INSIGHTS

BOOKS *et al.*

ILLUSTRATION: BENEDETTO CRISTOFANI/SALZMAN ART

SUMMER BOOKS

The scientist's summer reading list

How will we eat in a warming world? What makes money real? Are we being good ancestors? From a graphic celebration of the semicentennial of the Apollo 11 mission to a dystopian foray into the digital afterlife, this year's summer reading picks—reviewed by an enthusiastic group of early-career scholars—aim to unpack where we came from and where we're headed. Focus on the big picture with an engaging exploration of space archaeology, dig into the details with a thought-provoking ode to algae, or sit back and LOL at an entertaining introduction to internet linguistics. –**Valerie Thompson**

Underland

Reviewed by **Ryan J. Haupt**[1]

Written as a travelogue, *Underland* documents Robert Macfarlane's excursions to some of the most remote and extreme subterranean places on Earth. Structured much like a trip to the underworld itself, the book begins with Macfarlane's descent below, where he reflects on humanity's complicated relationship with the world beneath our feet, and then ascends "sadder but wiser," just like the archetypal hero returning from the abyss.

During his travels, Macfarlane is often with a guide because the places he visits would be foolhardy to traverse alone. Some are scientists whose work beneath Earth's surface takes on a sense of holy purpose. These include a physicist in a slowly collapsing halite tunnel trying to detect the fleeting subatomic particles of creation and an ecologist listening in on the chemical conversations between trees. Many are not scientists but are experts nonetheless, deftly explaining the deadly mechanics of underground rivers, the societal dangers and cultural costs of mineral extraction, and the increasing pace of glacial retreat.

Macfarlane's exquisite prose vividly draws the reader into spaces that many may tremble to enter. There are times when the sensation evoked is one of such peril that it takes a few harried breaths and a frantic page turn to remember that he must have survived. He writes, while hunting for molin (meltwater holes) in the Knud Rasmussen glacier on Greenland, for example, "Your aim is to dislodge nothing, not even a grain of quartz. You move tenderly. .... You *never* put your full foot-weight on a boulder without testing it first. You *never* move

when someone is directly below you on the fall-line. You *never* put your foot or your arm into a gap between rocks, in case the one above drops down. Shins and forearms break easily in stone jaws."

Much of humanity's relationship with the underground has to do with those who came before: The first to leave their marks on the cave wall or entomb a loved one with the hope that the underland would provide safe refuge in an afterlife. Macfarlane embraces that idea but also flips it with a refrain oft-repeated throughout the book: "Are we being good ancestors?"—a forward-thinking riff on philosopher T. M. Scanlon's question of "What We Owe to Each Other."

It is through this lens that Macfarlane deftly considers the strange economics of mining and the seemingly organic underground systems built beneath our cities to transport us, our supplies, and our waste. Countercultures thrive in such spaces among the dead of generations long passed.

We put important things underground, both to safeguard the past and to protect the future. Macfarlane's coda considers the long-term ramifications of storing nuclear waste, which will persist long after humanity is gone. How can we impress on future intelligent beings the absolute danger of something we have locked away as though it were something of incredible value?

Although there is empirically much to learn from *Underland*, there is perhaps more value in what is simply felt as one quietly contemplates Macfarlane's journey into our pockmarked planet.

Underland: A Deep Time Journey,
Robert Macfarlane, Norton, 2019. 496 pp.

Archaeology from Space

Reviewed by **Dominique Langis-Barsetti**[2]

Ten years after the publication of her first scholarly tome dedicated to the relatively new field of "space archaeology" (*1*), Sarah Parcak leaves behind the matter-of-fact tone of textbooks to offer readers a more personal view on satellite remote sensing and how it has come to take its place in the archaeologist's toolbelt. Her new book takes readers across the globe as she seeks to understand the distant past with the help of modern satellites. Her writing is full of evocative anecdotes and personal insights gleaned from years of experience in dusty trenches as well as behind the computer screen, poring over satellite images.

