

FUTURE NEWS

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IN THIS EDITION

Welcome to Tomorrowland

The Story of Estonia

by Vivienne Walt

(page 2)

Futurists in Action

What is a futurist?

by Rohit Talwar

(page 9)

BOOK REVIEW

The Gene - An Intimate History

by Siddhartha Mukherjee

(page 11)

Signals in the Noise

60 Future Crimes that Don't Exist Today

by Thomas Frey

(page 14)



WELCOME TO TOMORROWLAND

Is the Tiny European Nation of Estonia a Preview of Our Tech Future?

by Vivienne Walt



TINY, BUT MIGHTY

Bordering Russia, Estonia is the smallest of the former Soviet states on the Baltic.



Picture courtesy of Fortune Magazine

“It is here that a group of friends, including Heinla, invented the hugely popular Internet calling platform Skype.

On a Spring afternoon, I'm gazing out the window of an office building on the outskirts of Estonia's capital, Tallinn, watching people stroll below, when a cream-colored plastic container mounted on black wheels rounds the corner and begins maneuvering its way among the pedestrians. The device looks like a kid's toy. But in reality it's a high-tech delivery robot called Starship and potentially the next mega-profitable invention to spring from this snowy, miniature country on the northern edge of Europe—one of the more unexpected launching pads on the planet. “If you look at sci-fi movies set 20 years from now, you don't see people carrying their groceries. Robots just arrive at their homes,” says Ahti Heinla, cofounder and CEO of Starship Technologies. Reality, he says, has caught up to sci-fi. “About two years ago we realized it was possible to create this part of the future right now.”

For a snapshot of how we might all be living tomorrow, there are few better places to visit than this picturesque city of 400,000, whose winding medieval alleyways offer an elegant contrast to its digital present. Creating the future now, as Heinla puts it, is Estonia's driving project, and increasingly it is its core business too.

Most Americans or even Europeans would be unable to find this pinprick on a map, squeezed between its small Baltic Sea neighbor Latvia and mammoth Russia. Its population, just 1.3 million, is about the same as Dallas or the Bronx borough of New York City. But its modest size and remoteness belies its clout. It is here that a group of friends, including Heinla, invented the hugely popular Internet calling platform Skype.

“Estonia offers a glimpse into what happens when a country abandons old analog systems and opts to run completely online instead.

Given Estonia's history, the invention of Skype in this country was ironic. While Americans were buying their first cell phones, about a quarter-century ago, Estonians were shut off from the world as an outpost of the Soviet Union. You could easily wait 10 years to be assigned a landline phone. By the time the Soviet Union imploded in 1991, the country was in a time warp. “We did not have anything,” says Gen. Riho Terras, the commander of Estonia's armed forces, who had been a student activist at the time. The country had to reboot from zero. Terras says each citizen was given the equivalent of 10 euros, or \$10.60. “That was it,” he says, laughing. “We started from 10 euros each.”

One generation on, Estonia is a time warp of another kind: a fast-forward example of extreme digital living. For the rest of us, Estonia offers a glimpse into what happens when a country abandons old analog systems and opts to run completely online instead. That notion is not fanciful. In various forms, governments across the world, including those in Singapore, Japan, and India, are trying to determine how dramatically they can transform themselves into digital entities in order to cut budgets and streamline services (and for some, keep closer tabs on citizens). Estonia claims its online systems add 2% a year to its GDP.

The moment I land in Tallinn, my phone pings with the city's free Wi-Fi network, which rolled out more than 15 years ago. But the extreme-digital life of regular Estonians is far less visible. At birth, every person is assigned a unique string of 11 digits, a digital identifier that from then on is key to operating almost every aspect of that person's life—the 21st-century version of a Social Security number. The all-digital habits begin young: Estonian children learn computer programming at school, many beginning in kindergarten.

In 2000, Estonia became the first country in the world to declare Internet access a basic human right—much like food and shelter. That same year it passed a law giving digital signatures equal weight to handwritten ones. That single move created an entire paperless system. Since no one was required to sign with a pen, there was no need for paper documents to pay taxes, open a bank account, obtain a mortgage, pick up a prescription, or perform most of life's other tasks, other than marrying and divorcing. “I established my company in about 20 minutes, without going anywhere,” says Kaidi Ruusalepp, 41, CEO of Funderbeam, an investment trading platform for early-stage, non-IPO startups, which she founded in 2013. “We never visited the tax board, the Social Security agency, anything,” she says. “Everything is online.”



Kaidi Ruusalepp, founder and CEO of startup Funderbeam, at her company's offices in Tallinn. Photograph by Piotr Malecki—Panos Pictures for Fortune

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So, too, are Estonians' taxes. Almost all Estonians file taxes online—within minutes. Since public registries are all linked in one system, Estonians can log in to prefilled tax declarations showing their income, property, number of children, and so on. They make necessary tweaks and hit the send button. (Outside the U.S., this type of approach is increasingly common.) Last year then—Prime Minister Taavi Rõivas earned loud cheers on *The Daily Show* when he described to host Trevor Noah how he had filed his taxes on his iPad during a few idle minutes in the Luxembourg Airport.

When I visit Rõivas, 37, in his office in the Estonian Parliament, it's weirdly devoid of paper. He says during nearly three years as Prime Minister the only time he signed his name in ink was in ceremonial guest books. Theoretically, he says, the government could issue an online order to send troops into battle. “I never signed any law physically,” he says. “Never.”

Estonians were also first to be able to vote online in elections, back in 2005. When I ask Estonian President Kersti Kaljulaid where she voted in last November's elections, which brought her to power, she responds as if my question is dumb: “From my computer at home.” Kaljulaid was speaking to me while we were on a boat to Tallinn from Helsinki, in neighboring Finland, where she had just signed a deal allowing the countries to recognize each other's digital ID cards. Now, for example, Finns and Estonians can visit doctors in the other country and automatically call up their medical records—all stored online. “We have been using digital identifiers for 17 years,” she says. “People have learned to trust the system.”

