Abstract

This collection of stories is about discovering identity, and the dreams that were born from this long hunt. Such a pursuit might have been chasing an ideal that never truly existed. Or worse yet, chasing somebody else’s hopes and dreams. Goals change. People change. Yet, as ephemeral as my dreams today might be, they are above all, my own.

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Introduction

It is weird that I would want to write.

English was not my first language, nor was my family literarily inclined. English was always seen in the same vein as the piano, or sports, or calligraphy. Useful for showing off, but not really something you got serious with.

My career choice and life trajectory should have been set in stone. Everybody I went to high school with was going to be a doctor, a dentist, or a computer scientist. Yet, my heart just wasn’t in it. I had the grades, but not the passion.

This was when I started writing in earnest, as an escape from the monotony and high-pressure situations of competitive Asian schools. I found freedom in creating worlds and crafting stories.

These stories are a collection written during my growing disillusionment with the medical industry, and a corresponding struggling period of depression. They are science stories, but they also represent an introspective journey, a journey for somebody who has never felt he truly belonged, not culturally or professionally or academically, an ongoing journey to finally find a place where he fits.

All of this work was written since 2019 in the Hopkins Master of Arts in Science Writing Program. I would like to thank my ever-patient thesis advisor Kim O’Connell, and Ethan Wong, who has helped me understand that I am at my best when doing something I enjoy. And for the time being, that is writing.

Kieran Tuan
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How would you copy a line of text? If your answer was to insert the text into the margins of an article, throw the article into a copy machine, then meticulously cut out the text with a pair of scissors, then you need help. Yet, this was precisely what scientists were forced to do until the invention of polymerase chain reaction, or PCR for short, in 1983.

By the 1980s, scientists were aware of the potential DNA had as the building blocks of life. They were interested in studying and manipulating DNA but were stymied by just how little there was to work with. The only way to create the desired genome sequence in sufficient quantities to study was through inserting said sequence into bacterium, then letting the bacterium reproduce the DNA through purely biological means. As such, DNA research was inevitably slow, difficult, and expensive.

In 1983, on a road trip from San Francisco to Mendocino, bioengineer Kary Mullis had a flash of insight. Would it be possible to cut out the middleman? Bacterium was just a medium to create more DNA, so why keep them in if it could be avoided? What if the entire process could be simplified to just the DNA, and the enzymes required to duplicate them, and maybe a splash of heat to speed up the whole process? If it could be done, then the process would transcend biology and ascend to the realm of mathematics—a world of unbridled power and of exponential growth.

And with this, polymerase chain reaction was born.

The underlying concept is elegant in its simplicity. When we interlace our fingers, we would have a flattened approximate of how the double helix works. Each finger is a
“letter” of the DNA sequence, and has a corresponding opposite slot to slide into, much like how each lock has its own key. Further, regardless of the positions of our original fingers, once intertwined, they will conform to roughly the same place. This means we can think of DNA as two molds, which each hand being able to tell us what the other hand is supposed to look like.

PCR can be divided into three processes. The first step is called denaturization, which does the job of separating the intertwined hands that are stuck together. Much like how warm water washes away glue, heat (around 94~98°C) helps break the bonds that hold the two DNA helixes together. Ever fry an egg? Eggs are mostly protein, which are basically long strings of DNA curled up into a ball. Heat will change the texture of an egg from runny to solid, and the same process is repeated here. By adding heat, the DNA unravels for easy access during the next step.

The second step is annealing. Put your fingertips onto each other. Your fingers have found the location they are supposed to be at before you can begin to interlace them. For your fingers to do this task, the hands must maintain relatively steady, so in PCR, the temperature, which raises the movement speed of molecules, must be lowered (to 50~65°C) for the molecules to begin binding. Here, the analogue for our sensitive fingertips is the primer, a strip of DNA that can find the correct place in the sequence to insert itself, acting as a landmark for following molecules.

The third and final step is elongation. Slowly slide your fingers into each other. To accelerate this process, the temperature is raised slightly (75~80°C), but not to the point where the fingers will separate again. At the end of these three steps, the original two hands have doubled to four, and by repeating the cycle again, that number will be
eight, and so forth. Usually, a PCR process is repeated 30~40 times, using the power of mathematics (2 to the power of 30 is over a billion) to quickly compound the amount of DNA replicated.

PCR is seen nearly everywhere DNA is used, be it forensics, genetic testing, or general research, and nowadays in COVID testing. The possibilities are endless, and the story of PCR is still being written in laboratories around the world.
Aortic Dissection—The Silent Assassin

The year was 1760, and King George didn’t know there was a bomb at Kensington palace.

The bomb was a small one. So small, in fact, that it was undetectable, even if the king’s men had known it was there.

It was just past six, and the king sipped hot chocolate while the butler read the news to him.

Lub-Dub. Lub-Dub. Lub-Dub. None of them heard the ticking of the timer.

At seven, the King went to do his morning business – not five minutes later the butler heard a loud crash. The butler ran in as fast as he could, but by then it was too late. King George was dead.

It would be sixty more years before physicians would have a name for the bomb that went off next to King George’s heart that day – aortic dissection.

* The bomb’s mechanism is a simple one. A small tear in the aorta (the biggest artery in the body) lets blood pour in – and out just as quickly. It becomes a cul-de-sac, the blood has nowhere else to go but back into the aorta. For now. Like erosion, the force of the blood slowly weakens the walls of the aorta, deepening the pool. The trickle of blood becomes a river, then a lake, and when the abused layer of the aorta gives way… Boom. That’s it.

Aortic dissection isn’t a common disease – but it is a deadly one. With a prognosis that worsens by the hour, forty percent die outright and never see the hospital. Of the
remainder, up to 20% will die in surgery. Yet, lethal as aortic dissection is, scarier still is just how silently it works.

* 

I last saw Dr. Lin Yi-Min three months ago. He was a good family friend, a genial man who carried himself with a youthful energy that suggested he was closer to twenty than his actual forty. I had a doctor’s appointment with him, but we didn’t meet at his clinic. We met at the funeral house. His funeral. It was a great shock to finally aortic dissection outside the textbooks. Dr. Lin had been an accomplished doctor, and aortic dissection still took him by complete surprise.

I met Dr. Fang, a cardiovascular surgeon and mutual friend at the funeral wake. Dr. Fang said there was little to be done after the event in Dr. Lin’s case. He had been sent to an advanced medical center in minutes and still died on the operating table. Cancer would have been a far more survivable disease. That was something you could see coming, and even the most aggressive forms of cancer weren’t remotely in the same ballpark of lethality as aortic dissection. In fact, trauma – such as being in a car crash (one in 100 odds of dying) and being shot (one in 20 odds) would have been better odds. Dr. Fang told me to not think of aortic dissections’ speed and deadliness in terms of diseases, but as something in the realm of poison.

According to Dr. Fang, diagnosing aortic dissection in advance is a task like finding Waldo. A bunch of diseases look similar at onset, such as aortic insufficiency (blood flowing in the reverse direction in the aorta), pleural effusion (fluid collection in the space between the lungs and the diaphragm), and heart attacks. But there is one critical indicator
of aortic dissection: Severe pain, or more accurately, a tearing pain that feels like a stab wound around the chest and back.

“But if you are feeling that kind of pain, the odds are already against you,” says Dr. Fang. The bomb named aortic dissection can be defused – but only with difficulty, through either notoriously risky open heart bypass surgery, or endovascular surgery, where a small balloon is inserted then inflated inside the weakened blood vessel, a complex procedure only a select few hospitals and surgeons are capable of performing. After all that, approximately 60% of cases will blow up regardless. The best course of action? To never have the bomb planted in the first place. Many genetic diseases can increase the risk of getting aortic dissection, such as Marfan syndrome and Ehlers-Danlos syndrome, connective tissue disorders that weaken the surrounding reinforcements of the aorta, in turn rendering the aorta more prone to breaking down. There are also vasculitides like Behcet's disease, inflammation-causing sicknesses that work directly against the walls of the aorta, but all these problems can be alleviated by one thing – a healthier lifestyle.

How this works is simple. Aortic dissection relies on blood pressure to start that first miniscule tear, the same tear that will start the chain reaction of incessant weakening of aorta layers and will end in the layers of the aorta breaking up with each other. Nip the burning fuse, and there is no threat.

In the end, our own lifestyle is the first bulwark against dangers of aortic dissection, but we can take heart in knowing that it isn’t the last. Science has come a long way since King George’s death. Thanks to stents, grafts and other modern advances, aortic dissection’s countdown is much less inevitable.
Residency taught me a lot of things – some stuck, most didn’t. The first two lessons were the most memorable. I learned the first lesson by spending many a time working thirty-six hours straight. *Time is like a wet sponge. The more you squeeze, the more you get.* The second lesson was understanding this wasn’t all of it. There was a darker side.

I entered residency an eager, bright-eyed young doctor. Here I was, finally free from the clutches of five long, grueling years of medical school, ready to do some real medicine. True, I had heard many horror stories about residency, but I had also heard much the same about med school, and before that, pre-med. Neither had been easy, but as a survivor, the tales were exaggerated, I felt.

