The Roads from Mars Hill

R P Vine

'Lowell always said that the regularity of the canals was an unmistakeable sign that they were of intelligent origin. The only unresolved question was which side of the telescope was the intelligence on.'

- Carl Sagan

PRIORY HOUSE EDITIONS

London

3rd Edition Text copyright © R P Vine 2026

Front and back cover art © R P Vine 2026

ISBN 978-1-0666057-0-5

All Rights Reserved

The right of R P Vine to be identified as the author and illustrator of this work has been asserted by him.

Names, characters, places, incidents and dialogues are products of the author's imagination or are used fictitiously. Any resemblance to actual people, living or dead, events or locales is entirely coincidental.

For Betty Vine, who bought me my first telescope, just as Lowell's mum did his.

Contents

Contents 4
Prologue 1
Drive 7
Space Ex 15

PROLOGUE

SET ATOP A forested hill, high above the west end of Flagstaff in Arizona where the main drag (Route 66) takes a sharp turn south, lies a little structure said to resemble the planet Saturn. A drum of east-coast granite below a jutting ring-like architrave, it is topped by a dome of translucent tiles in hues of pastel blue and pink.

Every evening, when the setting Sun slants cool through the surrounding Ponderosa forest, those tiles glow like an over-arching dusk sky.

The tiles reproduce a rosy-fingered dusk, to misquote Homer, because it was the sole occupant's favourite time of day. Mine too. That lucent time just before the air starts to cool and the first brilliant orange star twinkles out through the clear desert air.

Around the back of this funny little century-old building high above Flagstaff is a doorway filled with a filigree of cast iron oak leaves flanking an Art Deco cross. Within is a simple granite sarcophagus, bathed in that evening glow.

This structure is the mausoleum of the amateur astronomer and Mars observer Percival Lowell, who died on November 12th 1916. The site of his tomb is his observatory at Mars Hill. Next door, his telescope, the famous 24-inch Clark refractor, is still operational within its original wooden dome. And that first orange star glowing overhead is Lowell's muse – Mars.

These days, the professional astronomers at Lowell Observatory seem almost embarrassed by Percy, preferring to bask in the legacy of another former colleague, Clyde Tombaugh, who discovered Pluto. Since my first visit to Mars Hill, a quarter of a century ago, this change of historical perspective has become plain. A banner over the entrance proclaims, 'Home of Pluto' and the tours focus on Tombaugh, too.

Tombaugh, you see, is famous for all the right reasons, Lowell for all the wrong ones. For Lowell made a colossal, very unscientific mistake, one doubtless embarrassing to a modern researcher but fascinating to me.

* * *

I have a map of Mars, framed and hanging on my wall. It's taken from a book, a derelict Russian academic tome written at about the same time as Lowell's wife was belatedly building his Saturnian mausoleum. The map is detailed, carefully inked and labelled. Trouble is, it's complete nonsense.

That Russian Mars map is covered in a network of thin, straight lines that once dominated planetary science, but that we now know just aren't there. Those imaginary lines are the canals of Mars and we mostly have Lowell to thank for them.

Lowell wasn't the first to have somehow seen linear markings on Mars: the Italian astronomer Schiaparelli saw them before him, describing them circumspectly as *canali* (channels in Italian). But Lowell it was who popularised the idea. He turned Schiaparelli's channels into canals, vast ones, then imagined a race of master engineers, expiring operatically on a parched Mars, who had built them.

The next generation of telescopes were larger and started to use mirrors instead of lenses. They gave bigger, better, clearer views than Lowell's. Their view of Mars was so much better, in fact, that Lowell's always-evanescent canals vanished, both in the eyepiece (for professional astronomy was still mostly a visual business, even then) and later as a serious theory.

But while mainstream professional astronomy moved on, popular culture clung on and a huge fictional universe grew from Lowell's grand mistake: *A Princess of Mars* and *The Sands of Mars*, *The Martian Chronicles* and *Stranger in a Strange Land*. Even Luke

Skywalker's Tatooine and Dune's Arrakis give more than a nod to Lowell's Red Planet.

Popular astronomy texts continued to include Lowell's ideas long after they had been debunked. As late as 1964, a coffee table book on Mars, illustrated by seminal space artist Chesley Bonestell, devoted an entire chapter to the canals, another to the aliens who built them.

The book's author, professional astronomer and friend of Bonestell's, Robert S. Richardson, wrote the following about his own views of the Martian canals through the very same telescope that had played a part in disproving Lowell's canals fifty years before:

> On the morning of June 4, 1956, I was on Mount Wilson working with the 60-inch reflector … A magnification of 700 made it seem as if Mars were being viewed from a spaceship … The bright red regions were covered with innumerable irregular blue lines, like veins running through some mineral. Several minutes passed before it occurred to me these markings must be canals.

Richardson was not alone. My seventies childhood bookshelf held several popular astronomy books that described the canals of Mars as if a current theory. Lowell's ideas took more than half a century to disappear into history. Before doing so, they had an astounding influence on the Zeitgeist.

* * *

Between 1895 and 1908, Lowell wrote three books about Mars and its canals and it is these quasi-scientific treatises that had such a profound influence, that imprinted the idea of Martian canals, along with a desert-locked race of aliens who had built them, into our culture.

Though Lowell's romantic writings were light on science fact, they set out a compelling science fiction vision of Mars and Martians.

Authors like H.G. Wells and Edgar Rice Burroughs enthusiastically took it up.

More fiction followed, lots of it, until memes of Martians and alien civilisations were embedded in the culture, until we had taken Lowell's ideas far more deeply to heart than if they had been true.

Lowell's imagined Mars wasn't just a source of fiction. It inspired early pioneers of rocketry, like Robert Goddard, to start dreaming of interplanetary travel. And Lowell-inspired fiction encouraged the first generation of planetary scientists, like Carl Sagan, to think of planets as places rather than just astronomical objects.

