


# full circle

SAMPLE  
TEXT

a search for  
the world that  
comes next



‘Australia lost a senator, the world gained a luminous writer. Scott Ludlam’s *Full Circle* is at once a comic chronicle of the climate apocalypse, a heartbreaking work of paleohistory and a fugitive tourist diary, strange, uncategorisable and magnificent.’ —Raj Patel, author of *Stuffed and Starved* and *The Value of Nothing*

# scott ludlam

The most common way people give up their power  
is by thinking they don't have any.

ALICE WALKER

## fireground

'A wind change occurred late in the afternoon, with the easterly coming in. This has caused a few spot fires in open country . . . 2 graders are currently en route to assist.'

In the terse language of the Rural Fire Service, that's bad news. On the map the fire reads as a little grey polygon, tractable and neat, drawn from direct observation and satellite hotspot mapping. On the ground it's the opposite: roaring, lethal and formidably out of control. A blaze sparked by a lightning strike days ago is being fanned into a monster. Now eight hundred and fifty hectares of uncaded Yuin lands are on fire in difficult and inaccessible escarpment country. While the RFS are bulldozing containment lines across its path and calling in water bombers, this easterly is sending burning embers out in advance of the front, igniting spot fires. They post photos to social media, footage of the thing they are trying to contain – mesmerising walls of ash pouring slow-motion into the sky. From this distance, the bombers look like tiny fireflies against the face of it.

We've been watching that polygon for days, hitting refresh while charred leaves drift to the ground in silence. Every twenty-four hours it's a different shape, extending, elongating; other polygons appearing alongside it, still dwarfed by the giants burning to the north.

Hit refresh. 'It's been a pretty difficult day for fire crews on the fireline today. RFS, Forestry Corporation crews, 3 dozers, 2 graders, 2 bulk water carriers and 1 helicopter all worked to try and establish more containment on the north, south and west divisions of the fire. They were plagued by spotfires starting new fires outside control lines, while also trying to hold existing control lines.'

Under a nightfall that's come too early, we pack some essentials just in case and confer with our neighbours. The air has a different timbre to it,

acid and sharp against the dead ambience of ashfall from the Shoalhaven fires we've been breathing for weeks.

While we sleep, a gusty norwester hits and it makes a run. Today was meant to be a birthday party. Waking, disoriented, to Flick banging on the door. We have to go. Fumbling, hit refresh; the polygon has grown two hideously outstretched rectangles, temporary placeholders for a thing moving too fast to map. 'EMERGENCY WARNING – The fire has moved quickly. If you're in Cobargo or Coolagolite, it is too late to leave. Shelter in place.' Fuck, it's close. It has already crossed the highway just to the south of us. Up and moving now, to throw our stuff into the car, assuring Sirius that although this isn't the walk he was promised, it will happen soon – now get in the car. An hour before dawn, the wrong horizon is aglow, deepest red. *Get in the car.*

The twilight highway is empty of traffic but for two tankers speeding towards us, directly into the path of the thing we're fleeing. The sun won't rise this morning; we'll see it days later as a flat orange disc behind the smoke. The quiet holiday town of Narooma is abuzz, headlights of caravan traffic queuing for fuel; rumours that Cobargo is burning. Coffee from a nervy little cafe just before the power dies across the whole town. Silence falls. It's begun. Lesson one: when it hits, a power grid made of exposed wires and wooden poles will immediately fail, taking out traffic lights, water pumps, petrol stations, refrigeration, whole categories of amenity we won't realise are gone until we try to call on them.

Our phones are serving up a glitchy pastiche of destruction: beach evacuations, tortured wildlife, a freeze frame of Cobargo's main street alight. It's killing people now, in vapour fires and kilometre-high firestorms. I can't bear it; hit refresh one last time before the phone network goes down. Our polygon is taking its place among the other giants; they are merging and combining into a 2000-kilometre-long fireground stretching from East Gippsland all the way to the Queensland border. We withdraw to the little park on the estuary which normally has sweeping views back towards the mountain. Today it's a sombre carnival of bewildered dogs and campervans, kids on swings and this impossible, shifting half-light. Lesson two: life continues, flows around, makes a way.

Under a blackout that will last for days, we dial up the national broadcaster on AM radios, share information with people we have only just met,

make a plan that's good for the next few hours. Sirius makes a dozen new friends, gets his walk like it's no big deal, the weirdo.



'Recent projections of fire weather suggest that fire seasons will start earlier, end slightly later, and generally be more intense. This effect increases over time, but should be directly observable by 2020,' wrote Professor Ross Garnaut back in 2008.