I had juggled the three Sss – study, sleep and social life – quite well as a medical student, and fully expected more of the same. The miscalculation was great. Med school was feared because it was terrifying to the general populace. Residency was horrifying to doctors.

Social life was the first casualty. I started going out less and less, until at the end of the first month, I looked over my itinerary and realized that I had never so much as left the half mile circle centered around my hospital.

Next on the chopping block was sleep. Seven hours turned to six, and then quickly five. Soon even five hours was a luxury.
Then at long last, my schedule came for my last sanctuary – study time. Which put me in a catch-22. I needed to study to improve at my job, but my job demanded so much time I could never actually study.

I was far from the only one beginning to crack at the seams. I overheard a near hysterical exchange between a colleague and her senior supervisor. The gist of the conversation, after pruning all the emotionally charged language, was thus – time was something you found piecemeal throughout the day, and not something to be enjoyed whole.

To my tired mind, this sounded like some whacky Zen philosophy espoused by a crackpot. Still, my colleagues were trying crazier stuff. Apart from the standard fare of copious amount of coffee, one guy was trying to get eight hours of sleep a day – by switching to a twenty-eight-hour day. (Surprisingly valid although you do have to build your schedule around it.) Another was looking into biohacking, trying to use power naps around the clock to fox his body into entering REM sleep (that’s the kind of sleep that actually matters) as soon as he hit the cot, trying to make four hours of sleep feel like eight.

There were darker habits too. I talked with an attending physician who we will call by a pseudonym, Dr. Whittard. He admitted he took considerable doses of Adderall during his residency years, and that he was tame compared to his compatriots. “Fentanyl, Ketamine, I’ve seen it all. Drug abuse by medical professionals is sadly a lot more common than the layman assumes, and small wonder. Access is as simple as signing a slip of paper, and as for why, it should be obvious! To keep ourselves functional enough – sane enough to do our jobs.”
Perhaps I might have gone down a similar dark path, but prescription laws are considerably stricter nowadays than in Dr. Whittard’s time of the 1990s and early 2000s, and instead settled for taking a leaf from the book of line cooks; by pre-preparing as much stuff in bulk as possible, I was able to cut down on the time spent doing the operation. Prefilled syringes, premeasured powders and cements, and a neat innovation of coating trays with bandages to make them easier to choose. Further, I broke down the bindings in my textbooks, turning them into bite sized booklets I could peruse between patients.

Still, there was only so hard I could squeeze my schedule. Diminishing returns set in sooner rather than later, and so I looked to what my seniors were doing, to see if there was anything more to learn, and there was.

I remember reading how ramen was used as a de facto currency in many prisons, because of how desirable it is (calories and breaking the monotony of prison fare), as well as its ease of trading and storage. My first thought was how similar it was to residency. Not just the lack of freedom, but how we used an alternate form of currency. Food was not enticing to us – but time was. It meant time to sleep, time to eat, and most importantly, time to remember what it was to be alive again.

Like prison, I was not alone. Meta studies such as one by Ishak et al. showed the massive burnout medical personnel at all levels of experienced. Medical students were said to be burning out at a rate of around 28-45%, depending on the study, while the number for residents reached as high as 75% for some specialties. Nor were full-fledged doctors exempt, though they were less affected than residents.
Despite this, dropout during residency was rare, with me knowing of only two cases during my tenure, and studies did show quality of treatment was not adversely affected, even if the resident in question felt it was due to lack of self-confidence. People simply cared too much to quit.

In a field as specialized as medicine, people tend to develop different talents. There were wizards with a scalpel, walking dictionaries of obscure medical knowledge, and living oracles at diagnosis. A problem that was easy to solve for one resident might take another an eternity. While we couldn’t directly trade time directly, we traded the closest thing to it. Favors.

We traded vacation dates (having a longer unbroken vacation meant less time spent traveling), we traded patients (doing things we were good at), and we traded help. We’re all human. Everybody makes mistakes. So, when a patient is bleeding out from an unforeseen complication, that is when a second, competent pair of hands is needed. The repayment could be in kind, or an extra night on call.

Yet, for all the techniques available to us to wrangle out more time – it was dangerous. Because, as I was all too painfully aware, it caused many a resident to lose focus on the original purpose of residency. To learn. I saw former child prodigies grovel for an extra twenty minutes of sleep. Their goals had changed from self-improvement to a baser one of survival. Every resident begins with a dream – but residency is where dreams go to die. For me, purpose is what keeps me stretching what little time I have to its limits.

Perhaps I will finish residency before all my resolve has eroded away.
Picking Up the Pieces

It took me about an hour to get ready for the game.

Twenty minutes of that time was spent trying to find the game board, a thin oak panel I finally found tucked behind my textbooks on anatomy. It was painted with nineteen lines by nineteen lines, the standard size and design for a game of Go, (or Weiqi or Baduk, depending on where you hailed from or from whom you heard about it first).

Next were sorting the stones, all three hundred and sixty of them, divided evenly between black and white. These pieces were low quality plastic, a far cry from the yunzi (sintered stones with a deep luster) that I had at home, but that made them easier to pour into their respective cups.

Then came the tea. My opponent was a strong one, and so I needed a strong tea to keep my mind in top shape throughout the game. Iron Buddha, a nice dark oolong, was my choice.

The last of the time was spent setting up the computer. Quite out of place among all the traditional paraphernalia of the game of Go, but I needed it to play my opponent, Jason Yeh, who was halfway across the globe in Pittsburgh. He was a PhD student at Carnegie-Mellon, working on his thesis in machine learning. He was also an avid Go lover, so it was particularly ironic that the subject of his work had nearly destroyed his hobby. Go was more or less the Oriental version of chess, though black moved first in Go. Players would then take turns placing stones on a board, with the end goal of taking more of the board for themselves than their opponent.

*
Machine learning is a very young science, with most of its accomplishments and general interest in the field appearing only in the past five years. This is why as late as 2016, consensus among Go players was that artificial intelligence would take decades to challenge top humans at the game, as it took AIs much of the 1990s and 2000s to increase in playing ability from a weak amateur to a mediocre one.

Much like the chess world before it with the defeat of Kasparov at the hands of Deep Blue, the paradigm shift was sudden and unforgiving. Chess professionals began turning to computers for advice, with many using programs to plan out elaborate opening strategies no unassisted human could hope to defeat. Whatever the program said was right, then it was law. In mid-2016, AlphaGo defeated Lee Sedol, a top human professional, in a matchup the pundits had Lee effortlessly winning. The Go world rocked, then righted itself. AlphaGo was still beatable, having lost one game out of five in the tournament. After all, as good as Lee had been in his prime, he had been recently dethroned as the best in the world by the newcomer Ke Jie.

Jason had told me then that this parity was only an illusion, and he was right. The illusion ended in 2017, with the arrival of AlphaGo Master’s historic dismantling of top pros with sixty straight wins and the humiliation of Ke Jie, the newly minted world champion, at Wuzhen. In the span of a few months, AlphaGo's ability had improved from being “merely” as good as the best human players to something much more.

* 

“Something alien,” said Jason during our game. His voice was slightly tinny from packet loss over Skype. “That’s what it feels like when I peer into the inner workings of artificial neural networks. They don’t lend themselves to being deciphered – and once the
program starts optimizing by playing against itself, the growth is exponential and can’t be followed by us, even if we did create it.”

I was already in a tight spot by early midgame – Jason’s analogy felt correct. I didn’t feel like I was playing a human. Jason had memorized many new josekis, or move sequences, like set openings in chess, except these sequences had been devised by superhuman AIs. It was frustrating to play against, considering I used to be the stronger player between the two of us – though never by much. We’d met each other about twenty years ago through this game, back when studying Go was considered the prim and proper hobby for academically gifted students, having been the recreational pastime of Asian nobility and kings. It trained the mind to be sharper as well as the heart to be more resilient, or so they said.

“Forced evolution,” said Jason as I was weighing my next move. “The metagame has changed a lot. You remember the Magic Sword joseki right? We spent so many hours learning it – now it’s dead. Nobody plays it.” I understood what he said. The Magic Sword had the distinction of being the most convoluted opening strategies ever devised in the game of Go, bar none. It was a crafty sequence of moves that involved creating optical and mental illusions designed to trap somebody who hadn't seen that exact variation of the game. AlphaGo had destroyed it with a simple, elegant move that had somehow eluded humans for centuries. I’d tried to play Go online in recent years, but the game had changed. The game itself had been slowly evolving, to be sure, with a particularly innovative move being researched and studied by strong players, then either adopted or discarded. Nowadays, however, all that evolution had been done. To put it in Ke Jie’s own words, we were playing Go – some two hundred years in the future.
Yet, the real problem, I felt, wasn’t the future shock of the individual moves or different openings – it was the fact an open-source program anybody had access to was significantly stronger than the best human, even if it was run on last generation hardware. This had made online play unfun, with rampant cheating abounding on all major Go servers. Pros now flat out refused to play anybody except another verified professional, for fear of playing against a superhuman program.

