1

The nature of megacities

> What is the city but the people?[1]
>
> —William Shakespeare, 'The Tragedy of Coriolanus', Act 3, Scene 1

> The city was rough on migrants, terrible sometimes, and also better than anywhere else.[2]
>
> —Katherine Boo, *Behind the Beautiful Forevers*

> They are verbs as well as nouns.[3]
>
> —Merlin Sheldrake, *Entangled Life*

Haruki Akamatsu had not felt the ocean crust heave 10 metres upward. He was not there to see the 6-metre tsunami surge inland, drowning thousands and clawing the earth bare with its retreat. He had, however, clutched the carpet beneath his desk as the twenty-first-floor office in Tokyo swayed sickeningly, thinking the worst was over when the swaying stopped. It was not, but Haruki would not know that until later, for he did not hear the nuclear power station reactors 274 kilometres north of Tokyo explode after cooling pumps failed and nuclear cores superheated. The pumps' reserve generators failed as well, submerged as they were beneath tsunami waters. He could not see, nor smell, nor taste, nor hear the radiation in the air, but it was there. He knew he should not be able to

1 William Shakespeare, 'The Tragedy of Coriolanus', Act 3, Scene 1, Line 198, in *Shakespeare, The Complete Works*, G.B. Harrison (ed.), New York, NY: Harcourt, Brace & World, 1968, 1292.

2 Katherine Boo, *Behind the Beautiful Forevers: Life, Death, and Hope in a Mumbai Undercity*, New York, NY: Random House, 2012, 41.

3 Merlin Sheldrake, *Entangled Life: How Fungi Make Our Worlds, Change Our Minds, & Shape Our Futures*, New York, NY: Random House, 2020, 88.

feel it, but his skin prickled, nonetheless. Yes, it was there, being inhaled into millions—no, tens of millions—of lungs, for this was the most populous urban area in the world.

Haruki was one of the many millions trying and failing to flee Tokyo. They sat trapped behind steering wheels, in bus seats, on trains. He rubbed his eyes, which were dry from staring skyward at the invisible radiation, and returned his gaze to the gridlocked road. Cars packed every lane in shared motionlessness. Even the righthand lanes—normally filled with vehicles coming into Tokyo—had been recruited and were now part of the failure.

He had thought the Shutoko, Tokyo's system of elevated and underground highways, was a better choice than the surface streets. Haruki looked down. The traffic below was as still as that above. Only pedestrians moved; open doors and vacant seats told him that some drivers had abandoned their vehicles to join them. He wondered whether the same had happened ahead, whether people had run from their cars and down exit ramps, blocking everyone behind. It had not surprised him when the Tokyo metropolitan police officer directed traffic on to both sides of the highway three hours ago. Why not? No-one would seek to enter Tokyo other than police, firefighters, soldiers and others whose duties demanded they turn their faces into the disaster everyone else was fleeing. Trying to flee. Streets would be open for them. Everyone knew disaster reaction plans reserved certain passageways for that purpose.

The flow of people had started from the north, trickling, then building into a stream before becoming a deluge that quickly settled into this anxious but motionless lake. The flow had been smooth but slow when he set out four hours ago. He had moved only 8 kilometres since then, covering the first 5 before the traffic slowed to a crawl, then oozing to a halt. That had surprised him. He had travelled to many other cities for work: Singapore, Manila, Jakarta, Los Angeles, Bangkok. None had adapted to the daily tides of humankind as well as Tokyo. Well, maybe Singapore, but none of the other big cities. Most were overwhelmed on a typical workday. Only today, after the government belatedly admitted that the wrecked reactors' radiation was advancing directly on the capital, did the flood of the desperate clog every passageway and with it hope of outrunning the unseen rider on Honshu Island's southbound winds. He could only hope his parents had made good the exit he now could not. They lived—had lived, he corrected himself, for surely none would return to the capital for some time to come—in Tokyo's southern suburbs rather than one of the more posh and exciting commercial centres. He had called once and texted countlessly after the prime minister's

announcement, receiving two messages in response before phones and Facebook, the internet, Instagram, Twitter and, well, everything, stopped working, smothered by the hundreds of millions of calls, texts, tweets, updates, photos and other desperate attempts to reassure, be assured, share and reshare. Yes, he assured himself, Sone and Tetsu Akamatsu must have made good their escape.

Haruki figured he was one of more than 38 million people trying to bolt from the world's largest megacity. There must be, he thought as he glanced up again, another 10 million fleeing from further north or north-east or north-west. Most of those, too, would have coursed into Tokyo along roads built primarily for going to or departing from the city. Where would they go, those who successfully escaped? Who would feed them? How would they shelter from the March cold? Where would they find the stuff of daily life once hastily packed bags and hurriedly filled cars emptied? Could the millions be decontaminated and treated for radiation exposure? How would they decide whom to treat first? The more vulnerable elderly? The increasingly rare young as Japan continued to age? The workers like him without whom the economy would surely collapse? Some would have relatives or friends who might take them in. What risk did kindness bring with it? Was contamination transmissible?

The above did not happen on 11 March 2011, of course, though the events behind this notional scenario merited labelling as Japan's '3/11'.[4] But it was a close-run thing. The 9.0 Richter scale earthquake centred