Sitting on a park bench at the end of the world, the air a dead colour, visibility down to about a hundred metres on the last day of 2019, can confirm: the effect is directly observable. Even without a phone signal, I know the timeline is awash with a thousand examples like this right now; reminders of the warning signs and reports and red flags stretching back decades. This one feels personal, I guess; Garnaut's draft report was tabled four days after I'd climbed up, wide-eyed, onto the privileged soapbox of a Senate term. Finding myself somehow in this benighted park twelve years deeper into what people have begun calling the Anthropocene; record drought, record temperatures, record fires, all of them predicted to several decimal places.

A bloc of transnational resource sector investors control the ministerial wing of parliament and hold absolute majorities in both chambers. One of our major political parties is wholly owned, the other is divided, traumatised and compliant. A tenacious green insurgency is holding the line in there, but in a building where numbers matter we don't have enough of them yet.

Garnaut's work is a demonstration of the credibility and accuracy of our scientific institutions, side by side with the near-total capture of our political ones. He's asked by a journalist for his reaction to seeing his report, twelve years on, circulating in news feeds and social media posts amid the falling ash. 'It's one of sadness, that I was ineffective,' he says. 'Having been given the opportunity to talk to Australians on this issue, that I was ineffective in persuading Australians that it was in our national interest to play a positive role in a global effort to mitigate the effects of climate change.'

Mate. Same. He's had the grace not to drop a passive aggressive 'I told you so,' but where does this leave us? On the strength of his report and the

work of thousands of others, backed by resurgent social movements and some adept parliamentary work, we won clean energy reforms and saw the ship begin to turn. Those laws lasted for exactly 730 days before coal and gas investors had them repealed, by 39 votes to 33.



The polygon now encloses nearly a quarter of a million hectares. Quite the birthday party, Flick. Here, with the phones blank, the roads closed and nothing to do but wait under a plume that has snuffed out the sun itself, it's time to work out what it means when your theories of change are burned to the ground.

PART 1

# the motive power of fire



The grounds for hope are in the shadows,  
in the people who are inventing the world  
while no one looks, who themselves don't  
know yet whether they will have any effect . . .

REBECCA SOLNIT

## the road to wattle

Early summer, 1998: a dozen people are working by torchlight and gas lanterns, miniature figures under giant trees. Bent in exertion, they're tearing into the bush track with spades and star pickets, taking turns to shovel the damp earth aside, bearing closer to the concrete culvert a few feet below. A short way back down the track, the warmth of a small fire lights the faces of another half-dozen people, and a pot of coffee is coming to the boil. A tarp has been slung across the roadway, sheltering a scatter of cushions and mattresses, a couple of sleeping kids. It's sketchy but homely.

Quiet conversation, laughter, and the subsonic rush of the forest behind the hectic racket of a twelve-foot trench being cut across the access road.

This forest. The traditional ground of the Pibelmun Noongar; walled cathedrals of silver trunks, a vaulted canopy framing a drift of stars. Some of these great old ones seeded three hundred years before the founding of my city. Tiers of understorey home to an intricate community of birds, insects, frogs and marsupials that live nowhere but here. You can't see them, with all the noise we're making. But you can feel the watchfulness: that sense of multitudes of eyes-on.

There's a minor celebration when we hit the buried culvert, and now the conversation turns to the best recipe for quick-set cement. I'm too new to this work to really understand what they have in mind: several lengths of chain are passed under the culvert, and a mess of wet concrete is being batched up on a big sheet of plastic. A couple of friends are admiring a two-foot section of steel pipe with an odd reverence; encrusted with welded spikes of rebar and scrap metal, it clearly has an important part to play in whatever is being done here.



I'm covered in mud, stepping back to the little campfire for another mug of coffee, as happy as I can recall being in a while.

Suddenly, a car is moving silently down the hill towards us. Headlights dipped; I can't tell who's steering, but there is quiet gravity in the sight of this battered station wagon rolling towards us, tyres crunching on the gravel. The earthmoving team pauses, leaning on their shovels. Now comes the hard part.

At the bottom of the trench, the concrete is already beginning to set, entombing the chains they've looped around the culvert and encasing all but the very end of that medieval-looking length of pipe. We line up and heave at the car, slewing it sideways across the track. Without really knowing how, we have shoved it into the trench and now here it lies, sunk up to its axles in the roadway. We begin to backfill, crude ramparts of an improvised roadblock.

It's ready sometime after midnight. A young woman crawls across the front seats onto a cramped bed of pillows and cushions, and I finally realise what it is we've done. A hole cut through the floor of the car lines up precisely with the lock-on pipe buried in the setting concrete. Into this, she extends her arm and clips a carabiner chained to her wrist onto a slender bar welded within the pipe. Ragged hair, focused eyes, a smile; thumbs up with her free hand.

Come the morning, if it's your job to police the passage of logging and earthmoving equipment through here, you have three options now. One: let them roll over the top and kill the woman in the car. Two: persuade her through legal threats or exhaustion to unclip and come off voluntarily. Three: dig out around the car and jackhammer through the concrete until you can put an angle grinder to the pipe, bearing in mind that it now encloses a fragile human arm.

