balancing one child on her knee while she patiently fed the other through his new Darth Vader mask, she said,

Mostly I’m too busy to think about things—rushing about shopping, looking after the children, hoping for part-time work in the library. That’s my profession. Then suddenly something catches you and you look again and suddenly you see this place and the ruins and I think how can I bring my children up here? We don’t talk about it all the time. You can’t live like

that. But every now and then, we talk about moving away to find better schools for the children, better opportunities, better health ... But this is my home, my motherland. I don't know how to live here—or how to live without Kurchatov.

Anna also had a robust riposte to accounts of the town's isolation and impermeability. She described looking out of the window as a little girl and watching 'curious Kazakhs from the villages paddling up the river, tying up their boats and wandering round the town by night'. 'Quite apart from that', she added briskly, 'where did all the people come from to work in shops, cleaning, driving—all kinds of things? From round here!' She was far from being the only one who gleefully described how porous the nominally-closed town could be. Anna's friend Maria, from another multi-generational Kurchatov family, told how, in the late 70s, her uncle, who also worked on the STS, wanted to introduce his new fiancée to his family in Kurchatov. He accordingly drove with her in his new Zaphorets car from Semipalatinsk then, 20 km outside the town, stopped the car, wrapped a rug round his girlfriend and, with much mutual giggling, carefully stowed her in his boot then sailed through the KGB checkpoint.

Unsurprisingly, a habitus of silence is stronger in households with a Soviet past accustomed to the military's insistence on not talking about work. Even here, declarations that the tests were intensely secret would suddenly be cut through: 'Of course we knew! Every time the china rattled and the lights swung to and fro we were afraid for our men out there.' Residents who lived through the surface tests speak of 'two suns' in the sky, a now common trope, and describe cowering against the shockwaves that regularly tore off roofs and shattered windows.

Rejection of a future orientation for both Kurchatov and the nation appeared through several wry interjections. Vladimir, a retired engineer, who had spent his working life on the STS and now picked up odd jobs from the Akimat or NNC, was scathing about the Nuclear Technopark's stalled construction. 'Look at it!' he said, 'is it a ruin or is it half built?' entangling the hoped-for future in the ruins of the past. Itemising the reasons why this particular future would never materialise, he continued,

The rooms were built without measuring the equipment that has to go in them, so now either the roof or the walls will have to come down to get the kit in. It's never going to happen. And even if they do finish it ... We're so far from anywhere—who'd want to set up a business here? Jobs for managers. Waste of money.

He was not the only one who grimaced at the Technopark, refused the act of moving on and cast future moves as indistinct from the ruins of the past, insisting instead on a present that ensnared and hobbled the future.

The clear temporal arc proposed by the NNC, placing wastes in the past and highlighting radiant atomic futures, was denied in other ways by residents, suggesting more complex temporal knotting. Thus during a walk with Valeriya, we paused by a broken plaster balustrade and looked back over Victory Square, now cracked, overgrown and filled with tumbleweed. Valeriya sighed happily and, stretching out her arms to things I could not see, said, 'Oh! It was so romantic! It was like St Petersburg! Moscow! We danced here all night in the summer with handsome young officers!' re-vivifying the heroic narrative for a brief moment.

Likewise with Lenin, a driver who had long worked on the site, she traced out the soldiers' town, happily comparing notes: 'And here was the carpenters' workshop! Here the library ...' She was not the only one to see—and see past the present ruins to their former state. At the same time, however, Valeriya was also acutely aware of the dilapidations and had spearheaded a fundraising campaign to restore a collapsed sports hall for the town's children. While regular commentary was rare, companions would sometimes pause on walks and, pointing to an empty spot, often a former kindergarten, describe what used to be there. As Anna's narrative above also suggests, there were occasional tears in the fabric of everyday busyness where ruination loomed large. Running up the stairs to his apartment, Piotr, a generally happy-go-lucky teacher, stopped, touched a curl of paint that had lifted from the damp wall and muttered, 'it's like living in a novel by Dickens'.

Kurchatov's wasted bodies from the tests were rarely mentioned but suddenly became more visible. Although there were the occasional jokes like Elena's uncle, and it was not too difficult to arrange visits out, incoming visits took months to arrange in the Soviet era and were at the behest of the KGB. For this reason, Chaikovsky said, there had been no cemetery on site. The Russian Orthodox church demands attendance by kin at gravesides; this would have been impossible in a closed town and therefore arrangements were made to return bodies to their natal towns. Correctly or not, this was interpreted by most residents as a deliberate attempt to conceal the number of deaths. As soon as the army had gone, Chaikovsky ordered a cemetery to be built. The effect was to make all too visible the high number of early deaths, often from suicide and alcoholism. Not one person who told me about this connected these deaths to radioactive contamination directly but rather to the sadness of living in this isolated place, with scarce employment and strained family lives.

These were all typical narratives from many of those who had lived through both the fat and the lean years, many of whom, like Valeriya, preferred to carol the glories of the Soviet period than dwell in the present or on what the future might afford. The idea that Kurchatov, like all other Soviet nuclear settlements, was built on prison labour²³ was ill-received and repudiated when I asked. But Gennadi silently led me to a patch of ground slightly beyond the main town itself. 'Over there,' he said, 'that's where they had the barracks for the prisoners. They were pulled down in the 1950s.'

