GENETICS

The fable of the dragon tyrant

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This paper recounts the tale of a most vicious dragon that ate thousands of people every day, and of the actions that the king, the people, and an assembly of dragonologists took with respect thereof.

Once upon a time, the planet was tyrannised by a giant dragon. The dragon stood taller than the largest cathedral, and it was covered with thick black scales. Its red eyes glowed with hate, and from its terrible jaws flowed an incessant stream of evil smelling yellowish green slime. It demanded from humankind a blood curdling tribute: to satisfy its enormous appetite, ten thousand men and women had to be delivered every evening at the onset of dark to the foot of the mountain where the dragon tyrant lived. Sometimes the dragon would devour these unfortunate souls upon arrival; sometimes again it would lock them up in the mountain where they would wither away for months or years before eventually being consumed.

The misery inflicted by the dragon tyrant was incalculable. In addition to the ten thousand who were gruesomely slaughtered each day, there were the mothers, fathers, wives, husbands, children, and friends who were left behind to grieve the loss of their departed loved ones.

Some people tried to fight the dragon, but whether they were brave or foolish was difficult to say. Priests and magicians called down curses, to no avail. Warriors, armed with roaring courage and the best weapons the smiths could produce, attacked it, but were incinerated by its fire before coming close enough to strike. Chemists concocted toxic brews and tricked the dragon into swallowing them, but the only apparent effect was to further stimulate its appetite. The dragon's claws, jaws, and fire were so effective, its scaly armour so impregnable, and its whole nature so robust, as to make it invincible to any human assault.

Seeing that defeating the tyrant was impossible, humans had no choice but to obey its commands and pay the grisly tribute. The fatalities selected were always elders. Although senior people were as vigorous and healthy as the young, and sometimes wiser, the thinking was that they had at least already enjoyed a few decades of life. The wealthy might gain a brief reprieve by bribing the press gangs that came to fetch them, but, by constitutional law, nobody, not even the king himself, could put off their turn indefinitely.

Spiritual men sought to comfort those who were afraid of being eaten by the dragon (which included almost everyone, although many denied it in public) by promising another life after death, a life that would be free from the dragon scourge. Other orators argued that the dragon had its place in the natural order and a moral right to be fed. They said it was part of the very meaning of being human to end up in the dragon's stomach. Others still maintained that the dragon was good for the human species because it kept the population size down. To what extent these arguments convinced the worried souls is not known. Most people tried to cope by not thinking about the grim end that awaited them.

For many centuries this desperate state of affairs continued. Nobody kept count any longer of the cumulative death toll, nor of the number of tears shed by the bereft. Expectations had gradually adjusted and the dragon tyrant had become a fact of life. In view of the evident futility of resistance, attempts to kill the dragon had ceased. Instead, efforts now focused on placating it. Although the dragon would occasionally raid the cities, it was found that the punctual delivery to the mountain of its quota of life reduced the frequency of these incursions.

Knowing that their turn to become dragon fodder was always impending, people began having children earlier and more often. It was not uncommon for a girl to be pregnant by her sixteenth birthday. Couples often spawned a dozen children. The human population was thus kept from shrinking, and the dragon was kept from going hungry.

Over the course of these centuries, the dragon, being well fed, slowly but steadily grew bigger. It had become almost as large as the mountain on which it lived and its appetite had increased proportionately. Ten thousand human bodies were no longer enough to fill its belly. It now demanded eighty thousand, to be delivered to the foot of the mountain every evening at the onset of dark.

What occupied the king's mind more than the deaths and the dragon itself was the logistics of collecting and transporting so many people to the mountain every day. This was not an easy task.

To facilitate the process, the king had a railway track constructed: two straight lines of glistening steel leading up to the dragon's abode. Every twenty minutes, a train would arrive at the mountain terminal crammed with people, and would return empty. On moonlit nights, the passengers travelling on this train, if there had been windows for them to stick their heads out of, would have been able to see in front of them the double silhouette of the dragon and the

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mountain, and two glowing red eyes, like the beams from a pair of giant lighthouses, pointing the way to annihilation.