In this particular place and time, option one is unthinkable. Options two and three will take many hours. Until the police and contractors show up and decide how they want to play it, the road into this small corner of the wild southwest is closed.

People are returning to the fire, dispersing, fatigue washing in. I'm too wired on caffeine to turn in quite yet, so let's sit a while as the firelight sets shadows dancing.

These memories are more than twenty years old now, but I'll never forget the sight of the sacrificial station wagon appearing out of the darkness; a battered piece of surplus technology repurposed and turned against a much larger and more complex machine.

To be clear, what we're doing here is unlawful. Chopping up access roads and implanting cars in them is against the law. Occupying such a vehicle and refusing an order to leave; that's unlawful too.

In contrast, it is entirely lawful to bring scrub-rolling dozers into this forest to pulverise the understorey and kill everything that doesn't flee; the state has granted an explicit licence for the contractors to do just that. It is also lawful to turn machines with tank-tracks and tungsten saws against these silvered giants, sending them thundering to the ground and turning this valley into a moonscape over the course of a fortnight.

So here's the problem: this localised extinction disaster is institution-alised. It has the full weight of global supply chains auspiced by modern industrial states behind it. Putting yourself in front of a bulldozer only slows it temporarily; the larger system learns, it adapts, and on some mornings it sends police in to lawfully beat the shit out of the people camped here.

I don't know what brought you here – I'm not even sure if we've met. But me, I'm one of the fortunate few – I'm here by choice. I hitched down here because it felt right, because I know and trust these people, and because the campaign has hit a tipping point and it's wild to be part of it. My family supports me being here. I work as a freelancer, so this has cost me literally nothing. I'm a temporary visitor from the comfortable bulge in the middle of the privilege bell curve, the university-educated part, where you are taught about bell curves but not about privilege. I haven't been forced into this campaign because my life depends on it, or through ancestral obligations to Country. Until quite recently, 'the environment' was just something I read about in books.

That changed the first time I stood at the edge of a working clearfell. Watching a living place being violently dismantled breaks something inside. Felling is dangerous work, and the teams are methodical, professional and terribly effective. Trees that had anchored these hillsides for more than five hundred years were being loaded onto trucks, soon to be

shredded into low-value woodchips for the international pulp market. We'd get some of it back in a few months' time, as plastic-wrapped toilet rolls and blocks of perfectly white copy paper. What was left on the ground in that ruined place was then pushed into piles and torched – and all of this, not to labour the point, was lawful.

That's why we're here, around this little crackling fire: to prevent that from happening right where we're sitting. Some of the most brilliant people I will ever meet have managed, over the course of more than thirty years, to turn the tide on this terrible destruction. Camped in the mud, organising demonstrations in the city, training two generations of newcomers, carefully working the politics. They don't know it yet, but they're about to succeed, swinging an election on the strength of this mobilisation and the presence of the place itself. Direct action gets the goods, so they say. They will silence the chainsaws, not just here but across a huge extent of this ancient ground. The law will change,<sup>1</sup> and this powerful win will pass into activist folklore, even as new national parks are being drawn up, along with retraining packages for affected logging communities.

The larger system learns, and it adapts. In its current configuration it demands a certain tonnage of woodchips, no matter what. International buyers will now hit Sarawak a few million tonnes harder, and Vietnam, and places where putting your arm into a lock-on pipe absolutely could get you killed. None of this is the fault, or the intention, of the people who put themselves on the line here. But we can't pretend that this isn't happening everywhere, or that we aren't now descending the rapids into a full-blown planetary extinction crisis. Turn the prism, and it looks like a climate crisis. And a crisis of democracy, of militarism, of poverty.

Years ago, I came across this old story about a village by a river. A group of villagers are washing clothes on the riverbank, and one of them looks up to see a young child floating past, clearly in distress. She wades in and rescues her, a little shaken. A shout – one of her friends has spotted another kid in the water, and then another. They drop their washing and set about rescuing these stricken children as they float past.

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1 Although, at the time of writing it remains illegal to implant station wagons in logging roads.

More kids are drifting helplessly down the river, and then more. Finally, in a fury, the original rescuer abandons the riverbank and strides away. ‘Wait!’ her comrades shout. ‘We need you here. Where are you going?’ Over her shoulder, she calls back, ‘I’m going to find the monster who’s throwing them in.’

Here, under these immense trees, we are organising a rescue. People in villages far from here – from Mathare to Mongolia to Minas Gerais – are organising other rescues. Soon we’ll set sail and meet with some of them, to learn a little of the rivers they stand in and the monsters they contend with. This traverse will take us from the floor of the Senate to a Hadean beach, from the winter of the Great Depression to a rebellion against extinction. While we travel, social movements working across every time zone will invoke one of those rare moments in history when they begin to converge and discover each other.