Other quiet observations undermined grander nationalist aspirations. I was given many answers to questions about who had dismantled the soldiers' town. Invariably, the first reaction was a vague 'hooligans', sometimes said to be from the local villages. Later, Oksana, a Ukrainian shop assistant told me how she had gone, hand-in-hand with her grandmother during the winter of 1993/4, to take what wood they could to burn. Most had already been removed.

Books were just lying all over the floor in the library where the shelves had been yanked out. It was so sad to see all those books by Marx and Lenin just lying there. All that hard work gone to waste. I gathered armfuls up to take home to rescue them. I still don't know what to do with them!

Oksana was not the only one to admit cannibalising empty buildings but most described vans coming and going with men systematically stripping them. The next line caught

me by surprise the first time I heard it, invariably with a broad grin on the speaker's face, 'Maybe those bricks are radioactive. Maybe they were going to build Astana (the new capital). What other big building project was happening then?'

Despite the half-joking way in which these observations were delivered, there is a strong chance the bricks were radioactive.²⁴ This was an oblique way of referring to the subject that few talked about directly: whether or not Kurchatov and its residents were contaminated. Recent incomers were more voluble but unspecific about its 'bad ecology'. But while raising the possibility that tests also affected the town, these comments also pointed to the uncontainability of the town itself. Not only was it invisibly expanding via these bricks stolen for 'recycling' but, it was suggested, contaminated bricks underpinned the President's spectacular new-for-old capital city, Astana (renamed Nur-Sultan in 2019), the 'face' of new Kazakhstan (Buchli 2007; Laszczkowski 2016). Not only was the new capital shackled to the past, these were shackles, the implication ran, that would bring down the whole nationalist enterprise. Although in 2020 Nur-Sultan is flourishing, in 2009 there were many comments that the speed of its construction, like many government policies, would result in its collapse.

Few spoke of the health problems and poverty of neighbouring villages, or indeed within Kurchatov. Only Talgat, a gentle man in Kurchatov's civilian administration, murmured that after the military left, it seemed as though the neighbouring land and its people were diseased, so terrible was the poverty. One of many Russians in their 60s who had chosen to stay, feeling they had nothing to return to, Lila was famously outspoken amongst friends. She articulated what others nodded to in agreement but hesitated to say. Describing the Nevada-Semipalatinsk campaign, she said that it had only emphasised Kazakh victims in the area,

As though a bomb had been invented that could distinguish between different nationalities when it fell! If that were true we could have ruled the world! Russians and other nationalities suffered too! But all you hear about are Kazakhs.

Another time, she quietly told me that she had tried to collect information and raise concern about the number of children born in Kurchatov with severe health problems but no-one had wanted to know, inside or outside the town. In the end, she said, she stopped as she found it hurt her heart too much to see the children. 'And so,' she said, 'I joined the silence.'

Unsurprisingly, the Soviet period still influences residents, often in ways that undercut the NNC's profession of openness and attempts to combat what they describe as 'radiophobia': the irrational fear of radioactivity (Stawkowski 2017). Families connected to the NNC's renamed Institutes still cosily refer to them not only by their earlier code names, but by diminutives of those codes, inadvertently adding layers of puzzlement to non-local interlocutors. Thus the Atomic Physics Institute is generally called 'The Central' much as the GeoPhysics Institute is simply 'the Union'. Equally, on top of the many formal code names for the town still regularly used, are other affectionate nicknames. Those who arrived via the Irtysh called the garrison after the landing stage where they arrived: Nadyerzhda, meaning 'hope'; others christened it Bereg, or 'shore', again indicating their disembarkation point, names that are still used not

only by the pioneers who coined them, but by those who arrived decades later. There is no intention here to deflect attention but the effect is to intensify the cultural intimacy of a particular community. A new moniker was added by passing motorists who, seeing the tall chimneys of the half-ruined town poke through its winter snow blanket, nicknamed it Titanic after the film came out in Russian.

Conclusion: Cartographic Ignorance or 'Where do you Draw the Line?'²⁵

As Tony Crook (2007) and Graham Jones (2014) suggest, ethnography itself is often implicitly grounded on the idea of secret knowledge, that all is not as it first appears; the ethnographer's task is to reveal what is 'actually' going on. Yet the various modes of secrecy from the Soviet to the post-Soviet eras were more complex and interwoven than simple ethnographic 'revelation' might suggest—as Crook also discusses in a different context (2007). Rather than revelation, finding out 'more' only seemed to point to another way in which knowledge and non-knowledge were refolded, producing different social effects. The figure, rather than the content, of any secret emerges as an ethnographic category of exegesis, and indeed my presence provoked some declarations that either everything was already known or that nothing was knowable. I suggest here that the 'full truth' and its absence, alongside other forms of unknowing, were organisational tropes that also played a part in managing some things out of existence.

In short, during the Soviet period the wasted lives and lands generated by the nuclear tests were eclipsed by a number of deflection strategies following the familiar Cold War repertoire²⁶ of secrecy: codes, isolation and guarded perimeters. The programme was also framed as a public good for global peace, which was and is supported by heroic narratives detailing the STS's construction. It is to Burke's (1969) idea that an invocation of an object, or representation, by simultaneous selection and deflection, that I now return but through the lens of cartographic boundaries that create an object, here a representation of a land tract, held within its limits.