Estonians might take all this tech wizardry for granted now, but the country was on its knees economically after the Soviet collapse. It had one huge advantage: It was starting from scratch. “People were paid in cash,” says Martin Ruubel, 41, president of Guardtime, a 10-year-old software security company that developed the country's blockchain system (more on that in a moment), sitting in his Tallinn office on the grounds of a converted former military barrack. Since no Estonian had ever had a checkbook, once the Soviets were gone the country simply skipped past pen and paper and issued bank cards. It was a money saver, but had another benefit: It pushed Estonians to get online fast.

Scrambling to piece together a country, the new leaders, young and inexperienced, also rapidly privatized the telecom industry. “It was highly successful,” says Mart Laar, 57, who became the first post-Soviet Prime Minister, at age 32, and is now chairman of the board of supervisors for the Bank of Estonia. Since so few people had even landline phones, many simply bought mobile handsets instead. Laar, a historian, says he knew nothing about computers but believed they needed to start with the latest technology. When Finland offered to donate its analog telephone exchange to its poorer neighbor for free, Estonia turned it down.

The government recruited Ruusalepp, now Funderbeam's CEO, as the new country's first IT lawyer when she was just 20 and still a student. “I had no law degree and no understanding of technology,” she says. Her first task was to create a law for digital signatures, years ahead of many countries. “We wanted to change the country. We had brains, and we just had to shoot,” she says.

Those early decisions set the stage for today's thriving tech scene in Estonia. Skype, founded in Tallinn in 2003, spawned a generation of techies and would-be entrepreneurs. “People thought, If Estonian guys could do something like Skype, I can do it also,” says Andrus Oks of Terra Venture Partners, an investment fund in Tallinn. And when Microsoft bought Skype in 2011 for \$8.5 billion, ex-Skypers plowed money into new startups in Tallinn, further attracting U.S. investments. Skype's founding developers, including Starship's Heinla, also launched a venture capital fund, called Ambient

Sound. “The Skype effect has been enormous,” says Heinla, who started Starship with Skype cofounder Janus Friis; major investors include Daimler A.G., as well as Silicon Valley firms Shasta Ventures and Matrix Partners.

Three Estonian Startups on the Rise

THE THRIVING TECH SCENE in the capital city of Tallinn has attracted the attention of venture capitalists worldwide. Here are a handful of companies to watch.



STARSHIP TECHNOLOGIES

Cofounded in 2014 by Janus Friis and Ahti Heinla, two of the Estonians who helped create Skype, the company is now testing its food-delivery robots in markets like London, Hamburg, and Redwood City, Calif. Auto giant Daimler is an investor.

JOBBATICAL

Founder Karoli Hindriks believes that “if everyone could do a year abroad, the world would be a better place.” Her company, founded in 2014, places skilled job seekers around the world for medium-term stints at overseas companies. Early investors include Union Square Ventures.

FUNDERBEAM

Possibly the world’s only online trading platform for early, non-IPO startups, it’s built on blockchain technology and was founded in 2013 by Kaidi Ruusalepp, who once served as the Estonian government’s first IT lawyer. Famed VC Tim Draper was an early backer.

Now, if you order Chinese takeout through platforms DoorDash or Postmates in Redwood City, Calif., or Washington, D.C., your food might arrive as a Starship test run, with a ping on your mobile phone letting you know your delivery robot is at the door. Starship is also doing test deliveries in Bern, Switzerland, and London, and Domino’s Pizza plans to test some deliveries by Starship soon in Hamburg.

The Skype effect does not end there. In 2011, Skype’s first employee, Taavet Hinrikus, cofounded TransferWise, an online money-transfer company, which now occupies four floors of a Tallinn building and handles about \$1 billion a month in exchanges around the world. Investors include Andreessen Horowitz and Peter Thiel’s Valar Ventures.

With hindsight, it seems inevitable that Russia would sooner or later collide with its pint-size former territory, which, aside from becoming a major tech hub, had rushed to join both NATO and the EU after the Soviet collapse.

Russia’s payback finally came in 2007—and it would markedly change Estonia. It happened when Estonia’s government decided to move a World War II memorial statue of a Soviet soldier from central Tallinn to a nearby war cemetery. Pro-Russian demonstrators burned barricades and looted stores in days of rioting. Then Estonia’s banks, its Parliament, and several public services suddenly went off-line, in one of the biggest-ever distributed denial-of-service attacks to hit a country. The 2007 cyberattack still haunts Estonia. “We were already really, really dependent on online. We had no paper originals for a lot of things,” says Guardtime’s Ruubel. Estonia believes Russia was behind the attack.

Shortly after, the only NATO-accredited cyberdefense center opened in Tallinn. And this year Estonia will open the world’s first “data embassy” in Luxembourg—a storage building to house an entire backup of Estonia’s data that will enjoy the same sovereign rights as a regular embassy but be able to reboot the country remotely, in case of another attack. “It was quite clear after 2007 that we knew how to fight against external attacks,” Ruubel says. “The worry was, What if there was an attack from inside the system, with someone tampering with the data?”



Street art on an office building in a Soviet-era industrial section of Tallinn. Photograph by Piotr Malecki—Panos Pictures for Fortune

The answer to that concern came in the form of the technology that now underpins crucial parts of Estonia's system, as well as some of its most successful startups, and that, in the years ahead, could help power the country's future growth: the blockchain.

Essentially a distributed database, a blockchain—the system that also underpins the cryptocurrency Bitcoin—serves as a public ledger that can never be erased or rewritten. The technology allows Estonia's engineers to strengthen its encrypted data and lets Estonians verify at any time that their information has not been tampered with. Estonians are also required to use two-step verification for many online tasks. These and other security measures, say Estonians, make their system as close to unbreakable as possible. (The U.S. State Department said last year that cybercrime “does not represent a major threat” in Estonia.) They contrast it, for example, to Edward Snowden's hacking into the NSA, which he continued over 18 months. “No Snowden can crack this system,” boasts President Kaljulaid.