“Normally, it would have taken consumer hardware centuries of running the training program before it can challenge us – but once Facebook decided to train their own program and then posted their software’s weights – that’s the results of their training – it was over. All that’s left is picking up the pieces.” Jason cut off here, thinking. I’d clawed my way back into the game from a position he hadn’t memorized.

From what I learned, these superhuman programs are easy to run but difficult to make. However, with many large companies (Google, Facebook, Tencent) having done most of the heavy lifting, the average player is able to reap the benefits. Some enjoy having access to a free teacher with unquestionable skill, but others, like me, feel there is relatively little to be gained without a human to explain just exactly the reasoning behind certain decisions. Why were this move chosen and not the other one? A human could have given an answer, but the black box of a program sits silent.

The future of Go had become uncertain. A few major sponsors of tournaments had pulled out, shrinking the prize pool and incentive to play professional. Perhaps the game would live on, but the age of human-led understanding and research into the game was now forever over. Now that I, and indeed anybody with a working computer, had the secret to ultimate Go skill, I found it lacked the luster I had imagined. Further, Go is only the
beginning. The program that defeated this game was designed as a prototype, a proof of concept of the application of machine learning. We might scoff at programs replacing humans in decision making now, just like the Go world scoffed at programs surpassing humans, and just like how Kasparov scoffed at Deep Blue.

And we all know how that turned out.
Making Friends With an Old Enemy

I cautiously tapped the glass jar. Uncountable millions of my erstwhile enemies were trapped behind the cool glass. I tapped again. A bubble of air lazily floated up from the jar’s milky-white depths. Then two, then three… then nothing. I frowned. My newfound alliance with lactobacilli was tenuous at best, and the two full garbage bags behind me – evidence of their last betrayal – still stung.

What I was making was called Chinese sauerkraut, or suan cai. It is a distant cousin of its German counterpart, sharing much of the same ingredients. The results I knew well. It was a flavor I grew up with. A medley of simple sugars and free amino acids, made all the more delicious by the primitive animal brain in me, evolved to prefer these broken-down elements to their larger predecessors of starch and protein. I knew the theory, I knew the science, I knew the results. My problem was the process.

This was my third batch in as many weeks, and the longest I had held this uneasy alliance together. These bubbles, these precious carbon dioxide bubbles, were living proof my fraying cooperation with these microbes had not yet fallen through. I might not have learned as much as I wanted from my two previous failures, but what I did learn was this. I was too lenient.

To keep a close eye on my subjects – ahem, allies, I had chosen a container out of glass for this attempt, a nearly heretical deviation from traditional ceramic urns. As a man of science, I had checked multiple sources as thoroughly as I could. These sources ranged from modern solutions such as Google to the ineffable wisdom of old wives’ tales. While some apocryphal data did suggest the urns helped with fermentation, I could not see a
concrete scientific reason to not simply, well, cheat and see what my microbial army was up to. I had little trust in these small minions, as just a few short months ago these same microbes were my sworn enemies, the exact kind of bacteria that causes caries – rotten teeth in layman’s terms. The bane of every dentist’s existence.

Fermentation is a weird thing to do, but quarantine changes us all in weird ways. In a sense, I was one of the lucky ones. A lot of things changed during the quarantine, and a lot of people’s lives were affected, some significantly, some permanently. My life, however, barely missed a beat. I had always split my time between the hospital and the internet, two constants in the COVID chaos. Though to be honest, there was the one thing I missed in all this – food. And not just any food. Comfort food. The kind I had back when the world was still sane.

As a denizen of Guangzhou, the culinary capital of China, I was used to eating like the kings of yore. Soft-boiled quail eggs spiced with cumin; tender whitefish roasted in a hearty mushroom sauce – these were the foods that took my mind off being a thousand miles from home. Nor was Guangzhou's culinary status an accident. Its unique geography made it into one of China's major port cities, and one of the five ports first opened to the West. Trade has always been part of Guangzhou's lifeblood, and this constant influx of people (there is a reason most American Chinese food is Cantonese, and Canton is the old name of Guangzhou), of ideas (Sun Yat Sen's successful democratic revolution against the Qing dynasty started in Guangzhou) and of food has sustained the city through the centuries. With the pandemic slowing the trade down a crawl, with every package requiring inspection and disinfection, fresh food became a much scarcer affair. And of the four major
Chinese cooking styles, Cantonese food is the most reliant on fresh produce. Small wonder most of the delicacies disappeared overnight when the pandemic started.

I was familiar with the notoriously inexact eyeballing prevalent in traditional Asian cooking, so I approached fermentation through the lens of science. Salt. Cabbage. Salt. I layered each leaf with a sprinkle of salt, sealed the jar, then congratulated myself. The celebration ended when bacterial cultures exploded in the brine. Failed temperature control. The results were in. Horrifying. Fascinating. Rotting. A lesser man might have called it quits. I, however, rummaged through other people’s teeth for a living.

The second try fell to sterilization. I had gone overboard in my zeal to annihilate all bacteria – and destroyed the lactobacilli as well. Thus, it was back to the backbreaking task of meticulously weaving salt and cabbage.

My third attempt did work, as long I moved the goalposts a bit. While the taste was markedly divergent from my memories, my ad-hoc suan cai retained the original character of the cabbage. It elevated my instant ramen broth, hinting at something familiar but also something unique, something entirely new. I gloried in the savory sourness. It did feel good to work with nature rather than against it, like I did daily as an orthodontist. And I know I am ready for round four.
Slicing the Seconds—The Chase for Faster RT

I knew where he was. He knew where I was.

I shuffled closer to the corner. He was there, just behind it.

I heard the unmistakable metal-on-cloth sound of a weapon being shouldered.

I took a step and crouched and fired.

Then ripped off my headphones when a massive roar of frustration came through it.

How are you so fast, howled my friend Justin, after his sentence had been suitably pruned of expletives. There was a time where I might have laughed and quoted the famous gamer term — *git gud* while stroking my own ego, but that time was long past. These days, most popular multiplayer games are no longer one-on-one pissing contests, but games that require actual, honest-to-god teamwork.

And a team is only as good as its weakest link. In esports, while some professional teams have been able to cover certain deficiencies in their lineup, teams generally do not manage it through exemplary teamwork, but with transcendental individual talent.

I knew I was fast. Always have been.

What I didn’t know is if such a talent was born or acquired.

If it could be trained—well, my merry band of friends would be able to terrorize a lot more games.

RT—reaction time, is something of a holy grail in competitive games. It always helps, no matter what. Clearly defined, reaction time is the time gap between seeing
something and reacting to it, most often measured in milliseconds. The less time it takes, the more likely you are to come out on top in any given game or situation. Think of the duels in those heavily stylized Westerns, with both men waiting for a handkerchief or some other visual cue to blow each other away. The winner? Well, the protagonist of course. But in the real-life situations of yesteryear, when pistols at dawn were still on the streets and not in stories, the person left laughing was the faster one.

In our more civilized time, we don’t challenge people to duels anymore, but with the COVID pandemic raging, many of my friends have turned to video games as a way to blow off steam, much more so than before, as many other avenues of relaxation have been forcibly closed.

According to Nielsen Games Video Tracking, gaming is at an all-time high since March 2020, with a 46% uptick in gamers in the United States. So here I was, suddenly finding myself with a new hobby, and playing with fellow rookie or returning gamers. After one night of gaming, I learned a hard fact. My teammates were, for lack of a more eloquent term—potatoes. As efficient and effective as a battery made out of sticking two pennies into a potato.

It felt good to be a superstar—at least at first. I was LeBron James, I was Tom Brady, I was Wayne Gretzky. But much like LeBron, I often came up short right at the end.

Everybody likes winning. So, I sought change.

Because it is always easier to improve people other than yourself, I got four of my friends into a video call and we did a human benchmark test. (You can find out yours too at https://humanbenchmark.com/tests/reactiontime). This was a test where you would
react to a color change on screen, and the time delay between the colors flashing and your button press would be your visual reaction time. We wanted to figure out what the limitations of our physical bodies were, so we could know if any improvements were real or imagined. Justin moaned about how now he was proven to be slow by science, but here are the results:

Justin—281ms.
Tim—264ms.
Beth—254ms.
Zach—226ms.
And myself—161ms.

To put the results into perspective, according to an Indian study, the human median VRT (that’s code for visual reaction time) is 247.6ms, with a standard deviation of 18.54ms. Justin, who was about two standard deviations from the human average, would have an IQ around 70 if we converted the tables to represent intelligence rather than reaction time. As for me, I was about 4.5 standard deviations from median, which would put me at about one in one hundred and fifty thousand people, or an IQ of 167.

So, why was I so much faster?

The first thing I looked at was age. The human body is a wonderfully built machine, but like all machines, it deteriorates with age. Reaction speed is reliant on how fast your neurons fire and conduct. Slower pathways clog up the signals, and there is no way around that. Thus, for an individual, today is likely the fastest you will be for the rest of your life. Yet, I was the oldest of the five. Nor did I feel I kept particularly good care of my body, having pushed my body through serious strain throughout my stint in the
educational system. (Out of the three major life choices in university, where time allows you to choose two out of the triumvirate of social life, grades, and sleep, I was the kind who would forgo the last.)