The previous sections have also traced the logic of diagrammatic thinking to consider what is actively unthought or absented through representations and attempts at limitation and containment. There were deliberate cartographic absences: secret nuclear establishments were unmapped, local settlements initially ignored. Nuclear knowledge itself was also purposely incomplete, distributed so that only a few could map out the whole programme. The Soviet emphasis on containment reappears in the post-Soviet era in a curious series of inversions. Perimeter fences disappeared while the town and site were put on official maps, which delineated their extent but also the NNC's concern or responsibility. Debates over what to do with the vast site hinge precisely on the question of what limitation affords.²⁷ Whether or not radioactive contamination can be caught and held fast by such geometry is a moot point; certainly residents query the stability of the town, its population, and its nuclear knowledge, thus challenging delimitation.

Linking town and site are thus the exploited and contested limitations of cartographic knowledge, both its presence and absence. A map after all only shows what is on it. Post-Soviet attempts to rehabilitate the STS, described below, are grounded on defining limits to the site, displayed on maps as a geometric overwriting of the physical terrain. But such

maps, part of the new rhetoric of openness, also act to limit remediation and monitoring efforts that reach the boundaries and no further. Radioactivity, like chemical pollution or landfill leachate (Reno 2018) does not easily lend itself to geometric definition; it is “amorphous and invisible” (Castán Broto 2015:94); leaks can be wayward, hard to assess and bound either temporally or spatially (Tsing 2015:28).

Attempts to contain Kurchatov and the site have never been wholly successful. Despite the efforts expended on secrecy in the Soviet period, the town proved surprisingly porous. With the removal of the fence, it is now strikingly unclear where the site starts and ends, although there are striped poles marking dangerous hot spots and some guards. Stabilising current expertise in Kurchatov for the NNC and national ambitions has also proved difficult. Some scientists have moved to work in other countries, thus wasting skills for the national effort. But even this image of holding people fast belies the fact that Kazakhstan’s nuclear capacity still depends on Russian expertise, training capacity and other facilities; many of the NNC’s scientists and engineers have Russian citizenship.

Characterisations of the STS differ markedly between those promulgated by the NNC and other ecologists who have worked on the site, as well as former employees I spoke to. In brief, since 2009 the NNC has been developing plans to return or shift up to 95% of the site to grazing, agriculture and mining (Magauov 2012:19; Witte 2013). The land is rich in minerals²⁸ and lush pasture; about 40,000 head of cattle already graze there illegally (IRES 2009) and a small coal mine has also operated, officially, on the STS since the 1990s. It is worth emphasising that extensive monitoring, securing and remediation activities have already occurred, continue and the NNC has declared this is a permanent commitment. Nonetheless that commitment is geometrically limited which, as we shall see, is seen by some as a crucial impediment.

A radically-different view is proposed by other scientists.²⁹ They stress that the site is essentially an open and thus expanding, ecological system, which is impossible to know and predict in its entirety. Uncertainty is compounded by the very nature of radioactive decay and transvector migration as well as the paucity of documentation about the tests. Activities such as mining and grazing, they claim, exacerbate the spread of contamination.

The NNC’s approach towards the STS, is arguably a task of containment, the alternative approach is based on openness, of the site and what may happen. While this is obviously an oversimplification and there are many shades between; the monochrome alternatives serve to highlight the differences. What interests me here is not so much who is right or wrong in their assessment, but the premises and consequences of different positions. Since each starts from a different epistemological premise, agreement is unlikely. The consequences of each approach are poles apart. One shuts down or ‘manages’ the STS. The other keeps it alive as an open question.

What this suggests, is that to know and name an object of enquiry it needs to be limited, finite. Following government guidelines, the IRES adopts a geometrical representation of the STS to artificially bound its sampling. A wide range of methods has been used: air photography, extant documentation, regular biochemical sampling, spectrometry, geological testing. The results are then extrapolated spatially and temporally. Thus the known parameters of the samples are extended to cover the whole STS—but no more and to stretch into the future. In effect, the predictive power of modelling a

limited number of variables in a closed system has been applied to the STS. This representation of the site as bounded and finite allows it to be known and modelled, as a laboratory experiment. Once knowable, it can be declared clean and, as we have seen, erased as a legacy and transformed into a commercially-viable future. It reminds us that, like a property object, such a representation of the site or 'waste object' must be created, defined, separated, cut out from a web of possibilities (Strathern 1996; Alexander 2004).

The proponents of the alternative approach adopt what they call an ecological stance, by which they mean that the site is essentially open and, in some respects, expanding (see Hird 2012). This works in several ways. They state that the site cannot be bounded spatially as contamination travels via several vectors. They suggest that extrapolation from spot samples for so huge a site is suspect, that samples need to be taken every 20 metres. Further, noting the unprecedented number of linked variables and the lack of documentation, they say that future effects cannot be predicted, only monitored and used to build up a unique accretion of knowledge about these steppelands and anthropogenic mutations.

The consequences of these two stances are stark and paradoxical. The reductive approach allows a knowledge object to be produced and predictions made. But the act of claiming the STS is knowable also serves to manage it out of existence, to erase uncomfortable histories and make it anew. The expansive approach, in contrast, by asserting the site's uniqueness and unknowability in toto, keeps it in view, maintains the STS as an ever-expanding question, an enduring present—rather than one that shifts into a developing future, what I have called above a chronotype of expansion.

Although these two approaches seem inimical, there are moments when the forward movement of reconfiguring Kurchatov and the STS is stopped in its tracks by what seems to be a counterclaim to the possibility of containment, when contradictions appear between appeals to Kazakh suffering from the Soviet nuclear tests and the emphasis on moving on to a Kazakh nuclear future. The project of state-building and legitimisation, is crucially interwoven with both nuclear futures and histories.