The book divides itself between the trenches and the sky because results obtained through satellite imagery must always be verified on the ground. She introduces readers to the field of aerial remote sensing through numerous case studies, turning complex research into something much more approachable. In one such case, Parcak takes readers to the Skagafjörður Church and Settlement Survey, in northern Iceland, where ground-based survey methods yielded promising results, and the addition of satellite images allowed researchers to identify new Viking walls strewn across the landscape.

Despite her faith in the promises of space archaeology, Parcak's book is not exclusively about success stories. She very candidly includes the occasional failure, reminding us, and herself, that setbacks and disappoint-

ing results are part of scientific exploration. She recounts, for example, an exploration in eastern Canada, where she and her team had been prompted to look for elusive Viking settlements and other ancient native sites. Despite a promising start, excavations eventually revealed that the "structures" identified on satellite imagery were simply unusual geological features.

Parcak also addresses the challenges faced today by archaeology, including looting and antiquities trafficking, and makes a plea for improving diversity within the field, arguing that archaeology has much to gain from incorporating the interpretations and perspectives of people of different origins and backgrounds. True to this philosophy, she ends by introducing readers to GlobalXplorer, a crowdsourcing platform she developed to empower stakeholders around the world by giving them a chance to remotely participate in archaeology. Beyond its academic goals, the project seeks to raise awareness about the threats faced by cultural heritage sites worldwide, in the hope that concrete measures against looting and other destructive practices will gain widespread support.

Throughout the book, Parcak's love for her work and the people she studies is evident, and her enthusiasm is contagious. From Vikings in Iceland and Canada to amphitheaters in Italy and back to her first love, pharaonic Egypt, she brings both the present and the past to life.

REFERENCES AND NOTES

1. S. Parcak, *Satellite Remote Sensing for Archaeology* (Routledge, 2009)

Archaeology from Space: How the Future Shapes Our Past, *Sarah Parcak,* Henry Holt, 2019. 288 pp.

Digital Cash

Reviewed by **Rachel O'Dwyer**[3]

Things change so fast with digital money that by the time an academic monograph emerges on the subject, some of its ideas may have already lost currency. Rather than try and predict the future, Finn Brunton's *Digital Cash* is a "history of the present," presenting contemporary innovations in electronic money and cryptocurrency through an archaeology of digital cash—in particular, those put forward by the cypherpunk and Extropian communities.

It might seem that Bitcoin emerged fully fledged with Satoshi Nakamoto's 2008 White Paper. But where do the key innovations—building chains of anonymous trust and the ability to control the reproduction and circulation of digital tokens—come from? Brunton traces the technical roots of the cryptocurrency to innovations such as blind signatures and asymmetric key cryptography, developments in Adam Back's Hashcash and Hal Finney's reusable proof of work (RPOW), and innovations described on the cypherpunk listserv, which brought together privacy and security activists beginning in the late 1980s. The latter include David Chaum's Digi-Cash, Wei Dai's b-money, and Nick Szabo's bit gold, parts of which would later converge in Bitcoin.

Brunton also draws connections between digital cash and the Extropian community, a transhumanist movement that emerged in the early 1990s that believed wholeheartedly in both cryogenic freezing and Hayekian economics. He explores the ideological motivations driving these technical innovations, including privacy, libertarian anarchy, and imagined future utopias.

The book also delves deeper into the past, detailing the fascinating history of American money, from 19th-century "wildcat banking"—a system of state-chartered financial institutions backed by questionable security—through to the early-20th-century "scrip"—de facto currencies that took the form of railway bonds, crates of eggs, pounds of honey, cigars, sacks of potatoes, and personal IOUs.

Finn Brunton explores the origins of cryptocurrencies in *Digital Cash*.

In addition to a history of currency, *Digital Cash* is a book about time, because money is, as Brunton shows, a way of banking on the future. Often this money is a "time out of joint," embodied in Technocratic energy certificates or Extropian "idea futures" that never come to pass. The book also explores money as a technology of memory, an object that carries traces of its history and circulation from sediment and bacteria through to effigies of forgotten sovereigns, chains of signatures, and, more recently, transactional data.