4 Sources for material about the Fukushima disaster include Yale-Tulane ESF-8 Planning and Response Network, *Yale/Tulane ESF-8 Planning and Response Program Special Report (Japan Earthquake and Tsunami), as of 2200 hours EST, March 25, 2011*, [Online], available from: slideplayer.com/slide/5350222/; World Nuclear Association, 'Fukushima Daiichi Accident', London: World Nuclear Association, June 2018, [Updated May 2022], available from: www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx; 'Mission impossible: Fukushima Dai-ichi', *The Economist*, [London], 7 February 2015, 22; NPR Staff and Wires, 'Food, gas shortages amid relief efforts in Japan', *KPBS*, [San Diego, CA], 17 March 2011, available from: www.kpbs.org/news/2011/mar/17/food-gas-shortages-amid-relief-efforts-japan/; Lucy Birmingham and David McNeill, *Strong in the Rain: Surviving Japan's Earthquake, Tsunami, and Fukushima Nuclear Disaster*, New York, NY: Palgrave, 2012; Nathan Hall, 'Fukushima-Daiichi: Multinational disaster response & longterm crisis management', Briefing slides, Santa Monica, CA: RAND Corporation, 14 May 2013; Mark Willacy, *Fukushima: Japan's Tsunami and the Inside Story of the Nuclear Meltdowns*, Sydney: Macmillan, 2013; The Saskawa Peace Foundation (SPF), *The Fukushima Nuclear Accident and Crisis Management: Lessons for Japan–US Alliance Cooperation*, Tokyo: SPF, September 2012, available from: www.spf.org/jpus/img/investigation/book_fukushima.pdf; Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (NEA), 'Timeline for the Fukushima Daiichi Nuclear Power Plant Accident', *News*, 7 March 2012, Paris: NEA, available from: www.oecd-nea.org/news/2011/NEWS-04.html; and National Diet of Japan, *The Official Report of the Fukushima Nuclear Accident Independent Investigation Commission: Executive Summary*, Tokyo: Government of Japan, 2012.

under the sea 400 kilometres north-east of Tokyo—the largest to strike the country since modern instruments began recording such events more than 130 years earlier—did create a series of tsunamis that ripped bare much of Honshu's north-eastern shores. Nineteen thousand people died. Three of the six nuclear reactor cores at the Fukushima Daiichi power plant did melt down after the one–two punch of shaking and flooding knocked out power to both their primary and backup cooling systems. Reserve generators, batteries and supporting equipment designed to come online lay useless, destroyed, as they were positioned too low to escape the invading waters.[5] The loss of those batteries and generators meant workers within the damaged plants—the men responsible for gauging the condition of the reactors—were literally in the dark as to their status. Three meltdowns; a fourth reactor badly damaged. Units 1 and 3 at the facility suffered the first explosions. Unit 3's reactor building was 'bent like candy'.[6] Unit 4 had been shut down and its fuel rods removed before the quake. Its refuelling had only just started. But hydrogen from the neighbouring Unit 3, the experts would later guess, made its way through shared ducts to feed another explosion there. The explosions in Units 1 and 3 scattered radiation about the site and beyond. The damaged Unit 2 added to the contamination. Fortunately, reactors 5 and 6 were shut when the tremors hit.

Officials from the country's Nuclear and Industrial Safety Agency tracked the radiation plume as it drifted from the site. They chose not to share its route with the public. Thousands of those fleeing unwittingly drove into the contamination. There were procedures for coordinating relief organisations that could have rendered aid, but the guidance dictated policies only for international catastrophes, not those at home. Disaster centres sent out advice via the internet, but loss of power when the reactors failed meant many had no access to its offerings. The elderly tended not to use computers anyway, so they would not have received the guidance unless someone passed the information along. Reports did eventually inform Tokyo's residents that slightly contaminated air and water had reached them. Deciding what to do was left to residents. Reports regarding safe levels of radiation were conflicting and inconclusive. To the north, emergency vehicles trying to reach the reactor site ran into a secondary

5 Birmingham and McNeill, *Strong in the Rain*, 12, 16; and World Nuclear Association, 'Fukushima Daiichi Accident'.

6 The words are those of Japanese nuclear reactor designer Setsuo Fujiwara.

tsunami—of vehicles fleeing the danger. Many never reached the disaster site. Officials celebrated reports of a generator truck finally succeeding. Joy quickly gave way to despair. The vehicle's electrical plugs did not fit those at Fukushima Daiichi. Little matter: the truck's cables were too short to reach the equipment needing power.

No, Haruki's traffic jam never took place. There was no panicked flight from Tokyo despite contamination of the capital's air and water. That it did not occur does not mean it could not have occurred. Just how close was the megacity's brush with catastrophic radiation in lieu of its minor contamination? Japan's prime minister at the time, Naoto Kan, recalled:

> [T]he future existence of Japan as a whole was at stake … We were able to halt the spread of radiation … by a wafer-thin margin thanks to the efforts of people who risked their lives. Next time, we might not be so lucky.[7]

A cold front lingering off eastern Honshu could have refused the radiation cloud's western drift that spared the tens of millions to the south. Tokyo would then have been the bullseye for its invisible poison. It seems at least a partial evacuation of the capital would have been inevitable had Fukushima Daiichi plant operators not disobeyed orders to stop pumping seawater into the failing reactors. Their managers feared 'the water would destroy the reactors and create an enormous commercial loss'.[8] The disobedience was no small feat of social assertiveness in Japan's hierarchical society. William Saito, an advisor to Japan's government, concluded that the men's decision to keep pumping 'basically totalled the plant … but saved the country'.[9] Just how momentous was the brush with catastrophe? The event caused Emperor Akihito to broadcast live for the first time since the end of World War II;[10] more than 100,000 members of the Japan Self-Defense Forces deployed to assist recovery—Japan's largest

7 Andrew Gilligan, 'Fukushima: Tokyo was on the brink of nuclear catastrophe, admits former prime minister', *The Telegraph*, [London], 4 March 2016, available from: www.telegraph.co.uk/news/worldnews/asia/japan/12184114/Fukushima-Tokyo-was-on-the-brink-of-nuclear-catastrophe-admits-former-prime-minister.html.

8 Judith Rodin, *The Resilience Dividend: Being Strong in a World Where Things Go Wrong*, New York, NY: PublicAffairs, 2014, 214.

9 ibid., 214.

10 Birmingham and McNeill, *Strong in the Rain*, 82.

military deployment since that conflict.[11] Those men and women were joined by 17,000 personnel from the US military supporting Operation Tomodachi ('Friendship') and representatives from 19 other countries.[12]

Despite Tokyo escaping the worst of the catastrophe, the combination of earthquake, tsunami and reactor failure stands as the world's most costly natural disaster … if one believes that any disaster today can be completely laid at the feet of Mother Nature. Estimates of direct and indirect losses exceed US$54 billion.[13] Japan's National Diet, the country's legislature, found that 'although triggered by these cataclysmic events, the subsequent accident at the Fukushima Daiichi Nuclear Power Plant cannot be regarded as a natural disaster. It was a profoundly manmade disaster that could and should have been foreseen and prevented.'[14] The same is true more often than not for other urban catastrophes. Though the term 'natural disaster' will appear in the following pages on occasion, it is a rare urban crisis that is not intensified by some form of human error, misjudgement or outright deliberate malice even given the presence of natural forces. In no few cases it is legitimate to ask whether the calamity would have occurred had those errors not been made or had judgements been wiser.