Thus, in 2009, in commemoration of the STS's closure for weapon testing, Nazarbaev released a statement via the IAEA which stated: 'The ecological disaster zone around the Semipalatinsk nuclear testing site occupies more than 300,000 square kilometres. One-ninth of all of the territory of Kazakhstan—a size comparable to the size of Germany—transformed into a toxic wasteland.' (IAEA 2009). Baldly put, this declares that the STS has exceeded its cartographic limits and irrevocably wasted, a strong word, the land. Complete remediation, this might indicate, is an impossible task as the object under question is constantly increasing in unforeseen directions. Simply leaving this behind via rhetorical term-shifting, might be the only option for a government bent on moving on to atomic futures.

Notes

1. The CNCPP's mission states, 'it is of the highest importance that displaced personnel find new opportunities to use their skills in a way which minimises the risk of nuclear proliferation. International security considerations mean that it is of the highest importance that acceptable economic and social conditions and the morale and loyalty of the individuals concerned are

maintained.’ The name, although not the acronym, has now changed from when I interviewed staff in the organisation in 2009 to the Coalition of Nuclear Centres and Partners.

2. Although in 2017, a 20% production cut (11,000 tonnes) was announced in response to the post-Fukushima decline in demand for uranium.
3. I also talked to many former employees and residents now living in Semey, Almaty and elsewhere.
4. Despite appearances, some of the two-storey buildings were bought cheaply after the Army left and are thus owned, not abandoned, with an obligation, more honoured in its breach, to maintain them. The half-ruined apartment blocks that were dotted between occupied ones in the quarter where I lived, were publicly-owned.
5. Werner and Purvis-Roberts interviewed NNC scientists as part of their comparative research into perceptions of risk, working closely with local medics, although their focus was not on other residents in Kurchatov. Stawkowski’s similarly excellent work has also included interviews with the NNC. What is presented here is intended to complement work by these scholars on health and risk perception.
6. Although I touch on nearby villages below, in terms of what was and was not known at the time of nuclear detonations, this is not my main emphasis.
7. Thus many of the techniques of unknowing described in this article such as compartmentalizing and deflecting knowledge and containment were and are found in most secret military installations, including but not only American, British, French and indeed Chinese Cold War nuclear installations. I outline the form they took in Kurchatov in order to explain the very particular contemporary approaches to secrecy and knowledge, which are distinct from the American continuation of Cold War practices in counter terrorism that Masco (2010) describes.
8. This vast complex was called the ‘white archipelago’ by Lev Alsthuler (1990), referencing the prison labour on which nuclear establishments depended (see also Medvedev 2000; Harrison 2013), or might be seen as a ‘plutonium economy’ to borrow Masco’s (2006) term for the US nuclear weapons industry. Brown’s (2013) book, narrows the focus to the plutonium-producing complexes of Hanford in the US and Chelyabinsk-40 (now Ozersk) in the Urals, but her neologism, plutopia, signifying the luxury afforded these residents, holds true, up to a point, for all secret nuclear establishments.
9. Although pseudonyms have been used for all other informants, Chaikovsky was adamant that his own name should be used, noting that he knew better than most what could be safely revealed and what could not.
10. Numbers cited range from 50,000 (Paxton 2011; Brummel 2011: 453) to the more usual 20,000.
11. This figure was given to me by the mayor on the basis of a referendum held in the town in 1993: he said that 6,000 soldiers had voting rights and 17,000 civilians and officers. These figures therefore only include those over 18. Although 1993 is ‘post-Soviet’ as the following section describes, the Soviet-turned-Russian army remained on the STS until 1994. This matches Saim Balmukhanov’s estimate (2014:5).
12. Each place on the test site was similarly coded (Akchurin 2007:20).
13. The same policy was followed in the US. An early suggestion for naming the atomic project was the Laboratory for the Development of Substitute Materials before place names were adopted instead. Thus, the Manhattan Engineering District Project eventually became the Manhattan Project (Kelly 2007).
14. The main site doctor speaking at the first open conference, suggested that one in three of the underground tests failed to go as planned (Mustovya 1992).
15. Thus the French carried out 196 tests in French Polynesia, the British tested in islands on the Western Australian coast and in Southern Australia (Maralinga).
16. The American part of the Campaign was explicitly on behalf of indigenous people harmed by American nuclear tests.
17. In Kazakhstan’s crashed economy after 1991, cannibalizing abandoned buildings for materials to use and sell was a widespread practice (see for example Alexander 2008, 2018). However, it remains a largely under-examined phenomenon.

