EPISODE 8

THE MARCH OF SCIENCE

Hi there. Welcome to the end of the world. My name is Michael Folz. And this is episode number eight of my podcast Dial It Back Or Die. In the last couple of episodes I've been tearing apart the so-called evidence that anything good about our lives today has had anything to do with liberal democracy, classical liberalism, or the theoretical magic of 'Enlightenment values'. And I promised at the end of the last episode that I would now tell you what the real reason is for our relative health and wealth, etc.

Well, I'm not going to pussy foot around here. I'm going to come right out and say it. Because it should be fairly obvious. Our astounding material progress of the past few hundred years in reality has virtually nothing to do with economics or political systems, with 'free markets' or 'free elections' or any other such claptrap. Rather it is almost entirely a direct function of Science and the adoption of the Scientific Method.

Now on the surface at least there is nothing controversial in saying this. After all, liberal democracy and those Enlightenment values both loudly proclaim not only that they value science above all other disciplines, but that their ideology is a direct repudiation of superstition and the like and a direct outgrowth of the scientific approach and way of thinking.

But, as I've already alluded to, every friggin' ideology which anyone has come up with for the past several hundred years, both those that have been adopted and those that haven't been, even the Nazis, has claimed the exact same thing. As I've mentioned, Marxists were utterly convinced that Marxist doctrine was as 'scientific' as were physics and chemistry.

So my goal in this episode will not be to convince you that the advancement of science has been critical to the creation of the modern world. After all, that should be more than obvious. Rather my goal will be to disabuse you of any belief that science—pure science—is in any way connected to whatever political or ideological beliefs that you may currently have.

And this might very well prove very difficult for me to do. Because even though it has become pretty well established by now that people tend to internalize just those facts which confirm their

preexisting left or right political outlook, still most of us think that Science doesn't operate that way.

Uh-uh. For instance, did you know that, when actually tested on specific scientific knowledge, climate change skeptics score just as well as do climate change believers? And if you're a climate change believer, such a statement might well totally shatter one of your core beliefs about climate change skeptics. So it is unlikely that you're going to accept this scientific fact about scientific facts. But it is indeed true. Because it turns out that the one determining factor in one's position on climate change is, you guessed it, preexisting political beliefs. And most definitely not one's basic knowledge of science.

And, while you're wrestling with that one, let me tell you a couple of stories. Because hopefully they're going to introduce several very important points to you. First, about the big difference which exists between the history that you think you know and the history which actually went down. Second, about how the scientific process actually works. And third, how our ideological indoctrination so often affects both our understanding of both history and science.

So let's begin:

Now in 1492 virtually everyone with any degree of education knew that the Earth was round. How could they not? After all, even in ancient times people had noticed that during a lunar eclipse the Earth's shadow upon the moon was curved. That could only be done by something round. Around 530 B.C. the great ancient mathematician, Pythagoras, theorized a spherical Earth. And the greatest ancient thinker, Aristotle, also declared it to be true.

Not only that, but shortly after this the knowledge was rather widespread that our planet was close to 25,000 miles in circumference. That had been known since at least 200 B.C., when an Egyptian Greek named Eratosthenes made a very clever insight. He knew that on the summer solstice the sun was directly overhead in the southern Egyptian city now known as Aswan. He also knew that the city of Alexandria, where he lived, was due north of Aswan. So on that day he measured the angle of the sun from the vertical at his house. It came out as 7 degrees, 12 minutes; exactly $1/50^{th}$ of a circle. Now back then, since land measurements were based on official strides, there was a guild of professional striders. So Eratosthenes hired one of them to carefully walk from Aswan to Alexandria, and he then multiplied that distance by 50. It is said that the number he came up with was within 1% of what we now know is the true circumference.

If that wasn't enough, around the year 500 AD the Indian astronomer Aryabhata came up with a

figure that was definitely within 1% of the true circumference. If that wasn't enough, in 830 AD Arab astronomers came up with an even closer value. And if *that* wasn't enough, around 1100 AD a Persian mathematician named Abu Rayhan Binwi, by just using trigonometry, got within 10 miles of the true figure.

But in 1492 Christopher Columbus wasn't a man who was very well educated. And he had come upon a map by an Italian named Toscanelli which had Asia extending 5000 miles further east than it actually does. On top of that Columbus had miscalculated the circumference of the Earth to be less than 20,000 miles around. Which is why in his mind it was a brilliant idea to sail west for 4,000 miles or so and reach China. Nor could he understand it when everyone laughed at him and pointed out that the distance he would have to travel was more like 15,000 miles, and that no ship's food and water could last that long.