The horrendous physical, economic, social and emotional devastation within Japan was soon forgotten by most of the rest of the world, aside from an occasional reminder when a news report sought to entertain by reporting exotic debris washing ashore in the eastern Pacific months afterward. News reports intrigued with near-fantastic stories such as the US Coast Guard sinking the wreck of the Japanese fishing trawler *Ryou-Un Maru*. The ghost ship had taken more than a year to drift across the ocean after being cast out to sea by the March 2011 tsunamis. Approaching another shoreline, it had become a danger to marine traffic.[15] Such diversions distracted from

11 ibid., 126; Willacy, *Fukushima*, 43.

12 Japan Joint Staff, 'Lessons learned from the Great East Japan Earthquake', Briefing slides, Disaster Relief Operation, J-3, Japan Joint Staff, 7 February 2012; and Ryoichi Oriki [General, Japan Ground Self-Defense Force, retired], Keynote presentation to Current and Future Operations in Megacities Conference, Tokyo, 17 July 2019.

13 Willacy, *Fukushima*, 271; and Dick K. Nanto, William H. Cooper, J. Michael Donnelly and Renée Johnson, *Japan's 2011 Earthquake and Tsunami: Economic Effects and Implications for the United States*, CRS Report for Congress R41702, Washington, DC: Congressional Research Service, 6 April 2011, available from: sgp.fas.org/crs/row/R41702.pdf.

14 National Diet of Japan, *The Official Report of the Fukushima Nuclear Accident*, 9.

15 CNN Wire Staff, 'US Coast Guard sinks Japanese fishing trawler near Alaska', *CNN*, 5 April 2012, [Updated 6 April 2012], available from: www.cnn.com/2012/04/05/us/japan-tsunami-ship/index.html.

the occasional academic writing contemplating the extent of calamity had Tokyo been forced to evacuate. The logistics alone boggle the mind. Haruki Akamatsu was right to wonder where the urban area's 38 million residents could go.[16] How would the government have provided them with food, drink, shelter, medical care and other necessities of life? From where would the massive amounts of those resources have come given the loss of the megacity's ports, trains and truck traffic? Some 50,000 evacuees from the Fukushima area were still living in temporary housing six years after the reactor explosions. They represented one in three of the 150,000 people who lost their homes in March 2011.[17]

The economic shock alone would have devastated Japan for years. Tokyo's is the largest urban economy on the planet. The megacity would rank as the 17th largest economy in the world were it a country—just a fraction less than South Korea's and almost twice that of Australia's.[18] The city's budget is greater than that of Sweden. The capital is home to more than one-quarter of the country's population—on only 4 per cent of Japan's landmass.[19] It hosts more foreign companies than any other urban area on Earth and is responsible for more than one-third of the country's national gross domestic product (GDP). Fukushima's radiation might have been invisible, but its crippling of Japan's capital would have visibly ravaged both the country's and the world's economies just as waves had ransacked north-eastern Honshu on 11 March 2011.

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16 While the political entity of Tokyo includes islands more than 1,600 kilometres distant, the megacity of Tokyo encompasses only the extensive urban area on the island of Honshu. In the case of Japan's capital, the following prefectures fall completely or largely within the megacity: Tokyo, Kanagawa, Chiba and Saitama. Lesser portions of Gunma, Tochigi and Ibaraki prefectures also do so. Demographia, *Demographia World Urban Areas*, 15th annual edition, Belleville, IL: Wendell Cox Consultancy, April 2019, 17.

17 Becky Oskin, 'Japan earthquake & tsunami of 2011: Facts and information', *Live Science*, [New York], 13 September 2017, [Updated 26 February 2022], available from: www.livescience.com/39110-japan-2011-earthquake-tsunami-facts.html.

18 Richard Florida, 'The economic power of cities compared to nations', [*CityLab*], *Bloomberg*, 17 March 2017, available from: www.citylab.com/life/2017/03/the-economic-power-of-global-cities-compared-to-nations/519294/; PricewaterhouseCoopers (PwC), 'Which are the largest city economies in the world and how might this change by 2025?', *PricewaterhouseCoopers UK Economic Outlook November 2009*, London: PwC, 22, 23, available from: pwc.blogs.com/files/global-city-gdp-rankings-2008-2025.pdf; Schumpeter, 'Global cities revisited: Where businesses locate now—and where they will go', *The Economist*, [London], 3 October 2013, available from: www.economist.com/blogs/schumpeter/2013/10/geography-business; and Tokyo Metropolitan Government, 'About our city', [Online], 2006, available from: www.metro.tokyo.lg.jp/english/about/index.html.

19 Somik V. Lall and Uwe Deichmann, *Density and disasters: Economics of urban hazard risk*, Policy Research Working Paper No. 5161, Washington, DC: The World Bank, January 2010, 9, doi.org/10.1596/1813-9450-5161.

What are the chances of a megadisaster striking this largest of megacities? Greater than you might think. Japan suffers about one in every five of the Earth's magnitude 6.0 or above earthquakes.[20] Tokyo is near the junction of four active tectonic plates.[21] In 2012, the country's joint military staff estimated the city had a 70 per cent chance of experiencing a major earthquake within the next 30 years.[22] The military is not alone in their concerns. That same year, scientists determined that portions of Japan including Tokyo were vulnerable to earthquakes twice as large and tsunamis three times as high as previously estimated.[23] Subsidence would compound the effects of a major shock thanks in part to withdrawal of groundwater beneath the city. Then there is the matter of the still-active Mount Fuji volcano that provides so striking a panorama from the city. The world's largest reinsurance company, Swiss Re, puts the Tokyo–Yokohama region at the top of the list for the number of people exposed to natural disasters among the 616 urban areas it considered.[24] Sure, that is partly due to its being the world's largest urban area—more people means greater exposure—but it is also because of the number and potential magnitude of possible disasters. And the character of daily life.