Beautifully written and meticulously researched, *Digital Cash* manages to connect these multiple pasts to key contemporary questions of digital value, ownership, and politics. All of which begs the question: What imaginary utopias, dystopias, and possible futures are we carrying in our wallets at this very moment?

Digital Cash: The Unknown History of the Anarchists, Utopians, and Technologists Who Created Cryptocurrency, *Finn Brunton,* Princeton University Press, 2019. 266 pp.

Slime

Reviewed by **Maren Preuss**[4]

Ruth Kassinger's *Slime* illustrates the important role algae have played in the world over time and begins with the story of cyanobacteria, describing how these prokaryotic organisms shaped early life on Earth by producing an oxygenated atmosphere. To the present day, cyanobacteria symbiotically living in the aquatic fern *Azolla* still play important roles for organic rice cultivation methods in Japan.

Kassinger recounts stories from her travels around the world, from an excursion to a nori farm and processing plant in South Korea to a coral restoration project in Bonaire. Algae, she reveals, are extremely versatile and can be used not only as a human and animal food source but also to produce glass, explosives, fertilizer, shoes, and "designer" oils.

The production of algal-based bioplastics, Kassinger argues, might be the solution to our plastic pollution problem. *Slime* explores ongoing research on different algal usages, such as bioplastic production, including the work of Daniel Ducat, Taylor Weiss, and Eric C. Young at Michigan State University's Plant Research Laboratory. Because bacteria-producing plastics require sugar to synthesize polymers, most bioplastics are too expensive to compete with petroleum-based plastics. The Michigan State team has genetically modified cyanobacteria to constantly leak sugars produced by photosynthesis. Adding these algae to the same containers as plastic-producing bacteria provides all the sugars needed to produce plastic polymers.

Kassinger also discusses ocean warming because of climate change and increasing nutrient pollution as a result of agricultural fertilizer and sewage. Both ocean warming and water pollution destroy coral reefs and increase algal blooms, which can have devastating effects on local communities and ecosystem functions. "People focus on the

More than 25 million tons of macroalgae are harvested each year.

PHOTO: CAVAN/ALAMY STOCK PHOTO

gross algal blooms and blame the algae," she writes, "but the cause is entirely human."

Kassinger mentions throughout *Slime* the importance of brown algae and the associated kelp forests. Brown algae have high biomass, are major contributors to oxygen production, and provide habitat for many marine organisms. She misses an opportunity, however, to highlight how ocean warming and water pollution are threatening these highly productive kelp forests. Kelp forests on Tasmania's east coast have declined by more than 95%, for example, and were listed as the first threatened marine community by the Australian government in 2012.

Overall, *Slime* gives a distinct view into these underappreciated organisms and demonstrates our intertwined history with algae. Hopefully, it will help readers see algae in a different light.

Slime: How Algae Created Us, Plague Us, and Just Might Save Us, *Ruth Kassinger,* Houghton Mifflin Harcourt, 2019. 318 pp.

Because Internet

Reviewed by **Martine van Driel**[5]

In her new book, *Because Internet*, Gretchen McCulloch divides inhabitants of the internet into five groups, arguing that "[y]our experience of the internet and the language therein is shaped by who you were and who else was around at the time you joined."

"Old Internet People" came online when the internet first started and tend to use a lot of programmer jargon. "Full Internet People" joined the internet in the late 1990s or early 2000s as a social web, a place to continue with and expand on their existing, offline relationships. Most of their internet slang came from peers, who used abbreviations and emoticons to connote tone of voice. "Semi Internet People" joined around the same period and initially used the internet for work purposes but continued to live their social lives offline. To Semi Internet People, "All meaning is face value meaning." "Pre Internet People," the oldest group, are late adopters who only sporadically use the internet out of necessity. According to McCulloch, "Internet slang like acronyms and emoticons is not just unfamiliar to them, it signals membership in a group that they have no desire to be a part of." "Post Internet People," the youngest group, have grown up with access to the online world and tend to infer emotional meaning from subtle cues.