Next, I considered experience. Practice makes perfect, right? But I haven’t gamed in years, only coming back with the wave of gamers brought on by COVID. Indeed, most of the other four have more extensive gaming backgrounds than I do, with my only claim to playing competitive games being a few short years of table tennis back in high school, over a decade ago.

I almost wanted to put the blame entirely at the feet of genetics and call it a day. But I knew there had to be other, tangible factors.

You can’t teach height in basketball. That’s a saying almost as old as basketball itself. In gaming, there is also the common wisdom that you can’t train reaction speed, being something hard capped by genetics. While research on this topic was inconclusive, my own conclusion was it was both true and false. True in the sense that there was a theoretical limit. The Olympics place the limit of human reaction time at 100ms, proven by their stance on sprinting. When a sprinter hears the gunshot, any start faster than 100ms is considered a false start, because physics simply do not allow humans to go that fast. But also false, because most humans stagnated far below their genetic or physical threshold.

But how to get closer to that fabled threshold? I knew I couldn’t figure it out myself.

So, I called Andrew, a man I met way back in high school, the last time I had the time and energy to play video games. He was a retired Salt Lake City esports player and
current coach who used to play competitively with and against the Ogre Twins, of which Tom “Ogre2” Ryan is considered the greatest *Halo* player of all time.

We talked over a game of *Call of Duty*. “Science has come a long way,” said Andrew. “Just as advances in sports science has seen Olympic records constantly shattered, athletes running further and jumping higher than ever before, esports has grown from a frat gathering into a professional sport, with coaches and support staff working on individual aspects of a player. The most important breakthrough we’ve made is *fitness*.”

Andrew sent me two pictures of different professional players. One from the early 2000s, and another, more recent one. The differences were striking. The player from two decades also was the stereotypical image of a nerd. Round and pale, the player held himself with an awkwardness that oozed through the photograph. Yet, the recent photograph of one Marcelo “coldzera” David would not have looked out of place in a fitness magazine.

“Reaction time is tied to physical fitness and diet,” continued Andrew, who had popped a bullet into my character when I tabbed out to check the photos. “That’s why so many modern professional players are so jacked. Diet is important not just because of how deeply they are related to weight and by extension fitness, but also because of certain chemical compounds have a positive effect on reaction times. Which, by the way, is why drug testing is done at the highest levels of esports competitions. I know most people might think muscles don’t matter in a video game, but nobody serious is taking steroids. It’s the stimulants all the way—stimulants that boost your reaction time to near
superhuman levels. Now, the *legal* supplements that actually work include anthocyanins—you get those from blueberries, and creatine.”

But there was another, even more powerful chemical that boosted reaction times—dihydrogen monoxide.

Dihydrogen monoxide was the be all and end all, the alpha and omega of all stimulants. It was also more commonly known as water. Which wasn’t that surprising if you really thought about it. Water is what allows chemicals in our body to mix so easily, and why we’re mostly water. Thus, any dehydration massively affects the speed of the neural pathways so critical to a fast reaction time.

Armed with new knowledge, we ran with a healthier diet regimen for two weeks, adding in a saner sleeping schedule for good measure. Some studies said it helped, and in any case, leaving the rigors of modern society messed up a lot of sleeping schedules. (Justin was waking up at 6pm.)

The results were promising

Justin—281=>266ms

Tim—264=>247ms.

Beth—254=>224ms.

Zach—226=>208ms.

With me wrapping up the end with 155ms. The lowest amount of raw improvement, but a significant one, nonetheless.

Next came the final trial—how well my friends could *carpe the secundum* in a real game, when put under the duress of explosions, ambient noise, and big men waving weapons. Andrew volunteered to test them. He was playing across the Pacific, so his own
reaction speed was handicapped by ping, which was how long the signal took to go from
the server (located in Asia) to his monitor in Utah. Most of the lag was due to the speed
of light, but it was still a noticeable disadvantage.

It was five on one, and we almost won.

“Reaction time actually over valued by the average player, because it is so easily
quantifiable,” explained Andrew in the post-game. “It has its value, of course, but the
important thing is to accrue all the small advantages into a bigger one. To get ahead—not
just at gaming—you need to make your time, your seconds count more. And there is so
much more to it than just reacting faster. You have to think about what you do in the
short-term future, your plans for the long-term, backup plans, as well as dedicated
practice on improving.”

Reaction time is a form of talent, we are born with it, and it can be honed to a
finer edge—and in many situations, talent alone can suffice.

But to succeed, to really succeed, to slice the second down to the absolute bone—
nothing beats continued dedication.
Physician, Heal Thyself

Raise your hand if you know a doctor who jumped into a fountain with his hair on fire.

Raise your hand if you’ve heard of a doctor beaten senseless by an angry mob.

Raise your hand if you’ve seen images of a doctor’s throat slit in the dead of night by a relative of the patient she just treated. Oddly specific, aren't they? I have had the misfortune of experiencing all three. The last case in particular on Christmas Eve, 2019.

Dentists usually don't like talking about work on social media. The job is boring enough. So when my social media wall and inbox were stuffed full of messages all talking about the same thing, I knew something important had happened. The death of Dr. Yan Wen, the doctor whose throat was slit. From what the messages said, it was obvious and chilling what had happened. Dr. Yan Wen had failed to save her patient—a patient admitted to the ER at the age of ninety-five due to a stroke., enraging the patient’s son to stab her repeatedly while she was working at the ER, and so because of pure unlucky happenstance that Dr. Yan Wen had gotten a sociopath for her patient's relative, she had died.

Perhaps it would have been easier for me to brush this away as an individual tragedy—if it wasn’t almost a monthly occurrence in my life. I'm not the sort who keeps up to date with the news, so most of what I hear is already common knowledge, which makes everything all the more tragic. Earlier in October 2019, a certain Dr. Fon had been stabbed to death by her patient. Different hospital, different circumstances, but the same story. Later, in January 2020, I also learned of an eye doctor and two orderlies being ambushed in his waiting room by a rogue patient. All three lived, but the doctor sustained
significant damage to his arms, and may never be able to operate again. So, to me, Dr Yan’s death spoke loudly of a greater problem, one I had faced often, where the relationship between the average doctor and the average patient in China was barely short of open war. Indeed, according to a 2013 paper, 85 percent of all medical personnel have faced violence of some sort in the workplace—a staggeringly high number.

There have been calls for reform by the Chinese physician union, with doctors citing the systems in other countries. In America, for all its quagmire of a medical system, for all its inefficiencies, there remains one gleaming gem that no amount of dust can dim: the trust that exists between a patient and their doctor. It is a trust that I confess I envy to no small extent.

The medical establishment across the ocean from the United States—the Pacific, not the Atlantic—belongs to a different world, a different language, a different quality of life, but also a different culture. When I diagnose my patients as a dentist, I see the doubt in their eyes, I see the defensiveness, the guarded caution within each word they choose to say to me. We are neither friends, nor allies, not even strangers. To them, we are the enemy, Grinches trying to reach into their wallets and steal their hard-earned money. In the West, doctors are highly educated, highly paid, and admired as beacons of reason, compassion, and authority. In the East, doctors are highly educated, and thus highly paid, and are considered untrustworthy by the population in general. To them, we are motivated by one thing, and one thing only. Avarice.

Yet, things like trust are not built in a day—but neither are they eroded in a day. As an intern, bright eyed and fresh off the medical school assembly line, I was ready to give anybody who walked in through the door all I had—and then some. Reality was as cold
and unforgiving to me as solid pavement after a fifty-foot drop. I was shouted down and threatened, had to get two orderlies to drag a guy off my mentor, and on and on, until it became routine. After such incidents, I noticed my mentor would often unconsciously touch his bald spot, where a patient setting his head on fire had destroyed the hair follicles and they never regrew. I learned to keep hospital security on speed dial. I developed a sixth sense to spot problem patients from a mile off. (One trick here was congruity. If a patient could not be honest when talking about himself, never expect facts to matter to him later. Another red flag was politeness—you wanted to turn away the ones who were too polite. These were the ones who had an impossible expectation of you, and all of that respect they were giving you would turn into wrath when you inevitably fell short of their bar.)

Trust, however, is never a single sided element. For its complete and utter breakdown, time and stress are both conditions. From both sides. I spoke with several of my patients, who have had suffered slights—imagined or not—at the hands of other physicians. One spoke of being constantly turned away despite his aching tooth. This I understood, as the tooth itself was beyond any hope of repair, being a blackened stubble loosely hanging on to the folds of the patient’s gums. The only recourse was extraction, and yet, extraction was contraindicated, both by the patient’s blood pressure of 220 mm Hg, as well as the necessary use of Acenocoumarol, an anti-coagulant due to his heart problems. I explained this to him six times, he nodded and smiled, but then said, “So can I pull my tooth now?” To a person who had only graduated from elementary school, I could not figure out how to explain why I could not treat him. In the end, I turned him away, wondering in the back of my head whether I had signed my own death warrant, if he'd come back to hurt me.
For all the abuse I have seen, I was well aware the patients aren’t solely responsible, or even bear most of the blame. The previous generation of doctors spent decades abusing their power, taking bribes and giving out prescription drugs or preferential treatment, causing patients to inherently believe any failed treatment is because the doctor didn’t give it his all—because he took a bribe. This mistrust is further exacerbated by the amount of propaganda top Chinese hospitals throw at the masses to garner patients. About 70 percent of all patient-on-doctor violence happens at triple A institutions, the most prestigious class of hospital in China, simply because of the extremely unrealistic expectations patients have of their treatment outcomes.