The suffering of Tokyo's urban-dwellers will not end when future tremors cease, winds abate, waters recede, soil stops its sliding or ash ceases falling. Tokyo's combined subway and other rail use exceeds an estimated 14 billion-plus riders annually—nearly twice the entire population of the

20 Justin McCurry, 'Tokyo "has 70% chance of powerful earthquake within four years"', *The Guardian*, 23 January 2012, available from: www.theguardian.com/world/2012/jan/23/tokyo-powerful-earthquake-four-years.

21 Yoshio Kumagai and Yoshiteru Nojima, 'Urbanization and Disaster Mitigation in Tokyo', in *Crucibles of Hazard: Mega-Cities and Disasters in Transition*, James K. Mitchell (ed.), New York, NY: United Nations University, 1999, 64. Another source states: 'Tokyo sits above two fault lines and [is] near another [while] just southwest of the city the Philippine Sea plate dives down under the Eurasian continental plate; right under that, the Pacific plate dives under that.' Banyan, 'When the Earth wobbled: An earthquake in Japan', *The Economist*, [London], 11 March 2011, available from: www.economist.com/banyan/2011/03/11/when-the-earth-wobbled.

22 Japan Joint Staff, 'Lessons learned from the Great East Japan Earthquake'; McCurry, 'Tokyo "has 70% chance of powerful earthquake within four years"'.

23 David Lochbaum, Edwin Lyman and Susan Q. Stranahan, *Fukushima: The Story of a Nuclear Disaster*, New York, NY: The New Press, 2014, 229.

24 Lukas Sundermann, Oliver Schelske and Peter Hausmann, *Mind the Risk: A Global Ranking of Cities under Threat from Natural Disasters*, Zürich: Swiss Re, 2014, 18–19, available from: www.swissre.com/dam/jcr:1609aced-968f-4faf-beeb-96e6a2969d79/Swiss_Re_Mind_the_risk.pdf.

world.[25] The sum of public transportation users riding on *all* forms of mass transit in the United States is roughly two-thirds of that for Tokyo alone[26] (by comparison, New York City's five boroughs account for about 30 per cent of public transportation commuters in the United States).[27] Though the physical damage to Tokyo was minimal in the aftermath of the 2011 disaster, tens of thousands of commuters walked long distances to return home as subways and trains automatically shut in response to the earthquake tremors that triggered the tsunami. Other residents were simply stranded and unable to notify family given overloaded mobile phone networks.[28] The issues go beyond mere inconvenience. Researchers looking into indirect causes of death after the 1995 Great Hanshin Earthquake that struck the Osaka–Kobe–Kyoto area (one of two urban agglomerations in Japan with a population of more than 10 million) found that more than 900 survivors later died after catching the flu in public shelters. It is no surprise that many people chose to sleep in their cars following another of the country's earthquakes in 2016. That decision came with its own problems; some suffered deep-vein thrombosis (better known as 'economy-class syndrome') thanks to remaining in a semi-reclined position for long periods as do passengers on long flights.[29]

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25 Statistics regarding rail ridership to, from and within the megacity of Tokyo are inconsistent and difficult to compare. This is in large part attributable to statistics varying in terms of what parts of the urban area they measure, the large number of private and public rail companies serving those various parts, differing years for which data are collected and contrasting ways of measuring usage—for example, whether a single trip commuting to the office is counted once or multiple times if it involves transfers. Daily ridership estimates range from roughly 8 million to more than 12 million, with estimations of annual ridership similarly ranging from between 4 and 5 billion (for only two primary rail companies) to nearly 15 billion. The 14 billion-plus number for Tokyo's annual ridership comes from a source that could not be independently substantiated. However, the following provides a 2013 value of more than 9.6 billion: Statistics Japan, 'Railway passenger transport', *Prefecture Comparisons*, Tokyo: Statistics Japan, 2010, [Updated 2022], available from: stats-japan.com/t/kiji/10796. Given other sources reflecting a significant increase in Tokyo's rail ridership over recent years, the 14 billion estimate seems reasonable. A very small sample of additional sources addressing the topic includes Ramon Brasser, 'Tokyo's rush hour by the numbers', *ELSI Blog*, Tokyo: Earth–Life Science Institute, Tokyo Institute of Technology, 26 November 2015, available from: old.elsi.jp/en/blog/2015/11/blog1126.html; and Geradi Yudhistira, Muhammad Iqbal Firdaus and Lira Agushinta, 'Transportation system in Japan: A literature study', *Journal of Management and Logistics* 2(3) (2015): 333–52, doi.org/10.25292/j.mtl.v2i3.108.

26 American Public Transportation Association, *Public Transportation Facts, 2020*, Washington, DC: APTA, 2022, www.apta.com/news-publications/public-transportation-facts/. The source reports: 'Americans took 9.9 billion trips on public transportation' in 2019.

27 Edward Glaeser, *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*, New York, NY: Penguin, 2011, 14.

28 McCurry, 'Tokyo "has 70% chance of powerful earthquake within four years"'; Banyan, 'When the Earth wobbled'.

29 '"Indirect" deaths from disasters', [Editorial], *The Japan Times*, [Tokyo], 23 March 2019, available from: www.japantimes.co.jp/opinion/2019/03/23/editorials/indirect-deaths-disasters/#.XLz2v-tKhn4. The author thanks Keisuke Ogawa for bringing this article to his attention.