The question of *Mars as the Abode of Life* (the title of one of Lowell's own books) lies behind NASA's missions to the Red Planet. The broader Lowellian idea of life in the solar system is a principal research aim for probes, past and present, to the outer planets. For even if Mars is barren, moons like Europa and Enceladus may have sub-surface oceans hosting life.

The search for alien life 'out there', for some new abode of life in the wider universe, is the driver for exoplanetary research using the next generation of space telescopes, like the recently launched Nancy Grace Roman Space Telescope. Meanwhile, the search for extraterrestrial intelligence (SETI) aims to find a replacement for Lowell's refuted aliens.

* * *

For this book, I planned on investigating those connections with Lowell's imaginary Mars by taking a trip to the Desert Southwest – to Lowell's observatory, but not only. For many of those connections are located in the desert too.

NASA's Mars landers, including Viking – the only one designed to look for life on Mars and whose landing sites Lowell-inspired Carl Sagan helped choose – were tested at a Mars analogue landscape in Death Valley.

The nuclear engines for an aborted US manned Mars mission once scheduled for the 65th anniversary of Lowell's death, were trialled at the Nevada Test Site, not so very far from Mars Hill.

One of the wackiest Mars projects of all was conceived at Los Alamos in New Mexico. A key figure in the project was physicist Freeman Dyson – another one inspired by Lowell's imagined Mars.

In south Texas, Elon Musk is building Starship to allow him to fulfil his dream of 'dying on Mars'. For the colonisation of Mars is almost an obsession for Musk and the oft-repeated goal of SpaceX.

The connections between Mars and Lowell and the Desert Southwest go deeper still. When mid-century space artists like Chesley Bonestell wanted to paint Mars as a place, they used the deserts of Utah and Arizona as a model landscape. Edgar Rice Burroughs set the opening of *A Princess of Mars*, the first planetary romance, in the Arizona desert.

This dry, empty land of huge spaces and skies is the epicentre of ufology, of Roswell and the supposed 'alien base' at Dulce. Many of the most puzzling UFO sightings and encounters happened in the desert, creating a whole counterculture that sprang up in the decades after H.G. Wells' Lowell-inspired *The War of the Worlds* was broadcast on the radio in 1938 and widely believed to be real.

The desert is home to the infamous Area 51, adjacent to the same secretive Nevada Test Site where they tested those nuclear rocket engines. Conspiracy theorists believe flying saucers and alien beings are kept at Area 51, their technology studied and harnessed. Is there any truth to those conspiracies? I wanted to investigate them for myself.

I also hankered after the *real* Mars. When I say real, I mean that bright orange planet in the dusk sky over Mars Hill. Because until someone finally steps down from a spacecraft onto dusty red Martian soil, perhaps from one of Musk's silver Starships, the real Mars will always be that biennial planet with its steady baleful gleam among the twinkling stars.

Seen through a telescope eyepiece, that fiery planet amid the stars becomes a faintly-marked, shimmering ochre orb – Mars as Lowell must have actually seen it, rather than the canal-crossed Barsoom from *A Princess of Mars* he believed he saw. As an amateur astronomer who enjoys observing Mars, those canals perplexed and intrigued me. I've spent countless hours straining through a telescope and never seen a hint of one. So how come Lowell did?

Lowell thought he was doing real science, so how did it happen? How did he look at Mars and see canals – evidence of a great civilisation? How did other astronomers pick up Lowell's fantasy and turn it into a mass delusion that persisted in popular books about Mars into the sixties?

I intended to find out, to view Mars at opposition through Lowell's own telescope. Would I glimpse those canals for myself or at least find a clue to why Lowell (and others, like Richardson) did?

I also wanted to observe Mars through one of the giant telescopes that came immediately *after* Lowell. I hoped to find out what the biggest 'Big Science' tools of his day – the 60-inch reflector at Mount Wilson and later the 82-inch at McDonald – reveal of Mars, to see why those telescopes helped sober observers like George Ellery Hale refute Lowell's canals.

To explore all those Martian connections, I set out on my favourite kind of trip – a road trip. That trip would take me to California and Nevada, Arizona and Utah, New Mexico and west Texas, to investigate Percival Lowell's fantastical legacy along the roads from Mars Hill.

Drive

On my childhood bedroom bookshelf, next to the Ladybirds and the popular astronomy books, whose paintings of Mars' canals were by then bordered with primitive plants in place of Lowell's Martian cities, lay a stack of National Geographic magazines. It was the adverts, with their lavish Madison Avenue artwork, that made me so desperate to see America.

Compared to cramped, grubby, rainy and over-populated 1970s Britain, I imagined an America big and sunny and colourful, shiny-hot and roomy-fresh – a place of infinite horizons and possibilities, of finned cars and shimmering deserts and great white-domed observatories set amidst the pines.

I yearned to go, but instead my childhood holidays took me to other cramped rainy places like Wales and Devon. A child psychologist has suggested British children secretly crave the windswept beaches, wasps and gritty ice creams of a 'proper' British seaside holiday. Well, not me.

I craved Arizona, Utah and Nevada, but especially California. Perhaps that's why I squandered so many adolescent evenings watching seventies cop shows for a glimpse of the Golden Gate or Highway One when I should have been doing my homework.

I nurtured that frustrated yearning for the American West into adulthood. Then a school friend landed a job in California. The other old friends I went drinking with on a Friday night (every Friday, for decades) promptly vowed to visit. Now here you need to understand that these friends ('The Lads') were a great bunch – on the whole – but back then we weren't always the most proactive.

I went to school with two future celebrities (Glamorgan cricketer Colin Metson and poet Glyn Maxwell), but though I'd love to name-drop them further, they sadly weren't among those Friday-night friends. If they had been, armed with their ambition and drive,

doubtless we would have made it to America. As it was, the dropouts happened slowly, the excuses varied and lame. In the end, only one was left apart from me – we'll call him Kurt.

At school, Kurt was cool and sporty. In the US they'd have called him a 'jock'. Later, Kurt joined the military and we lost touch for a few years. When I saw him again, he was, sadly, much changed.