Servants were employed by the king in large numbers to administer the tribute. There were registrars who kept track of whose turn it was to be sent. There were people collectors who would be dispatched in special carts to fetch the designated people. Often travelling at breakneck speed, they would rush their cargo either to a railway station or directly to the mountain. There were clerks who administered the pensions paid to the decimated families who were no longer able to support themselves. There were comforters who would travel with the doomed on their way to the dragon, trying to ease their anguish with spirits and drugs.

There was, moreover, a cadre of dragonologists, who studied how these logistical processes could be made more efficient. Some dragonologists also conducted studies of the dragon's physiology and behaviour, and collected samples—its shed scales, the slime that drooled from its jaws, its lost teeth, and its excrements, which were specked with fragments of human bone. All these items were painstakingly annotated and archived. The more the beast was understood, the more the general perception of its invincibility was confirmed. Its black scales, in particular, were harder than any material known to man, and there seemed no way to make as much as a scratch in its armour.

To finance all these activities, the king levied heavy taxes on his people. Dragon related expenditures, already accounting for one seventh of the economy, were growing even faster than the dragon itself.

Humanity is a curious species. Every once in a while, somebody gets a good idea. Others copy the idea, adding to it their own improvements. Over time, many wondrous tools and systems are developed. Some of these devices—calculators, thermometers, microscopes, and the glass vials that the chemists use to boil and distil liquids—serve to make it easier to generate and try out new ideas, including ideas that expedite the process of idea generation.

Thus the great wheel of invention, which had turned at an almost imperceptibly slow pace in the older ages, gradually began to accelerate.

Sages predicted that a day would come when technology would enable humans to fly and do many other astonishing things. One of the sages, who was held in high esteem by some of the other sages but whose eccentric manners had made him a social outcast and recluse, went so far as to predict that technology would eventually make it possible to build a contraption that could kill the dragon tyrant.

The king's scholars, however, dismissed these ideas. They said that humans were far too heavy to fly and in any case lacked feathers. As for the impossible notion that the dragon tyrant could be killed, history books recounted hundreds of attempts to do just that, not one of which had been successful. ''We all know that this man had some irresponsible ideas,'' a scholar of letters later wrote in his obituary of the reclusive sage who had by then been sent off to be devoured by the beast whose demise he had foretold, ''but his writings were quite entertaining and perhaps we should be grateful to the dragon for making possible the interesting genre of dragon bashing literature which reveals so much about the culture of angst!''

Meanwhile, the wheel of invention kept turning. Mere decades later, humans did fly and accomplished many other astonishing things.

A few iconoclastic dragonologists began arguing for a new attack on the dragon tyrant. Killing the dragon would not be easy, they said, but if some material could be invented that was harder than the dragon's armour, and if this material could be fashioned into some kind of projectile, then maybe the feat would be possible. At first, the iconoclasts' ideas were rejected by their dragonologist peers on grounds that no known material was harder than dragon scales. But after working on the problem for many years, one of the iconoclasts succeeded in demonstrating that a dragon scale could be pierced by an object made of a certain composite material. Many dragonologists who had previously been sceptical now joined the iconoclasts. Engineers calculated that a huge projectile could be made of this material and launched with sufficient force to penetrate the dragon's armour.

The manufacture of the needed quantity of the composite material would, however, be expensive.

A group of several eminent engineers and dragonologists sent a petition to the king asking for funding to build the antidragon projectile. At the time when the petition was sent, the king was preoccupied with leading his army into war against a tiger. The tiger had killed a farmer and subsequently disappeared into the jungle. There was widespread fear in the countryside that the tiger might come out and strike again. The king had the jungle surrounded and ordered his troops to begin slashing their way through it. At the conclusion of the campaign, the king could announce that all 163 tigers in the jungle, including presumably the murderous one, had been hunted down and killed. During the tumult of the war, however, the petition had been lost or forgotten.

The petitioners therefore sent another appeal. This time they received a reply from one of the king's secretaries saying that the king would consider their request after he was done reviewing the annual dragon administration budget. This year's budget was the largest to date and included funding for a new railway track to the mountain. A second track was deemed necessary, as the original track could no longer support the increasing traffic. (The tribute demanded by the dragon tyrant had increased to one hundred thousand human beings, to be delivered to the foot of the mountain every evening at the onset of dark.) When the budget was finally approved, however, reports were coming from a remote part of the country that a village was suffering from a rattlesnake infestation. The king had to leave urgently to mobilise his army and ride off to defeat this new threat. The antidragonists' appeal was filed away in a dusty cabinet in the castle basement.