Officials worry that they have no means of finding out where the millions of stranded evacuees will be or what aid they will need when calamity visits a megacity (remembering that mobile phone networks may be overloaded even if they remain operational). We will come back to this challenge later when looking at the weeks following Hurricane Sandy's devastation in New York City.[30]

This book is meant for those interested in protecting the world's urban areas from the worst effects of disasters. These include but are not limited to city administrators; police, fire and medical personnel; commercial interests; soldiers who could find themselves called on in times of emergency; members of local and international nongovernmental organisations (NGOs) and intergovernmental organisations (IGOs); and the many others whose responsibilities are key to preparing for, reacting to and assisting with recovery from calamity. It also includes those on whom a neighbourhood initially relies in troubling times—usually individuals other than the men and women bearing the label 'first responder'. Important as formal emergency response personnel are, it was not firefighters who first escorted occupants of the World Trade Center's Twin Towers down the smoke-choked staircases and on to concrete-powdered streets on 9/11. It was not the police or medical personnel on whom hundreds would rely when buried beneath rubble after an earthquake struck Japan's second largest megacity in early 1995. Nor was it ambulances or squad cars that rushed most victims to medical facilities when terrorists attacked Tokyo's subway system only two months later. It was neighbours—sometimes friends, occasionally relatives, but often strangers—who found themselves delivering lifesaving aid thanks primarily to proximity. More than one-third of those suffering during that 1995 Tokyo sarin nerve agent event were transported to hospitals by good Samaritans in their private vehicles or taxi drivers cut from the same cloth.[31] Another third walked. This was not due to negligence or lack of caring on the part of emergency responders. Rather, the sheer number of people suffering during a megacity catastrophe quickly overwhelms. We will see in later chapters that Japan has come to recognise this as the norm. The Tokyo megacity's

30 The author also thanks Keisuke Ogawa for summarising this information, taken from Japan's 13 April 2019 edition of *Yomiuri Shinbun* (newspaper).

31 Tetsu Okumura, Kouichiro Suzuki, Atsuhiro Fukuda, Akitsugu Kohama, Nobukatsu Takasu, Shinichi Ishimatsu and Shigeaki Hinohar, 'The Tokyo subway sarin attack: Disaster management, part 1—Community emergency response', *Academic Emergency Medicine* 5(6) (1998): 613–17, at 614, doi.org/10.1111/j.1553-2712.1998.tb02470.x.

many urban governments prepare information, public spaces and stocks of tools and other supplies in recognition of the citizen as saviour or aid provider. The importance of formal aid providers should by no means be underestimated, but it is also important to recognise and prepare the *first* first responders on whom thousands will also rely in the immediate aftermath of a mass tragedy and in the days, weeks and months to follow when food, water, shelter and care for the injured are in short supply.

A first look at the world's largest urban areas

> The five zip codes that occupy the mile of Manhattan between Forty-first and Fifty-ninth streets employ six hundred thousand workers (more than New Hampshire or Maine).[32]
>
> —Edward Glaeser, *Triumph of the City*

> 25 percent of businesses do not reopen at all after a major disaster.[33]
>
> —Judith Rodin, *The Resilience Dividend*

> Besides these peacetime calamities, there is always the possibility of war.[34]
>
> —Francis Gies and Joseph Gies, *Life in a Medieval City*

As the most populous urban area in the world, Tokyo is certainly an outlier. Further, more than half the world's 35 largest urban areas are cities in developing countries that often do not share Tokyo's government effectiveness, quality of infrastructure or similar resources in preparing their residents for calamity. Japan's capital therefore provides an admittedly optimistic view of things to come. Yet, it in many ways provides an example others can seek to match in preparing for, responding to and recovering from disaster.

Tokyo might be an outlier, but it is not alone. More than half of those 35 largest urban areas are in the Indo-Pacific region, which extends from the eastern Pacific Rim to the western border of India. Many, like Tokyo,

32 Glaeser, *Triumph of the City*, 5.
33 Rodin, *The Resilience Dividend*, 294.
34 Francis Gies and Joseph Gies, *Life in a Medieval City*, New York, NY: Harper Perennial, 2016, 193.

sit atop or close to the 'Ring of Fire' that traces the edges of the Pacific Ocean. These are likely to share one or more of Tokyo's vulnerabilities to natural threats. More than 6,000 people lost their lives and another 400,000 were injured in the Great Hanshin Earthquake of 1995. Most were lost to crush injuries, which reflected changes to Japan's building codes after the 1923 Tokyo quake in which 140,000 people died—nearly nine of every 10 of whom were killed by fire. Those fires burned for 40 hours and scorched 44 per cent of the city.[35] It was primarily on older, less well-to-do neighbourhoods that the later Great Hanshin quake visited its damage, while newer, better constructed and more wealthy neighbourhoods remained all but intact.[36] An ocean away, Los Angeles shares Tokyo's threat of seismic activity; geologists expect a major quake on the San Andreas Fault to occur every 150 years;[37] it has been more than 300 years since the last. Manila, Lagos, Mumbai and Dhaka are by no means unique in terms of megacities that regularly suffer extensive flooding, while 40 per cent of Jakarta is below sea level. Pumps for ridding that city of floodwaters failed in early 2020. In what seems too common a story (and one we have not heard the end of), they had been submerged and were inoperable as a result.[38] Dhaka, Bangladesh's capital, experienced nine major floods in the half-century from 1954 to 2004. Its 40 canals could do much to lessen the megacity's notorious susceptibility to floodwater—if city leaders stopped permitting encroachments and tolerating other mismanagement of its channels.[39] Were floods not enough, Dhaka has the Indian and Eurasian tectonic plates as near neighbours. Estimates put damage at more than one-third of the megacity's buildings and deaths at 25,000 should an earthquake of 7.0 or greater on the Richter scale

35 Kumagai and Nojima, 'Urbanization and disaster mitigation in Tokyo', 66; and Iware Matsuda, 'Two surveys for taking measures to cope with the coming earthquake to the Tokyo Metropolis', *GeoJournal* 38 (March 1996): 349–53, at 349, doi.org/10.1007/BF00204728.

36 Birmingham and McNeill, *Strong in the Rain*, xiv.

37 Suzanne Perry, Dale A. Cox, Lucile Jones, Richard Lewis Bernknopf, James Goltz, Kenneth W. Hudnut, Dennis Mileti, Daniel Ponti, Keith Porter, Michael Reichie, Hope A. Seligson, Kimberley Shoaf, Jerry Treiman and Anne Wein, *The Shakeout Earthquake Scenario: A Story That Southern Californians Are Writing*, USGS Circular 1324, Reston, VA: US Geological Survey, 2008, doi.org/10.3133/cir1324.