True, Kurt still looked a lot (really an awful lot) like Che Guevara. But the chiselled features had turned pudgy, the long hair lank. Behind those once-steely eyes lurked rampant self-doubt. Kurt's big hands shook and he smoked too much.

Something had happened to Kurt during his years in service, though I never learned what. Still, Kurt wanted to go to America and hang out, drive the roads, see the sights, 'watch the hazy sun sinkin' in the sea'.

So one grimly dank November Saturday, Kurt and I went up to London to buy our tickets to California. An exciting moment. Our plan was to cruise the discount travel ('bucket') shops that then lined Shaftesbury Avenue and get a good deal on a flight to 'Frisco' (as Kurt called it).

It was a good plan, except that all the bucket shops were closed on Saturday afternoons. This shouldn't have been a problem. London's King's Cross station was only twenty minutes from home, after all. But before our train home reached Potters Bar, I saw that look of doubt in Kurt's eyes morph into defeat. He just wasn't prepared for this magnitude of setback. He wasn't going to go.

I last saw Kurt a few years later one Friday pub night with The Lads. Kurt was leaving. His life hadn't been going too well, but he had decided to turn it around, go backpacking around Eastern Europe, maybe Russia. Who knew, even China.

Kurt's dad had given him some cash and he was off, army-surplus Bergen, red-star T-shirt and all. He cut a dashing figure, a big man of few words, dressed in camo and drawing deep on a roll-up. I

got so caught up in the whole thing I gave him the coat off my back because he didn't have one.

Kurt lasted just a couple of weeks into his big trip. He made it to Prague and checked into a five-star hotel, then blew all his cash on a fortnight's room service and cable TV. His dad apparently blamed our bad influence and we never saw him again.

I realised that if I was going to drive America I was going to have to do it alone. So I blew a modest inheritance from my Uncle Ken on tickets and a rental car, took four weeks off and just went. I had no plan, nothing much booked beyond the first night.

No one thought it was a good idea. The Lads believed (or maybe hoped) I'd get raped by a biker gang. My mum just thought it was a waste of money. But I loved it, found the freedom and discovery unbelievably liberating and transformative.

Since that first one, I've been slipping off to do solo road trips whenever I can. If aliens, UFO conspiracies and secretive bases are one kind of American fantasy, then road trips are surely another. At least, they are for me.

* * *

That first big US road trip included a visit to Flagstaff and Mars Hill. I had hoped for a chance to view through the Clark refractor, but it was in too poor a state for regular use – the dome was shut, Lowell's giant refractor just a dim sparkle of brass through a window.

Now yet another road trip to the American desert offered me a happy conjunction of Mars and time and place to explore Lowell and his legacy, and return to Mars Hill. I'd even read that Lowell's refractor had been magnificently restored for outreach. Hopefully I'd get to look through it at last.

But a desert road trip was also an opportunity to confront a more personal ghost than Lowell's. You see, after many US road trips, dozens over the decades since Kurt, I'd had a really bad one a few years before. Now I wanted, needed, to expunge the ugly memories.

My previous road trips had been gloriously solitary, but then I had risked going with a couple of acquaintances whose idea of a road trip proved very different from mine. According to Sartre, 'hell is other people'. On that road trip he was right.

My biker mates were bullying bores who had no interest in either the landscape or culture we rode past. We explored the road alright, but that was all – the actual blacktop and a few closely connected areas of tarmac next to gas stations and diners. We even smoked and ate on the road, literally.

The photos look cool; the trip was anything but. I discovered a lot of things I would rather not have. And not just that my love for the road went beyond tar with small stones in it.

I discovered just how dangerously unpleasant it is riding in leathers above a smokin'-hot Harley V-twin through the desert at a hundred and twenty in the shade. I discovered how soul-destroying American TV is, especially when your two 'mates' are lying in their leathers watching it in a motel at midday having just ridden past the Grand Canyon without stopping.

Then there was the dirt, the noise, the petrol blowbacks. The overwhelming experience of riding through a truly epic desert storm (the type with bullets of water, not depleted uranium – but still).

Meanwhile, my Harley – one of those enormous ones with fairings and panniers and cruise control – looked the part, but it was part of the problem. It was a brute to ride, especially at low speed. I finally dropped it on a hairpin above Sausalito, exhausted and demoralised by weeks of daytime TV and night rides on Red Bull to avoid the heat.

The whole thing had shaken my love of road trips, of America generally. More troublingly it had shaken my faith in myself. Since that terrible trip, I had stopped dreaming one of my life's most enduring escapist dreams: me, a car and a desert road.

So, at the back of my mind as I boarded the Virgin Atlantic flight to Los Angeles this time were a whole bunch of niggling doubts.

Would I still be up to all that desert driving? Had I become too soft to swallow weeks of lonely roads and lonelier motels? Most worryingly of all, would it still *mean* something?

Ever since that first post-Kurt adventure, I have revelled in empty, vanishing-point roads, the glorious singularity of being completely alone, the only person who knows where I am. Would I still? A phrase from an old song kept surfacing from my subconscious:

And when he got there, he didn't find nothing but road ...

* * *

Road-trip angst was the least of my worries on the plane. I immediately struggled to find space in the overhead locker for my telescope, the one I planned to use for looking at Mars through clear desert skies.

Then I sat down and struggled to find space for a skinny old bloke, me. For the lady in the next seat was – and I am searching for the politically correct, non-fat-shaming words here – body-positively large. Her armrest was up and barely half my seat remained for me.

I inadvertently touched her bum trying gingerly to retrieve my seat belt from under it. I felt my face glow. She glared at me and started whispering to her husband. He glared at me too. Then a lady in front heard and glowered in quivering puce fury at me through the seat-gap.

I wanted to scream that I was happily married (well, mostly) and that if I'd been contemplating a career as a molester then this frankly wouldn't have been the opportunity I'd waited a lifetime for. But I didn't. Instead, we all settled into an uncompanionable but very British silence. It was a long, *long* flight to LA.