Although the title suggests that this book takes a prescriptive approach to language, discussing the "rules" for online communication, the content shows quite the opposite. McCulloch describes a variety of uses of the internet such as listservs, texting, social media, and memes and explains how language—primarily English, with some examples from other languages—has adapted to each function without judgment. She considers how emojis have developed from emoticons and discusses how gesture research can help us understand how emojis function in the world of texting and online chat. Explaining that both gestures and emojis fulfill a similar role in offline and online settings, she reveals how emojis make up for the lack of paralinguistic features in online communication. This section will be particularly interesting to nonacademics as well as junior researchers because she explicitly discusses the process she used in researching these features.

McCulloch resists exploring internet language as a new phenomenon. Instead, she builds her investigations on older research into sociolinguistic features, discussing key experiments such as William Labov's 1962 "fourth floor" study, which identified the presence of linguistic differences between social classes. These studies are woven into a compelling narrative rich with examples from her own online activities, a healthy dose of humor, and plenty of cat memes. Although it probably will not provide any novel insights for new media linguists, the breadth of topics covered—from conversation analysis to meme culture to the development of texting as we now know it—makes this book useful, engaging, and enjoyable.

Because Internet: Understanding the New Rules of Language, *Gretchen McCulloch,* Riverhead Books, 2019. 336 pp.

Moonbound

Reviewed by **Emily A. Margolis**[6]

As you bury your feet in the sand this summer, imagine tucking your toes into something a little more exciting: lunar regolith. This July marks the 50th anniversary of

the first human Moon landing, an event recently feted at box offices and on bookshelves. Jonathan Fetter-Vorm's nonfiction graphic novel *Moonbound: Apollo 11 and the Dream of Spaceflight* is the latest contribution to this commemorative craze.

In Fetter-Vorm's retelling, the familiar mission unfolds in parallel with historic events that made this moment possible. Beginning with the cosmic collision in which Earth's satellite formed, the graphic novel brings readers into the notebooks of astronomer Johannes Kepler, the imagination of author Jules Verne, the subterranean Nazi factory where concentration camp laborers assembled guided ballistic missiles, and the Soviet design bureau responsible for the first satellite. Deftly avoiding the trap of teleology, Fetter-Vorm alternates these historical vignettes—visually distinct in their monochromatic representation—with vibrantly colored scenes from inside Apollo 11 and on the lunar surface.

Wherever possible, Fetter-Vorm excerpts dialogue from mission transcripts and renders scenes from original photographs and films. His commitment to accuracy and detail are at their best inside the Apollo 11 command module, Columbia. In one panel, pilot Michael Collins is shown tracking the mission on a hand-drawn wall calendar. This and other markings (the walls functioned as a notepad of sorts) were largely unknown until 2016, when the Smithsonian National Air and Space Museum undertook a 3D scan and photometry of the spacecraft.

Through deep engagement with the latest historical scholarship, Fetter-Vorm commemorates the mission without simplifying it. He introduces readers to a cast of characters whose contributions to the space program were circumscribed by sexism and racism. His work acknowledges that the space age and civil rights struggle were not only contemporaneous but connected.

The book's epilogue reveals Fetter-Vorm's purpose: to inspire the next generation of space enthusiasts. It opens on a moment of discovery in 2012, as a submersible approaches remnants of a Saturn V rocket, Apollo's launch vehicle, on the ocean floor. The next page is dominated by the face of a young boy—eyes wide and mouth agape in wonder—as he encounters the recovered engine part at a museum. This sense of adventure and accomplishment, Fetter-Vorm suggests, can be recaptured through hard work, ingenuity, and national purpose.

Space scientists, engineers, and policymakers of the future—working for the public or private sector—must be prepared to address public relations challenges as well as scientific and technical ones. Almost as an afterthought, Fetter-Vorm gestures toward contemporary critiques of the Moon landing program. Fifty years on, it is easy to forget that the American public was generally ambivalent about this multibillion-dollar endeavor—a fact that dogged NASA from the early 1960s and that had a material impact on the way it conducted and presented Project Apollo.

Accessible to young adults but enjoyable for readers of all ages, *Moonbound* educates while it entertains.

Moonbound: Apollo 11 and the Dream of Spaceflight, *Jonathan Fetter-Vorm*, Hill and Wang, 2019. 256 pp.