38 'The incredible sinking city: Jakarta submerged', *The Economist*, [London], 11 January 2020, 32.

39 Helmut Breitmeier, Judith Kuhn and Sandra Schwindenhammer, 'Analyzing urban adaptation strategies to climate change: A comparison of the coastal cities of Dhaka, Lagos and Hamburg', Paper contributed to DVPW Congress 21: Politics in Climate Change—No Power for Just Solutions?, 2009, 14, 17.

strike.[40] Taking an example from outside the Indo-Pacific region, Türkiye's megacity of Istanbul shares Tokyo's discomfort of sitting amid several major fault lines. As Constantinople, it suffered multiple massive tremors in just over a century from 447 to 558 CE—the last collapsing the city walls and exposing the people within to attacking Huns. Another tremor struck so severely roughly a millennium later that residents labelled it 'Little Judgement Day'.[41]

It is a fair argument that nothing has changed the human experience more than urbanisation. Bear with me for a brief torrent of numbers that help us better understand what makes cities—particularly the largest and most influential of them—crucial to humankind. The 1920 census reflected the fact that the US population had become more urban than rural. The world followed suit during the first decade of this millennium. The majority of the 35 urban areas with a population of more than 10 million abut the coast, adding cyclones/hurricanes and tsunamis to whatever other threats confront a particular city. The interconnectedness of the most influential of these megalopolises means a catastrophe dramatically impacts the lives not only of their own residents but also of other millions living thousands of kilometres distant. Cities in the United Kingdom collectively account for 78 per cent of that country's jobs—impressive, but in the United States, the figure is 84 per cent.[42] The United Nations estimates that urban areas generate 80 per cent of the world's GDP; in some countries, a single city is responsible for more than half of national wealth creation.[43] Beirut accounts for 75 per cent of Lebanon's GDP, while Amman in nearby Jordan provides some 55 per cent of that country's employment.[44] With nearly 13 million people, the capital of Democratic Republic of Congo (DRC), Kinshasa, houses, coincidentally, only 13 per cent of the country's population but generates 85 per cent of its income.[45] With the occasional exception, the world at large continues its march towards more people living in cities. (India is de-urbanising in some locations given public

40 Imtiaz Ahmed, 'Dhaka: Stressed but Alive!', in *Building Resilience in Cities under Stress*, Francesco Mancini and Andrea Ó Súilleabháin (eds), New York, NY: International Peace Institute, June 2016, 17, available from: www.academia.edu/27153738/Building_Resilience_in_Cities_under_Stress.

41 Bettany Hughes, *Istanbul: A Tale of Three Cities*, London: Weidenfeld & Nicolson, 2017, 252, 408, 442.

42 United Nations Human Settlement Programme (UN-Habitat), *Urbanization and Development: Emerging Futures*, World Cities Report 2016, Nairobi: UN-Habitat, 2016, 27, 33, available from: unhabitat.org/sites/default/files/download-manager-files/WCR-2016-WEB.pdf.

43 ibid., 27.

44 John de Boar, 'Resilience and the fragile city', *Stability: International Journal of Security & Development* 4(1) (2015), Art. 17, doi.org/10.5334/sta.fk.

45 UN-Habitat, *Urbanization and Development*, 7.

policies guaranteeing minimum income to farmers.) This is somewhat ironic from a historical perspective. Dispersing critical national assets seemed wise during the Cold War given the destructive power of nuclear weapons. Virtually all countries have now cast aside such fears in the face of urban efficiencies of scale and inexorable human migration to cities, but with these concentrations comes the possibility of national calamity should a dominant city suffer devastation.[46] The largest urban area in a country often dominates not only economically, but also politically and socially.

The twenty-first century may or may not prove to be the Asian Century. It already is and will continue to be the Urban Century. Unfortunately, governments have no deep history on which to draw when it comes to readying for megacity disasters. There were only 16 urban areas with more than *1* million residents in 1900—less than half of the 35 with populations 10 times greater or more today.[47] The fact that more than half of Earth's population resides in urban areas means 3.5 billion people call these phenomena home. Some estimate the number will rise to 6.4 billion—70 per cent of the planet's men, women and children—by 2050. Ninety-five per cent of the increase will be in the developing world.[48] Seventy-five per cent of those living in Latin America and the Caribbean are already urban types.[49] China alone has more people living in towns and cities than the combined total populations of the United States and Japan.[50]

Those 3.5 billion people in today's urban areas occupy only about 3 per cent of our planet's land area. They are responsible not only for 80 per cent of Earth's economic productivity, but also for between 60 and 80 per cent of its energy consumption (depending on whom you ask)

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46 United States Army Training and Doctrine Command (TRADOC), *The Changing Character of Warfare: The Urban Operational Environment*, TRADOC Pamphlet 525-92-1, Fort Eustis, VA: TRADOC, April 2020, 8, available from: adminpubs.tradoc.army.mil/pamphlets/TP525-92-1.pdf.

47 PwC, 'Which are the largest city economies in the world', 20.

48 Jo da Silva, Sam Kernaghan and Andrés Luque, 'A systems approach to meeting the challenges of urban climate change', *Journal of Urban Sustainable Development* 4(2) (2012): 125–45, at 125, doi.org/10.1080/19463138.2012.718279; and United Nations, 'Goal 11: Make Cities Inclusive, Safe, Resilient and Sustainable', *Sustainable Development Goals*, New York, NY: United Nations, 2015, available from: www.un.org/sustainabledevelopment/cities/.

49 Paul Teng, Margarita Escaler and Mely Caballero-Anthony, 'Urban food security: Feeding tomorrow's cities', *Significance* 8(2) (2011): 57–60, at 57, doi.org/10.1111/j.1740-9713.2011.00486.x.