After hours of cramped misery, I arrived at LAX and stretched out into the spacious privacy of my rental car at last. I'd wanted some Detroit muscle car, a Charger or a Mustang. But all my astronomy gear – telescope and mount, cameras and eyepieces –

wouldn't have fitted. So I was driving a big gold minivan. No glamour, but still a big, lazy 'V' engine and an automatic transmission for those rumble-and-squeal peel-outs.

I purred through the late-night LA traffic, enjoying the neon streets, the warm air. Gleaming lights danced off the windscreen. Roadside palms fluttering in the hot breeze. It reminded me of the movie *Drive*. I heard its soundtrack in my head. A weird, lonely and, I suspect, very male pleasure in car, night, road.

Perhaps I was going to fall in love with the American road again after all.

* * *

This is a road trip and so I want to confront this dubious love affair with motoring – mine and most likely yours as well.

I was brought up by a single mum who didn't drive. We rode the bus or train or tube. We walked, a lot. Occasionally we took a taxi smelling faintly of beer puke left over from the previous Saturday night.

I was insanely jealous of friends and relatives who had the impossible luxury of a comfy, fresh-smelling, *private* car. I longed for a friend's dad's stately Rover or my Uncle Ken's duck-egg blue 1958 Hillman Minx convertible ('Hillary').

I vaguely blamed Mum for this state of affairs. She had learned to drive at some point, taught way back by a different uncle, my rural-Kentish Uncle Tom, in an old Ford Popular. But for some reason, Mum had never taken her test.

So to me, travel meant suffering. Queuing by a bus exhaust belching diesel fumes. Endless train journeys in old-fashioned compartment coaches. Sitting freezing in a green London Country double-decker, looking glumly at the hole in the clutch housing meant to blow warm air. Trying to find a taxi in the rain. Huddling at a rain-blown country station where the waiting room was somehow colder than the platform.

Perhaps all that uncomfortable public transport was why, wherever we went, I loved provincial museums with classic motorbikes and cars. I was fascinated by anything that had an engine and let you get places on your own terms.

Once a week, a cleaner called Margaret used to help out (Mum worked full-time). Margaret would arrive on a brown Honda C50 step-thru which I deeply admired, with its put-putting exhaust and purringly invisible motor – an understated little mechanical marvel that gave Margaret a freedom I could only dream of.

By my teens I hated public transport, loathed packed tubes and buses, dirty seventies train stations and those reeking taxis.

Then when I was sixteen, I met a group of the cool lads from school posing on their gold 'Fizzies' (Yamaha FS1E mopeds). Fizzies were stupid, smelly, slow, screaming little bikes; but oh how much I wanted one. Mum sensibly said no.

My first driving lesson, in a white 1979 Ford Escort 1.3L, was on my seventeenth birthday. I'd looked forward to it for months, but it was a blow to my dreams.

The instructor, Mr Greenhalgh, was ex-police and he believed in giving boys a first-lesson shock to quash their overconfidence. Unlike most of my mates, who had driven in car parks with their dads, I had no overconfidence. So driving thirty miles in urban traffic, with no idea what I was doing and Mr Greenhalgh doing astonishingly little to help out, made for an unforgettable seventeenth.

I passed my test just six months later. Mr Greenhalgh had given me bags of confidence in the end. I went straight out for a spin up the motorway just because I could. Next day, I drove a car packed with school friends into central London, something I'd think twice about now.

I loved everything about cars and driving, from the smell of Halfords car polish to the excitement of a sweeping curve taken at speed. I had racing lessons at Brands Hatch and took part in the Marlboro Challenge in a Ford XR3.

I seemed to spend most of my late teens reading car magazines and fantasising about fast cars. I took my girlfriend to the 1982 motor show and got to sit behind the wheel of a Ferrari 308 GTB. I can still recollect the smell of its leather. I had become a total car bore. The girlfriend ditched me for an actuary, which says a lot about just how much of a bore.

My love of cars collided with my yearning for America to produce a burning desire to go on a road trip. I ruefully recall giving up on a school General Studies exam, to sit dreaming a music video fantasy of a muscle car on a sunset desert highway with some meat-headed metal soundtrack.

For once, reality didn't let that fantasy down. On my first ever real-life road trip, the post-Kurt one, I landed at San Francisco and immediately took charge of a big Mercury saloon. I drove it straight downtown and fell hopelessly for the American road. I cruised the Golden Gate Bridge, drove the oceanside curves of Highway One, squealed the switchbacks of Lombard. Later, I headed out into the southwestern desert.

I was instantly addicted: to the freedom and detachment, the endlessly changing vistas, of never knowing where I'd end up. Back in 1991, it all seemed like one long rock video. I hardly needed the local FM stations on the radio. Car-themed tracks like Saxon's *Wheels of Steel* played endlessly in my numb skull as I drove. I've never quite recovered.

Space Ex

After the short, movie-perfect drive from LAX, I booked into a motel on Sepulveda Boulevard, dumped my stuff and found a nearby gas station with a late-night shop to buy snacks and beer. The breeze was still warm, still fluttering the palms. The mood was chill.

I had always disliked LA, preferring Chicago and New York, Seattle and even Austin among US cities. But this time I thought I was finally *getting* it.

Alone in my room later, I cracked a favourite Californian beer, watched some old *X-Files* episodes to get in the mood for desert alien encounters, and relaxed.

City sounds of traffic and sirens and beats drifted in. I remembered this sensation from my very first road trip – a lightness of spirit, a feeling of freedom and opportunity. I was alone, but I didn't feel lonely. I felt good. I was supposed to phone home, but I didn't.

* * *

Next morning, after coffee and bagels on the motel terrace, I joined the packed interstate back towards LAX. A turning off onto busy West 120th Street took me to the nondescript suburb of Hawthorne. After a few miles, the boundary fence of a small airport came up on the right. One of the biggest buildings on the airport bears a gigantic 'X', writ with a flourish. It's the reason I was here.