There are a great many children in the water, so it’s time to be up and moving. The first hints of dawn are touching the sky. With the access road bottled up, the forest protectors will be able to move many more people onto the main road into the logging area, where the confrontation will be easier for television news crews to reach. Later, I’ll catch the smell of woodsmoke on my clothes, and it will bring back how this improvised extinction roadblock looked under the torchlight. It looked rough, and clever, and beautiful, like the rising global movement it is a part of.

Because we were here, there will be no logging in Wattle Forest today.

## the oldest book in the world

On the eastern shores of the Mediterranean, in present-day Lebanon, stands the ancient city of Byblos. It is one of the oldest continually inhabited cities in the world, and somehow you can feel it. Walk these streets with someone who knows how to read the place, and the jumbled layers tell a story. The mountains behind are hazy, decked with unregulated apartment stacks built in a hurry for those fleeing the war in 2006, and the civil war before that. Closer to the coast, a mess of freeways and concrete tilt-up intersect with graceful architectures of the mid-twentieth-century French mandate.

We step back further, down cobbled streets past the Ottoman-era Sultan Abdul Majid mosque with its sky-blue dome, evening call to prayer echoing across the rooftops. Deeper, now: blocky ruins of a twelfth-century Crusaders' castle the highest landmark in the old city, still bearing the scars of capture by Salah ad-Din. Archways of a Roman amphitheatre built a thousand years earlier. We call the city by its old name now, Jbeil, as we walk back through the years of occupation by Alexander the Great, hundreds of years as a Persian client state before that, Assyrians before them, Egyptians before them.

Shorelines reconfigure as the centuries unfurl; the original seaport silted up and only recently rediscovered. In your mind's eye, watch as Phoenician merchant ships slip out of port laden with cedar bound for Memphis and Alexandria. They'll return carrying precious papyrus, upon which scholars will write in the earliest recognisable forms of the Latin alphabet.

Deeper. Curved foundations of palaces long gone. Layers of trauma and war; walls built and ruined and built again. Bronze Age pottery fragments. The plastered floors of vanished houses laid down by a fishing community in the early Neolithic. The narrow avenues of the old souk still bustle with commerce and culture, lending continuity to the generations of families who built every age of this place. From some time after the closing of the Ice Age, these streets have shifted and reconfigured, languages and whole bodies of law have come and gone, and the city has endured.

There is a much older story here, if you know where to find it.

Down one narrow laneway, we step into a vaulted shopfront that looks, from the outside, like some kind of gallery. We are welcomed by a genial curator and his knowledgeable young son, both of them eager to share. On the walls hang intricate friezes in fine-grained limestone – fossil silhouettes of fish and crustaceans and rays preserved in the most extraordinary detail. These distant creatures lived in the long-vanished Tethys Sea a hundred million years ago – a span of years ten thousand times the age of this city.

At the back of the gallery, a heavy rack holds a block of these stone tablets, sliced vertically in a way that allows you to leaf through them, carefully, like the pages of the oldest book in the world. A form of geological memory can be recalled here, achingly fragile lives smothered by marine sediments under a younger sun, pressed into the fossil record as the seasons turned, and turned. If you know how to read them – as the curators of this small gallery clearly do – you can infer things about the world these creatures inhabited: how hot it was, what they ate, a little of how they lived.

Among those who have spent their lives trying to read meaning into these ghostly pages, the book is divided into chapters marked by relatively sudden changes in the geological narrative. The chapter they call the Permian ends with a mass extinction a quarter of a billion years ago. The more recent disappearance of the dinosaurs marks the sudden end of the Cretaceous chapter. All the way down into more recent times, when new technologies and more intact sediments mean the book can be read at higher and higher resolution.

Follow the storyline now through two and a half million years of Pleistocene Ice Ages broken by warm interglacial periods. The ice in retreat as shorelines advance, arriving, finally, in the long, eleven-thousand-year Holocene summer, in which the city of Byblos, and the entirety of our written history, is made and remade.

Into these most recent strata of the geological record, something new. In changing sedimentation patterns around river mouths, geologists read the quiet aftermath of ancient deforestation in Europe. In air bubbles trapped in an Antarctic snowstorm five thousand years ago, faint traces of increased methane levels from rice cultivation in China.

In the late 1800s, the signal becomes unambiguous. A thin film of localised ashfall in the British Midlands proliferates rapidly as industrial coal-burning hopscotches across the northern hemisphere. Radioactive isotopes of caesium and plutonium, falling out downwind of nuclear-weapon detonations in the 1950s and '60s. In the background, slowly, trace amounts of carbon dioxide in the atmosphere and oceans continue to rise, exhaust gases building up faster than the planet can draw them down.

At a conference of the International Geosphere-Biosphere Programme in 2000 – an event that sounds like an absolute riot – one Nobel laureate's throwaway line brings things to a momentary standstill: 'We no longer live in the Holocene, but in the Anthropocene.'