50 Peilin Wu and Minghong Tan, 'Challenges for sustainable urbanization: A case study of water shortage and water environment changes in Shandong, China', *Procedia Environmental Sciences* 13 (2012): 919–27, at 920, doi.org/10.1016/j.proenv.2012.01.085.

and three-quarters of humankind's carbon dioxide pollution.[51] But do not let that 'only about 3 per cent' fool you into thinking urban tenants are crammed cheek-by-jowl into living spaces. The megacity of New York is the largest in the world in terms of area—three times the size of Rhode Island (and, by the way, it is not the United States' densest major urban area; that is Los Angeles).[52]

It would be comforting to think that at least the developed world's largest urban areas are ready for coming disasters. The examples of 2011 Tokyo (Fukushima) and New York make it clear that even the best prepared fall short. New York City had crisis plans in place before Hurricane Sandy paid its October 2013 visit. Despite what we will see was a decidedly mixed performance, it was and remains among the world's most disaster-prepared urban areas—a situation helped by its police force and fire department being larger than many countries' armed forces. Plans notwithstanding, the city was unready for Sandy's severity and long-range consequences. Outages left some neighbourhoods without electricity for more than two weeks (and therefore without heating, refrigeration, elevators, water and several ways to receive information)—no small matter for the semi-mobile or immobile living in high-rise apartment buildings. Garbage was not collected. Medical services fell short of need. People could not cook or flush toilets. Those already suffering health issues were thus put at further risk as they went without proper nutrition, ran short of water, failed to receive required medications and lacked heat as temperatures dipped into the mid-40s Fahrenheit (6–8°C) when a chilling storm hit the city with a second punch a week after Sandy's departure.[53]

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51 United Nations Conference on Housing and Sustainable Urban Development (Habitat III), *Urban ecosystems and resource management*, Habitat III Issue Paper 16, New York, NY: United Nations, 31 May 2015, 2, available from: habitat3.org/wp-content/uploads/Habitat-III-Issue-Paper-16_Urban-Ecosystem-and-Resource-Management-2.0.pdf.

52 Demographia, *Demographia World Urban Areas*, 16th Annual Edition, Belleville, IL: Wendell Cox Consultancy, April 2020, 40, 74. Other sources claim New York is the country's densest city. Presumably, those so doing are looking at the city only in terms of its five boroughs. Such apparent discrepancies are common in discussions of urban areas. They are generally the result of differing definitions (Los Angeles megacity's suburbs tend to be denser than those of New York City), year of data collection or similar differences in the underlying analysis.

53 Michael T. Schmeltz, Sonia K. González, Liza Fuentes, Amy Kwan, Anna Ortega-Williams and Lisa Pilar Cowan, 'Lessons from Hurricane Sandy: A community response in Brooklyn, New York', *Journal of Urban Health* 90 (2013): 799–809, doi.org/10.1007/s11524-013-9832-9.

One in every 12 of Earth's people lives in a city of more than 10 million.[54] What follows is a look at how occupants in the largest, most widely connected and most influential urban areas prepare for, survive and rebound from a calamity. Ours will not be a look at creeping disasters like those arising from higher sea levels or economic disparity (though we will consider how ocean rises make disasters even worse, as was the case with Sandy. New York City is one area where sea levels are rising about 50 per cent faster than the global average).[55] Nor will the pages to come contemplate similarly gradual challenges such as India's already critical shortage of urban water.[56] Likewise, ours is not a concern with long-term dangers due to urban pollution such as the abysmal air quality that shortens lives in Delhi and Beijing. Crime and corruption can make the bad worse, but these day-to-day plagues will only concern us in terms of how they aggravate megadisasters. We will instead reflect on tragedies that are more like a boxer's punch than a slow strangling. The culprits include both Mother Nature and humans. The disasters we cover include deliberate abuses of urban humankind: the 9/11 attacks, Mumbai's 2008 terrorist attacks and the already mentioned sarin nerve agent attack on Tokyo's subway in 1995. We will also include suffering brought about by the misfortunes imposed by war—a source of lessons rarely thought of when the focus is on urban perils brought about by nature's unkindness or acts of the misguided fringe. The nature of war's punishments differs somewhat from that inflicted by other means, but preparations for and recovery from disasters spawned by combat's brutality share much with those brought about in other ways. Thus, those responsible for the waging of war in a city and its subsequent recovery can learn much from civil calamity no less than urban warfare can provide lessons in readiness for disasters brought about by other means. I hope that what follows offers some value during the recovery of Ukraine's urban areas from the tragedies ongoing as this book goes to print.

54 *Demographia World Urban Areas*, 15th edn, 3, 4.

55 Jeff Goodell, *The Water Will Come: Rising Seas, Sinking Cities, and the Remaking of the Civilized World*, New York, NY: Little, Brown & Company, 2017, 149.

56 Jessie Yeung, Swati Gupta and Michael Guy, 'Experts: India has just five years to solve its water crisis—Groundwater has been steadily decreasing', *CNN*, 27 June 2019, [Updated 4 July 2019], available from: edition.cnn.com/2019/06/27/india/india-water-crisis-intl-hnk/index.html.

Timing *is* everything: The why and what of this book

> Nations appear and fall, but cities endure and rediscover how to succeed. Their longevity gives them time to develop free institutions and a loyal citizenry. Beijing, Athens, Damascus, Philadelphia, Cairo, Delhi, and Rome, to name just a few, have seen empires come and go while they remain. The fall of the Roman Empire never entailed the fall of Rome. The Prussian empire and then the Third Reich were vanquished, but Berlin, though bombed into rubble, survived.[57]
>
> —Benjamin R. Barber, *If Mayors Ruled the World*

> It's notable that most of Karachi's violence is not blamed on Islamist extremist groups. But extremists have established a presence in Karachi, attracted by many of the same factors that make the city rich … Taliban fighters are believed to visit Karachi when they need places to hide … Al Qaeda used the city as a receiving station for militant recruits and a base for attacks outside Pakistan. This should not surprise; the international airport and financial system offer links to the outside world while some universities and religious schools have become centers of Islamist political thought.[58]
>
> —Steve Inskeep, *Instant City*

No city of size and influence comparable with today's megacities has ever experienced major combat operations or a catastrophic citywide act of terror. This is true despite the multiple locations suffering the latter in Mumbai, Paris and London in recent years. Hopefully none ever will. But hope cannot replace preparation or a diligent response. These pages therefore seek to offer something to those responsible for disaster readiness, from leaders of international response organisations and nations to the individual on the street, no matter what a catastrophe's cause. The largest and most influential of urban areas have known their share of disasters. Many, too, are the lessons from other environments that will prove valuable when preparing for megacity misfortunes to come. We will therefore plunder knowledge drawn from events in smaller cities, towns and even rural areas when they offer ore rich in preparedness

57 Benjamin R. Barber, *If Mayors Ruled the World: Dysfunctional Nations, Rising Cities*, New Haven, CT: Yale University Press, 2013, 222.