Inequality of responsibility was what caused the divide. That is to say, in any given conflict, we doctors were guilty before proven innocent. On the other side of the coin, patients generally had no option but to pray the doctor they got in front of them was well trained and had their best interest at heart, because they could understand little of the jargon we spoke. Inequality of responsibility, so we feared them. Inequality of information, so they feared us. And fear directly causes conflict.

Doctors in China are generally overworked and strained for time, with little extra energy to explain the science behind all the procedures and decision making, a problem exacerbated by the relative lack of medical knowledge across the general populace. I have met many patients who insist on the wisdom of their neighbor of relative, over the advice of a medical professional. Impossible standards, improbable results. Yet now, a similar thing is happening in the States. The advent of COVID is pushing medical personnel to their utmost limits, with all the lowered quality of care that entails. I’ve seen clips of doctors
in the hardest hit states suffer nervous breakdowns, and the overflowing hospitals with patients lying in the corridors.

Further, the Internet and free sharing of information in modern America has seen the birth of dangerous misconceptions, where ideas which might once have disappeared into the darkness of obscurity are instead able to take hold, for they are now leeching off those of similar minds, finding comfort and validation and so survive. I used to not be worried about misconceptions like anti-vaccination, for as vocal as anti-vaxxers were, they were a very small minority. But COVID exposed flaws unforeseen in the system and culture. The amount of people who refuse to wear masks is utterly astounding, despite studies and doctors stating the contrary. I fear this may be the start of the same vicious cycle of mistrust in China, though I also believe this trend can still be reversed, so as long as both sides work together.

For us doctors in China, however, the rift is wide, and grows wider by the day, with many of my colleagues meticulously gathering data on their patients in case of a lawsuit, to the point where the doctors care more about their own safety and protection, over the needs and wellbeing of their patients. Some have even taken up martial arts or carry a weapon when doing their rounds. I am not like that, not yet, but I can feel myself slipping. What if someone, angry I could not heal them, sets me on fire, or beats me, or slits my throat.

I know people often say, “Physician, heal thyself.”

But sometimes we need help too.
Lessons Learned

Quarantine. A word that gets thrown around a lot these days. Many of us don’t even know what it really means anymore. COVID-19 has shown quarantine to be anything from a mild, barely enforced suggestion to straight up martial law.

In the United States, quarantine has proven to be ineffective due to widely unequal standards and lax implementation. But how strict must quarantine be to return life to normalcy?

The short answer? Surprisingly little. The long answer is while quarantine can be done elegantly, it requires dedication and tact from the authorities, and as nobody has significant experience in dealing with pandemics and quarantines of this scale, learning from those who are doing well may allow us to come up with more sophisticated strategies.

For the early part of the COVID-19 crisis, I was in Taiwan, cool and safe as the world burned around me. The ports of entry were easy to close, one of the few benefits of being on an island.

As a hospital dentist, my work dictated my return to China in September. I expected to see an unrecognizable, quarantined world. What greeted me was normalcy. The malls were bustling with people, the restaurants were full, and school had resumed, although changing from online to offline classes wasn’t seamless, with major delays in standardized testing holding up the academic cycle, because graduating students couldn’t apply to universities without their test scores.

I wondered. Logic dictated that China should have been hardest hit, being where the virus had the most time to do damage. Yet somehow China seemed relatively
unscathed. There must be a lesson here to be learned from how they handed the crisis. And the one thing they did differently? Quarantine early, and quarantine well.

In February and March 2020, China accounted for the vast majority of COVID-19-related cases and deaths worldwide. The progenitor city, Wuhan, would not have looked out of place in a zombie film. Heavily armed men in full biohazard suits prowled the streets, and citizens were barricaded into their own homes. Food prices skyrocketed to the point of being reminiscent of the Weimar Republic. But the coronavirus did not end in March. The United Kingdom just declared lockdown while the United States pushed their all-time high every single day.

The Chinese government claimed there were few, if any new cases, but many people, me included, were highly skeptical of the numbers provided by the Chinese government. I half expected them to be sipping tea as their house burned down.

However, no matter how well bureaucratic red tape can fudge the numbers, it cannot hide the number of patients in the emergency room (ER). In late October, El Paso, Texas, was forced to convert a convention center into an emergency medical site to provide additional hospital beds. Hospitals were so overrun that some patients were airlifted out of the city, a similar situation to Wuhan earlier in 2020 — but not the Wuhan of today. As for the ER at my own hospital, it was sparsely filled in September, and remains sparsely filled today — but we will see how the situation develops this coming winter.

My quarantine on my return to China from Taiwan was a surprisingly uneventful affair. All of us on the flight were swabbed as we disembarked, corralled onto a bus specifically prepared by medical personnel in biohazard suits and, finally, led to our hotel rooms where we stayed for two weeks. Instead of turning us completely loose at the end of
quarantine, an official personally drove each of us from the hotel to our airport or train station, where another person shadowed us until we boarded our next flight or train. When we arrived in China, yet another official greeted us, recorded our location, and followed-up once a week thereafter. No urgency. Only routine.

But that was it. After quarantining, I switched sides and joined those sweating quietly in biohazard suits. Though the work was physically demanding (and I sometimes had an itch that was impossible to scratch), it was not mentally taxing whatsoever. While we took all the necessary precautions still, there was no real worry about COVID anymore. As dangerous as the virus was, the odds of contracting it felt so low it seemed only a possibility in a thought experiment. China was posting single digit numbers of new infected — on a bad day. Weeks could go by without a single new indigenous case, in a country of 1.4 billion people.

When comparing mortality rates, COVID-19 is not a particularly terrifying disease. Other viruses are much deadlier. Hantavirus has a 36% mortality rate and Ebola is virtually a coinflip for survival at 51%. Even close cousins of COVID-19, MERS and the original SARS, are much more deadly, with 30% for MERS and 9.5% for SARS, in stark contrast to COVID-19’s 2.3.

The real danger of COVID-19 is how infectious it is, how fast it spreads. Much like wildfire, the most effective way to control the virus is by stopping its spread. Firebreaks are constructed, where trees, and sometimes even property, are destroyed in order to contain the advance of the flames. Around the world, the most successful results have been seen in countries that have chosen the pandemic equivalent of a firebreak—quarantine.
A half-hearted firebreak is as effective as no firebreak at all, as the flames can still leap across the firebreak and continue its advance. The same holds true for quarantine. A loosely executed, loosely enforced quarantine is merely no quarantine but with extra steps.

While quarantine itself is well understood and documented, it is generally reserved for a few irregular cases and applied on a local scale. The kind of quarantine effort required to fully lockdown any country, much less one of China’s size, is an unprecedented task. One doctor told me about Taiwan’s quarantine of one hospital during the SARS outbreak in 2003, underlining the difficulty of successful quarantine.

Dr. Hong Shi Qi, former Minister of Public Health for Hsinchu, was one of the few volunteers who entered the He-Ping hospital in northern Taiwan after its emergency lockdown on April 24, 2003.

“This was the event that has made quarantine of hospitals tantamount to political suicide in Taiwan,” said Dr Hong. “The sudden lockdown was done out of fear, but without the logistics in place. Nine hundred medical personnel were forced back into the hospital from their homes, which was locked down for 14 days with inadequate medical resources or food. As a result, 57 personnel were infected and 7 died, while 24 patients died to lack of care or infection.

“To execute a successful quarantine, political will alone is not enough,” continued Dr Hong. “It has to be meticulously planned, with locks and checks in place to ensure safety while remaining airtight. For now, Taiwan errs on the side of safety, choosing lukewarm quarantine measures that rely more on luck than any actual scientific method, such as the 3+11 quarantine system previously in place, where inbound pilots were only
quarantined for 3 days in a regulated environment then spent the next 11 days in unsupervised self-isolation, much less than the incubation period for COVID. Small wonder shortly after the policy change, COVID appeared in Taiwan. In other words, if you do quarantine, do it right, or don’t do it at all.”

A counterpoint to Dr. Hong’s stance is that China has also showed that, when begun early enough, quarantine can be extremely effective without overly intruding on personal freedoms, though harsher methods are required once the virus is already here and spreading. While such moderate measures may be too late for COVID-19 in the United States, several experts believe they are likely a new mutated strain of COVID-19 will appear in the near future, perhaps triggering another wave. Whether such a thing will happen is still up in the air, with research both for and against the possibilities of other mutations causing a new wave of infections. But for COVID-19, and for pandemics in general, until and unless a vaccine appears, the name of the game is quarantine. And we can hopefully learn how to control COVID-19, and quickly, for the path has already been laid out for us.
Memoirs of an Alien Invasion

The Enemy

The alien invasion started in the summer of 1979, but nobody cared.