The antidragonists met again to decide what was to be done. The debate was animated and continued long into the night. It was almost daybreak when they finally resolved to take the matter to the people. Over the following weeks, they travelled around the country, gave public lectures, and explained their proposal to anyone who would listen. At first, people were sceptical. They had been taught in school that the dragon tyrant was invincible and that the sacrifices it demanded had to be accepted as a fact of life. Yet when they learnt about the new composite material and about the designs for the projectile, many became intrigued. In increasing numbers, citizens flocked to the antidragonist lectures. Activists started organising public rallies in support of the proposal.

When the king read about these meetings in the newspaper, he summoned his advisors and asked them what they thought about them. They informed him about the petitions that had been sent but told him that the antidragonists were troublemakers whose teachings were causing public unrest. It was much better for the social order, they said, that the people accepted the inevitability of the dragon tyrant tribute. The dragon administration provided many jobs that would be lost if the dragon was slaughtered. There was no known social good coming from the conquest of the dragon. In any case, the king's coffers were currently nearly empty after the two military campaigns and the funding set aside for the second railway line. The king, who was at the time enjoying

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great popularity for having vanquished the rattlesnake infestation, listened to his advisors' arguments but worried that he might lose some of his popular support if he was seen to ignore the antidragonist petition. He therefore decided to hold an open hearing. Leading dragonologists, ministers of the state, and interested members of the public were invited to attend.

The meeting took place on the darkest day of the year, just before the Christmas holidays, in the largest hall of the royal castle. The hall was packed to the last seat and people were crowding in the aisles. The mood was charged with an earnest intensity normally reserved for pivotal wartime sessions.

After the king had welcomed everyone, he gave the floor to the leading scientist behind the antidragonist proposal, a woman with a serious, almost stern expression on her face. She proceeded to explain in clear language how the proposed device would work and how the requisite amount of the composite material could be manufactured. Given the requested amount of funding, it should be possible to complete the work in fifteen to twenty years. With an even greater amount of funding, it might be possible to do it in as little as twelve years. There could, however, be no absolute guarantee that it would work. The crowd followed her presentation intently.

Next to speak was the king's chief advisor for morality, a man with a booming voice that easily filled the auditorium.

''Let us grant that this woman is correct about the science and that the project is technologically possible, although I don't think that has actually been proven. Now she desires that we get rid of the dragon. Presumably, she thinks she's got the right not to be chewed up by the dragon. How wilful and presumptuous. The finitude of human life is a blessing for every individual, whether he knows it or not. Getting rid of the dragon, which might seem like such a convenient thing to do, would undermine our human dignity. The preoccupation with killing the dragon will deflect us from realising more fully the aspirations to which our lives naturally point, from living well rather than merely staying alive. It is debasing, yes debasing, for a person to want to continue his or her mediocre life for as long as possible without worrying about some of the higher questions about what life is to be used for. But I tell you, the nature of the dragon is to eat humans, and our own species specified nature is truly and nobly fulfilled only by getting eaten by it...''

The audience listened respectfully to this highly decorated speaker. The phrases were so eloquent that it was hard to resist the feeling that some deep thoughts must lurk behind them, although nobody could quite grasp what they were. Surely, words coming from such a distinguished appointee of the king must have profound substance.

The speaker next in line was a spiritual sage who was widely respected for his kindness and gentleness as well as for his devotion. As he strode to the podium, a small boy yelled out from the audience: ''The dragon is bad!''

The boy's parents turned bright red and began hushing and scolding the child. But the sage said: ''Let the boy speak. He is probably wiser than an old fool like me.''

At first, the boy was too scared and confused to move but when he saw the genuinely friendly smile on the sage's face and the outreached hand, he obediently took it and followed the sage up to the podium. ''Now, there's a brave little man,'' said the sage. ''Are you afraid of the dragon?''

''I want my granny back,'' said the boy.

''Did the dragon take your granny away?''

''Yes,'' the boy said, tears welling up in his large frightened eyes. ''Granny promised that she would teach me how to bake gingerbread cookies for Christmas. She said that we would make a little house out of gingerbread and little gingerbread men that would live in it. Then those people in white clothes came and took Granny away to the dragon...The dragon is bad and it eats people…I want my Granny back!''