One of my favourite childhood movies was *It's a Mad, Mad, Mad, Mad World* – a desert road trip to find treasure hidden beneath a 'Big W' of palm trees. The 'Big W' sequence was filmed just a few miles south of here. But Hawthorne's 'Big X' isn't some logical sequel. Rather, it marks the headquarters of Space Exploration Technologies.

I drove past the main SpaceX HQ, past Rocket Road, turned right onto Jack Northrop Avenue, and parked up. Walking the hot sidewalk back towards the junction with Crenshaw, the object I had come to see loomed into the sky.

Right there, standing on the corner of Crenshaw and Northrop, was a huge rocket booster, a Falcon 9, sitting on its extended landing legs over a big X – as if it just landed on a drone ship. Just a glass wall stood between me and the silver nozzles of its nine Merlin rocket engines.

Up close it was much bigger than I'd imagined and gave a sense of the colossal scale of the whole launch-and-land system, something I would see for myself a year later when I watched a pair land with twin sonic booms – Bang! Bang! – after a Falcon Heavy launch at Cape Canaveral.

Towering into the sky, its little grid-fins actually the size of kitchen tables, it was hard to believe this monster rocket routinely slows itself from hypersonic speeds to perform a precise and gentle landing. But reusable rockets would not exist at all, if not for the pull of Mars on SpaceX's founder.

* * *

Elon Musk is a character who will keep muscling in on this narrative, not least due to his own Lowellian obsession with Mars.

Many people absolutely loathe Musk and by extension his companies too. An old friend of mine loved his Tesla, but sold it solely because 'Elon bad'. Even SpaceX suffers from the same public disdain for all things Elon.

I later saw this antipathy for myself on a NASA bus tour during that same visit to Cape Canaveral. The guide was scathing about SpaceX, even though we tourists were all fans, there to see a Falcon Heavy launch.

Some of the hate may be rational, but consider this statement from award-winning New York Post writer Maureen Callahan in 2018

(for reference, a Falcon 9 booster had first successfully landed three years prior and was already one of the most successful launch platforms at the time):

> Elon Musk is a total fraud ... he has yet to succeed at anything but somehow spins every failure into proof of imminent success. His only accomplishment has been this decades-long Jedi mind-trick.

Then again, many others (derided as 'fanboys') adore Musk: his social media fanbase is huge. I am not much for heroes – that Musk is a candidate has nothing to do with his abrasive persona and edgy tweets.

Musk is irascible and outspoken. He has little time for niceties. He is a workaholic. Doubtless he has a Mars-sized ego. He is probably not a pleasant or easy person. Personally, I dislike some of his views.

No, what impresses me is his drive to create a better future. Musk made millions out of PayPal, but then spurned mega yachts and desert islands, casinos and box-ticking philanthropy. Instead, Musk decided singlehandedly and literally to change the world.

Giving away the odd billion (like Bill Gates or Warren Buffett) is easy once you've got enough of them. Elon Musk works crazy hours and sleeps on the factory floor to save us from ourselves.

For Musk didn't invest his entire wealth in Tesla and SpaceX to get rich. He did it to force renewable energy on the world and expand our species into the cosmos as a hedge against existential risk. Yet he fully expected to fail and lose everything trying. And in 2008 he nearly did.

Yet despite many setbacks and all the naysayers, he is slowly achieving those lofty goals.

Before SpaceX, private launch was scarcely a thing. Now, SpaceX dominates launch globally and operates the only internet

service that works everywhere, bringing connectivity to the developing world.

SpaceX reused their Falcon 9 boosters some five hundred times before anyone else did. Until the recent Artemis missions, SpaceX was the only western organisation of any kind able to reliably launch crew.

But none of those accomplishments represent SpaceX's true ambition. For Musk started it with one core goal: the colonisation of Mars.

Many try to portray Elon's Mars obsession as a rich man's folly. But for Musk this isn't – as it surely is for other space billionaires – an expensive joyride. Indeed, Musk has been notably absent from SpaceX's own tourist trips, in contrast to Branson and Bezos who were among the first to fly on their own rockets.

Rather, Musk believes going to Mars is nothing less than an existential need for humanity. When we come to talk about existential risk later, we'll see he may even be right: a mix of visionary altruism and hubris. Like me, lots of small boys wanted to go to Mars and mourned NASA's failure to do so. Only Elon Musk has had the preposterous ambition to try to do it himself.

* * *

SpaceX began when Musk took a trip to Russia, accompanied by his best mate from college, an engineer (Jim Cantrell), his own ambition and a paltry million dollars. His intention was to buy a rocket, but the trip was a fiasco – the Russians wouldn't take him seriously and one allegedly spat in Musk's face.

That abortive trip to Russia didn't put Musk off – it convinced him to go it alone. Now, as SpaceX remorselessly undercuts Russia's launch business, the phlegm is flying in the opposite direction.

True, the three initial Falcon 1 missions were failures. The company was facing bankruptcy when the fourth launched successfully on the last fumes of Musk's PayPal millions. Even after its successor,

Falcon 9, was launching reliably, numerous attempts at landings were explosive failures. Many pundits said re-use would never be possible, certainly never economical.

But since 2015, singed and smoky Falcon 9 boosters, like that one on the corner of Crenshaw and Northrop, have landed successfully around six hundred times and counting. As I write, some have been re-used more than thirty times. Re-use has lowered the price of launch to the point where no one else can compete on cost. SpaceX has gone from plucky startup to accusations of monopoly in fifteen years.

But Falcon 9 – impressive though it surely is towering above LA, cheap to launch though it is compared with the competition – may be retired within a decade, despite its success and the global satellite industry's dependence on it. The reason? With its expendable upper stage and modest capacity, Falcon 9 is still too expensive and too limited for Musk's future Mars plans. So now SpaceX is developing something even more insane and mind-blowing (to use a pair of Musk-isms). That mind-blowing something is of course Starship.

* * *

In the late 1940s, my favourite space artist Chesley Bonestell painted the artwork for a book by Willy Ley, a former colleague of rocket scientist Wernher von Braun. That book, *The Conquest of Space*, was revolutionary. It describes an imaginary rocket journey around the solar system, treating the planets as real places to explore.