How did the Enemy establish their beachhead? Well, the sources were contradictory at best, just as the Enemy liked it. Some said the Enemy hid themselves amongst the cargo of the super freighter *Ever Spring*, while other sources believed they were smuggled in by human traitors — the quislings. All sources, however, agree that they came in egg form, those signature pinkish red sacs that looked dangerously like mulberries to the untrained eye.

Contrary to later, popular belief, the Enemy was not invincible, at least, not during the outset of the war. One has to remember the Enemy relied on subterfuge to bypass our lines. The Enemy dared not fight. They were weak from the voyage, weak from crossing the Pacific, and in retrospect could have been easily destroyed as late as 1980, before they entrenched themselves in the countryside.

Though perhaps, their success was inevitable, for they had one great weapon even at the dawn of the war, which they wielded to stunning effect. The weapon named apathy. The *shield* named apathy. Apathy, because the Enemy was not some unknown quantity, some terrifying element from beyond the stars.

They were aliens, yes, but aliens of terrestrial origin.
And therefore, understandable, tangible, and indeed were not particularly threatening. So, who cared about the Enemy finding representation on both sides of the Pacific? An afterthought at best.

Then, once suitably fortified, the Enemy showed their true colors.

They weren’t herbivores, though they did have a taste for algae during their youth and higher plants after adulthood.

They weren’t predators. They were capable of consuming flesh, but they lacked the means to hunt.

They weren’t even parasites, at least not truly, though the gusto with which the Enemy sucked the vitality out of our ecosystems, they might very well have been. No, they were omnivores, and they found our farms absolutely delectable.

They have had many names over the years, as varied and ever changing as the lands it took over. To the taxonomists, it was *Pomacea canaliculate*; to the Indonesians, it was the mythical Keong Emas, within which a princess was trapped; to us, it was the “Snail of Longevity and Prosperity,” with all the irony that entailed, for we named it before the invasion; and lastly, to its indigenous South America, it was simply the apple snail.

The apple snail. Not a name that strikes fear into the hearts of men. But then why would something so small and innocuous be spoken of with such vitriol by farmers? Why were these snails the Enemy?

Rice, or *Oryza sativa*, was why.

It is not an understatement to say rice is the lifeblood of Asia. You can find rice in every corner of our cuisines, even if you ignore the fact rice is the staple food of half of humanity and provides one fifth of all calories consumed by humans, as well as the
predominant energy source for seventeen countries in Asia. Miso, for instance, is a globally famous Japanese dish. One might point out it is made from soybeans, and not rice, but the truth is rice is used to obtain Koji mold, or Aspergillus oryzae, which is critical to the fermentation process that turns soybeans into miso.

Vast tracts of land are rightly devoted to rice, with Cambodia taking the helm with ninety percent of its total agricultural lands being used for rice production. Yet, this means Asian countries are dangerously vulnerable to the Enemy, for rice paddies are the perfect habitat in which it can thrive. Full of young, energy rich rice seedlings for the Enemy to grow with, full of stagnant water for the Enemy to travel with, and full of handy stationary stalks for the Enemy to reproduce on.

**The Quislings**

Know thy enemy. In order to understand the invasion, I first needed to understand what made apple snails, a fairly tame species by all accounts, suddenly morph into ravenous harbingers of doom.

Now, as a city boy, I was woefully underqualified to talk about the war on the ground, and COVID limited my options even further. However, I was lucky enough to be able to get into contact with Dr. Zhao Yi Lian, an ophthalmologist who decided city life was not for him and chose early retirement to his family farm down in the rural south of Taiwan.

While not primarily a rice farmer, Dr. Zhao, like anybody in the business, knows and fears the apple snail. I asked him over a skype call, with two big questions on my mind:
“How did apple snails spread so fast so quickly?” and “Why haven’t we won this darned war yet?”

“All invasions are vastly easier when somebody gives you the key. Remember, this was forty years ago, when Taiwan’s economy was entering its zenith, and entrepreneurs were poking under every rock for hidden business opportunities. Our newfound wealth meant a whole new class of nouveau-riche, and so French haute cuisine was all the rage. The iconic escargot was exotic enough to command respect and still familiar enough to be easily stomached. Instead of importing French snails, people had the thought to import the hardier and more fecund apple snail. After all, snails are snails, and research at the time did show apple snails to be quite nutritious,” explained Dr. Zhao, his professor-like demeanor out of place on his thin tanned face.

Nutrition wasn’t everything. Once the novelty of eating snails basted in butter had worn off, people realized apple snails were actually not tasty. The ironic name had already stuck, however. “Longevity and prosperity,” laughed Dr. Zhao, the kind of laugh that crinkled his eyes, “Yes, it did command amazing prices. Three hundred dollars in 1980, for a single specimen. That was enough to feed a family of four for a week. People also called it the Sycee snail, though that name has since fallen out of use.” For western audiences, the sycee was a rounded Chinese silver ingot, which also denoted prosperity.

Dr. Zhao dug out some old newspaper clippings and squinted at them, “See here. Sycee snails, omnivorous, eats everything from leftovers to fallen leaves, very easy to raise, and very compact. A million and change can be raised in a single acre. A kilogram of snail meat can be produced for just six dollars. Two hundred snail farmers have begun farming Sycee. The Taipei Hilton has begun serving Sycee snails and is popular with Japanese and
Hong Kong tourists. The Sycee snail is the snail of the future.” Of course, we know they weren’t. The snails sold badly, and those two hundred farmers dumped their snails into the rice paddies, and they stuck and supplanted. Just like how to the Taiwanese, the name “Longevity and Prosperity Snail” stuck and supplanted the original name of sycee.

“As for why we can’t win the war,” he continued, “weight of numbers.” A single female apple snail can produce 325,000 offspring within a single year. Miss a single egg amongst the rice, and the snails will be back the next year with a vengeance. It’s like trying to sift self-multiplying needles out of a haystack, a losing proposition if there ever was one. “We can’t keep the snails in checks like the Argentinians because we don’t have the predators like the snail kite and Limpkins, birds which only range from Florida to South America, or the climate or even the crops.” Dry grown rice, like the ones grown in South America, are largely immune to apple snails because the crop is too tough by the time the snail can get to it, whereas paddy rice gives apple snails direct access to vulnerable seedlings.

“Evolution takes many, many, many generations to get anywhere. Even with our directed efforts, it takes about twenty generations for you to get something roughly resembling a modern dog from a wolf, and it took us four thousand years to turn the insides of the watermelon red, and another four hundred to remove all the leathery yellow flesh. Thus, in Asia, apple snails are effectively from another planet in evolutionary terms, where all of the checks and balances in its native habitat are gone, and evolution has not had the time to produce any new ones.”
“It isn’t just us,” finished Dr. Zhou, “China, Japan, Thailand, the Philippines, they’ve all tried to eradicate the apple snail, to no avail. Once a piece of land is invaded by them, then that land is the snail’s to keep.”

The Future

There has never been another apex predator that has affected nature as much as humans have.

Which means we need to be careful when dealing with invasive species like apple snails, because we might inadvertently create more problems than we fix.

One thing we could possibly do is what China has done to her invaders over the centuries. Sinicization, or assimilation. Invasive species can be brought into the fold, but even directional evolution will take many years, if not generations, to accommodate the ecological niches now taken by the invasive species, which will outgrow and outcompete most indigenous species. Take Australia for example: it has a fearsome reputation for its deadly fauna, being home to 20 of the 25 most venomous snakes in the world, most famous of which is the inland Taipan, carrying enough toxicity in one bite to kill around a quarter million mice. Yet, due to its prolonged isolation from other continents, their fauna actually isn’t very competitive compared to Old World species, with pack hunting behaviors trumping poison as a weapon choice. After all, if they eat you and die, you are still dead.

The apple snail is already partly assimilated in certain parts of northern Honshu, where the colder weather slows down the snails’ growth sufficiently and desyncs the grown cycle of snails and crops. These snails prove incapable of eating the rice, as their young are too weak to get through the hardened exterior of a fully grown rice plant, and they are
largely dormant during the periods where rice is vulnerable. Instead, these snails are nicknamed “guardian snails,” due to their ability to eat the weeds and maintain crop output.

However, manipulating the complex and dynamic ecosystem is something we should do as a last resort. Our attempts at building enclosed ecosystems have been good enough for a short while, but inevitably fall apart over longer timescales, and failure outside a lab would be one of epic proportions with far-reaching consequences.

The apple snails might survive, might thrive, or might die out in their new environments. Nature doesn’t care about the survival of one species over another. Ninety-nine percent of all species that have ever existed are extinct. But nature does care about continuation. Take away enough building blocks or the wrong blocks, and the system will fall apart like a house of cards. An invader still needs subjects to rule over, or he is nothing but king of the ashes.

As for why we should care?