Outside the country, however, there are some doubts as to whether the Estonians' technology is as secure as they claim. In 2014—seven years after the suspected Russian hack—engineers at the University of Michigan studied Estonia's online-voting system and concluded that determined hackers—such as Russian operatives—could feasibly penetrate it, creating fake votes or altering the totals in order to rig elections “quite possibly without a trace,” they wrote in their report. “Estonia's system places extreme trust in election servers and voters' computers—all easy targets for a foreign power,” they said. Estonia disputed the claims, saying that it had worked flawlessly in six elections and that it had “a level of security greater than was possible with paper ballots.”

To Estonians, the potential of extreme-digital systems for both governments and businesses is dizzying—and with the blockchain, it has only just begun. Guardtime, which has 150 employees and estimates about \$23 million in revenues in 2015, is now among the world's biggest blockchain companies, with clients around the world, including Lockheed Martin and the U.S. Department of Defense. Funderbeam uses so-called colored coin technology, based on the public Bitcoin blockchain, to keep track of transactions and investments. That eliminates the need for brokers and clearing agents.

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—Estonian
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“We work on the premise that unexpected outcomes are more important than trend extrapolation alone.



Children in a coding class in an elementary school in Tallinn. Photograph by Piotr Malecki—Panos Pictures for Fortune

Ruusalepp, whose early backers at Funderbeam included the Silicon Valley venture capital investor Tim Draper, says she regularly hears Americans argue that paper records are more secure. Estonians, by contrast, would be aghast to have their medical records in paper folders in doctors' offices, she says. "You can never see who has looked at your data," she says. "Blockchain solves the issue of trust."

Those who created Estonia's system say they believe the arguments raging in the U.S. over data privacy are largely misplaced. The focus should instead be to give people control over who accesses their data, by using blockchain technology. "The real issue is data integrity," says Toomas Hendrik Ilves, an Estonian-American from Leonia, N.J., who served as Estonia's President from 2006 until last November, and is now a senior fellow at Stanford University's Center for International Security and Cooperation and sits on the World Economic Council's Future of Blockchain group. He says it could take many years for the U.S.'s sprawling agencies to create an Estonian-type blockchain architecture. "I'm smack in the middle of Silicon Valley, at Stanford, and the amount of creativity is amazing," Ilves says. "But the public sector is lagging way, way, way behind."

Having built perhaps the world's most seamless digital system, Estonia still faces a major limitation: its size. With just 1.3 million Estonians, it runs like a well-oiled machine. But engineers claim there is vast spare capacity. Built right, the system could work with huge numbers. (The U.S. could in theory reengineer its databases from scratch, say Estonian technologists, and serve 300 million Americans just as well.) To more fully leverage its technological advantage and boost economic growth, Estonia needs more market participants.

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Since Estonia had little means for attracting masses of immigrants to its icy Northern European landscape, it came up with a quirky idea—another of its firsts in the world: offering people virtual residency. Taavi Kotka, 38, a software engineer and entrepreneur, dreamed up the concept after becoming the government’s chief information officer in 2013. Kotka wrote a policy paper arguing that the population needed to grow fast, and proposed a target of 10 million people by 2025. Since Estonian women were not about to have 10 babies each, the alternative was to figure out what kind of product the country could offer to the rest of the world. Somewhat like Delaware-based corporations in the U.S., e-residents of Estonia can now run their European operations remotely and do business in euros. “We want to be the office for micro and small companies, because that is basically what our country is,” say Kotka, who now works as a consultant to Estonian startups. “You cannot grow without customers.”

Estonia’s first e-residency cards rolled out in December 2014. The microchips inside them are identical to Estonians’ digital ID cards but come without citizens’ rights, like voting or public pensions, and there is no obligation to pay taxes in Estonia. This is no tax haven: Estonia requires that e-residents pay their taxes to whatever country they owe them. But for a fee of 145 euros (about \$154) e-residents can register companies in Estonia, no matter where they live, gaining automatic access to the EU’s giant common market—about 440 million once Britain leaves the union. Of about 18,000 e-residents so far, about 1,400 have formed companies in Estonia. On average, each of those companies spends roughly 55 euros (about \$58) a month on accounting and office administration in Estonia.

This year the government doubled its budget for the program and intends on doubling it again in 2018, saying it’s determined to ramp up e-residency numbers quickly. As numbers grow, so too will the business services Estonia offers. Officials have traveled to Tallinn from around the world to examine how to start their own e-residency programs. Kaspar Korjus, managing director of the e-residency program, says his office hosts about 500 delegations a year. “So far the only revenue model for countries is taxes,” he says. “But if we get 10 million e-residents paying \$100 a month each, maybe we would not need taxes.”

The possibilities do not end there. With its government running on the blockchain, Estonia could in theory begin marketing other inventions as they unfold—creating huge new business. Rõivas, the former Prime Minister, says Estonia is working on developing “precision medicine” that would tap into the genome data of its 1.3 million citizens in order to better diagnose illnesses, treat people, and design personalized drugs. “We can use blockchain to make sure that the data exchanged is able to be traced,” he says.

It’s possible to imagine Estonia’s idea becoming a multibillion-dollar business in the years ahead—turning the whole view of government as a bureaucracy offering public services into an entity generating profits.

Perhaps only a place that started over from scratch in 1991 could reimagine the idea of a country. As I watch the Starship robots maneuver across the company’s office in Tallinn, CEO Heinla says he believes Estonians, after decades of living under Soviet rule, were uniquely suited to creating new ways of doing things, including how to run a government. “People grow up and see an establishment they cannot break into,” he says, so Estonians simply built something new, and more efficient. Older, more set in its ways—and more skeptical—the rest of the world has yet to catch up. Just don’t expect Estonia to wait for us.