The Anthropocene. Ever since that conference, the word has steadily diffused out of academic journals into popular culture. It has a certain ominous mystique to it; in my mind's eye the great-grandchildren of the fossil curators of Byblos are reading the closing of the Holocene and the incendiary dawn of a new geological age, leafing through the ash-smudged fossil record and wondering at the sudden silencing of the world.

Palaeontologists and earth systems scientists are still skirmishing over what this Anthropocene concept even means, and when this new age began. With the coal burning? The methane in the air bubbles? One view is that we passed through an invisible inflection point in the 1950s, as our industrial and agricultural footprint transcended local environmental impacts and began tilting the earth system as a whole. The 'great acceleration', some of the IGBP scientists call this lift-off moment. 'Only beyond the mid-20th century is there clear evidence for fundamental shifts in the state and functioning of the Earth System that are beyond the range of variability of the Holocene and driven by human activities,' wrote Professor Will Steffen and his colleagues in 2015.

But which humans? Which activities? Immediately, this geological conversation is veering into oncoming political traffic.

For earth scientists, the Anthropocene is a sedimentary event layer signifying a new chapter being bulldozed into the oldest book in the world. For fossil curators, this layer will record the passing of the scimitar oryx, the Floreana giant tortoise and the Saint Helena olive, in a gathering cascade of extinction. It will hold the memory of a changing

atmosphere and the acidification of the oceans, for as long as the planet exists.

Most of us aren't earth scientists or fossil curators. Most of us are just trying to get by, yet somehow we've jumped from localised ash fallout to a full-blown planetary extinction emergency in just the faintest blink of geological time. How we got here is hard to comprehend, particularly for those of us conditioned to accept rocket-fuelled great accelerations as somehow normal.

To organise any kind of coherent response to what's been unleashed here, the oldest book seems momentarily too slow a metaphor. Imagine instead a scorched black eucalyptus leaf fluttering out of an ashen sky, coming to rest on an empty chessboard extending from horizon to horizon. Out here, we'll try to face up to the scale of the thing.



Dear future generations: Please accept our apologies.  
We were rolling drunk on petroleum.

KURT VONNEGUT

## coins of the anthropocene

Have you heard the one about the original creator of the game of chess, this wily mathematician who submits his invention to the ruler of the country? Asked by the delighted queen what he wants by way of reward, the mathematician requests to be paid in gold. He proposes the queen place a single coin on the first square of the chessboard, two on the second square, four on the next, eight on the one after that, doubling the number of coins on each successive square up to the sixty-fourth.

The queen, perplexed that the mathematician would ask such a meagre reward for his creativity, nonetheless orders her chancellor to total up the coins. In disbelief, the chancellor calculates that this simple sequence of sixty-three doublings has the queen owing the mathematician 18,446,744,073,709,551,615 coins. The coin stack on the sixty-fourth square will reach a little over nine trillion kilometres from earth, nearly a quarter of the way to Alpha Centauri.<sup>2</sup>

Variations on this story are sometimes told in maths classes to give students an idea of how rapidly a system undergoing exponential growth will punch a hole through the ceiling. To understand what it means for us right here and now, imagine the chessboard expanding invisibly to cover our battered old planet, and instead of coins let's travel back in time a short distance and play the game with metallic ores. Iron ore, bauxite, copper, nickel, every tonne of it.

Start in the year 1901. The anti-colonial Boxer Rebellion in China reaches its bloody conclusion, the parliament of Australia sits for the first time, and welfare campaigner Emily Hobhouse reports on appalling

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2 That's assuming the coins are 1 millimetre thick and there are 9,223,372,036,854,775,808 coins on the sixty-fourth square.

conditions in British concentration camps in South Africa. Drop about 150 million tonnes on the first square of the chessboard – that’s the total estimated figure of metal ores mined, shipped and smelted by the world economy in that year. Call it the queen’s first coin.

Jump forward a quarter of a century to 1925: the first public demonstration of television transmission is given in London, and Adolf Hitler publishes the first volume of *Mein Kampf*. Total metal ores mined and traded: 326 million tonnes. Two coins, give or take.

Twenty-seven years and a shattering world war later, we drop four coins on the next square. It’s 1952: the US government successfully tests the world’s first hydrogen bomb, and the Mau Mau launch a guerrilla uprising in Kenya. We’re up to 620 million tonnes.

The next doubling to 1.2 billion tonnes drops in 1967: it’s the Summer of Love in Haight-Ashbury, Suharto takes office as the second president of Indonesia, and the Israeli military occupies the Gaza Strip, the West Bank and the Golan Heights in the Six-Day War.

Sixteen coins in 1995: the year in which the World Trade Organization is established, and Typhoon Angela slams into the Philippines and Vietnam.

