FICTION

Silicon and surveillance

Sean Carroll finds Thomas Pynchon on compelling form in a tale of big data and bigger conspiracies.

Thomas Pynchon's novels have several recurring themes: paranoia and conspiracy, pastiches of high and low culture, synchronicity and coincidence, shadowy networks lurking around every corner, and the impact of science and technology. With the coming of the Internet age and the surveillance society that sprang up in the wake of 11 September 2001, it seems as though reality has finally caught up with his vision. In his latest work, *Bleeding Edge*, Pynchon takes full advantage of this convergence.

The first question asked of a new Pynchon book is: is this one of the sprawling, spiralling, time-tripping monsters with innumerable characters and a plot that is tricky to bring into focus, like *Gravity's Rainbow* or *Against the Day*; or is it one of the fun detective stories with a well-defined protagonist, like *The Crying of Lot 49* or *Inherent Vice*? *Bleeding Edge* is definitely in the latter category. There is a colourful cast of memorable personalities, and high jinks often ensue, but the tale is told linearly, from the point of view of an acknowledged main character, with something approximating an explicit goal.

The year is 2001. The dot-com bubble has just burst and Silicon Alley, New York's version of Silicon Valley, is in disarray. The Internet revolution is just beginning to gather steam. And, of course, the imminent 11 September attacks loom over every page.

The novel begins simply, in the mundane beauty of an ordinary morning. Maxine Tarnow is walking her kids to school in Manhattan on the first day of spring, stopping to admire the sunlight shining through a pear tree's blossom. The lapsed-licence fraud investigator is about to be drawn into a sinister web of intrigue. An old acquaintance asks her to investigate the suspiciously successful dot-com for which he is filming a corporate documentary. Poking around brings Tarnow into contact with shady hackers, gregarious Italian–American venture capitalists, Mossad agents, bloggers, petty fraudsters who are in over their heads, trophy wives, a private investigator whose primary tool is his sense of smell, a pair of disarmingly likeable Russian gangsters with a fondness for hip hop, and a mysterious government operative. Some will be exiled, some will run away and some will carry on; not all will survive.
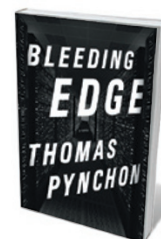
Pynchon often turns to science and engineering as sources of imagery and symbolism. His first novel, *V.*, which has its 50th anniversary this year, discussed circuit diagrams and humanoid automatons. *Gravity's Rainbow*, published 40 years ago, featured thermodynamics, chemistry and probability theory. Set in the eighteenth century, the 1997 *Mason & Dixon* meditated on the metaphysics of a clockwork universe while anachronistically nodding to the collapse of the wave function in quantum mechanics as a metaphor for the march of the British surveyors Charles Mason and Jeremiah Dixon westward through the American colonies into unknown territory. *Bleeding Edge*'s big-data-era backdrop is a perfect fit for Pynchon's sensibility.

When you are interested in paranoia and conspiracies, it is important to distinguish signals from noise, and true clues from false leads. This is also the situation in which modern scientists find themselves, searching for significance among countless spurious correlations in a flood of data.

Tarnow, when not breaking into secret passages or pulling her handgun on rapacious dot-com capitalists, spots fraudulent bookkeeping through deviations from Benford's Law (the expected distribution of first digits in numerical data), and her secretary's observations of a pattern in the empty cells of an Excel spreadsheet.

Geek culture is evocatively rendered, often through throwaway jokes and asides. The interior of a smoke-filled limousine has "picked up a Gaussian blur"; a couple, asked if they will be living together

Bleeding Edge
THOMAS PYNCHON
The Penguin Press: 2013.

or separately, answer "True" in unison, and then explain "Sorry. Nonexclusive 'or.'" Characters explore the Deep Web — a real but murky sector of the Internet unindexed by search engines and populated by dynamic content and entrepreneurs concerned with privacy. And they lurk in DeepArcher (say it out loud), a virtual space of Pynchon's invention. This is a virtual-reality interface that grows organically, allowing its denizens to construct sanctuaries away from the surface web with no clear instructions — "part of getting constructively lost". Characters who have met untimely ends in "meatspace" seem to linger on in DeepArcher, although it is impossible to tell who is really behind the face of an avatar.