58 Steve Inskeep, *Instant City: Life and Death in Karachi*, New York, NY: Penguin, 2011, 11.

value. In return, it is fortunate that understanding how better to ready for megacity catastrophes will advise those preparing for disaster response elsewhere.

The why behind this book

> Cities have always been cradles of culture, technology, and commerce, where history's most luminous minds and civilizations converged.[59]
>
> —Janette Sadik-Khan, *Street Fight*

> One hundred thousand soldiers encircled—but did not isolate—IS [Islamic State] in Mosul.[60]
>
> —Thomas D. Arnold and Nicolas Fiore, 'Five operational lessons from the battle for Mosul'

> We overbuild, and we built it wrong.[61]
>
> —Yu Kongjian, Peking University landscape architect, commenting on the fact that 70 per cent of Chinese cities are on floodplains

It was August 1993. My family and I were driving across the United States to California after five years in Europe and the Middle East. The new assignment was a year-long fellowship at an American think tank. Phone conversations with my soon-to-be colleagues informed me that I would be able to work on whatever topic we thought would be of value to those sponsoring my research. Interminable miles across west Texas provided plenty of time to contemplate. It struck me that as the planet became more and more urbanised, I might be able to offer something of value for when disaster struck built-up areas. On arriving in California, I proposed that my year should focus on the challenges posed by what we called 'urban operations'. My colleagues seemed enthused, not so much my sponsors. I was told to find another topic.

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59 Janette Sadik-Khan, *Street Fight: Handbook for an Urban Revolution*, New York, NY: Viking, 2016, 2.

60 Thomas D. Arnold and Nicolas Fiore, 'Five operational lessons from the battle for Mosul', *Military Review: The Professional Journal of the US Army* 99 (January–February 2019): 56–71, at 60, Fort Leavenworth, KS: Army University Press, available from: www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/Jan-Feb-2019/Arnold-Mosul/.

61 'Soaking it up: Flood-proofing cities', *The Economist*, [London], 20 November 2021, 42.

Five weeks later, 18 US soldiers died when Somali militia shot down two helicopters in Mogadishu and ground forces rushed to the crews' rescue. My colleagues came back to me. My sponsors had reconsidered. I spent the bulk of what remained of that fellowship year considering urban areas' wartime concerns. Later years saw a return to the think tank community on a permanent basis. The scope of urban considerations became more inclusive. This book is a culmination of a quarter of a century's study of the topic—invaluably aided by insights graciously offered by the more than 1,000 individuals who granted interviews during that period and whose paths I have been lucky enough to cross since those ill-starred days of 3–4 October 1993 on Mogadishu's streets.

The what of this book

> Once the battle has started, commanders at all levels will often experience the frustration of being out of contact with their subordinates. By the very nature of the terrain, communications will be difficult. These difficulties will be compounded by the fact that in this type of fighting, there will be a mass of individual fire fights out of sight of each other.[62]
>
> —R.D. Jenkins, 'Notes on fighting in built-up areas (FIBUA)'

> The cities most at risk are those where these events are already common—although there is some evidence of the geographic range of some extreme weather events expanding. Coastal cities will be doubly at risk as sea-level rise increases hazards from coastal flooding and erosion. For any city, the scale of the risk from these extreme weather events is also much influenced by the quality of housing and infrastructure in that city and the level of preparedness among the city's population and key emergency services.[63]
>
> —David Satterthwaite et al., *Adapting to climate change in urban areas*

It quickly became obvious during those years of study that the men and women called to aid a city in times of distress were far more likely to find themselves helping in the aftermath of a disaster outside the bounds

62 R.D. Jenkins, 'Some notes on fighting in built-up areas (FIBUA)', *British Army Review Special Report: Urban Operations Report 1*, Winter 2018, 28–37, at 32.

63 David Satterthwaite, Saleemul Huq, Mark Pelling, Hannah Reid and Patricia Romero Lankao, *Adapting to climate change in urban areas: The possibilities and constraints in low- and middle-income nations*, Human Settlements Discussion Paper Series, London: International Institute for Environment and Development, January 2007, 17, available from:pubs.iied.org/pdfs/10549IIED.pdf.

of war. What was no less obvious was that any such help would require a team featuring a wide range of expertise regardless of the disaster's underlying cause. This book strives to provide value to all who seek to minimise the suffering of anyone experiencing an urban catastrophe. This first chapter begins to set the table regarding what urban areas and megacities are—a less straightforward undertaking than one might think. Chapter 2 picks up where Chapter 1 leaves off, delving deeper into the megacity's character and the implications when calamity visits. It is in this second chapter that we challenge the common (and historically inconsistent) understanding of what qualifies as a megacity and why they present disaster planners and responders with exceptional challenges. The next three chapters contemplate the challenges and opportunities inherent when calamity strikes these largest and most influential urban areas (Chapter 3), the role of information and influence during such events (Chapter 4) and the essentiality of bringing all relevant parties together when addressing catastrophe and its aftermath (Chapter 5). The three succeeding chapters offer thoughts, respectively, on preparing for, responding to and recovering from megacity crises, each doing so in terms of:

- context
- how the urban area functions as a system and part of systems greater than itself
- maintaining control in terms of safety and security during and in the wake of misfortune
- orchestrating the efforts of those with a role to play when adversity calls
- exceptional considerations when disaster involves military combat operations
- final thoughts given the above.

If you are one for alliteration, you might think of these six elements as context, collectiveness, control, cooperation, additional considerations and concluding thoughts.

Chapters 9 and 10 bring the whole to a close, sweeping up what the previous eight did not and casting our minds forward to deliberate on what the future could offer in the way of urban disaster preparedness and recovery.

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