Thirty-two coins in 2009, the booming globalised economy now trading more than 4.8 billion tonnes of metal ores in the year the United Nations COP 15 climate negotiations end in failure in Copenhagen.

Smooth out the zigzags of global commodity markets, peer past the dust and dinosaur forms of colossal pieces of mining equipment and bulk freighters the size of city blocks. This is what a mild-sounding 3 per cent annually compounding growth rate will do. An increase of 3 per cent a year will double the number of coins on each successive square about once every quarter-century. Non-metallic mining – that’s all the limestone, sand, gravel and whatever – has grown slightly faster since 1901, doubling every twenty years. Coal, oil and gas are a little slower, doubling about every thirty years. You get the idea.

The simplest explanation for this explosive growth is that it coincides with the rapid and unprecedented expansion in human population – from a little over 1.5 billion people in 1900 to more than 7.8 billion at the time of writing. But simple explanations are sometimes wrong. World population growth hit an inflection point in the late 1960s and began to decline

as women's literacy and access to primary healthcare improved across the Global South, and reductions in child mortality led to smaller family sizes. Nobody suggests our population is set to double again; barring catastrophe, it appears to be headed for a plateau later this century. But there is no indication that the material consumption of the world economy is slowing, by any measure. If anything, the growth curves for key commodities have become even steeper over recent decades.

A better fit for the accelerating growth in material consumption can be found in something non-material: money. If you add up the total monetary value of all the goods and services produced in a country in a year, you arrive at a magic number called the Gross Domestic Product, or GDP. The world's combined GDP has been growing at about 3 per cent a year, doubling more than five times since 1901 and almost perfectly tracking the surging growth of the industrial tonnage out on the chessboard.

Is this correlation, or causation, or just coincidence? Answering that is harder than it sounds, but for the moment the key thing to notice is that one of money's main functions is just to multiply itself. And because it only exists as symbolic transactions between people and institutions, it is free to multiply into infinity like the mathematician's imaginary coins.

The physical flows and fabrics of a living planet are not so free. Between 1901 and 2015, the human infrastructures of mining, farming, factories and quarries processed a staggering 3.4 trillion tonnes of raw materials in total. By the unyielding mathematics of compounding growth, in fourteen decades' time we're expected to churn and burn through that amount every single year.

GDP figures accurately track the one-way consumption torrent of the modern economy: from mine to landfill, with a brief pause in the hands of people this kind of economy calls consumers. When particular flows or commodities or workforces buckle or collapse, the doubling shifts somewhere else. To the financial system, the physical flows are almost beside the point; they are simply intermediaries, carrier waves for the duplication of money.

In the glossy annual reports, all the focus is on the input side: tonnages ripped and shipped, board-feet slabbed and chipped, gigalitres pumped and burned, annually compounding metrics of a planet in liquidation.

The architects of this locust economy never sought to design waste retrieval and recycling systems for this growth machine, so it piles up on the edge of town. We've brought materials into circulation that have no known disposal path – an ocean of plastics, incomprehensible new chemicals and murderously long-lived radioactive isotopes. The one that is raining scorched leaves onto the chessboard, the one we can't even see, is the invisible pollution from coal, oil and gas combustion: a careless elbow in the face of the planet's highly strung thermal regulation systems.

These are the coins of the Anthropocene, and this is what they buy us. Our present political and economic leaders are unswervingly determined to deliver the next stack twice as high on the next square, no matter what. Anybody who suggests that this is an impossibly dangerous way to organise our economy is treated like a freak.

That's a problem. In the 1990s, US public-policy thinker Joseph P. Overton introduced an idea that would end up carrying his name. He proposed that public debate is characterised by ideas that are considered reasonable and worthy of discussion. These ideas lie safely within the Overton window. Outside this window lie all the ideas considered extreme, ridiculous or outright unthinkable.

The assumption that coin-doubling growth is good and necessary and normal is so mundane, so beyond question, that most days it's all you can see through the Overton window. There do seem to be some freaks outside, banging on the glass about extinction or something, but because the window has become so firmly fixed in place it's hard to understand what they are on about.

Joseph Overton suggested that over time, cultural and political tides can move the window, with activists and innovators bringing ideas previously considered extreme into the range of matters that sensible centrists feel comfortable talking about. But today things seem askew: everyone knows something is horribly wrong, but the window refuses to shift.

We were checkmated the moment we bought into the mathematician's coin-doubling scam. Across much of the industrialised world, the consequences of endlessly doubling down now infuse popular culture like background radiation. Dystopian premonitions hover at the intersections of documentary and science fiction, an annoying cohort of doomers and

whole sub-genres of apocalypse porn flirting with the aesthetics of global collapse. A few billionaires are even proposing to go and set up colonies on Mars, but as much as we might wish they'd just fuck off and live under a plastic dome millions of kilometres away, it wouldn't stop people from being crushed under the next drop of their coins. The window seems to be jammed, stuck somehow, and so rather than continue trying to shift it politely, maybe it's time we put a brick through it.