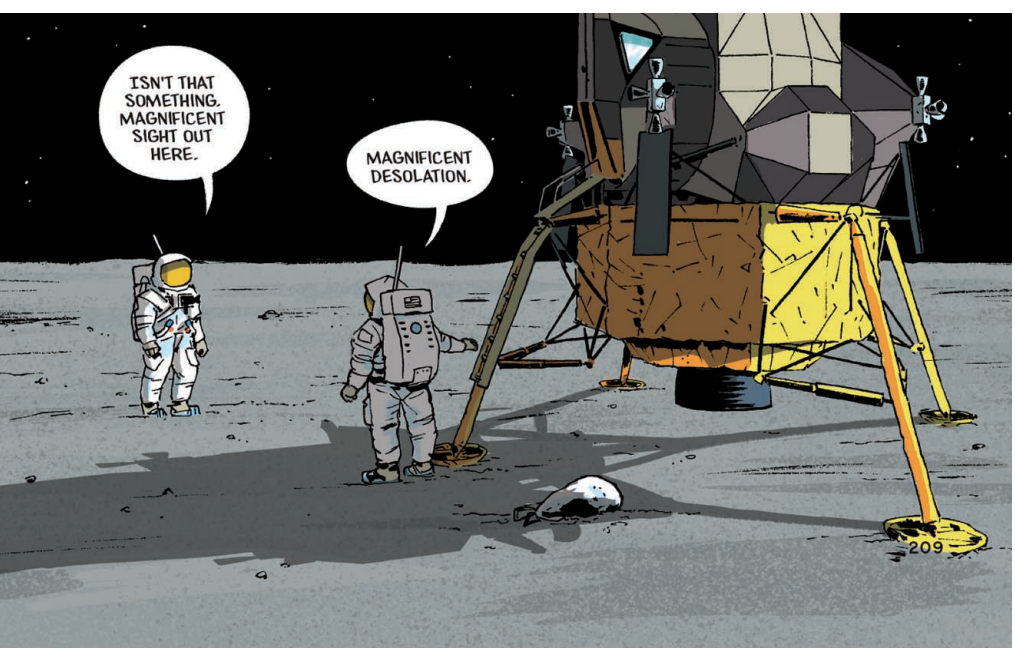

IMAGE: COURTESY OF JONATHAN FETTER-VORM AND HILL AND WANG

The Fate of Food

Reviewed by **Meha Jain**[7]

Imagine you have just eaten the best burger of your life, covered with creamy avocado, crisp lettuce, and a ripe tomato and nestled between a hearty bun. Now, what if that burger did not come from a cow but was cultivated from stem cells? What if the avocado spread was crafted by a 3D printer, and the lettuce and tomato were grown in a warehouse with no natural sunlight or soil? What if you learned that the bun was made by using an ancient ancestor of wheat that is more resilient to drought and was weeded and harvested by robots? Although this may sound like science fiction, according to journalist Amanda Little, it is all possible today.

Over the coming decades, food demand will increase as the world's population surpasses 9 billion people and diets change to include more land-intensive dairy and meat. At the same time, agricultural systems will likely face more uncertainty because of climate change and the degradation of natural resources on which they depend, such as fresh water and healthy soils. The United Nations estimates that food production may have to increase by up to 70% by mid-century to ensure global food security. In *The Fate of Food*, Little explores how we may be able to meet this growing demand and, answers the question: if we aren't able to, "how screwed *are* we exactly?"

Little interviews innovators at the forefront of a new wave of food production that is more automated, environmentally sustainable, and resilient. Her research takes her from smallholder farming systems in Ethiopia to large-scale organic farming operations in China and across more than a dozen U.S. states. During her travels, she meets with entrepreneurs who are blending technological innovation with tried-and-true agroecological practices and with individuals who are entirely upending traditional food production systems.

There are many potential solutions to sustainably increase food production, she reveals. These include using robots equipped with artificial intelligence (AI) to differentiate between crops and weeds (reducing the amount of herbicide applied to crops) and disseminating seeds that are more drought-tolerant to communities that have been ravaged by a lack of rain.