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FUTURISTS IN ACTION

WHAT IS A FUTURIST?

by Rohit Talwar – CEO Fast Futures

The role of a futurist is growing in prominence, and demand for our input is rising. Businesses and governments increasingly see 'ownership of the future' as a key strategic goal. It is now common for futurists to be called in to advise businesses, governments, NGOs and - increasingly - individual clients, about our rapidly evolving reality and how to navigate the emerging landscape. Good futures work and foresight research involve the use of many different tools and techniques to identify and analyse the forces, trends, developments, and ideas shaping the future.



Rohit Talwar



Here we explore some of the key processes that a futurist employs and some typical applications of foresight.

A Futurist

Futurists are best known for generating, perceiving and envisioning alternatives to the expected outcomes of today's events.

A futurist provides the foresight and practical insights that help a variety of clients to understand the trends, developments and ideas that could shape the future. Being informed about what's coming next and how these 'future factors' could interact and play out helps individuals, society, businesses and governments make better decisions, prepare for a range of possible futures, anticipate emerging risks and spot opportunities early.

“ We work on the premise that unexpected outcomes are more important than trend extrapolation alone.

Looking to the future: methods of foresight

We futurists have a wide range of research, planning and visioning tools that we use to explore the emerging future. This starts with ‘horizon scanning’ to identify critical future factors coming over the horizon - some clients like to look one to five years ahead - others are thinking 20-50 years into the future. The data you gather through horizon scanning can then be explored in different ways to assess the potential impacts of and interactions between critical future factors.

A commonly used tool is scenario planning which help us explore different possible ways in which the most important and uncertain driving forces of change could interact and play out. This is very powerful in helping organisations ‘future proof’ their thinking, explore a range of possible futures and rehearse different possible strategic responses. We use a variety of strategy and visioning tools to help clients build on the scenario insights to develop powerful new business ideas, create bold strategies, prototype possible solutions, and then generate imaginative products and services.

Futurist scenarios usually incorporate a combination of technologies and innovative developments that already exist, those that are about to emerge and those on the medium to long-term horizon. Additionally, we explore the potential impact of numerous other factors and indicators beyond science and technology to inform our scenarios, which means good scenarios actually resemble short stories incorporating both hard evidence of what we can see and creative exploration of the potential impacts and implications of what has yet to happen. Hence, these ‘stories from the future’ are what differentiate futurists from other disciplines such as economic analysis, statistical forecasting and trend extrapolation. Hence, although research-based, scenarios incorporate creative thinking and intuitive processes, which are not so common in more mainstream analytical approaches.

The future will not necessarily resemble the past

Unlike traditional forecasters, futurist scenarios reject the idea that the future is simply the continuation of past trends. We look for indicators that have the potential to result in unexpected outcomes. these include including weak signals of emerging change, and low probability high impact events that are very difficult to predict such dramatic breakthroughs in science and technology, unusual political developments or natural phenomena - often know as wild cards or black swans. We work on the premise that unexpected outcomes are more important than trend extrapolation alone, so we look at the alternatives to the ‘expected’ or predicted future. Being informed about what’s coming next and how these future factors could interact and play out helps clients make better decisions, prepare for a range of possible futures, anticipate emerging risks and spot opportunities early. Challenging the status quo concept of a ‘likely future’ is a key part of our contribution to our work with client organizations.

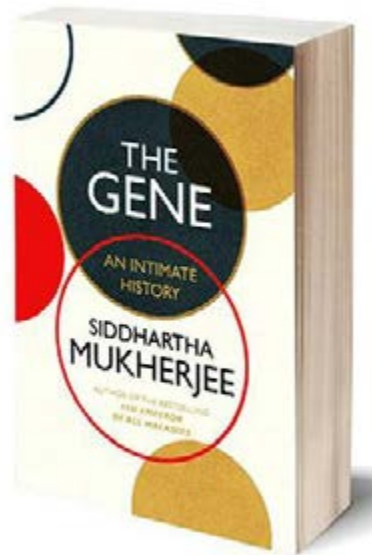
We tend to look specifically for items of information that surprise us, that challenge our assumptions, that require us to consider radically different paradigms and business models, or that present a completely new perspectives on the future. These are the types of inputs that form the foundation of good foresight research and the basis of effective future scenario creation.

We believe that the goal is not to predict the future but rather to prepare ourselves for a range of alternative possible futures. The exploration of the underlying drivers and the creation and evaluation of scenarios are a critical part of developing the capacity of leaders, managers and planners. Good foresight processes help prepare us for an uncertain world and navigate our organisations through the choices, changes and transformations required to survive and thrive in a range of future scenarios.

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Book Review

by Charles Brass – Chair, futures foundation



The Gene
An Intimate History
by
Siddhartha Mukherjee

One of the epigrams that opens this book is from the famed Japanese author Haruki Murakami, who in his masterpiece *IQ84* wrote:

Human beings are ultimately nothing but carriers – passageways – for genes. They ride us into the ground like racehorses from generation to generation. Genes don't think about what constitutes good or evil. They don't care whether we are happy or unhappy. We're just means to an end for them. The only thing they think about is what is most efficient for them.

This, and the personal family experience of the author, explain both why this book was written and why it is so important.

Siddhartha Mukherjee is an Indian doctor and writer who first gained international attention with his majestic look at cancer called “The Emperor of All Maladies”.

The current book was written as a logical extension of the journey that lead him to try and understand cancer. As he explains throughout both books, the Mukherjee family has a long history of genetically influenced medical conditions, including various cancers as well as mental health issues. Mukherjee opens “The Gene” with a detailed exploration of his family’s various mental health challenges and sets up the rest of the book by concluding that, long before he became a doctor – or even before any of his family members had any tertiary education – his grandmother had concluded that there had to be some genetic basis to their story.

He then proceeds, in a 500 page, six part journey, to track the history of heredity and genetics from the mid-19th century through the present day into some speculations about its future history.

Although this is an extremely comprehensive journey into the science of genetics, it is written for a lay audience; and takes the time to explore the personalities (and sometimes the personal agendas)

of those whose contributions are featured.

