



SCENARIO #3: Negative Drivers

A story of death and redemption in three acts.

Things fall apart; the center does not hold; mere anarchy is loosed upon the world 2008-2011

What a difference a year can make. In early '09, when the new president took office, all of the news was about just how tolerant and forward-looking the American public had become. Oh, the media kept sniping, and the losing ticket found lucrative homes in think tanks, but there was a real sense, back then, that we'd really turned a corner, and that the future was looking bright. Some of us even dared to have some hope for the future.

Not the scientists, though. Environmental doom-sayers were getting all of the press, but they were hardly the worst Cassandras out there. The World Health Organization had been fearing mutations in the H5N1 flu virus that would allow non-avian vectors since 2006, when scientists have discovered a mutation that could make it more readily transmissible. Little did we know that, before the president had issued her first state of the union address, we were already lost—and the WHO had missed the real threat. Everyone called it the Rot.

One of the lesser-known aspects of global warming is that it tends to make animal-to-human (or "zoonotic") disease transmission more likely. Rapidly-changing environments, new migration patterns and the like give new opportunities for evolutionary changes to take hold. Biologists still aren't quite sure what the source disease was for the Rot, but whatever it was, a small mutation made it spread quickly to humans through mosquito bites. The INSTEDD pandemic monitoring system, run by Google, first starting putting up alerts in August, 2009, warning of a possible proto-outbreak in remote areas of China; everyone assumed it was the bird flu, and the Chinese government, along with WHO, implemented long-planned containment measures. But it wasn't the flu, and by September, the pandemic had spread to urban (and manufacturing) areas. By the end the outbreak, the Rot had killed 10% of China's population.

My nomination for the scariest comment ever to appear in a newspaper: when a mutation was found in a sample taken from a patient in Turkey in early 2010, a Center for Disease Controls doctor, interviewed on the scene, said that it meant "the virus is trying different things to see if it can more easily infect humans." It didn't help matters that the CDC doc died a few days later. As did the reporter who filed the story.

By October of '09, the World Health Organization had announced an "urgent recommendation of quarantine" on all travel to and from China. With the footage of bodies in the streets smuggled out from rural China, the world decided to take WHO seriously, at least in terms of human travel. Much to the dismay of medical leaders, most nations still continued to traffic materials to and manufactured goods from China, figuring that using nasty pesticides on the shipments would be enough to kill any transmission vectors. If we ever get the stomach for it, I'd imagine that the ministers and bureaucrats who decided on that one will be in for some pretty lively show trials.

You see, unbeknownst to WHO researchers, the Rot turned out not to need an animal host to survive transport; synthetic fibers worked just fine. China was at the time the manufacturing center of the world, and all sorts of goods (clothing, in particular) continued to be shipped to world markets. You might remember a company called WalMart; it was well-known for its rapid supply

chain, and for having stores in nearly every neighborhood across the US. Unfortunately, that meant it managed to bring the Rot virus to nearly every neighborhood across the US. This spread the pandemic before most people knew what was happening.

Dark humor lives in the most dire circumstances. By the mid-point of 2010, the most commonly-reproduced editorial cartoon had WalMart as 19th century Americans giving disease-ridden blankets to 19th century Indians—i.e., the rest of us. WalMart didn't think it was very funny, but was too busy dealing with financial collapse to worry about filing any lawsuits. It wasn't alone, of course; every large retail outfit faced the same fate.

Econ 101, first decade version: at the time, the United States bought nearly a quarter of all China's exports, and megastores like WalMart turned out to be ultra-effective vectors for quick transport of the disease. Forget the language, forget the nominal leadership—for all intents and purposes, China and the US were the same country. No surprise, then, that the US was far and away hit the hardest of all Western nations, and like China, lost about 10% of its population.

Thirty million dead from the Rot in the US. Today, everyone knows at least one person who had died a horrible death during the pandemic, and most of us know a lot more than that.

As soon as it was clear that the Rot was showing up in cargo, collapse was unavoidable. All nations called a quarantine on goods shipped from China. China, suddenly losing its export dollars, called in trillions of dollars in debt from the USA. The US dollar crashed. The credit rating of the United States went through the floor.

