

For my daughters:

March 28, 2020

The Coronavirus Pandemic

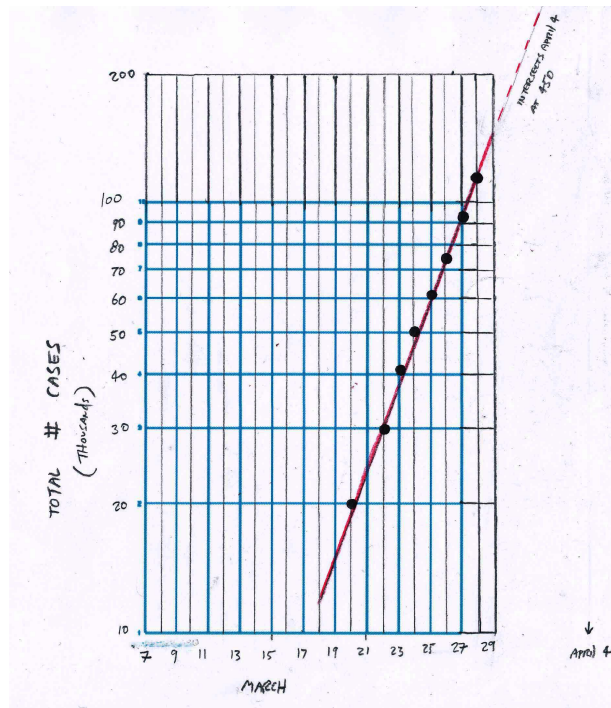
Where We Are, and May Be Going

Yesterday the total number of Covid-19 cases in the United States rose to over 100,000 (the most in the world) and deaths surpassed 1,500. This pandemic is no fake news, but the real thing. It will affect our family for generations, and change your future lives in ways neither you nor I can anticipate. I have been following this as closely as I can – that is to say, I daily collect what data I can access on the computer, read my science journals and the newspapers religiously, and from all this try to generate for myself as clear a picture of what is going on as I can. Given that this is impacting you three directly, I thought as your father I should try to paint that picture for you.

TOTAL NUMBER OF COVID-9 CASES

Let's start by taking a look at the overall level of coronavirus infection in the United States. I have collected daily data since March 11, when the total number of cases was only a few hundred and there were as yet no deaths. If you make a simple graph of this data (# cases vs date), you get a line that swoops up like a rocket, reaching over 100,000 in only 17 days. That kind of graph doesn't convey much, and is scary. But if you look at the data set carefully, there is something yelling at you: on March 20, the total number of cases was 20,000; three days later on March 23 the number has doubled to 40,000; three days later THAT number has doubled, to just under 80,000. You see? The case number is doubling every three days – the growth is exponential!