On page eighty-eight is a famous painting by Bonestell. A silver rocket sits amid the unnaturally jagged mountains of a pre-Apollo Moon with a half-Earth hanging above. Nothing like the Lunar Module, Bonestell's rocket is a sleek, shiny, pointed thing, with *fins*.

Chesley would recapitulate that rocket for another book, *The Exploration of Mars, in 1956*. Except that now its silver fins were resting on the ochre dust of Mars.

The bullet-shaped, finned rockets from *The Conquest of Space* and *The Exploration of Mars* derive from an era that Lowell directly influenced, through rocketry pioneers like Robert Goddard and von Braun. In the 1940s and early 1950s, the V-2 was the only big rocket in existence, so to mid-century boys that's how Moon and Mars rockets were *supposed* to look. SpaceX's Starship is for them.

Musk has called Starship his 'Tintin' rocket. That's because Tintin's fifties moonship in *Destination Moon* and *Explorers on the Moon*, by cartoonist Hergé, was based on the V-2 – even down to its chequered paint from wartime tests.

Starship's mid-century look is marketing genius, but it represents the reality of Starship's unusual construction from stainless steel and the need for streamlining. The Lunar Module was all exposed tanks and foil because it was discarded in space, never to encounter air. Starship is designed to launch from planets with an atmosphere – from the blue planet hanging over the finned rocket in Bonestell's painting, but from Mars too.

Now that Starship is successfully launching, we may yet see that image from *The Conquest of Space* become reality. Starship will likely land on the Moon – all spindly legs and dust-blasting retros – just like Bonestell's rocket. Only after that will it venture to Mars.

And once it gets to Mars, we're not just talking about a few brief Apollo-style forays. Musk envisages selling a kind of emigrant ticket to private individuals wanting to make 'a new life off-world' like the ads in the classic movie *Blade Runner*.

As it stands, Musk reckons the ticket price to Mars with expendable rockets would be much too high. As he ruefully notes, 'You can't create a self-sustaining civilization for $10 billion per person'. So Musk wants to drop that price to perhaps a hundred thousand dollars. If Musk can achieve that, he believes the probability of establishing a self-sustaining civilization is very high.

To enable that kind of 'routine' emigration at modest cost, Starship will need to achieve both aircraft-level reuse and serious

economies of scale. SpaceX is planning several launches per day from multiple sites – now including Florida and later Louisiana, as well as south Texas. But if it works, Starship will carry the first settlers to Mars in cabins with picture windows in a 1950s retro-fantasy rocket. You may not like Elon Musk, but you have to admit he's got style.

* * *

Later in this trip, we'll detour down to the gulf coast of Texas to see Starship evolving in its shiny stainless steel. But for now, I drove back to the freeway and headed north to find the remains of a previous reusable rocket dream.

Northeast of SpaceX lies LA's Exposition Park. There, I discovered whole city blocks given over to gardens and museums, clustered around the giant Memorial Coliseum. Among them was LA's California Science Center, which houses one of the few surviving Space Shuttles.

Short of time, I hurried past some models of famous Mars spacecraft. One was Mariner 4 that made the first Mars flyby, the pictures from which finally ended Lowell's fantasy Mars of canals and cities. Another was Viking, the first successful Mars lander, set in its own diorama.

Signs routed me through a gallery, down and out into the back garden where the Shuttle Endeavour had its own building. Nearby, one of its giant orange fuel tanks lay discarded incongruously among the roses like an oversized pumpkin. I'd spotted it earlier from the Natural History museum next door.

Incidentally, the tank and orbiter are soon to be erected together as a new display with a pair of solid fuel boosters as if waiting for launch – much as they are at Cape Canaveral. It's a scheme that delivers on awe, but detracts from seeing the engineering details.

I walked into a darkened and spot-lit hall and there it was, *the Space Shuttle,* in this case the Endeavour orbiter. For me this was a

big moment. A bunch of very strong and very mixed feelings came over me in a rush.

I had always wanted to see a Shuttle launch, as so evocatively described in a favourite track by the rock band Rush, back when I was a teenager in 1982.

I could only guess what it must have looked like with its boosters, rising on a golden blast of fire, as Rush had it. But there was a problem. The Shuttle killed fourteen astronauts. It also wasted Carl Sagan's billions and billions – not stars but dollars. Trivially, it marked the end of my boyhood space dreams.

On my birthday in 1969, Apollo 11 landed on the Moon and my monomaniacal small-boy's obsession with space intensified. I looked forward to growing up with space stations and Moon bases and missions to Mars.

I imagined myself one day living in a lunar cave base with a lava stalactite outside my window, leaving prints in the red sands of Mars. Then it all just ... ended. The reason was that magnificent machine in front of me at the Science Center.

* * *

The Space Shuttle program built the most complex machine in history, but cost a ruinous two hundred and ten billion dollars. The Shuttle was sold as a 'low cost' route to space – ten million dollars per flight. In actuality, that sum ballooned to one and a half billion dollars. Allowing for inflation, that's about 40% *more* than a Saturn V launch cost back then.

It's hard for me not to look at the Shuttle today and see a huge and deadly white elephant, a requiem for the dream of interplanetary space travel, the thing that killed NASA's plan for Mars by swallowing its budget whole.

I understand, or at least I think I do, why NASA wanted a reusable spacecraft in the 1970s. Like Musk today, they understood that reusability was the key to lowering the cost of going to space. But

the Shuttle was never all that reusable, requiring lots of costly refurbishment before each mission and with tanks and boosters discarded anyway.

After hundreds of successful Falcon 9 landings, it's easy to be critical of the Shuttle's over-complex approach. But that's not quite fair. A Falcon 9 relies on computer power unimaginable in the 1970s. A SpaceX Starship may ape the silver rocket in the fifties movie *Destination Moon*, but its technology is aggressively present day.