Well, because we are the alien invasion.
The Price of a Smile

Saturday was always the busiest day of the week, but we always made time for Adam.

Adam, a pseudonym for confidentiality reasons, was a cheerful boy of nine, who spent his time in the waiting room quietly playing on his mother's phone. This was one of the perks of being an orthodontist. We don't use drills. And most patients, even the young ones, are there because they wanted to be there, so there is little kicking and screaming to be heard. Well, if you didn't count the kicking and screaming coming down the hall from the pediatric department.

Over a year ago, Adam had first come in because his parents were worried his teeth wasn't growing, when everybody else in his age and class had already grown out of their baby teeth. Sometimes missing teeth get, well, missed due to being in an inconspicuous place in the mouth, but not in Adam's case. He was missing two front teeth.

Of course, I wasn’t relying on memory alone. The habit of keeping detailed medical records was the first thing drilled into me during residency. It was more than protocol, or even liability. This was because there were seven of us residents— and that's if you didn't count our mentor, Dr. Wu Zhang, the head of orthodontics at the Guangzhou
Overseas Hospital, a major medical center in China. Medicine drew many similarities with the military. Both were rigid hierarchies, and both were slow to change in some ways. We still used the master and apprentice system from the medieval days, though we used the term mentor to give it a more modern vibe. As we rotated on a basis of whichever doctor was free at the moment, it was simple etiquette to keep the records straight for your successor.

I always reread the records before treating a patient, no matter how well I remembered it. Flipping through the records always gave me a sense of nostalgia, with the handwriting of former residents who had concluded their residency and left for other pastures years ago. Some I had met and known, others I only knew through their written words. This was something you rarely saw in other medical specialties, but a full orthodontic treatment lasts for about three years on average, and outliers can last up to eight, and that was if you didn't count post-procedure care, which lasted for an additional two to four years. The only constant throughout the years was my mentor's co-signature.

The first signature on Adam's record was mine. It was an orthodox record, stating the patient's essentials, primary complaint, and a preliminary examination of the patient. Adam's teeth, however, were anything but orthodox, even by the standards of people who fixed crooked teeth day in and day out.

It wasn't easy even getting Adam to open his mouth. Children become self-conscious of their physical differences at an early age, and can be mean and cruel to people who look different. Trying to open his mouth by force was always a last resort. I used one of the oldest tricks in the book, one drawn directly from the fables of Aesop, in particular The North Wind and the Sun, still relevant after all these centuries. I asked
Adam about his favorite sport. He spoke with a slight lisp about how he loved to play basketball, though it was hard to find people wanting to choose him for their team. I saw enough to confirm that he was indeed missing two upper front teeth. The left maxillary central and lateral incisor, to be exact.

I followed standard procedure and opened orders for an x-ray and cone bean computed tomography scan. This is a procedure that can be thought of as hundreds of two-dimensional x-ray pictures formed into one comprehensive three dimensional model. I also photographed his teeth from multiple angles and took a plaster cast of his teeth. We do this for every prospective patient, even those who do not eventually choose orthodontic treatment. It is wise to keep these items as evidence in case of a future lawsuit, especially in China, where fraud is still more prevalent than in the United States.

I expected Adam's front teeth to be impacted, or stuck in the jawbone, and they were. Just not in the direction I assumed. Most impacted teeth were like plants hidden just below the soil, upright and just waiting for the chance to grow out. Adam's front teeth were pointed towards the roof of his mouth.

Adam was definitely lucky to be born now. A decade ago, orthodontics was still in its infancy in China and was rarely considered due to its prohibitive cost and time required. The treatment plan devised for Adam back then would have likely been one requiring sacrifice: One of Adam’s teeth, filling the gap with a removable partial denture, the same kind your grandmother used to use. He would have ever understood the joy of biting into a juicy apple.

But the rise of dentistry and in particular orthodontics has been meteoric, just as China's rise on the world stage. While the average Chinese wage is much lower than that
in the West, and orthodontic treatment prices are still roughly on par with the West due to imported methods and materials, the sheer numbers of Chinese citizens means that even the edges of the bell curve have large numbers--meaning we have a wealthy, educated upper middle class with only one child per family. Indeed, many of our cases are adults who have finally found it within their means to receive treatment but alas, their golden window of opportunity has passed, their teeth too old and inflexible to be moved easily. They will still see improvement, of course, but not as marked as children will. Expectations have to be tempered, but not for Adam.

As much as I knew a solution was feasible, Adam's problem was still beyond my grade. Throughout my residency, I'd learned to handle the simple orthodontic problems, though orthodontics is unique in that it is less a hard science and more of an art. There was a mysticallity about it, even to other dentists. Even to me. There are very few rigid guidelines, and studies cannot agree with each other. Even good results cannot discern whether a better outcome could have been reached with a different approach.

Watching an absolute master at work is mesmerizing. The way the problem is considered, is reasoned, is evaluated is difficult to describe. It took me nearly a decade of schooling to finally be able to appreciate the casual elegance of my mentor's solutions.

The second record was signed by my mentor alone. I asked much about the treatment procedure back then, and I asked him again when Adam revisited us for a check up in early September.

Fundamentally speaking, the problem was broken down into three, much more manageable chunks. First, because there hadn't been a tooth in there for quite a few years, the lower front teeth had actually grown up like weeds, blocking the impacted front teeth
from reaching their ideal position, even if they had been allowed to grow. This was solved by a handmade anti-curve of Spee arch wire, which in layman's terms, pushed down his lower front teeth while maintaining the balance of his other teeth. Of note is that, due to the current high prices of orthodontics in China, we often receive the patients of untrained or unlicensed practitioners who messed up, to put it succinctly. The most common mistake is failing to consider the teeth and jaw as a whole, and tunnel-visioning on a local problem. This results in many joint or periodontal related problems down the line, as it is like giving a man a fish, but never teaching him how to fish. It works, but only briefly.

The second problem was his Angle Class II malocclusion, which basically meant his lower jaw was too backwards from where it was. This was solved with a relatively orthodox twin block retainer, where we used the power of his masticatory muscles — chewing muscles—to force his lower jaw into shape.

Lastly, the elephant in the room was the upward-turned impacted teeth. This was the main problem and risk. A case such as this was very rare and therefore very dangerous, because there was very little scientific literature on the subject; all we could scrounge up were a meager few case reports and even fewer studies. There was no beaten path to take. We had to make our own way. People don't like reporting on their failures, no matter where they are from. A risk had to be taken. The question was: how much?

Impact technology had improved greatly in the past, but it wouldn't solve Adam's problems in the short term, and being bullied or ridiculed for looking different could do a number on Adam's psyche. We wanted to try pushing our limits and pull out the tooth, although we'd risk it injuring other teeth or the nasal cavity on its way out, and to pull it
free of bone we'd have to use a higher than recommended amount of force (150–200 grams vs 110–124 grams recommended) with a jury rigged system because no orthodontic system was designed with such an application in mind.

We cut open a window into Adam's bone, above the gum line, and applied an orthodontic bracket there to act as a fulcrum. The attachment was difficult due to the blood contaminating the contact surface, and so we attempted it three times, only getting the job done by using glass isomer instead of the normal resin as an adhesive (much stronger but unsightly and harder to remove down the line). Next, we rigged a pulley system to break down the force to within tolerance limits, by bending a 0.18-inch nickel-titanium wire into a hook, and applying a stainless steel implant (a material chosen for its inability to bond to bone, so we could remove it with minimal fuss at a later date) to act as an anchor.

Then all we could do was wait.

The first three revisits were the hardest. There were six weeks between each of them, as we followed the progression of the teeth through newly taken x-rays, looking at the width of the periodontal membrane, which indicated whether the tooth was still alive, or would roll over and die due to the stresses placed on it.

Fourteen months after the operation, I looked inside Adam’s mouth. The teeth had survived the surgery and loss of blood, though Adam's ordeal was far from over. We had reduced the forces involved once Adam's teeth had cleared the bone, and it would take another six months at the earliest before his teeth would be ready for conventional orthodontic braces, which would accompany Adam all the way through puberty. Perhaps
somebody else will come across my records years in the future, and be confused at trying to reconcile the Adam of a year ago and the Adam of the future.

    I picked up the elastic band. Just reapplying and slightly changing the direction of the force today.

    “Don't worry, it won't hurt,” I said. Not a lie, and a rarity in my profession.

    Adam looked up at me and smiled confidently.
The evening air was oddly warm for October. I was outside an izakaya, a Japanese-styled gastropub known for both its food and its price tag. Yet, it would be well worth it if she showed up. No, it wasn’t a date. I was here to interview one of the busiest people I knew. More, I had rescheduled on short notice. Very short notice. Most people wouldn’t show, certainly not after an eighteen-hour workday and two hours’ drive.

Thankfully, Dr. Feng Jin wasn’t most people. You see, she was a soldier of fortune. A doctor of fortune. In the pre-COVID world, she might have been called a locum tenes, a Latin phrase roughly meaning “to substitute for,” describing temporary physicians contracted for anything from a few days to many months, working for hospitals, agencies, or governmental organizations. But now, Dr. Feng Jin was a mercenary, with everything the word entailed.