As any student of genetics might expect, the story begins with Gregor Mendel – but even as he explains Mendel’s involvement Mukherjee returns to ancient Greek philosophers such as Pythagoras and Aristotle, both of whom were fascinated by how it was that new life developed and from where it got its identity.

Also not surprisingly, Charles Darwin enters the picture very early in the first part, but (as with many of the major players) Mukherjee is careful to acknowledge the many others who influenced (and even contradicted) Darwin’s views. Often overlooked luminaries like Sir John Herschel, Richard Owen, John Gould, William Paley, Thomas Malthus, Alfred Wallace and Jean-Baptiste Lamarck are given appropriate recognition.

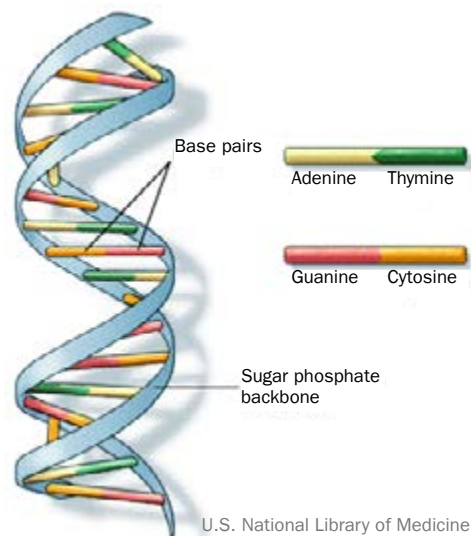
A good example of Mukherjee’s thoroughness is the attention he pays to Fleeming Jenkins (of whom I had never previously heard) who was not afraid to criticise Darwin and in the process push him to greater and deeper insights (p44-).

Mukherjee is also not afraid to acknowledge the (now largely discredited) place of Francis Galton (who was Darwin’s cousin) and the eugenics movement in helping scientists better understand heredity. Part of the reason for this acknowledgement is Mukherjee’s recognition that eugenic principles and practices are again rearing their head in the 21st century as human ability to manipulate genetic information to all sorts of ends is ever increasing.

The second part of the book focuses on the period from 1930 to 1970 during which scientific understanding of genes, genotypes and phenotypes expanded rapidly (the word ‘gene’ was first coined in 1905).

This is the era of Crick and Watson (and their colleagues Maurice Wilkins and Rosalind Franklin whose

contributions are often overlooked, but not in this book), but it began with men like Thomas Morgan and experiments on fruit flies. Mukherjee also acknowledges the importance of mathematics in this journey, with people like Ronald Fisher bringing statistical analysis to bear on the observations of experimental scientists, and beginning to explain just how these packets of inheritance (genes) might work.



DNA structure

The story of Crick and Watson's discovery of the structure of DNA has been written many times, and here reads like an adventure story. Mukherjee shows how their work grew out of experiments in Nazi Germany, was sidetracked in some countries by what he calls "junk science" (p128) and was the ultimate winner in an often acrimonious race with other researchers, such as Linus Pauling.

After deciphering the structure of DNA (and its cousin RNA) the race became to understand how a particular geometric arrangement of relatively simple amino acids could cause some cells to become muscles and other become neurons.

This is the point at which it becomes difficult to summarise the history any more concisely than Mukherjee has done. It takes a hundred pages to explain how the genes that make up DNA create proteins that encode messages that make things (which are mostly just other proteins). It is not for nothing that this section is called: "in

the sum of the parts there are only the parts" (a quote taken from a poem by Wallace Stevens) (p88).

Next Mukherjee turns his attention to the deliberate intervention of humans in the genetic process (nothing that through plant hybridisation and animal breeding this has been happening for thousands of years – but by the 1970s human understanding of the processes involved had become much more sophisticated). Here the reader meets concepts like cloning, plasmids and recombinant DNA. Again Mukherjee lets the stories of the key players involved be the backbone of explaining their research, their insights and (increasingly) the consequences of their work.

It is in the 1970s that the scientific community begins to think deeply about the moral and ethical dimensions of their research, a theme that becomes more prominent through the second half of the book.

It is also in the 1970s that the world of commerce – patents, corporations and profit – begins to have a significant impact on genetic research and applications, and Mukherjee is as vigilant as ever in tracing this history.

It is only now that we arrive at the middle of the book, but from here the speed of the story increases rapidly.

Most of the second half of the book forces on human genetics – although Mukherjee acknowledges the many ways in which increasingly sophisticated non-human genetic research has been influential. In five pages (p322-326) Mukherjee summarises the genetic makeup of humans, and then in the last two sections of the book looks at how this makeup is being fiddled with in ever more complex ways.

He explains how variations in DNA now allow scientists to track the movement of human populations from their emergence in the Rift Valley in Africa, and how modern manipulative techniques can insert genes into embryos and change the nature of the creature that emerges.

He also explores how mitochondrial DNA (smaller versions of DNA that

exist outside the cell nucleus and are entirely inherited from our mothers) seems to prove there was at some point a single female ('the primordial Eve) from whom we are all descended.

He looks at epigenetics – the interplay between genes and the environment, once assumed not to affect descendants, but now shown to be potentially important in shaping future generations).

In the final 90 pages Mukherjee explores very recent genetic history (including providing graphic details of genetic experiments that have gone wrong with fatal consequences) and looks to the future. Throughout he keeps his reader close to his personal story. As he says: "This book began as an intimate history – but it is the intimate future that concerns me" (p467). He knows there is a chance he will pass on potentially deleterious genes to his children, and spends some time wondering just what he might or should do about that.