18. There is insufficient space here to detail the numerous interventions and international collaborations to reduce immediate danger: e.g. warheads were taken to Russia in 1995, detonation shafts were blocked up, weapon-grade plutonium was airlifted to the States in Project Sapphire from nearby Ust-Kamenogorsk; Kazakhstan and the US's Operation Groundhog covered one contaminated area with steel-reinforced concrete. Project Amber and the Trilateral Threat Reduction Cooperation secured or removed "a dozen" bombs worth of plutonium on the site 2005-2012, according to the US's official estimate (The White House 2012).
19. Larissa Ptitskaya, former Director of the Institute of Radioecology and Safety is typically quoted as the source of this. My own informants corroborated this, but may have been quoting her.
20. In Britain, former Cold War atomic installations are now 'Scheduled Ancient Monuments', a classification that protects them as heritage.
21. A wide range of monitoring methods has been used including aerial photography, spectrometry, regular sampling and analysis of plant material and water, transvector migration of radionuclides etc. It is beyond this paper's scope to detail each one. Rather my emphasis is on the disputed efficacy of geographically-bounding such activities.
22. As noted by the IAEA's report on the remediation of radioactive contamination (1999), there are many remediation technologies. However different technologies are recommended for different kinds of radionuclides, each of which has specific characteristics. In situ technologies are categorized as: containment, stabilization/immobilization and finally treatment (1999:19). To the best of my knowledge, on the STS, attempts have been made to remove the most hazardous material, contain and block access to other areas beneath reinforced concrete, mothball in concrete bunkers testing equipment and technical components that were exposed to radiation. This does not mean that all contamination has been contained, secured and / or removed.
23. Andrei Sakharov wrote in his memoirs, 'Prisoners' hands built the plants, the test area, roads, and homes for future co-workers. The prisoners lived in the barracks and walked to work in a convoy accompanied by shepherds' (1990).
24. Bricks absorb radioactivity; thermoluminescence signals in bricks have been used to establish dosimetry to measure external radiation exposure (Takada *et al.* 2000).
25. Colonel Harrison, commander of the Air Force squadron responsible for monitoring nuclear test clouds during the 1950s later said: 'There isn't anybody in the United States who isn't a downwinder.... When we followed the clouds, we went all over the United States from east to west.... Where are you going to draw the line?' (Gallagher 1993:97).
26. I use 'Cold War' here to indicate all the nuclear powers during the Cold War period.
27. In the early 1990s, international actors such as the US and Russia also carried considerable weight in their views on what should happen to the site.
28. Including coal, gold, fluoride and molybdenum.
29. I focus here on the question of limitation. However, many believe the figures put out by the NNC are fabrications. Thus, in 1999 the former Head of the Department of Radiation, Safety and Environment at the Institute of Radiation Safety (1994-1998), Musin Zholdybayev said that a NNC report which found only 10% of the STS territory was contaminated was misleadingly low; he believed that up to 50% of the site was contaminated and unsuitable for economic development (Khabar Television 1999).

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References

- Arkchurin, Ildar. 2007. *Semipalatinskii yadernyi polygon: sozдание, stanovlenie, deiatel'nost*. Moscow: Golden Bi.
- Alexander, Catherine. 2004. Values, Relations and Changing Bodies: Industrial Privatisation in Kazakhstan. In *Property in Question: Appropriation, Recognition and Value Transformation in the Global Economy*, edited by Caroline Humphrey, Katherine Verdery, 251–274. Oxford: Berghahn Books.
- . 2008. Waste Under Socialism and After: A Case Study From Almaty. In *Enduring Socialism: Explorations of Revolution and Transformation, Restoration and Continuation*, edited by Harry West, Parvathi Raman, 148–168. Oxford: Berghahn Books.
- . 2018. Homeless in the Homeland: Housing Protests in Kazakhstan. *Critique of Anthropology* 38 (2):204–220.
- . 2019. Indeterminate Classifications: Being 'More Than Kin' in Kazakhstan. In *Indeterminacy: Waste, Value and the Imagination*, edited by Catherine Alexander, Andrew Sanchez, 134–160. Oxford: Berghahn Books.
- Altshuler, Lev. 1990. Tak my delali bombu. *Literaturnya Gazeta*, June 6: 13.
- Anon. 2007. Istorია dlinoi v 60 let, *Spektre rezonans*, 6th Sept 2007 no 16(78).
- Bakhtin, Mikhail. 1981. Forms of Time and of the Chronotope in the Novel. In *The Dialogic Imagination*, 84–258. Austin: Univ. Texas Press.
- Balmukhanov, Saim. 2014. *The Semipalatinsk Nuclear Test Site – Through My Own Eyes*. Trans. Elizabeth Bykowski. Fort Belvoir, VA: Defense Threat Reduction Agency.
- Balmukhanov, Saim, J. N. Abdrakhanov, Timor Balmukhanov, Boris Gusev, N. N. Kurakina & T. G. Raisov. 2006. *Medical Effects and Dosimetric Data from Nuclear Tests at the Semipalatinsk Test Site*. Defense Threat Reduction Agency, 8725 John J Kingman Road, MS 6201 Fort Belvoir, VA 22060-6201.
- Balmukhanov, Saim, Galina Raissova & Timor Balmukhanov. 2002. *Three Generations of the Semipalatinsk Affected to the Radiation*. Almaty: Sakshy Publications.
- Baločkaitė, Rasa. 2010. Post-Soviet Transitions of the Planned Socialist Towns: Visaginas, Lithuania. *Studies of Transition States and Societies*, 2(2):63–81.
- Barker, Holly. 2013. *Bravo for the Marshallese: Regaining Control in a Post-Nuclear, Post-Colonial World*. Belmont, CA: Wadsworth.
- Barth, Fredrik. 2002. An Anthropology of Knowledge. *Current Anthropology* 43(1):1–18.
- Barthes, Yannick. 2017. *Les retombées du passé - Le paradoxe de la victime*. Paris: Seuil.
- Bauer, Susanne, Boris Gusev, Tatyana Belikhina, Timur Moldagaliev & Kazbek Apsakilov. 2013. The Legacies of Soviet Nuclear Testing in Kazakhstan. Fallout, Public Health and Societal Issues. In *Social and Ethical Aspects of Radiation Risk Management*, edited by Deborah Oughton, Sven-Ove Hansson, 239–258. Oxford: Elsevier Science.
- Bauer, Susanne, Boris Gusev, Ludmilla Pivina, Kazbek Apsakilov & Bernd Grosche. 2005. Radiation Exposure Due to Local Fallout From Soviet Atmospheric Nuclear Weapons Testing in Kazakhstan: Solid Cancer Mortality in the Semipalatinsk Historical Cohort, 1960–1999. *Radiation Research*, 164(4 Pt 1):409–419.