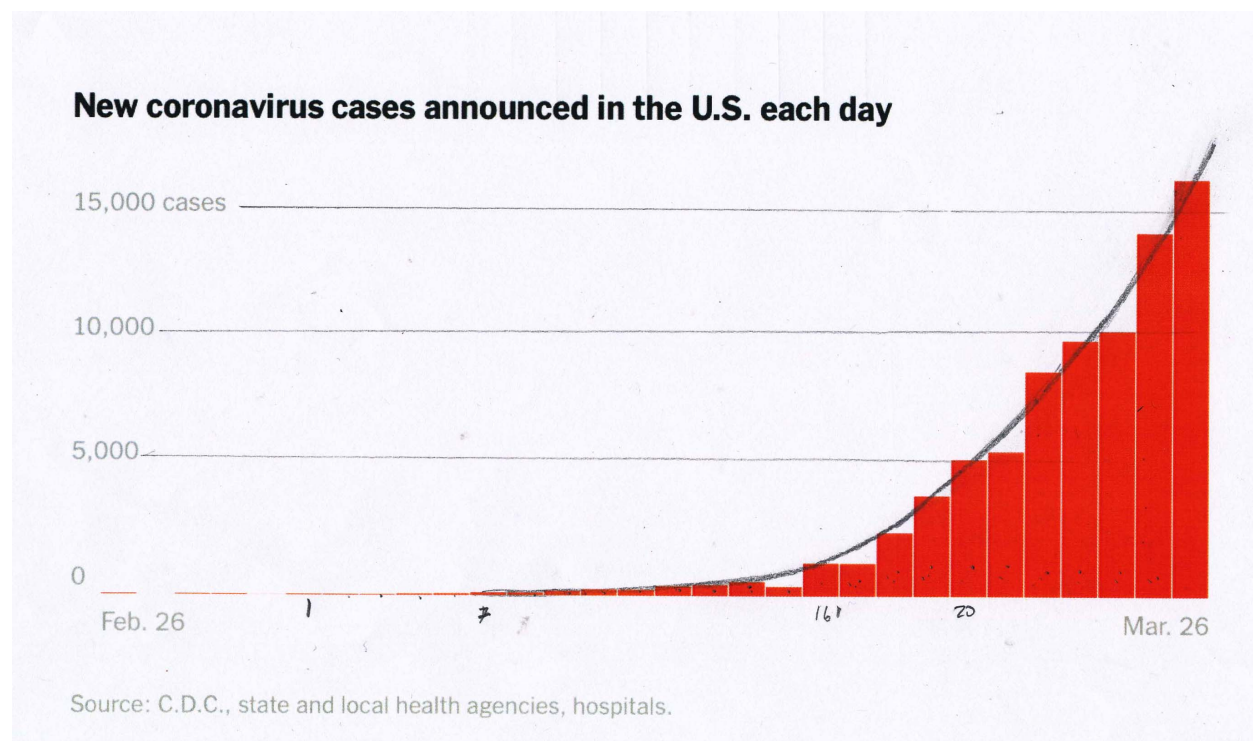
How does a scientist plot exponential data? On a log scale graph, exponential data will fall on a straight line. And this data does. Here is the USA data, plotted as a log graph:



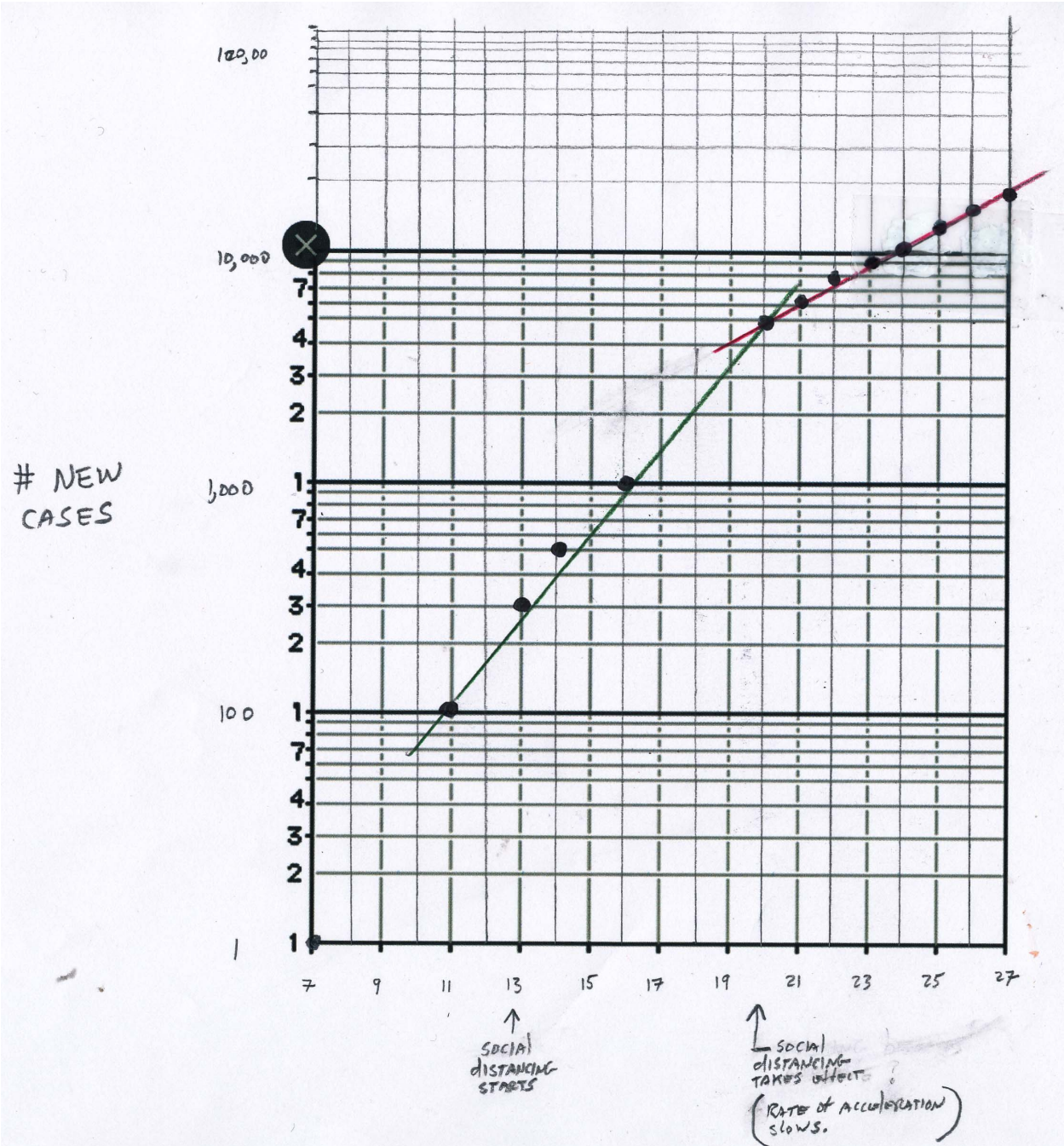
What does this graph tell us? Well, one obvious fact jumps out: things are not slowing down. The function line (the red line) does not bend to the right, even a little bit. This rocket is still accelerating. Why such explosive growth? The World Health Organization says that the average person-to-person transmission rate of Covid-19 is 2.2 – every infected person tends to infect two people! Boom.

SOCIAL DISTANCING

What about all this social distancing that Dr Fauci has so loudly urged our nation to adopt? Will that help reduce the person-to-person transmission rate below 2.2? To get a grip on the influence, if any, of social distancing on the coronavirus pandemic, I have been following the daily data – the number of new coronavirus cases announced in the U.S. each day. The data look like this:



Another exponential curve, demanding a log plot, right? I don't want to make this seem more difficult than it is, but it is important that you focus tightly on what I am about to show you. As this log plot of new case data is very important for understanding what is going on right now, I am going to place it BIG on the next page. As you can see on the graph, I started collecting this daily data on March 11. One place on the graph is important to note: Dr Fauci first recommended social distancing on March 13. As you may recall, it took about a week after that for most Americans to pay attention and start seriously to restrict their contact with other people.



Ugly, isn't it? But revealing. The impact of social distancing can be clearly seen: The number of new cases starts out low, at only 100 new cases a day, but accelerates at a scary clip, doubling every two days! Then, a week after Dr. Fauci recommended social distancing, the rate of acceleration suddenly slows dramatically. The rate is still a little frightening, doubling every four days, but that is half of what we were looking at. Social distancing really does work! We don't have to take Dr Fauci's word for it. Its right there in the data.