Still, the Shuttle flew an average of fewer than five times per year over its thirty-year service life. That's less than one launch of a given shuttle per year (five flying shuttles were built, Endeavour being the last). It's hard not to dream of what might have been if they'd just spent the cash re-purposing Apollo technology: Mars missions less than a lifespan after Lowell.

* * *

In the flesh, or rather aluminium and ceramic, the Shuttle orbiter is a magnificent thing – a muscular plane with three huge rocket motors sticking out of the back.

Looking at Endeavour, surrounded by rapt crowds in dim atmospheric lighting, I could see why it is still so divisive. Some see a towering US technological achievement. Others see a tragic waste of life and resources and *time.*

I took my time to explore Endeavour. I peered closely at the left wing's leading edge. There, one of the innocent looking black carbon panels had cracked after being hit by a piece of the orange foam coating the Shuttle fuel tank, causing of one of the Shuttle's deadly failures – the 2003 Columbia disaster.

I examined an RS-25 shuttle rocket motor, the first to embrace reuse. Up close, I tried to figure out how it all worked – its complex mass of piping and turbo-pumps. For the RS-25 was revolutionary. It employed a high-efficiency staged combustion system that Starship's Raptor engine expands on.

The solid fuel boosters and external fuel tank from the Shuttle have been re-purposed as part of NASA's Space Launch System, their 'new' booster for lunar and interplanetary missions. But that reuse of Shuttle technology extends to some actual Shuttle hardware.

Low-mileage, one careful owner RS-25 Shuttle engines, like the one I'd been examining, are being reused in the first stage of the SLS booster. Powered by them, SLS recently launched Artemis II, NASA's first mission beyond low Earth orbit since the end of Apollo in 1972. Artemis successfully circumnavigated the Moon and went over 250,000 miles from home (the furthest ever) bringing to an end years of dispiriting delays and cost overruns.

Even so, it's still possible that SpaceX's Starship program will make SLS obsolete in the longer term. SLS remains extremely expensive despite all those reused components and it is fully expendable, unlike Starship. If Starship succeeds, SLS may be the last booster NASA ever develops.

* * *

Back in the main Science Center building, nearby the Mars probes, I found an exhibit that made a poignant juxtaposition with the Shuttle. The display was of a tiny space capsule from the previous era – a truncated cone of darkened, pleated metal with a half-consumed heat shield at one end and a cylinder at the other. Inside were two very cramped seats, each with its own small window.

This was the Gemini XI capsule which flew into orbit with two astronauts on board – Pete Conrad and Richard Gordon – on September 12th 1966. The Gemini capsule was launched by a similarly modest rocket, a converted Titan ICBM of the type that used to populate prairie silos in flyover states.

Later in the trip, I happened on one at the Titan Missile Museum south of Tucson. The museum preserves an original Titan in its underground silo, complete with its ominous 'no-lone-zone'

launch bunker, full of antique computers and mounted on huge springs to help protect it from a nuclear blast.

All the Cold War apocalypse stuff at the bunker was fun, but much more significant to me was the Titan itself. Peering through an armoured green blast door into the silo, I was astonished by just how small it really was – much smaller than a SpaceX Falcon 9.

The public profile of Gemini is modest too, its legacy eclipsed by the later Apollo missions. Nonetheless, Gemini did much of the development for important stuff like rendezvous, docking and EVAs (Extra-Vehicular Activities) that Apollo would build on.

Gemini XI had another distinction: until (only just) surpassed by SpaceX's Polaris Dawn in 2024, it went furthest from Earth of any manned spacecraft except Apollo. The highest point of its elliptical orbit (its 'apogee', a compound of the Greek words for 'away from' and 'land') was over eight hundred miles from Earth.

Eight hundred miles may not sound much, but the Shuttle never ventured above three hundred and eighty miles. No one in the museum was paying Gemini XI much attention, but it went further than crowd-attracting Endeavour ever did.

All that money and effort, the terrible loss of life, and the Space Shuttle was confined to a mission that ended a few hundred miles up – *nothing*!

In December 1972, the last moon-walker, Apollo 17's commander Gene Cernan, wrote his daughter's initials in the lunar dust and climbed back into the Lunar Module. He opined hopefully that we'd be back 'not too long into the future'. But for almost fifty years into that future, nothing went more than a few hundred miles from home. That's roughly the distance from LA to Vegas. I'll say it again – really, *nothing*.

When Artemis II finally circumnavigated the Moon in 2026, it did so nearly sixty years after Apollo 8 did it first.

Sixty years! Compare that to the mere forty between the flight of the Opel Rak.1, the first purpose-built rocket-plane (a wood-and-

fabric glider with metal fireworks strapped to it) and Apollo 11's first lunar landing.

Sixty years *before* Apollo 11 was Lowell's era, a time of tweedy astronomers and telescopes with brass fittings, of straining at an eyepiece, dreaming of dying civilisations on Mars and dinosaurs on Venus.

I've grown old – literally – waiting for humans to resume travelling in deep space. Despite all the plans for Moon bases and Mars missions, despite the pledges from successive presidents and all that science fiction exploring and boldly going, the reality is we haven't gone, boldly or otherwise.

Sure, now astronauts have finally returned to deep(ish) space on Artemis, they have more computing power in their phones than the whole Kennedy Space Center back in the space race era. We've traded the dream of Captain Kirk's 'strange new worlds' for his communicator.

How has this happened and why? Perhaps the better CGI has become, the more satisfied we are with fictional space exploration – so much easier, cheaper and glossier than the tough and gritty real thing.

The 2015 blockbuster *The Martian* was an account of a NASA astronaut's stranding on Mars. Everyone praised its NASA-involved 'realism'. But in reality, the first boot on Mars may well belong to a SpaceX colonist.

This state of affairs is parlous, but also deeply puzzling. A puzzle much worthier of a conspiracy theory than whether NASA faked the Moon landings (they didn't and we do now have the images of Apollo landing sites to prove it).