Siddhartha Mukherjee

He finishes by concluding that we need "a manifesto – or at least a hitchhiker's guide – for a post genomic world" (p483) and suggests 13 statements that should form part of this guide (only the first sentences are reproduced here, they are elaborated on pages 480-483 of the book):

1. A gene is the basic unit of hereditary information
2. The genetic code is universal
3. Genes influence form, function and fate, but these influences typically do not occur in a one-to-one manner

4. Variations in genes contribute to various in features, forms and behaviours
5. When we claim to find "genes for" certain human features or functions, it is by virtue of defining that feature narrowly
6. It is nonsense to speak about 'nature' or 'nurture' in absolutes or abstracts
7. Every generation of humans will produce variants and mutants; it is an inextricable part of our biology
8. Many human diseases – including several illnesses previously thought to be related to diet, exposure, environment, and chance – are powerfully influenced or caused by genes
9. Every genetic 'illness' is a mismatch between an organism's genome and its environment
10. In exceptional cases, the genetic incompatibility may be so deep that only extraordinary measures, such a genetic selection, or directed genetic interventions, are justified
11. There is nothing about genes or genomes that makes them inherently resistant to chemical and biological manipulation
12. A triangle of considerations – extraordinary suffering, highly penetrant genotypes, and justifiable interventions – has, thus far, constrained our attempts to intervene on humans
13. History repeats itself, in part because the genome repeats itself. And the genome repeats itself, in part because history does.

In today's apparently time-poor world, reading 500+ pages on a single theme might be a daunting task. However, for anyone interested in better understanding what makes us who we are, I recommend this book very highly.

Signals in the Noise

60 FUTURE CRIMES THAT DON'T EXIST TODAY

By **Thomas Frey**



Most of our heroes were rule breakers. Yes, virtually everyone that holds a prominent place in our history books was a rebel, rule breaker, and occasional criminal.

No, I'm not saying these people should have been arrested, but I think it's safe to assume that others may have been imprisoned and perhaps even killed for committing similar crimes.

But crimes in the future will require even greater levels of sophistication. As technology explodes around us, rule-breakers will have far more rules to consider in their trailblazing efforts.

We are witnessing a decline in traditional criminal groups, a void that is being filled by a growing virtual criminal underground made

up of individual criminal entrepreneurs, who come together on a project-by-project basis. Seasoned criminals will lend their knowledge, experience and expertise to the growing 'crime-as-a-service' business model.

This is already happening in the area of cybercrime, but will soon infect virtually every level of 'traditional' organized crime, involving everything from designer drugs, to circumventing immigration laws, to large-scale counterfeiting of brand name products.

As we consider the forces at play, I'd like to step you through a number of future crimes and the emerging technologies that will be used to perform them.



Future crimes will attract a whole new breed of criminal!

FUTURE CRIMES THAT DON'T EXIST TODAY

The same technologies that enable us to 3D print our own guns, also gives us the ability to create our own drones, intimidation engines, signal jammers, spyware, rockets, and gene hacking equipment. Virtually every new technology, created with all the best of intentions, can and will be used against us at some time in the future.

Suffice it to say that criminal minds are working overtime to concoct new and unusual opportunities for exploiting each of these emerging crime fields.

DRONE OFFENSES

Future drones will need to comply with thousands of unknown laws and regulations that are still in the process of being written.

- 1.) Transport of illegal substances** – Bombs, poison, drugs, body parts, etc.
- 2.) Weaponized drones** – Equipped with guns, lasers, Tasers, flamethrowers, and more.
- 3.) Voyeurism** – Inappropriate spying on people in their residences or in restricted personal spaces.
- 4.) Disruptive marketing** – Traffic-disrupting in-your-face messaging.
- 5.) Illegal shooting or destruction of drones** – The anti-drone crowd is growing.
- 6.) Noise violations** – Future drones with speakers and sound amplification systems attached (think flying concert speakers), can be turned into destructive weapons.

Signals in the Noise

60 FUTURE CRIMES THAT DON'T EXIST TODAY

7.) Drone bullying – Acts of intimidation, threatening moves, or displaying images to shame or embarrass someone.

8.) Drones killing other drones – Drones specifically designed to capture or destroy other drones.

MIXED REALITY DISTORTIONARIES

Imagine a mixed reality game showing the world we live in, only with visual overlays that make people around us unwitting players and pawns that we attempt to influence from inside this altered reality adventure. Think of it as the game of life, operating with a completely different rulebook.

9.) Mixed reality games designed to score points by injuring others – Users score points for physical bruises, verbal abuse, public shaming, and even physically disabling or killing someone.

10.) Purposefully distorted realities – Often times people stand to profit when they can get clients or customers to think something is wrong. Whether it's visually distorting the dental work needed, the amount of treatment required for a medical condition, or your role in a criminal activity, there is a special place in hell for those who perversely benefit from the suffering of others.

HISTORY DISTORTERS

We've long dealt with historical revisionists and blatant fabricationists, but as we move into the age of super news-fakers, it will become increasingly difficult to separate fact from fiction. Over time we will develop a technology that enables us to replay an unalterable visual representations of past events. But even technologies like that can be abused in new and unusual ways.

11.) Bald-faced character assassination – Piecing together bad snippets of anyone's life can make them look like a fool. We all have the frailties of being human, and good judgment is everybody's shortcoming at one time or another.

12.) Blatant revisionists – For some, painting false realities, drawing false conclusions, and reimagining past events will become a new criminal art form.

13.) False memes – Perpetuators of false research, polls, and studies.

14.) Counterfeit conclusionists – The fine art of reaching false conclusions. Since it's an asymmetrical relationship between researchers and those consuming the information, scientists need to be held to a higher standard.



How long before everyone becomes blackmailable?

SOCIAL BLACKMAILERS

In much the same way Google's personalized marketing system delivers targeted ads, an intimidation engine can be invented for the sole purpose of delivering highly targeted threats. As cyber crime escalates, we run the risk of having our social structures deteriorate into invisible mafia-style communities with the blackmailers ruling the blackmailees. While most will be doing it for money, others for revenge, few, if any, will be capable of understanding the true behind-the-scenes turf wars taking place.

15.) Threatening children – With social media it will become increasingly easy to intimidate someone with the threat of harming their child, friend, or loved one.