The attacks on the World Trade Center happen about two-thirds of the way through the book. Rather than inducing a dramatic change, they lead to a slight shift in balance, pulling some notes down and bringing others to the foreground. Every type of conspiracy theory is tossed into the pot and stirred. Pynchon highlights the life-goes-on aspect of New York after the attacks, but laments the swiftness with which "forces in whose interests it compellingly lies to seize control of the narrative" work to keep people "cranked up, scared, and helpless".

Bleeding Edge is an elegiac yet compulsively readable novel. The humour crackles, eliciting chuckles on almost every page. No one works magic with words like Pynchon, and here he is at the height of his powers, by turns gripping, thought-provoking, inventive, touching and poetic, not to mention warmly human. Tarnow is a rich, believable character, and we are fortunate to be privy to her wry commentary on the rogue's gallery of characters who cross her path.

'Big data' is a modern buzzword, but a long-standing theme for Pynchon has been how the search for signals in the noise is, in part, a quest for meaning amid chaos and entropy. At the end of the novel, in a world transformed by atrocities large and small, Tarnow's boys once again head off to school. This time they make the journey without their mother. Life does go on, even as everything changes; the best we can do is care. ∎

Sean M. Carroll *is a theoretical physicist at the California Institute of Technology in Pasadena. His books include* The Particle at the End of the Universe.
e-mail: seancarroll@gmail.com

A worker using an electrolysis furnace to produce aluminium in Krasnoyarsk, Russia.

INNOVATION

Superpowered invention

Leonid Gokhberg and **Dirk Meissner** compare accounts on the trajectory of innovation in two towering economies.

Many of us believe that science is indispensable for generating innovation, and that innovation is a basis for manufacturing, which, in turn, is a must for the economy. But is the road that straight? In truth, it takes decades to recognize the fruits of scientific discovery and economic activity.

Science historian Loren Graham and environmental scientist Vaclav Smil examine this issue in two nations with economic and political models that have evolved very differently. Graham's *Lonely Ideas* tackles Russia's powerful history of scientific invention, its long-standing inability to benefit from this, and its post-Soviet potential for change. Smil's *Made in the USA* looks at the United States' innovation-led economic power, built on twentieth-century might in manufacturing everything from cars to electronics, but now weakening — and even creating trade deficits in high-tech products such as computer equipment.

What emerges are distinct challenges. The United States, Smil argues, should revitalize manufacturing (of household appliances or construction equipment, for example) to support growth and investment in health care and education, among other positive socio-economic impacts. In Russia, Graham shows, the challenge is to reshape an economy now

Lonely Ideas: Can Russia Compete?
LOREN GRAHAM
MIT Press: 2013.

Made in the USA: The Rise and Retreat of American Manufacturing
VACLAV SMIL
MIT Press: 2013.

reliant on oil and gas, and to make it competitive through technological upgrading and integration into global value chains — the interlinked processes that take a product from conception to end use.

Smil notes that US innovation co-evolved with the emergence of a middle class rooted in industry, such as steel manufacture in the nineteenth century, and automobile production in the twentieth. A Russian middle class has never fully emerged, yet Graham fails to tackle this issue. Rather, he focuses on the inventiveness of Russian scientists, describing impressionistic examples such as the early work of Nikolai Basov and Alexander Prokhorov on lasers in 1954. In exploring the country's failure to turn invention into innovation, he briefly covers key factors such as the investment climate, institutional frameworks, policies and the societal mindset. His discussion of various areas of technology such as genetics is interesting, although some of his conclusions are odd. For instance, ▶