- Bennett, Grahame. 2011. Kazakhstan at the head of nuclear renaissance, *Building a Nuclear Safe World: The Kazakhstan Way*, Ministry of Foreign Affairs of the Republic of Kazakhstan.
- Bidanova, Anna. 2009. *Osobaya energetika Kurchatova, Kazakhstanskaya Pravda*, 23 April 2009, p9.
- Boztaev, Keshirim. 1997. *Semei Poligony*. Almaty, Kazakhstan: Kazakhstan Publishers.
- Brown, Kate. 2013. *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters*. Oxford: Oxford University Press.
- Brummell, Paul. 2011. *Kazakhstan*. New York: Penguin Random House.
- Buchli, Victor. 2007. Astana: Materiality and the City. In *Urban Life in Post-Soviet Central Asia*, edited by Catherine Alexander, Victor Buchli, Caroline Humphrey, 40–69. London: Routledge.
- Burke, Kenneth. 1969. *A Grammar of Motives*. California: California University Press.
- Castán Broto, Vanesa. 2015. Dwelling in a Pollution Landscape. In *The Anthropology of Postindustrialism: Ethnographies of Disconnection*, edited by Ismael Vaccaro, Krista Harper, Seth Murray, 91–112. London: Routledge.
- Chari, Sharad & Katherine Verdery. 2009. Thinking between the Posts: Postcolonialism, Postsocialism, and Ethnography after the Cold War. *Comparative Studies in Society and History* 51(1):6–34.
- Crook, Tony. 2007. *Anthropological Knowledge, Secrecy and Bolivip, Papua New Guinea: Exchanging Skin*. Oxford and New York: Oxford University Press.
- Dilley, Roy & Thomas G. Kirsch, Eds. 2015. *Regimes of Ignorance: Anthropological Perspectives on the Production and Reproduction of Non-Knowledge*. New York: Berghahn Books.
- Fortun, Kim. 2001. *Advocacy after Bhopal: Environmentalism, Disaster, New Global Orders*. Chicago, Ill.: University of Chicago Press.
- Gallagher, Carole. 1993. *American Ground Zero: The Secret Nuclear War*. Boston: MIT Press.
- Gardner, David. 2010. Former Soviet State Incubating High-Tech Businesses at Former Nuclear Weapons Site. *Scientific American*, Jul. 14 2010. <http://www.scientificamerican.com/article/kazakhstan-nuclear-technology/>.
- Gershon, Ilana & Dhooleka Sarhadi Raj. 2002. Introduction: The Symbolic Capital of Ignorance. *Social Analysis*, 44(2):3–14.
- Grant, Bruce. 2001. New Moscow Monuments, or, States of Innocence. *American Ethnologist* 28 (2):332–362.
- Greenall, Robert. 2005. Life after The Bomb in Kazakhstan. *BBC News*. Tuesday, 6 December 2005. <http://news.bbc.co.uk/1/hi/world/asia-pacific/4501776.stm>.
- Gudowski, Wroclaw. 2001. *Short report from a visit to National Nuclear Centre – Semipalatinsk Nuclear Test Site*. Stockholm: Royal Institute of Technology. http://neutron.kth.se/oldsite/gallery/conferences/iaea_semipalatinsk/nuclear_site/semipalatinsk_report.pdf. Last accessed 8th July 2014.
- Harley, J. Brian. 1989. Deconstructing the map. *Cartographica: The International Journal for Geographic Information and Geovisualization* 26(2):1–20.
- Harrell, Eben & David Hoffman. 2013. *Plutonium Mountain: Inside the 17-Year Mission to Secure a Dangerous Legacy of Soviet Nuclear Testing*. Cambridge, MA: Harvard University, Belfer Center for Science and International Affairs.
- Harrison, Mark. 2013. Secrecy, Fear, and Transaction Costs: The Business of Soviet Forced Labour in the Early Cold War. *Europe-Asia Studies* 65(6):1112–1135.
- Hird, Myra. 2012. Knowing Waste: Toward an Inhuman Epistemology. *Social Epistemology*, 26(3–4):453–469.
- Holloway, David. 1994. *Stalin and the Bomb*. Yale: Yale University Press.
- I.A.E.A. 1998. *Radiological Conditions at the Semipalatinsk Test Site, Kazakhstan: Preliminary Assessment and Recommendations for Further Study*. Vienna: International Atomic Energy Agency.
- . 1999. *Technologies for Remediation of Radioactively Contaminated Sites*. Vienna: International Atomic Energy Agency.
- IAEA. 2009. Communication Dated 29 June 2009 received from the Permanent Mission of Kazakhstan with Regard to a Pressrelease to note a Commemorative Meeting of the 20th Anniversary of Shutting Down of the Semipalatinsk Nuclear Testing Site. INFCIRC/763. Vienna, Austria: Internal Atomic Energy Agency.