If you think about the money, it makes it easier not to think about the corpses. The US lost nearly one fifth of its imports through the drying up of Chinese goods. Another 40% of US imports came from Mexico and Canada, both of whom were hit by the pandemic, just not as hard as the US; each lost "only" 3% of their populations. No surprise, both lost some manufacturing capacity, but as worldwide inflation spiked, some of the drop in goods exported got made up for by steep price increases. Both nations saw exports to the US diminish, as it was simply unable to pay for the kind of consumerism it had been known for.

People started to draw pre-World War II Germany analogies. The US got to experience hyperinflation, which meant that oil producers were unwilling to extend credit to the USA. No credit=no oil. Shelves started to go bare—not just of consumer goods, but of the key components and parts needed to keep the economy and our lives going. Let me tell you, it was not a fun time to be trying to make a living.

We had protest rallies, marches on Washington, riots, attempted assassinations, successful assassinations... pretty much a cornucopia of catastrophe. All of it came from one simple fact: we needed a way to keep going.

Deus ex Nanomachina **2012-2017**

So where could we find a solution? Everything had its detractors. When some of us suggested that, maybe instead of trying to get back to a simple life, we should figure out how to jump over the gap to the next generation of tech, we were dismissed as looking for "techno-fixes." That's probably true, but lots of people understood just how many lives those "techno-fixes" could save.

Those of us who had been paying attention knew that early breakthrough from programs springing from IDEAS Factory program begun in 2007 indicated that molecular manufacturing looked possible. Fortunately, the president and vice-president had some good advisers helping them deal with this mess, and they picked up on the possibility that we might be able to leapfrog our way out. In the midst of nothing but bad news, some of us started to feel just a tiny bit of hope that survival might be possible.

Evidently, BillG himself was one of us. The Gates Foundation offered \$25 Billion to support molecular nano research, if the US Government matched its grant dollar-for dollar. The main

additional requirement was that 1/3 of the money be spent on treatment and early detection of communicable diseases, no surprise given both the Gates Foundation mandate and the fact that the planet had just lost close to half a billion people to pandemic disease. Fortunately for all of us, the administration opted to convince Congress to throw in its lot with the Gates Foundation and match the Gates Fund.

Congress debated for 4 days and then surprised the hell out of us all: it matched Gates' money 2 for 1, rolling out the Molecular Manufacturing Manhattan Project Act of 2012, what we started to refer to 3MP. 3MP had three main tracks—manufacturing, healthcare, and energy independence. Ambitious, yeah. I guess that total economic and social collapse has a way of focusing a politician's mind.

The one third of 3MP's 75 billion dollars that was earmarked for the early detection and prevention of communicable diseases was known as 3MP-Med. This was fastest to see results, since a lot of it was based on nanomaterials science, not nanomanufacturing. 3MP-Med devoted its efforts to creating sensors for detection of an array of toxins, for decoding compounds, and for designing and precisely manufacturing specific cures to be distributed widely in inoculation and treatment programs. 3MP-Med had some official slogan of "For the Collaborative Effort to Maintain Global Health and Well-Being," but for most folks on the project, "Never Again!" was slogan enough.

Most analysts saw energy independence as a primary means of triggering a general recovery in the US, and to help with the remaining climate change not cleared up by the loss of 500 million or so people and a global depression. The conventional wisdom was that the president's promise of "a solar roof on every home" was a major factor in her reelection, but I think it was because the opposition managed to find the only two people proud to admit they voted against 3MP to run. About half of 3MP's energy research funds went towards the realization of efficient and dirt-cheap solar power. Some of the green types started to call 3MP-Energy, "3MP-Sol."

The last third of 3MP funds were committed to solving the problem of a manufacturing base at home. This was the trickiest part; health-care tech relied on well-understood advances, and even the solar energy designs took advantage of existing prototypes. However, 3MP-Mfg decided that nanofactories were the only viable solution to the recovery of domestic manufacturing, and those of us who had followed the idea since Drexler's Engines were treated to the surreal sight of politicians, talk show hosts, and even pop singers talking about "molecular manufacturing."

So, 2013: we get the initial roll-out of the massive SOAR "Solar On All Roofs" jobs program, designed to crank out high-efficiency solar cells. Initially, the production comes from established companies, but by the end of the year, those of us who followed the tech developments closely started to see early indications that the great scaling-down in the manufacturing processes coming from 3MP-Mfg was really going to change everything.