## the systems game

Sometime between this coin-doubling and the next, the chess game ends because the board is on fire.

While we're thinking about that, here's a different game, one that's played with only one rule. It works pretty well with about two dozen people; you just need a little bit of space. Here's how it goes. Everyone stands in a circle, facing inwards, about an arm's length apart from one another. Each participant has to choose two other people at random – silently, without letting on who they've chosen. Ready? Okay – here's the rule. When the game starts, you have to move so as to stay an equal distance from the two people you've chosen. You don't have to stand directly between them, just try to keep the same distance away from both of them at all times.

That's it. That's the rule.

Go.

I first came across this game years ago, just before the night we closed the road into Wattle. It was introduced as part of a workshop series on nonviolence and civil disobedience, co-hosted by American author and anti-nuclear campaigner Joanna Macy. In addition to practical techniques for locking down equipment, dealing with police and understanding your legal rights, Joanna Macy stirs in a measure of deep ecology, Buddhist philosophy and something I'd only tangentially read about before, something she calls systems theory. Instead of dropping a bunch of academic papers about chaotic attractors and scale-free networks on us, she starts with this game.

The moment she calls 'go', the circle dissolves. The two people you're following, now they're moving too, trying to keep an equal distance from the two people they've chosen. In your peripheral vision you're trying to keep track of where your people are, avoiding collisions with others, aware that everyone is now weaving and careening around each other in a complex, unpredictable and strangely hilarious dance. Give it a few minutes, and unplanned crowd dynamics will arise; the tempo will slow, or everyone will begin to bunch up, until someone makes a move that drags two other people out of the flow and suddenly you're all in wild motion again.

Just one rule, everyone in the game applying it as best they can in real time.

No supercomputer will ever be able to predict where we'll all be standing when Joanna calls 'stop'. Nobody is in charge of where we end up. We're all exercising a certain amount of agency, but none of us is completely free of the influence of those we're bound to. Everything that happens in the game depends on everything else that is happening, and trying to orchestrate or direct a particular end state would seem to be formally impossible. My enduring memory of all the times I've played the systems game is of the intangible collective presence that arises: a larger, fleeting *something* emerging from the moment-to-moment interaction of the crowd's individual players.

The search for a theory that would explain these dynamics – and the emergence of that something – takes us all the way back to the nineteenth-century study of thermodynamics, with a handful of scientists and inventors struggling to improve the efficiency of the first generation of steam engines. Through slow trial and experimentation, they were stumbling towards some profound understandings. In his one and only publication, *Reflections on the Motive Power of Fire*, in 1824 French physicist Sadi Carnot put it like this: 'We may therefore state the following general principle: The amount of motive force in nature is unchanging. Properly speaking, it is never created and never destroyed; in reality it [merely] changes form, that is, assumes one or another form of motion, but never vanishes.' This observation ended up being formalised as the first law of thermodynamics, the law of conservation of energy. Energy in the universe is never created or destroyed; it merely changes form.

But changing form carries a cost that you never get back. This second law, flowing from the first, would be of more immediate use to the makers of these machines. Heat dissipates until everything is the same temperature; water flows downhill; friction bleeds energy out of moving machinery and disperses it as waste heat. You'll never see a cold object spontaneously transferring heat to a warmer object. The whole universe is falling inexorably towards thermal equilibrium – cold and dead and empty and pointless and dead, as though a Morrissey album has founded its own branch of physics.

The second law gave rise to the evocative concept of entropy. This term was coined by German mathematician Rudolf Clausius in 1865 as the measure of disorder in a closed system, which only ever goes up until equilibrium is reached. As energy dissipates, entropy increases, and this is always and forever a one-way ride. It means these bearded imperial nerds will never be able to build a steam engine with anything like 100 per cent efficiency. The moment they light up the coal in the furnace is the moment high-grade chemical energy begins its cascade into low-grade waste-heat, never to return. ‘Reality is irreversible,’ as Russian biophysicist Mikhail Volkenstein put it.

It is in the dissipation that everything interesting happens. Carnot and Clausius and the others may be laying the theoretical foundations for a world lit by coal-fired electricity, but they are writing their treatises by the light of gas mantles and candles. Look closer, at the dance of one of these small, perfect flames. Closer: to see what is happening as the superheated gas boils off the melting wax. The fastest, most efficient way for the candle to dissipate this energy is through a teardrop-shaped flame. Entropy is increasing, heat is flowing from a highly concentrated source to gently warm the surrounding air, and while it lasts, this ephemeral structure will float there, illuminating the room.