- IRES (Institute of Radioecology and Safety). 2009. *Semipalatinsk Test Site: Current State*. Kazakhstan: National Nuclear centre.
- Johnston, Barbara. 2007. *Half Lives & Half Truths: Confronting the Radioactive Legacies of the Cold War*. Santa Fe, New Mexico: School for Advanced Research Press.
- Jones, Graham. 2014. Secrecy. *Annual Review of Anthropology* 43(1):53–69.
- Kadyrzhanov, Kairat. 2011. Becoming a New Nuclear Power, A Peaceful One. In *Building a Nuclear Safe World: The Kazakhstan Way*, Ministry of Foreign Affairs of the Republic of Kazakhstan, Astana, Kazakhstan.
- Kassenova, Togzhan. 2009. The Lasting Toll of Semipalatinsk's Nuclear Testing. *The Bulletin of the Atomic Scientists*, 28 Sept. 2009. <http://thebulletin.org/lasting-toll-semipalatinsk-nuclear-testing>.
- Kassymova, Didar, Zhanat Kundakbayeva & Ustina Markus. 2012. *Historical Dictionary of Kazakhstan*. Lanham, Toronto, Plymouth, UK: The Scarecrow Press, Inc.
- Kelly, Cynthia. 2007. *The Manhattan Project: The Birth of the Atomic Bomb by Its Creators, Eyewitnesses, and Historians*. New York: Black Dog and Leventhal.
- Khabar Television. 1999. Kazakhstan, Russia Hide Contamination. 7 September 1999. <https://www.nti.org/learn/facilities/732/>.
- Kwon, Heonik. 2008. *Ghosts of War in Vietnam*. Cambridge: Cambridge University Press.
- . 2010. *The Other Cold War*. New York: Columbia University Press.
- Laszczkowski, Mateusz. 2016. 'City of the Future': Built Space, Modernity and Urban Change in Astana. Berghahn Books.
- Lerner, Steve. 2010. *Sacrifice Zones: The Front Line of Toxic Chemical Exposure in the United States*. Cambridge, MA: MIT Press.
- Lukashenko, Sergei N. 2008. *Semipalatinsk Nuclear Test Site: Present State*. Pavlodar: Press House Ltd.
- Magauov, A. 2012. Remediation of Contaminated Areas of Kazakhstan. In *Proceedings of an International Conference on the Remediation of Land Affected by Radioactive Residues*, Vienna: IAEA. pp17–20.
- Mair, Jonathan, Ann Kelly & Casey High, Eds. 2015. *The Anthropology of Ignorance: An Ethnographic Approach*. New York: Palgrave MacMillan.
- Masco, Joseph. 2006. *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico*. Princeton: Princeton University Press.
- . 2010. "Sensitive but Unclassified": Secrecy and the Counterterrorist State. *Public Culture*, 22 (3):433–463.
- McClelland, Jim. 1985. *The Report of the Royal Commission into British Nuclear Tests in Australia*. Canberra: Australian Govt. Pub. Service.
- Medvedev, Zhores. 2000. *Stalin and the Atomic Gulag*. Trans. Tony Simpson. Spokesman, 69.
- Mustova, L. 1992. Polygon, *Ekspress*, 9th January. 4–9.
- Ninetto, Amy. 2011. Civilization and its Insecurities: Traveling Scientists, Global Science, and National Progress in the Novosibirsk Akademgorodok. *Kroeber Anthropological Society Papers*, 86:181–202.
- . 2005. The Natural Habitat of Science: Shifting Locations of Freedom and Constraint Among Migrant Russian Scientists.. *Anthropology of East Europe Review*, 18(2):37–41.
- Panov, Yevgeni & Gennady Shalametov. 2008. Polygon: fakty, oshibki, vymysly. *Chelovek, Energiya, Atom: nauchnyye publikatsii zhurnal*, 2:20–24. Kazakhstan: National Nuclear Centre.
- Paxton, Robin. 2011, November 10. *Haunted by past, Kazakhstan Shuns Nuclear Bomb*. Reuters. <https://www.reuters.com/article/us-kazakhstan-nuclear/haunted-by-past-kazakhstan-shunsnuclear-bomb-idustre7a93up20111110>.
- Petryna, Adriana. 2002. *Life Exposed: Biological Citizens After Chernobyl*. Princeton, NJ: Princeton University Press.
- Purvis-Roberts, Kathleen, Cynthia Werner & Irene Frank. 2007. Perceived Risks from Radiation and Nuclear Testing Near Semipalatinsk, Kazakhstan: A Comparison Between Physicians, Scientists and the Public. *Risk Analysis*, 27(2):291–302.