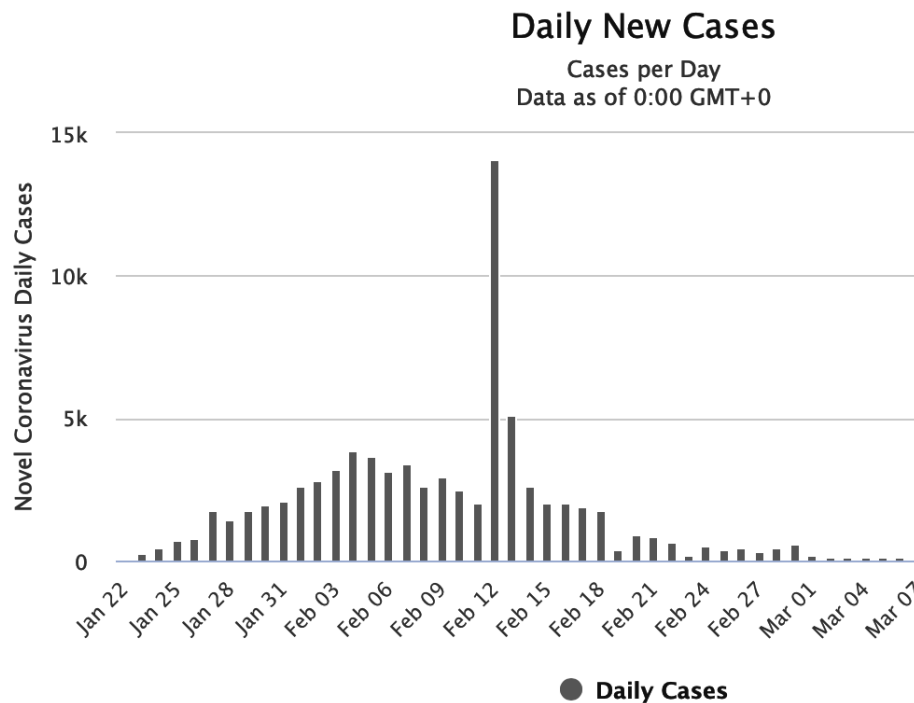
WHAT'S NEXT?

However, and it's a very big however, the number of new cases is still doubling every four days. Our hospitals are already filling, respirators are in short supply, and every day there are more and more patients. Where is this going? Is there anything in the daily incidence data that gives us a hint? No. At least not that I can see. So, does our family have to face the scary future in the dark? No. Two other countries have travelled this same road, China and Italy. By looking at what happened in those countries, we can make an informed guess as to what is coming our way.

China

Let's start with China. They first reported Covid-19 cases on January 20:

Daily New Cases in China

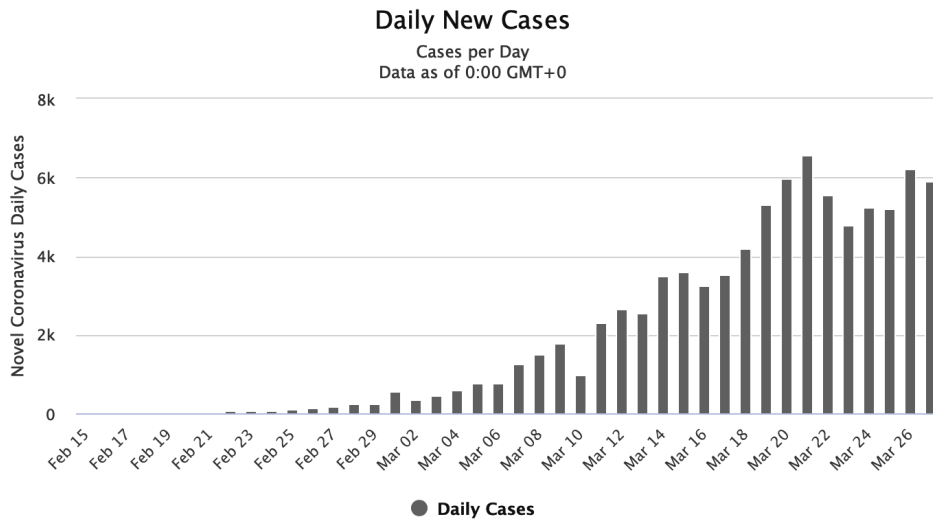


The spike on Feb 12 is an abnormality due to a change in clinical criteria. The pandemic increase in coronavirus cases begins on Jan 22. The government quickly implements a severe social distancing regime, testing essentially the entire populations of cities where the outbreak was most severe, and isolating anyone who tested positive. As you might imagine from the significant impact of the far milder social distancing going on in the United States, there was a strong impact on the daily load of new cases in China, which peaks in only two weeks on Feb 05. It takes four more weeks for the pandemic to end in China (there have been no new cases since March 7), with about two thirds of the total cases occurring after the peak in daily new cases.

Italy

Now let's have a look at Italy. It is second only to the United States and China in total number of Covid-19 cases, with 86,498 cases as of yesterday (they are not done yet). That's a lot of cases for a country with only one fifth as many people as the United States. Why so many more *per capita*? Because things got started (that is, had at least 100 cases a day) in Italy three weeks earlier than in the United States, around Feb 22. Here's what has been going on there:

Daily New Cases in Italy



Clearly things are not over yet in Italy, but the rate of increase seems to have peaked. The data are a little rough, but somewhere around March 21 seems to have been the most rapid rate of increase. Exactly a month after the outbreak began, that's twice as long as the rate of increase took to peak in China, no doubt reflecting the far less rigid social distancing implemented by the Italians. If this continues to follow the path we have seen in China (2/3 of cases after the peak), The Italians are only about half-way done. They can expect another 80,000 cases, occurring over the next two months. The more severe social distancing now being imposed in Italy may lessen this, and shorten the time somewhat, but I am convinced they are looking at at least another month of hard times.

United States

So where does that leave us? Well, the daily number of new cases hasn't peaked yet here, but it seems to me reasonable to predict that the time to reach the peak here in the United States will be longer than in China and shorter than in Italy. For a working number when we can't know for sure what is going to happen, I suggest splitting the difference and calling the time from start to peak three weeks. We started March 20, so three weeks is: April 4.

READING TEA LEAVES

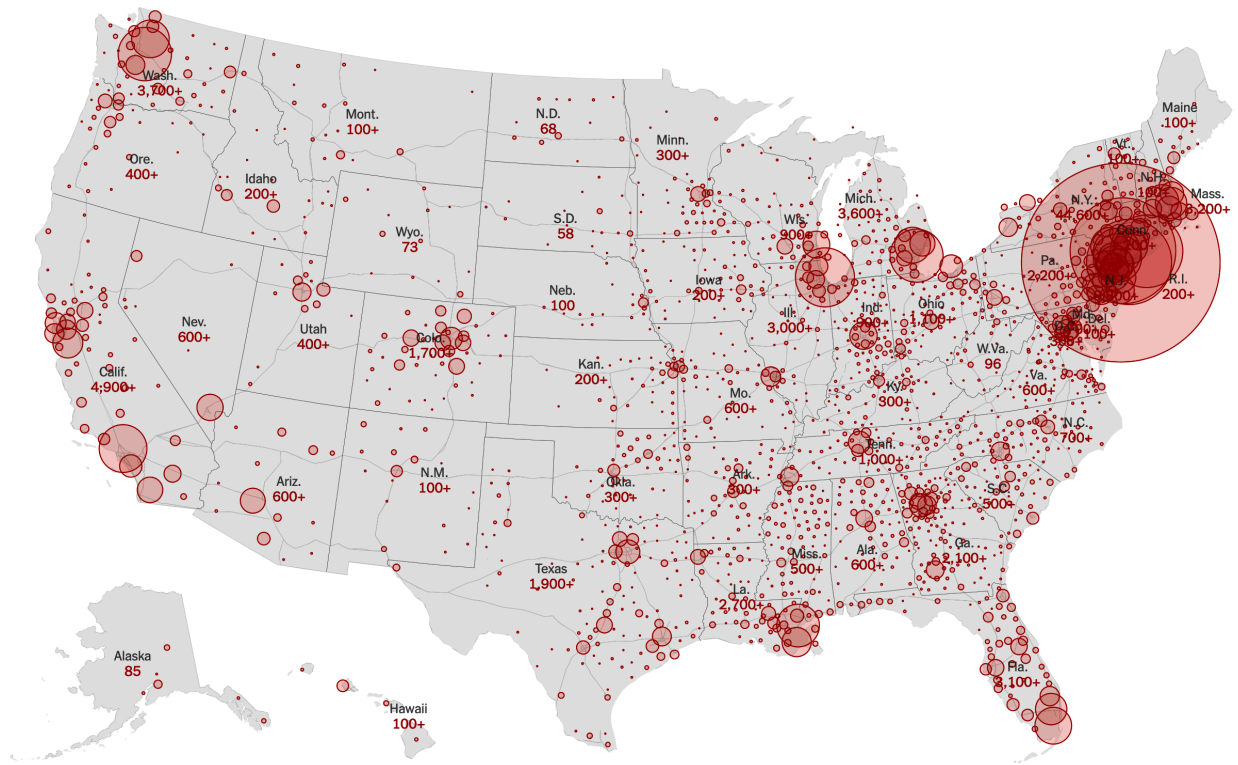
This puts us in a position to do some fancy guessing. I'm your father, and I won't lie to you. This is only guesswork. It's always tricky (some would say stupid) to assume that what happens in other countries will happen the same way here. But it's all we have to go on, so it seems to me a reasonable first stab at predicting what's coming down the road.