But what was the difference? Regular old locum tenes, in the form they existed in the States, were a largely peaceable lot, professionals who filled temporary vacancies in underserved rural towns where it didn’t make financial sense to have a constant position. The popularity of locum tenes has been meandering vaguely upwards in the past several years, though not seeing constant increases from year to year. Then along came COVID, and the resulting spike in physician burnout in 2020 has caused a mirrored spike in
demand for locum tenes. This demand was far more pronounced in China. It created a quasi-profession that shares striking similarities with the mercenaries of old.

_A slap on the back._ I turned around, and Dr. Feng Jin was there, smiling, pretty, energetic as always. She didn’t look like a mercenary, or a stereotypical doctor. Dressed in jeans and t-shirt fashion of a teenager or twenty something, she might have passed for a college student if not for the faint lines around her eyes. I hadn’t seen her in about a year, and she wore her hair differently now, in a tight bun. We went way back. Dr. Feng Jin was one of the people who showed me the ropes when I first entered the field, even though she was an ER specialist and I was not. She playfully punched me again. “You know, if I were still at my old job, I wouldn’t be here.” And she was right. For the most part, doctors have a very militaristic schedule and hierarchy, and Dr. Feng, being only in her early thirties, was closer to the bottom than the top of the totem pole, in terms of seniority.

That is, if she hadn’t thumbed her nose at what proper medical society expected of her and walked out the door two years ago. A door opened by COVID.

“So, what’s the reason you really left?” I asked Dr. Feng, once we’d sat down and our food came. Back then, she had cited personal reasons and whatnot, the standard Chinese empty nothing to save their superiors’ face.

“Office politics for one,” she said. “I was sick and tired of it.” Then she closed her eyes and started enjoying the food.

I suppose it is up to me to fill in the blanks here. Her answer, while succinct in the extreme, was understandable. From personal anecdotal experience, there are serious power struggles under the table, though few if any will ever see the day of light.
Departments vie over funding, and people vie over promotions. It can be even more cutthroat than corporate office politics because departments like Internal Affairs and Human Resources don’t exist to act as a check on the power of those at the top. Power does corrupt, and it really was a rat race in its ugliest form. People trying to please their superiors, while driving their subordinates as hard as they could, all the while finding an opening to stab their colleague in the back. There are only so many permanent positions a hospital can give, after all, and rising to the rank of visiting scholar is akin to becoming a tenured professor. It’s often the same thing for academic hospitals. During Dr. Feng’s years in the hospital, she had thrown her lot in with the losing side in a power struggle, and that isn’t the sort of stain you can wash off, not even with time. After two snubs for promotion, Dr. Feng understood the writing on the wall.

Further, I knew Dr. Feng’s story was only one side of the coin. Another doctor who I knew well and had interviewed before, one Dr. Fang Zi Hung, had completely different experiences from Dr. Feng’s, where he had stayed within the system and worked his way quickly through the ranks, though the analogy he had used for his view on the matter was one of trickle-down economics. According to him, the most able doctors, be it in terms of clinical ability, research potential or social skill, tend to gravitate towards the most prestigious and competitive research centers and hospitals. Not all of them make it, and those who don’t are “exiled” to lesser hospitals, or second tier hospitals are they are known in China. These exiled elites will then take over many top positions in their new hospital, compressing the vacancies for home-grown talent in said hospitals. These doctors are then further moved down the line to ever more rural and small-scale hospitals, with some choosing to ditch the system completely and become
private healthcare workers or something like Dr. Feng. Also of note is the stigma involved around being a private healthcare worker in China. Respect is generally reserved for practitioners who retired after a lengthy tenure in a reputable healthcare center. Anything less and there will be whispers of them not being competent enough to make it.

“Oh, and the money.” She continued, “The money is much, much better than a permanent position ever gave me.” To understand Dr. Feng’s fixation with money, it is helpful to understand standard Confucian values place doctors at the unofficial fifth and last place in the Chinese hierarchy of occupations of Shi, Nong, Gong, Shan, Yi, or scholar, farmer, craftsman, businessman, and doctor, in that order. This was Chinese society’s prejudice until very recently, when the perceived high income of doctors disavowed most Chinese parents of the notion that medicine was a second-rate profession. For people of Dr. Feng’s age, however, it meant they had chosen medicine primarily for the money, before it had become a respectable profession.

Yes, there are still those doctors who went in it to save people, but if my experiences in medical school were any indication, a significant amount of people came because the grades required were high, and the grades were high because the pay was high.

Thus, you can imagine their shock when the Chinese government began to crack down on rampant corruption and other revenue sources after 2017, such as changes towards designating many previously unregulated drugs as controlled substances, most famous of which was carfentanil, an opioid a hundred times as potent as fentanyl, and ten thousand times as potent as morphine. I think it does not need to be said why this change
would cut deeply into the pockets of certain Chinese doctors. Another far reaching change came in 2018, when medical professionals lost the ability to prescribe any medication, regardless of illness or specialty. Before then, anybody, so long as they had prescription powers, could prescribe *any* drug for *any* illness, so long as the hospital stocked said drug. Again, it is best left unsaid how such a power could be abused.

So now you had a group of disgruntled medical professionals, who felt they were cheated out of what was rightfully theirs. Certainly, most were merely unhappy and slogged along at reduced pay. Yet, when the population numbers get as big as they are in China, you are bound to get some outliers who were willing to bend the Declaration of Geneva (we don’t swear the Hippocratic Oath) to its absolute limits. They were waiting for a chance, and COVID was that chance.

I started with the softball questions, such as how COVID affected Dr. Feng’s prospects. “Most cities can’t handle the sudden influx of cases when there is a COVID outbreak,” she said. “Not just for COVID alone, but once the resources are diverted for COVID care, something else has to give. And that’s where people like me come in. I won’t lie, COVID is one of the best things that’s happened to my career.”

I was intimately aware of China’s current COVID strategy — which was a zero case strategy. Great on paper, but there were some major caveats. Incidentally, this was the main reason that China suddenly had such a great need for locum tenes. By pursuing a strategy that involved ensuring zero cases for 1.4 billion people, instead of treating it as an endemic disease like the US has done, China requires a significant number of highly mobile medical personnel, to stamp out any flare of COVID before it can spread like wildfire.
Originally developed during the debacle at Wuhan, “square cabin” hospitals, so named for their distinctive modular, rectilinear look, have undergone serious refinement from their early days during the Wuhan lockdown, where an entire megacity of 13 million people was quarantined for 10 weeks, evolving from steel and mortar hospitals into inflatable and modular systems. China can now build an entire hospital in hours, but medical personnel are one of the pieces not included in the package.

The logical thing here would be to draw on local personnel wherever there is an outbreak, but that isn’t viable for two reasons. “First, there just aren’t enough trained people at rural areas, even if you draw from surrounding townships. Even the more developed ones have difficulty staffing a full square cabin hospital, even if you draw from the entire province. The only cities that really have a chance at stopping an outbreak on their own are Beijing, Shanghai, Guangzhou and Shenzhen, elite company, to say the least,” said Dr. Feng.

“And secondly, no hospital wants to get associated with COVID.” She said, “Bad for business. Very bad.” I nodded. In September, my own hospital had a single possible case walk into the ER, and even though the danger was detected before any physician came into contact with the patient, and the entire hospital was forced to close for two days, and it took a further six days before we returned to what passed for normality. That was a lot of revenue, gone just like that.

“Now, I work for the state, at least nominally. Though we all know where we actually go is decided by bribery and internal politics. The highest bidder, so to speak, and we are but a piece in their games,” said Dr. Feng.
While I am not privy to inner workings of the Chinese government, there were several notable cases where different Chinese municipalities would intercept medical supplies meant for another. Power struggles were very real.

She paused for a moment, before saying, “Never has medicine been so divested from humans. Doctors are hidden faceless behind hazmat suits, in a special bus when we aren’t working with square cabin hospitals. Patients are no longer people, just one piece of tape with their name printed on it. I do my part, and pass it off to the next doctor who does his part. An assembly line. At least the pay is good, very good, I make as much in three hours as I used to in twelve. As long as the pandemic — or at least the fear of it — exists,” she sighed.

“Discipline is easy to achieve during peacetime, but in the chaos of the pandemic… there are too many unfettered and enterprising souls. And I’m one of them. Perhaps this particular iteration of locum tenes has no future. Perhaps it will disappear when the pandemic ends. But I don’t care. Not anymore.

“You want to know why I really gave up?” she asked quietly. “Crisis of faith. In medicine and in myself.”

And with that, she got up and was gone.

The lights of the city illuminated the night sky, but it was still more black than grey.
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Jen Yun Tuan, who prefers to be called Kieran, was born and raised in Taipei, but somehow ended up with most of his friends hailing from the United States. This constant influx of different societal values has made his outlook an uncommon one. Kieran is a trained orthodontist, although sometimes he wishes he had spent the time pursuing his own desires outside of medicine. He is also an avid gamer. Kieran currently resides in Guangzhou, where he splits his time between dental work and freelance writing.