Heat a pan of water until it begins to boil, and the water will self-organise into bubbling convection cells – hot water rising, dissipating heated steam into the air, cooling and falling back towards the bottom of the pan. The same overturning convection structures can be observed on the surface of the sun, or in a bowl of hot miso soup. At the scale of the whole planet, slow-moving ocean currents and the largest-scale weather systems are in ceaseless overturn, dissipating equatorial heat towards the poles.

We may all be sliding towards the eventual heat-death of the universe, but the structures and standing waves that form as energy tumbles from high-grade to low have shaped everything we see around us. The study of such ‘dissipative structures’ is one of the tributaries that led, in the mid-twentieth century, to the development of what is known as general systems theory.

Austrian biologist Ludwig von Bertalanffy went looking for a unifying theory that would describe any complex system with constituent parts;



he probably would have enjoyed the swerve and flow of Joanna's game. In 1946 he wrote: 'It seems legitimate to ask for a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general.'

A quick search turns up this definition of system: 'a regularly interacting or interdependent group of items forming a unified whole'. Any discipline that seeks to formalise the universal principles of 'systems in general' would seem to be hopelessly ambitious in scope. After all, we could be referring to the solar system, or the immune system, or an ecosystem. Or, for that matter, the phone system, the criminal justice system or the global financial system. This is a word that really gets around, and when it shows up it usually means things are getting complex.

Over the decades, this quest for simplicity has ramified into dozens of disciplines and sub-disciplines, elegant propositions and empty dead ends. The cybernetics people, with their feedback loops and ballistics tables. Game theory types, with their bounded rationality and prisoner's dilemmas. The chaos theory school, wielding strange attractors and infinitely self-similar fractal geometries. More than metaphor, it seemed the stirring of a butterfly's wings in the Amazon might really trigger a storm in the North Atlantic.

It's not immediately obvious why Joanna would invoke any of these abstractions at a civil disobedience workshop for a few dozen middle-class kids learning how to shut down logging operations. Or, for that matter, their relevance to people working any dimension of the larger struggle against a coin-doubling economy that has clearly lost its mind. Most of us don't have the time or the faintest flicker of interest in bringing graph theory or nonlinear dynamics into any part of our waking lives, so, as fascinating as these things might be to some, what is the pitch here, exactly?

By the 1990s, students of what would come to be termed 'complex adaptive systems' were turning their minds to questions that had previously been squarely in the domain of political philosophers and revolutionaries. Lines of inquiry that had begun with steam engine efficiency were somehow casting light on patterns of social contention, and the stratification of classes, and outbreaks of industrial action.

Across widely diverse contexts, some researchers clocked the recurrence of a fourfold cycle of innovation and conservation, collapse and

renewal, operating at scales from local to global. Named it the ‘adaptive cycle’ and began to see it all over the place: the beginnings of a theory of how natural and social systems undergo regime changes. Ecologists put forward a name for the complex interplay of fast and slow adaptive cycles that sometimes collide with spectacular effect: they called it *panarchy*.

Thermodynamics won’t help us find the people throwing children into the water: that’s a political journey. But ever since I first played the systems game, I’ve wondered whether a theory of collapse and renewal might be valuable when we do finally meet our monsters face to face.

I can’t shake the memory of the fossil gallery of Byblos, turning stone blocks carefully backwards through the oldest book in the world. On different terrains, these pages can be read all the way back into deep time, to spiral shells and track marks on seafloors made by beings that haven’t existed for half a billion years. Deeper still, to rocks in the heart of the Pilbara in Western Australia, where chemical signatures hint at the presence of tiny lives making their way amid the late stages of the fiery bombardment that formed our world. Wondering what we’d see if we turned to the page before that —

A visionary book for our wild times. Scott Ludlam draws on his experience as a senator and activist to capture our world on a precipice and explore what comes next.

One way or another, we are headed for radical change. We are now in the Anthropocene – humans are changing the earth's climate irreversibly, and political, human and natural systems are on the cusp of collapse. Ludlam shines a light on the bankruptcy of the financial and political systems that have led us here: systems based on the exploitation of the earth's resources, and 99 per cent of the world's population labouring for the wealth of 1 per cent.

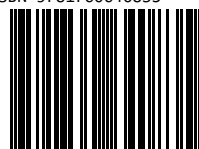
In *Full Circle*, Ludlam seeks old and new ways to make our systems humane, regenerative and more in tune with nature. He travels the globe to see what happens when ordinary people stand up to corporations and tyrants. He takes the reader on a journey through time to discover the underlying patterns of life. And he finds that we are at a unique moment when billions of tiny actions by individuals and small groups are coalescing into one great movement that could transform history.

Bringing together a wealth of new ideas, *Full Circle* outlines a new ecological politics.

'Ludlam's insights are often cogent and deep – and more than that, they're *earned*. His willingness to engage in the fight he's describing gives his take on these existential questions real power.'

—**Bill McKibben**, author of *The End of Nature*

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