So here goes: If you go back and look at the first graph (the total number of cases occurring in the United States), you can see where I noted on the lower right corner of the graph the date of April 4, my best guess as to when the rate of increase of the coronavirus will peak. That date intersects the function line of the graph (the red line) at a total number of cases of about 450,000. That's the case load at the point where the daily incidence stops increasing. We will still be looking at some four weeks of more cases after the peak, but fewer each day. How many cases in all? Probably as many again, if our pattern follows China and Italy. Something like a million cases overall. Any chance of fewer, of a quicker end? I don't see it. The pandemic lasted in China for three weeks after it reached peak daily incidence, with far better social distancing, near-universal testing, and isolation of all people identified by this extensive testing as being infected. There is no way we get through this more quickly than they did.

SO WHAT SHOULD WE BE DOING?

We have 100,000 cases today, and are going to be looking at some 800,000 more over the next five weeks. Not very good news, but I don't see any other way to look at the data. Trump's suggestion that Americans should contemplate going back to work by Easter is a joke. We have, with social distancing, succeeded in reducing the person-to-person transmission rate well below 2.2. The last thing we need to do is allow that rate to increase again. With the Spanish flu a century ago, infections came back with a vengeance the second year, after isolation of the initial year's patients had been relaxed. We must not make that same mistake again.

Where does that leave our family? What should each of us do to avoid Covid-19 infection? Nikki, you live in New York, within the densest cluster of Covid-19 in the United States (more than a third of all cases!) and so today are at far greater risk than your sisters in Atlanta and Santa Fe. You should wear a N-95 face mask when you run in Central Park, and have your groceries delivered. Suzanne and Caitlin, you are at far less risk, but because Covid-19 cases are exploding all over the country, you three should each assume the entire country is exposed. Cases will increase the most rapidly wherever there are the most people, as you can see on the map on the following page. For all three of you, the key to surviving this mess is keeping contact with others to a minimum. Keep to yourselves. Shelter at home. Don't pet other people's dogs.



Doesn't sound like much fun, does it? The end of April is the soonest ray of sunshine I see – and that's if state governors don't relax social distancing (I fear they will). Until that day, you three should plan on continuing your social distancing, as your mother and I will. It's only another month. You are not alone. We are in this as a family – just a little separated. Until we can be together again, please live carefully. I will give you all a big hug at the other end of all this.

Dad