At this point the child was crying so hard that the sage had to return him to his parents.

There were several other speakers that evening, but the child's simple testimony had punctured the rhetorical balloon that the king's ministers had tried to inflate. The people were backing the antidragonists, and by the end of the evening even the king had come to recognise the reason and the humanity of their cause. In his closing statement, he simply said: ''Let's do it!''

As the news spread, celebrations erupted in the streets. Those who had been campaigning for the antidragonists toasted each other and drank to the future of humanity.

The next morning, a billion people woke up and realised that their turn to be sent to the dragon would come before the projectile would be completed. A tipping point was reached. Whereas before, active support for the antidragonist cause had been limited to a small group of visionaries, it now became the number one priority and concern on everybody's mind. The abstract notion of ''the general will'' took on an almost tangible intensity and concreteness. Mass rallies raised money for the projectile project and urged the king to increase the level of state support. The king responded to these appeals. In his New Year address, he announced that he would pass an extra appropriations bill to support the project at a high level of funding; additionally, he would sell off his summer castle and some of his land and make a large personal donation. ''I believe that this nation should commit itself to achieving the goal, before this decade is out, of freeing the world from the ancient scourge of the dragon tyrant.''

Thus started a great technological race against time. The concept of an antidragon projectile was simple, but to make it a reality required solutions to a thousand smaller technical problems, each of which required dozens of time consuming steps and missteps. Test missiles were fired but fell dead to the ground or flew off in the wrong direction. In one tragic accident, a wayward missile landed on a hospital and killed several hundred patients and staff. Now, however, there was a real seriousness of purpose, and the tests continued even as the corpses were being dug out from the debris.

Despite almost unlimited funding and round the clock work by the technicians, the king's deadline could not be met. The decade concluded and the dragon was still alive and well. The effort, however, was getting closer. A prototype missile had been successfully test fired. Production of the core, made of the expensive composite material, was on schedule for its completion to coincide with the finishing of the fully tested and debugged missile shell into which it was to be loaded. The launch date was set to be the following year's New Year's Eve, exactly twelve years after the project's official inauguration. The best selling Christmas gift that year was a calendar that counted down the days to time zero, the proceeds going to the projectile project.

The king had undergone a personal transformation from his earlier frivolous and thoughtless self. He now spent as much time as he could in the laboratories and the manufacturing plants, encouraging the workers, and praising their toil. Sometimes he would bring a sleeping bag and spend the night on a noisy machine floor. He even studied and tried to understand the technical aspects of their work. Yet he confined himself to giving moral support and refrained from meddling in technical and managerial matters.

Seven days before New Year, the woman who had made the case for the project almost twelve years earlier, and was

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now its chief executive, came to the royal castle and requested an urgent audience with the king. When the king got her note, he excused himself to the foreign dignitaries whom he was reluctantly entertaining at the annual Christmas dinner and hurried off to the private room where the scientist was waiting. As always of late, she looked pale and worn from her long working hours. This evening, however, the king also thought he could detect a ray of relief and satisfaction in her eyes.

She told him that the missile had been deployed, the core had been loaded, everything had been triple checked, they were ready to launch, and would the king give his final go ahead. The king sank down in an armchair and closed his eyes. He was thinking hard. By launching the projectile tonight, one week early, seven hundred thousand people would be saved. Yet if something went wrong, if it missed its target and hit the mountain instead, it would be a disaster. A new core would have to be constructed from scratch and the project would be set back by some four years. He sat there, silently, for almost an hour. Just as the scientist had become convinced that he had fallen asleep, he opened his eyes and said in a firm voice: ''No. I want you to go right back to the lab. I want you to check and then recheck everything again.'' The scientist could not help a sigh escaping her; but she nodded and left.

The last day of the year was cold and overcast, but there was no wind, which meant good launch conditions. The sun was setting. Technicians were scuttling around making the final adjustments and giving everything one last check. The king and his closest advisors were observing from a platform close to the launch pad. Further away, behind a fence, large numbers of the public had assembled to witness the great event. A large clock was showing the countdown: fifty minutes to go.

An advisor tapped the king on the shoulder and drew his attention to the fence. There was some tumult. Somebody had apparently jumped the fence and was running toward the platform where the king sat. Security quickly caught up with him. He was handcuffed and taken away. The king turned his attention back to the launch pad, and to the mountain in the background. In front of it, he could see the dark slumped profile of the dragon. It was eating.