16.) Threat of isolation – We're all social creatures by nature and the threat of alienating, and thereby isolating, us from our friends may be a fate worse than death.

ARTIFICIAL INTELLIGENCE PLAGUES

It will become easy to rely on artificial intelligence to make most of our decisions for us – where to go, who to meet, what music to listen to, and even how to entertain our kids. But what happens when our A.I. goes bad or is coopted by those with sinister motives?

17.) Traffic accidents – Since driverless cars and drones will be managed by A.I., corrupted software could disrupt the entire transportation grid through a series of crashes, accidents, and massive traffic jams.

18.) Operating system amnesia – It's what happens when information losses, alterations, and purposeful distortions take place.

Signals in the Noise

60 FUTURE CRIMES THAT DON'T EXIST TODAY

19.) Power and data outages – Brownouts, blackouts, and information sieges designed to cut certain people off from the utilities, help, and services they need.

20.) Analysis paralysis – A.I. will soon become a crucial part of our daily decision-making processes, but system “overload” hacks, equivalent to “denial of service attacks,” will cause enormous problems.

LEGACY REVISIONISTS

Few things in life are more disturbing than having a person's legacy destroyed after they're dead. Character assassination of dead people can be relatively easy, with living children being the primary subjects of this kind of attack.

21.) False motives, false intentions – If a person is no longer alive to defend their actions, it's relatively simple to distort their motivations.

22.) Made-up involvements – With social media, our circle of loosely associated friends and acquaintances has expanded exponentially, so contriving intimate affairs with virtually any other person on the planet becomes a relatively easy hack.

23.) Fabricated consequences – Altering cause and effect relationships has become a common instrument used in political circles to twist people's thinking to draw the wrong conclusion.

24.) Rewriting conclusions using incorrect assessments of impact – Most spin masters have a massive set of tools in their toolbox, including the ability to turn any tiny blip on the radar screen of life into the appearance of a full blown nuclear-style holocaust.

SPACE CRIMES

Every military strategist knows the extraordinary advantage a destructive person could have directing an attack from a near earth vantage point, and it's only a matter of time until amateur rocketeers are capable of exploiting this opportunity.

25.) Launch-from-space EMP blast – Capable of bombing a country's financial systems into the stone ages.

26.) Launch-from-space pandemic – Deadly contagions and viral outbreaks will be easier than ever to fabricate, distribute, and infect over the coming decades.

27.) Launch-from-space communication blackouts – As we become more reliant upon data/voice communications, our key points of vulnerabilities become increasingly obvious.

28.) Launch-from-space incendiary bombs – One carefully directed blast could cause immeasurable damage.

ROBOT CRIMES

Black hat robots are coming. With our growing imbalance between the super rich and the super poor, a likely scenario will be a scaling up of techno-stealth warfare of the clandestine kind, with black hat technologies used to disrupt our systems, industries, and government in new and unusual ways.

29.) Black hat drones, black hat robots, black hat car crashers, and black hat data manipulators – Terms like this will soon become a common part of every future criminal's vocabulary.

30.) Hacker psycho-bots – One slightly deranged psycho-bot can easily be a thousand times more destructive than a single suicide bomber today.

Cryptocurrency miscreants

Cryptocurrencies have become the perfect tool for hiding transactions. As an example, Monero is a cryptocurrency that was launched in 2014 with enhanced privacy features. Monero leverages identity-obscuring ring signatures to paint a super-confusing picture of which funds have been sent by whom and to whom.

31.) Secret transactions – Cryptocurrencies open the door for truly secret communications and money transfers.

32.) Clandestine wealth storage – It becomes impossible to deter criminal activity when there's no way to understand how the transactions are made and how the money is being stored.

CRISPR GENE HACKING

Genetic engineering has long promised cures for diseases and general improvements for the human condition, and CRISPR has emerged as the gene designer's tool of choice for making it happen. At the same time, gene manipulation is a tool that can be used in all the wrong ways.

33.) Creating destructive new life forms – We have no idea how harmful new life forms can and will be.

34.) Fabricating super contagious new diseases – This will include anything that compromises the health, security, or long-term viability of people.

35.) Sadistic human editing – Without checks and balances we can expect fringe scientists to attempt risky schemes such as adding multiple sex organs, heightened levels of fear, anxiety, paranoia, or self-destruction.

Signals in the Noise

60 FUTURE CRIMES THAT DON'T EXIST TODAY

36.) Super-baby hackers – People wanting to make a name for themselves will test extreme theories by designing babes with four legs, five eyes, grotesquely large heads, super short or super tall, etc.

Little by little, whatever tiny amount of control we thought we had over our day becomes infested with new life-sucking time-barnacles that congest our mind and adds surface-scratching aggregate to the smooth day we had planned. Like a leaky sieve carrying our daily time supply, however much we started with is never even close to what we end up with.

If someone steals our money, it's an obvious crime. So why isn't it an equally obvious crime if someone needlessly squanders our time?

41.) Time scarcity laws – Needlessly wasting our time will soon become a crime.

42.) Lost time penalties – Since time is a scarce commodity we will soon see time penalties to reimburse for lost time.



How long will our brains be safe?

BRAIN HACKERS

We like to think of our own mind as a safe haven for our thoughts, but what if it isn't? What happens when our own grey matter becomes hackable.

37.) Implanting false memories – As our understanding of the human brain improves, hacking memories or inducing memory blackouts may become a common occurrence.

38.) Merged memories – Without our knowing, our minds could simply become co-mingled with someone else. The voices in our head may be coming from an elderly French woman with no understanding of who we are.

39.) Using false directives to supersede our free will – Our highly valued free will may not be so free after all. We may be forced to commit crimes even if we physically resist.

40.) Embedding dominant personalities – For domineering criminals, if we ever object to what they're doing, an embedded dominant personality will overrule our objections and force us to conform.

TIME CRIMES

Sitting needlessly at stoplights, or watching the minutes tick away as we wait in some line, or being forced to fill out yet another form, our precious time is being coopted by everyone from inconsiderate businesses, to overbearing government, to painful security checks at the airport.