- Reno, Joshua. 2018. Kept in Suspense: The Unsettling Indeterminacy of US landfills. In *Indeterminacy: Waste, Value and the Imagination*, edited by Catherine Alexander, Andrew Sanchez. Oxford: Berghahn Books.
- Rhodes, Richard. 1986. *The Making of the Atomic Bomb*. New York: Simon and Schuster.
- . 1995. *Dark Sun: The Making of the Hydrogen Bomb*. New York: Simon & Schuster.
- Rindzevičiūtė, Eglė. 2015. The Overflow of Secrets: The Disclosure of Soviet Repression in Museums as an Excess. *Current Anthropology*, 56(S12):S276–S285.
- Sagdeev, Roald. 1994. *The Making of a Soviet Scientist: My Adventures in Nuclear Fusion and Space From Stalin to Star Wars*. New York, NY: John Wiley & Sons.
- Sakharov, Andrei. 1990. *Memoirs*. Trans Richard Lourie. London: Hutchinson.
- Sergazina, Galina & Saim Balmukhanov. 1999. *Istoriya sozdaniya Semipalatinskogo Ispytatel'nogo Yadernogo Poligona*. Kazakhstan: Semipalatinskoe Regional'noe Upravlenie Okruzhayushchej Sredy, Semipalatinsk.
- Shkolnik, Vladimir. 2011. Kazakhstan's Role as a Nuclear Leader. In *Building a Nuclear Safe World: The Kazakhstan Way*, Ministry of Foreign Affairs of the Republic of Kazakhstan, Astana, Kazakhstan.
- Shkolnik, Vladimir & Littlefield Adriane. 2002. *The Semipalatinsk test site: creation, operation and conversion*. US Department of Energy, Office of Scientific and Technical Information: Sandia National Laboratories, Albuquerque, NM, and Livermore, CA.
- Šliavaite, Kristina. 2005. *From Pioneers to Target Group: Social Change, Ethnicity and Memory in a Lithuanian Nuclear Power Plant Community*. University of Lund: Lund Monographs in Social Anthropology.
- Spears, Ellen. 2014. *Baptised in PCBs: Race, Pollution and Justice in an All-American Town*. Chapel Hill: University of North Carolina Press.
- Stawkowski, Magdalena. 2014. *Radioactive Knowledge: State Control of Scientific Information in Post-Soviet Kazakhstan*. University of Colorado Boulder: PhD Dissertation.
- . 2016. "I am a Radioactive Mutant": Emerging Biological Subjectivities at the Semipalatinsk Nuclear Test Site. *American Ethnologist*, 43(1):144–157.
- . 2017. Radiophobia Had to Be Reinvented. *Culture, Theory and Critique*, 58(4):357–374.
- Stone, Richard. 2003, May 23. Plutonium fields forever: a decade after inheriting the Soviet Union's vast nuclear testing range in Central Asia, authorities in Kazakhstan are only now discovering the extent of a dangerous legacy underfoot plutonium hot spots that pose a serious proliferation threa. *Science* 300(5623):1224.
- Strathern, Marilyn. 1996. Cutting the Network. *JRAI*, 2(3):517–535.
- . 2010. A Community of Critics? Thoughts on new Knowledge. *JRAI*, 12(1):191–209.
- Takada, J., M. Hoshi, T. Nagatomo, M. Yamamoto, T. Imanaka, T. Takatsuji, I. Yoshikawa, S. Endo, M. Ishikawa, B. I. Gusev & A. K. Sakerbaev. 2000. Radiation Exposure on Residents Due to Semipalatinsk Nuclear Tests. Japan Health Physics Society, Tokyo (Japan); 1 v; May 2000; [7 p.]; IRPA-10: 10. International Congress of the International Radiation Protection Association; Hiroshima (Japan); 14–19 May 2000.
- Tsing, Anna. 2015. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton, NJ: Princeton University Press.
- Vikhrev, Vladimir. 2002. Gorod Stremitsya v Budushcheye, *Kurchatovskiy Vestnik*. 16th May 2002, p2.
- Werner, Cynthia & Kathleen Purvis-Roberts. 2006. After the Cold War: International Politics, Domestic Policy, and the Nuclear Legacy in Kazakhstan. *Central Asian Survey*, 25:461.
- . 2007. Unraveling the Secrets of the Past: Contested Versions of Nuclear Testing in the Soviet Republic of Kazakhstan. In *Half-Lives and Half-Truths: Confronting the Radioactive Legacies of the Cold War*, edited by Barbara Johnston, 277–298. Santa Fe, New Mexico: School of American Research.
- . 2014. Cold War Memories and Post-Cold War Realities: The Politics of Memory and Identity in the Everyday Life of Kazakhstan's Radiation Victims. In *The Anthropology of the State in Central Asia*, edited by Madeleine Reeves, Johan Rasanayagam, Judith Beyer, 285–309. Bloomington, Indiana: Indiana University Press.

- Werner, Cynthia, Kathleen Purvis-Roberts & Nurlan Ibraev. 2003. Comparative Perceptions of Risk From Nuclear Testing in Kazakhstan: Preliminary Results and Proposed Research. *Central Eurasian Studies Review* 2:11.
- The White House. 2012. *Fact Sheet: History of Trilateral Threat Reduction Cooperation at the Former Semipalatinsk Test Site*. March 26. Office of the Press Secretary. <https://obamawhitehouse.archives.gov/the-press-office/2012/03/26/fact-sheet-history-trilateral-threat-reduction-cooperation-former-semipa>.
- Witte, Michelle. 2013. Farming is Possible around Former Semipalatinsk Nuclear Test Site, Say Experts, *Astana Times*, November 4th 2013. <http://www.astanatimes.com/2013/11/farming-possible-around-former-semipalatinsk-nuclear-test-site-say-experts/> (Accessed 20 August 2014).
- World Nuclear Association. 2014. Uranium and Nuclear Power in Kazakhstan. <http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Kazakhstan/> (Accessed 26 August 2014).
- World Nuclear News. 2014. Russia helps Kazakh nuclear power plans, World Nuclear News, May 30 2014. <http://www.world-nuclear-news.org/NN-Russia-helps-Kazakh-nuclear-power-plans-3005141.html>.