Some twenty minutes later, the king was surprised to see the handcuffed man reappearing a short distance from the platform. His nose was bleeding and he was accompanied by two security guards. The man appeared to be in frenzied state. When he spotted the king, he began shouting at the top of his lungs: ''The last train! The last train! Stop the last train!''

''Who is this young man?'' said the king. ''His face seems familiar, but I cannot quite place him. What does he want? Let him come up.''

The young man was a junior clerk in the ministry of transportation, and the reason for his frenzy was that he had discovered that his father was on the last train to the mountain. The king had ordered the train traffic to continue, fearing that any disruption might cause the dragon to stir and leave the open field in front of the mountain where it now spent most of its time. The young man begged the king to issue a recall order for the last train, which was due to arrive at the mountain terminal five minutes before time zero.

''I cannot do it,'' said the king, ''I cannot take the risk.''

''But the trains frequently run five minutes late. The dragon won't notice! Please!''

The young man was kneeling before the king, imploring him to save his father's life and the lives of the other thousand passengers onboard that last train.

The king looked down at the pleading, bloodied face of the young man, but he bit his lip, and shook his head. The young man continued to wail even as the guards carried him off the platform: ''Please! Stop the last train! Please!''

The king stood silent and motionless, until, after a while, the wailing suddenly ceased. The king looked up and glanced over at the countdown clock: five minutes remaining.

Four minutes. Three minutes. Two minutes.

The last technician left the launch pad.

30 seconds. 20 seconds. Ten, nine, eight…

As a ball of fire enveloped the launch pad and the missile shot out, the spectators instinctively rose to the tips of their toes, and all eyes fixated at the front end of the white flame from the rocket's afterburners, heading towards the distant mountain. The masses, the king, the low and the high, the young and the old, it was as if at this moment they shared a single awareness, a single conscious experience: that white flame, shooting into the dark, embodying the human spirit, its fear and its hope…striking at the heart of evil. The silhouette on the horizon tumbled, and fell. A thousand voices of pure joy rose from the assembled masses, joined seconds later by a deafening drawn out thud from the collapsing monster as if the Earth itself was drawing a sigh of relief. After centuries of oppression, humanity at last was free from the cruel tyranny of the dragon.

The joy cry resolved into a jubilating chant: ''Long live the king! Long live us all!'' The king's advisors, like everybody that night, were as happy as children; they embraced each other and congratulated the king: ''We did it! We did it!''

The king, however, answered in a broken voice: ''Yes, we did it, we killed the dragon today. But damn, why did we start so late? This could have been done five, maybe ten years ago! Millions of people wouldn't have had to die.''

The king stepped off the platform and walked up to the young man in handcuffs, who was sitting on the ground. There he fell down on his knees. ''Forgive me! Oh my God, please forgive me!''

MORAL

Stories about ageing have traditionally focused on the need for graceful accommodation. The recommended solution to diminishing vigour and impending death was resignation coupled with an effort to achieve closure in practical affairs and personal relationships. Given that nothing could be done to prevent or retard ageing, this focus made sense. Rather than fretting about the inevitable, one could aim for peace of mind.

Today we face a different situation. Although we still lack effective and acceptable means for slowing the ageing process, we can identify research directions that might lead to the development of such means in the foreseeable future.[i]

''Deathist'' stories and ideologies, which counsel passive acceptance, are no longer harmless sources of consolation. They are reckless and dangerous barriers to urgently needed action.

Many distinguished technologists and scientists tell us that it will become possible to retard, and eventually to halt and reverse, human senescence. A recent straw poll at the 10th Congress of the International Association of Biomedical

[i]Calorie restriction (a diet low in calories but high in nutrients) extends maximal lifespan and delays the onset of age related illnesses in all species that have been tested. Preliminary results from an ongoing study on rhesus and squirrel monkeys show similar effects. It seems quite likely that calorie restriction would work for our species too. Few humans, however, would be willing to put themselves through a lifelong hunger/diet. Some researchers are searching for calorie restriction mimetics—compounds that elicit the desirable effects of lowered caloric intake without us having to go hungry.