43.) Onerous time-limit laws – Very often people are forcing us to fail by creating situations with “far too little time to make something happen.” When situations fail a “reasonableness standard,” it will be considered a criminal act.

44.) Destructive Deja vu – Will we soon have the power to cause someone's life to happen in random order, shifting from childhood, to retirement, to teen dating, to job loss, to your deathbed? Time hackers can be a vicious lot.

DRIVERLESS TERRORISTS

There will be little need for suicide bombers in the future as the hacking of driverless vehicles will open the door to a whole new set of perils.

45.) Destruction fanatics – Driverless vehicles equipped with bombs, dangerous animals, chemical agents, Saran gas, etc.

46.) Child abduction/kidnapping – With kids traveling unescorted to their schools, friends, or after-school activity, an abduction is only a hacker's algorithm away.

47.) Communication jammers – Future communication jammers may be totally undetectable with their ability to block all forms of light, heat, sound along with virtually every fragment of the visible and invisible spectrum.

48.) Self-destructing fear generators – Think in terms of mobile land mines designed to intimidate people, blatantly obvious, casually driving through neighborhoods, but set to explode if anyone messes with them.

Signals in the Noise

60 FUTURE CRIMES THAT DON'T EXIST TODAY

MEGAPROJECT MANIPULATORS

Gone are the days where people are impressed by projects costing \$10-\$50 million or even \$100 million. We are witnessing an explosion in the number of \$1 billion+ projects with some, like the artificial archipelago being built in Azerbaijan, Turkey's massive Urban Renewal project in Istanbul, and the new construction of Masjid Al Haram in Saudi Arabia each exceeding \$100 billion.

But along with these mega-investments comes a new breed of money manipulators and con artists hoping to capitalize on flaws in the implementation process.

49.) False job claims – Most countries will be heavily invested in keeping their people employed so most proposals will come with bogus job claims, something that is not easy to prove until after the fact.

50.) Deceptive economic benefits – Claims of large-scale economic benefit are always attractive to politicians, but good intentions do not make viable business operations.

51.) Fabricated need – Infrastructure is usually an easy sell, especially when existing infrastructure is failing, but bogus "need" is a slippery slope that giant project con men will exploit.

52.) Fictitious accounting – The startup world has been a magnet for those who can make unattainable number look doable, and the world of megaprojects is creating an even stronger magnet.

INDUSTRIAL GENOCIDE

All industries are a bell curve with a beginning, middle, and an end. Yes, all industries will eventually end.

Along the path of our increasingly volatile business landscape will be many winners and losers. As a result, industries on the verge of gasping their last breath, will try to reinvent themselves in the role of a viable new industry. Many will be able to accomplish this unless there's menacing people causing interference.

Invariably the demise of certain industries will benefit one country over another, turning industrial warfare into a new criminal battlefield sanctioned by governments.

53.) Manipulate global demand – When the buyers are forced to go away, an industry will simply cease to exist.

54.) Remove financial backing – Refer to my comments on blackmail to understand how financiers can be manipulated into backing away from a deal.

55.) Hoarding of parts or materials causing costs to skyrocket – Most successful products are formed around critical components that are often hard to make and hard to get. Arranged shortages become an easy pinch point in a manufacturer's supply chain.

56.) Causing all stocks in a specific industry to tank – We've only scratched the surface on fake news. Well-crafted rumors, designed to spawn other rumors, can easily force even the best stocks to slide. In the future it won't take much to remove the valuation floor altogether, sending stocks into a total freefall.

WHEN THE DARKNET GOES SUPER DARK

Have you ever run across a situation so frustrating that you wish you could hire a "fixer?"

Maybe it has to do with gangs moving into your neighborhood, or the local slumlord not willing to repair a dangerous situation, or a local politician taking bribes, or finding out that your husband is also married to someone else in another state.

My guess is that we've all run into problems that are outside of our ability to deal with and we need help. But the help we need is not the normal kind. We don't have millions to throw at lawyers and we don't have the time, patience, or resources to go through official channels.

Reasons like this are why the darknet has evolved into a place where less-scrupulous people offer less-scrupulous solutions. But the darknet has the potential to go super dark.

57.) Destroy the economy of an entire country – This is already happening on certain levels. By adding a few new tools, this will only get easier.

58.) Instigate a massive natural disaster – In the future, our ability to control hurricanes, earthquakes, hailstorms, or locust infestations will all be within reach.

59.) Forcing a nuclear power plant to self-destruct – Every new technology gives master manipulators additional capabilities.

60.) Remove a world leader from office – Once the playground of secret government agencies, the super puppet-masters of the future need only make a down payment on the super darknet.

Signals in the Noise

60 FUTURE CRIMES THAT DON'T EXIST TODAY



Will the world become a safer or far more dangerous place in the future?

FINAL THOUGHTS

Oddly enough, the reaction to most future crimes will transition from “Oh my god!” to “What the hell just happened?”

On one hand we're putting more and more power into the hands of an individual. On the other, we are witnessing something of an arms race with governments and enforcement agencies pushing intrusiveness to whole new levels. This can be both good and bad.

It's good if we catch the bad guys before their sinister plot unfolds, bad if we don't want the government constantly peering over our shoulder.

The downside of a super-connected society is that we can easily connect with others who share our frustration, and shared frustrations often ferment into unusual forms of conflict.

This is where the ‘crime-as-a-service’ business model will evolve into sophisticated business operations with literally thousands of unwitting people engaged on multiple levels, but few if any knowing the exact nature of the plan for deniability purposes.

Battlefields of the future will continue to morph along with our tech cultures, and many of the weapons of the future will be unrecognizable by today's standards.

In much the same way we never want to show up with a knife for a gunfight, our police forces are a terrible match for tomorrow's criminal undergrounds. We are a long ways from having the right tools and tech needed to deal with tomorrow's criminal enterprises.

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