Back in the day, I was an avid collector of Ladybird children's books, whose artwork imitated the style of Chesley Bonestell. I have a Ladybird book ('How it Works' The Rocket), from 1967, whose final page shows a dad watching the Moon's cratered surface with his kids through the picture window of a tourist spaceship. They're dressed for a day trip, leaning into the view from red vinyl diner-style seats.

I love that image's cosy banality – family space travel. I gazed at that painting many times as a child, thinking that at least the dad might one day be me. How could that image have been so wide of the mark?

The book's closing sentences read, 'Men may land on the Moon by 1970. And this will be just the beginning.' As it turned out, for the dream of family space travel and of trips to Mars too, that was pretty much the end. And that magnificent space plane at the Science Center, the Shuttle, was largely to blame.

* * *

After my encounter with the Shuttle, I drove underneath Sunset Boulevard, out of the Los Angeles Basin and up into the golden hills, past the mansions and country clubs of Bel Air. Coming down again, past Mulholland Drive, the snaking, cracked concrete freeway brought views of sprawling suburbs in the San Fernando Valley.

Somewhere away to the right was Pasadena, home of the Jet Propulsion Laboratory that makes Mars rovers. Above it in the mountains nestled Mount Wilson Observatory, from where I later hoped to see Mars with my own eyes as Lowell's refuters saw it. But for now, I veered west onto the Ventura Freeway towards the suburb of Canoga Park, headed for an old space company – Rocketdyne.

Eventually, I spotted the thing I was looking for on the east side of De Soto Avenue. It was sitting in a round flowerbed at the entrance to Rocketdyne's car park. Very strange it looked too, surrounded by carefully tended shrubs and blooms: a towering silver rocket engine.

The engine was placed there on my sixteenth birthday, to mark a decade since the first Moon landing. And that's because the engine is a legendary F-1, the engine that powered Apollo.

I parked up, walked over across the neatly trimmed verge and circled it, rubber-necking in awe.

The F-1 rocket engine is a superlative. Two storeys high, its nozzle looks voluminous enough to envelop my minivan. Developed in the mid-fifties, closer to Lowell's era than the present, it is still the most powerful liquid-fuelled rocket engine ever flown (the Russian RD-170 develops more power but has four nozzles).

'How powerful?' asks the small boy in my head.

The turbine which drove the F-1's fuel and oxidiser pumps, and which I could see above the pleated skirt of the nozzle, had the power output of almost sixty Formula One racing engines. The gas generator alone had half the thrust of a V-2 rocket. Each complete F-1 produced more than one and a half million pounds of thrust at lift-off – that's twenty-seven V-2s, or a squadron of fighter jets at full throttle.

Despite such huge power, the Apollo Saturn V booster needed five F-1s. The booster for NASA's proposed Mars mission would have required as many as eight.

The F-1 is the antithesis of the Shuttle. This monumental but quite simple engine, designed within a decade of the last of the wartime V-2 missiles, had until recently launched every single crewed mission beyond Earth orbit and with a 100% success rate.

We have nothing to equal the F-1's sheer power now. In 2013, NASA engineers tested remnant components from an F-1 in an effort to understand and potentially re-develop its lost capability.

That makes this great silver space machine sitting on the side of a road in an LA suburb like some alien artefact. An inscrutable device from a distant time, a half-forgotten technology that would need to be painstakingly reverse-engineered to replicate today.

Yet sixty years ago, one Wernher von Braun seriously believed he could use the F-1 to launch man to Mars by the early eighties, perhaps on the anniversary of Lowell's death: no wasted Shuttle billions, no SpaceX Starship required.

* * *

The novelist Edgar Rice Burroughs' *A Princess of Mars* was originally published in 1912. The novel was set on Barsoom, the Martians' name for Mars, a parched and dying planet of canals and warring cities, directly inspired by Lowell who was still actively writing about Martians and their canals at the time.

In the novel, the titular princess, Dejah Thoris, draws a map of Mars on the marble floor of a ruined palace with a 'great diamond from her hair'. The hero of the books, John Carter, describes her Mars thus:

> It was crisscrossed in every direction with long straight lines, sometimes converging towards some great circle. The lines, she said, were waterways …

Those waterways were, of course, Lowell's canals. Just a few miles on, I came across one.

Driving down from the mountains on the Antelope Valley Freeway, towards the city of Palmdale, I found a scenic turnout. To the north, the foreground was dominated by a reservoir, Lake Palmdale. Its blue waters contrasted vividly with the arid desert beyond. In front was a wide and meandering waterway.

This was the California Aqueduct. It looked how I imagined a Barsoomian canal might have appeared to Dejah Thoris – even of width and concrete-lined.

In fact, to have been visible from Earth, even with the most powerful telescope, a real Martian canal would have had to have been orders of magnitude larger.

The California Aqueduct is some thirty metres wide. On Burroughs' Barsoom, a waterway (a term he generally prefers to 'canal') takes five hours to cross 'without a single halt', which would make it at least 15–20 miles wide – a width that agrees well with astronomers' estimates at the time.

Despite its smaller scale, the California Aqueduct's purpose is the same. It brings vital water from wetter lands in the north, through

the desert, to the parched and growing cities and farms of southern California, just as the Barsoomian canals took water to the parched cities and arable lands of Lowell's and Burroughs' Mars.

The California Aqueduct was begun in the sixties, but its progenitor, the LA Aqueduct, was built in Lowell's day and it is interesting to speculate whether one influenced the other.

Standing in the hot sun and dry air on the edge of the Mojave Desert, I just longed to run down the slope and dive into the aqueduct's clear waters. Instead, I rejoined the freeway and drove on down to the city of Palmdale.

On the way, I stopped at a vast suburban shopping centre to buy the gallons of bottled water (probably delivered by the aqueduct) that I was going to need to avoid expiring in the parched desert myself. But before heading on into the Mojave, I wanted to take a close look at a UFO. Or rather something often mistaken for one. For UFOs are arguably another legacy of Percival Lowell's Martians, or at least of the thought-world they spawned mid-century.