It's commonplace now, but at the time, it was amazing: high-efficiency solar cells sprouting on the roofs of homes and businesses all over the US. Anything that got any kind of sunlight was re-imagined as a power source. Neighborhood "Solar Gardens" (like the Victory Gardens from WWII) showed up in urban neighborhoods in every city. And while neighborhood power was important in and of itself, it also became an organizing force; across the United States, communities began to reorganize socially around events at collectively maintained (and protected) solar gardens.

When 3MP-Med developed a vaccine for the Rot in August of 2014, along with a means of quickly decoding future epidemic vectors, the world stopped and celebrated. You've seen the pictures—everyone filled the streets, crying, cheering. The shelling from the Kurdistan-Greater Baghdad war stopped, entirely, for more than two days. We realized that this could well be the beginning of the end of communicable disease. Some blogger decided to call the first inoculation from the program "the shot heard 'round the world," and the term stuck.

When the global quarantine was lifted in early 2015, few nations (especially the people of the United States in particular) had much desire to start rebuilding global trade. This had traditional

economists going nuts, because all of their models no longer worked. This wasn't protectionism, this wasn't isolationism... it was global-localism.

Much of the 3MP-Mfg work had been in coordination with SOAR, but by 2016, building on its joint scale-reducing work with the energy project, 3MP-Mfg produced the first workable Molecular Manufacturing Facility, or MNF (for Molecular Nanofactory). It wasn't some desktop system, but neither was it a massive factory. The first generation MNF was the size of a standard cargo container, and could easily be transported on a truck.

The size had more to do with making people feel safe than with any specific technical needs—3MP advisors suggested that cargo containers were the right balance of human-scale and industrial-scale. Most of the space was taken up by raw materials storage, cooling systems, backup power, redundant computing systems, and the like. The first MNF was more than capable of providing a neighborhood with most of its material needs for more than a year without "refueling," and neighborhood nanofactories (NNFs) started popping up all over US.

Angels Dancing on the Head of a Pin **2018-2020**

First gen MNFs had to be built by a pretty high-tech, large-scale facility. The National Nanomanufacturing Production Site was the subject of a lot of political jockeying, but no surprise, Illinois (the newly-elected president's home state) won out. The monopoly on making MNFs didn't last long, though. In early 2018, the first full, self-copying nanofactory appeared. Most of the later-generation MNFs got the self-production upgrade, and some clever hacker types managed to get the upgrade working on MNFs as old as the second generation models (the first gen had some weird hard-coded protocols).

Self-reproducing MNFs changed the game completely. The old way of thinking of "economies of scale" required you to think bigger; with MNFs, economies of scale meant thinking smaller. By mid-2018, a combination of better systems and smarter design meant the development of super-efficient solar power products... costing nearly nothing to make.

I gotta hand it to the Japanese, though. They'd been also-rans in the development of nanofactories, and even though they were hit pretty hard by the Rot, their cities just didn't take to the neighborhood-scale MNFs. By 2019, though, Hitachi had engineered its own MNF, and realized that it could be made small enough to fit on a kitchen counter. The era of the personal nanofactory (PN) had begun. Hitachi was soon joined by a bunch of competitors, with Sony, Apple, and Nokia leading the pack. These early PNs were limited in important ways, and larger goods still needed to be produced at the local NNF. I've heard rumors about what the next version of the iMake is supposed to be able to do, though, and I can't wait.

This year's big news is the development of a machine for clinics that can analyze individual genotype and develop vaccines for diseases that are specific to that person. A result of MIT's Personal Genome Project and Chandra Open Pharmaceutical Systems in Bangalore, the reader design is one of the first pieces of Creative Hardware Commons gear likely to see wide use. Some of the aging geeks of my generation call it the tricorder, much to the annoyance of our younger colleagues.

Analysts and futurists are now all chattering about the likelihood of PNs starting to appear all over the world. It's the kind of story that makes me feel as nervous as it does excited about the future. Economists I know are wondering about how to deal with a new economy that looks like it might begin to be based on abundance. The politicians are wondering what to do about a world where anyone can make just about anything. The rest of us are wondering about just what will come next.

By the CRN Scenario Working Group (see INTRODUCTION)