Little takes a balanced approach when describing each new technology or potential solution. She acknowledges, for example, that AI-enabled robots are only realistic for large-scale, relatively rich farmers. Similarly, she concedes that promoting new drought-resistant seed varieties can lead to

Drones may soon allow farmers to spot pests, weeds, and irrigation issues without setting foot in their fields.

problems if farmers become dependent on store-bought seeds and their prices rise.

Little's main point is an important one: In order to solve the world's impending food production challenges, we cannot take a one-size-fits-all approach of either "reinventing" the food system with technological innovations or "deinventing" it with a return to preindustrial organic farming. Instead, she proposes a third option, one that blends the use of new technologies and ways of farming with more traditional, sustainable agricultural approaches. If we adopt such a strategy, she is optimistic that we will meet growing food demand in a way that is simultaneously more sustainable, nutritious, and resilient.

The Fate of Food: What We'll Eat in a Bigger, Hotter, Smarter World, *Amanda Little,* Harmony, 2019. 350 pp.

Fall

Reviewed by **Bianca Jones Marlin**[8]

In his latest novel, *Fall*, Neal Stephenson tells the story of Richard Forthrast, better known as "Dodge," a video game magnate who has willed his brain to research in the hopes of being reanimated. Heeding the call of the "Eutropians," Dodge and seven others lead the charge for digital immortality, foretelling the emergence of new technology that will upload the brain of the financial elite to a virtual cloud. But what happens when a human-generated simulation begins to replicate the chaos by which life arose?

After his untimely death, Dodge's cryopreserved connectome is scanned and activated by using a vast network of computers, each processor dedicated to simulating the thousands of synaptic connections of an individual neuron. Emerging into the nascent "Bitworld," he experiences awareness amid a cacophony of static and light. Being the firstborn of the digital afterlife, Dodge is given free rein to design the world according to the pattern of his memory. But he is not alone for long. As other patrons are uploaded from the corporeal "Meatspace," Dodge assumes the role of king of the digital genesis, making subjects of the pantheon of bit-souls.

But Dodge's quest to create a more perfect life after death is challenged by the arrival of competing tech guru Elmo Shepherd, who seeks to impose his own version of eternity on the afterlife. Shepherd enters Bitworld with superior programming algorithms, acquired and refined after Dodge's death. He trades Dodge's lifelike renderings of uploaded souls for winged avatars, enslaved by his new algorithm. Dodge and his host of early Bitworld settlers retreat to an alternate plane described as the "lake of fire," waiting for an opportunity to reestablish their rule.

Eventually, Stevenson introduces the birth of new souls that are native to Bitworld, evoking a central question: Whence comes life and afterlife? Meatspace clientele struggle against the children of Bitworld for dwindling virtual resources. The children are faced with a moral conundrum, facing the prospect that their reality is filtered by the elite ruling class Shepherd has installed.

Fall invokes contemporary issues in neuroscience, focusing on the interplay between the hard-wired brain connectome and dynamics of synaptic learning. In doing so, Stephenson offers a sobering conclusion to the epistemology of the internet age that includes both subtle advice—reminding us, for example, that pride comes before the fall—and, ultimately, an outward rebuke of the quest for apotheosis.

In this great undertaking, however, Stephenson's cast of Meatspace characters is often lacking in dimensionality. They are described as unique individuals, but their contributions to dialogue could easily be interchanged with little repercussion. In addition, the book's generous narrative often strays toward the tangential without offering a clear contribution to the overall story arc. But perhaps it is Stephenson's intention that readers accompany Bitworld souls through aeons of incremental evolution, rediscovering the mundane as well as the sublime. Such an ambition would be admirable, but it fuels impatience in the reader, who may find herself wishing to return to the exciting central characters.

Fall offers an important allegory of mankind's struggle to understand our place in the universe, surrounded as we are by natural laws, myth, purpose-seeking, joy, and suffering. The reader is left with a sense that achieving perpetuity may ultimately be a pyrrhic victory.

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Fall; or, Dodge in Hell, *Neal Stephenson,* William Morrow, 2019. 890 pp.

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The scientist's summer reading list

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