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Gerontology revealed that the majority of the participants thought it either probable or ''not improbable'' that comprehensive functional rejuvenation of middle aged mice would be possible within 10–20 years.[2–4] At present, there is little agreement about the timescale or the specific means, nor is there a consensus that the goal is even achievable in principle. In relation to the fable (where ageing is, of course, represented by the dragon), we are therefore at a stage somewhere between that at which the lone sage predicted the dragon's eventual demise and that at which the iconoclast dragonologists convinced their peers by demonstrating a composite material that was harder than dragon scales.

The general ethical argument in the fable is simple: there are obvious and compelling moral reasons for the people in the fable to get rid of the dragon. Our situation with regard to human senescence is closely analogous and ethically isomorphic to the situation of the people in the fable with regard to the dragon. Therefore, we have compelling moral reasons to get rid of human senescence.

The argument is not in favour of lifespan extension as such. Adding extra years of sickness and debility at the end of life would be pointless. The argument is in favour of extending, as far as possible, the human *healthspan*. By slowing or halting the ageing process, the healthy human lifespan would be extended. Individuals would be able to remain healthy, vigorous, and productive at ages at which they would otherwise be dead.

In addition to this general moral, there are a number of more specific lessons:

1) *A recurrent tragedy became a fact of life, a statistic*. In the fable, people's expectations adapted to the existence of the dragon, to the extent that many became unable to perceive its badness. Ageing, too, has become a mere ''fact of life''—despite being the principal cause of an unfathomable amount of human suffering and death.
2) *A static view of technology*. People reasoned that it would never become possible to kill the dragon because all attempts had failed in the past. They failed to take into account accelerated technological progress. Is a similar mistake leading us to underestimate the chances of a cure for ageing?
3) *Administration became its own purpose*. One seventh of the economy went to dragon administration (which is also the fraction of its GDP that the US spends on health care). Damage limitation became such an exclusive focus that it made people neglect the underlying cause. Instead of a massive publicly funded research programme to halt ageing, we spend almost our entire health budget on health care and on researching individual diseases.
4) *The social good became detached from the good for people*. The king's advisors worried about the possible social problems that could be caused by the antidragonists. They said that no known social good would come from the demise of the dragon. Ultimately, however, social orders exist for the benefit of people, and it is generally good for people if their lives are saved.
5) *The lack of a sense of proportion*. A tiger killed a farmer. A rhumba of rattlesnakes plagued a village. The king got rid of the tiger and the rattlesnakes, and thereby did his people a service. Yet he was at fault, because his priorities were wrong.
6) *Fine phrases and hollow rhetoric*. The king's morality advisor spoke eloquently about human dignity and our species specified nature, in phrases lifted, mostly verbatim, from the advisor's contemporary equivalents.[5] Yet the rhetoric was a smokescreen that hid rather than revealed moral reality. The boy's inarticulate but honest testimony, by contrast, points to the central fact of the case: the dragon is bad; it destroys people. This is also the basic truth about human senescence.
7) *Failure to appreciate the urgency*. Until very late in the story, nobody fully realised what was at stake. Only as the king is staring into the bloodied face of the young pleading man does the extent of the tragedy sink in. Searching for a cure for ageing is not just a nice thing that we should perhaps one day get around to. It is an urgent, screaming moral imperative. The sooner we start a focused research programme, the sooner we will get results. It matters if we get the cure in 25 years rather than in 24 years: a population greater than that of Canada would die as a result. In this matter, time equals life, at a rate of approximately 70 lives per minute. With the meter ticking at such a furious rate, we need to stop faffing about.
8) *What happens next?* The king and his people will face some major challenges. Their society has been so conditioned and deformed by the presence of the dragon that a frightening void now exists. They will have to work creatively, at both an individual and collective level, to develop conditions that will keep lives flourishingly dynamic and meaningful beyond the accustomed three score years and ten. Luckily, the human spirit is good at adapting. Social stasis will also have to be avoided, and this might require some institutional changes—for example, education might have to become a periodic activity engaged in throughout the lifespan rather than just in the initial segment of a person's life. Another issue that they may eventually confront is overpopulation. Maybe people will have to learn to have children later and less frequently. Maybe they can find ways to sustain a larger population by using more efficient technology. Maybe they will one day develop spaceships and begin to colonize the cosmos. We can leave, for now, the long lived fable people to grapple with these new challenges, while we try to make some progress in our own adventure.

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