So it was a total fluke of world history that he should meet up with Ferdinand and Isabella. Because at the time Spain was a rather uneducated hillbilly backwater of Western Civilization, and was probably the only place where the people in power didn't know the true circumference of the Earth. What's more, 1492 was the year that the (educated and cultured) Moors had been finally driven from the Iberian peninsula, and that the kingdoms of Aragon and Navarre had united. So the king and queen were looking for new fields to conquer. After all, little neighbor Portugal had recently risen to world prominence by navigating new sea paths around Africa to India and China. Surely Spain could accomplish the same feat by backing this Columbus guy and his magical map!

The rest, as they say, is history.

But while Columbus was on his way to believing that he had actually reached the East Indies, a young man named Nicolas Copernicus was in the midst of his university studies in Warsaw. He would go on to become a poet, a philosopher, a medical doctor, a priest, a diplomat, and one of Europe's most renowned scholars. He would end up becoming a central and respected figure both in the affairs of his native Poland and in those of the Catholic Church.

But he also had an amateur's passion for astronomy. And from his youth he had been involved in both astronomical observations and correspondence with the other astronomers of Europe. Around 1510 he dusted off an old idea that had first been hypothesized around the year 400 B.C. by a follower of Pythagoras named Philolaus, and that then had been championed by a philosopher named Aristarchus around the year 250 B.C. The theory was that the Sun was the center of the Universe and that the Earth and the other planets all revolved around it.

By 1514 he had written a 40 page outline of his heliocentric speculation, with the emphasis on speculation, since he was not that much of a mathematician and was hardly what we would today call a scientist. Over the next decade or so he shared this little manuscript with his friends and correspondents. He also worked on a larger book which fleshed out his theory. In 1533 these ideas were presented to Pope Clement V11, who was very interested and impressed by them.

Friends kept telling him he should publish his book, but he always held back. He was afraid that if he did publish he would be criticized, even ridiculed, by all the far more learned natural philosophers of Europe. Finally, in 1543, he agreed to publication, and the book came out right before his death.

He had good cause to fear criticism. Because this wasn't really a new idea. And he hadn't really added any new scientific data or findings to it. Indeed, many of his hypotheses look incredibly ignorant in retrospect. For instance, he believed that while the Earth moved around the Sun, this planet was still the center of all the gravity in the Universe. He also believed that only the Earth moved, and that all the other planets were stationary.

And the plain fact was that Ptolemy, recognized as the greatest of the ancient astronomers, and most other ancient thinkers had had very good reasons for rejecting this theory way back then.

Because it didn't make sense.

Because, first and foremost, it was totally unscientific.

For instance, there was the problem of parallax. If you're, say, riding on a train, and you see a set of objects in the distance, such as a group of trees or houses, they appear in a certain order. But as you continue to move that apparent order changes. The Greeks no longer believed that the stars were holes punched in the sky. Therefore, if the Earth was moving around the Sun, how come their apparent positions never changed? (We now know that this is because the stars are many light years away, but this understanding of distance would have been beyond inconceivable to both the ancients and to Copernicus. And, in fact, with our incredibly strong telescopes these days, we actually can measure tiny levels of parallax.)

Anyway, a much larger issue was that of motion. Given that the Earth's circumference was about 25,000 miles, given that the day was 24 hours long, and given that the Sun appeared to rise every morning, this meant that the Earth would have to be spinning at over a thousand miles an hour. Again, a speed that would have been incomprehensible back then. And if you spin a plate (or a Frisbee) at a much, much lower speed, nothing stays on it. So why didn't we (and everything else) fly off into

space?

If you answered, 'because of gravity', you need to realize that up until Isaac Newton in 1688, nobody had any remotely accurate understanding of what gravity was. (Indeed, up until the present day gravity remains the least understood of the primal forces.) But let's assume that the ancients (and Copernicus) did know about gravity. That still doesn't answer this question: If an apple falls to the ground because of gravity, why doesn't the Moon? If the Sun is the center of the solar system, why doesn't the Earth fall into it?

Again, the answer to this—which involves the wonders of centrifugal and centripetal force—had to wait for Newton's publication of the 'Principia Mathematica' in 1688, long after Copernicus' death.

But the biggest problem with the heliocentric hypothesis was something that, again, the ancient Greeks had discovered fifteen hundred years earlier. It is this: If you take the *observed* positions of the planets, and then try to plot them in circular orbits around the Sun, ***it doesn't work.***

The numbers just don't add up.

And the more accurate the observations got as the centuries went on, the more the facts didn't fit the heliocentric theory. Given the data, it was absolutely impossible for the planets of the solar system to circle the sun in circular orbits.

And this is why the smart people of the Sixteenth Century rejected the ideas of Copernicus. Not because they were afraid to admit that the Earth wasn't the center of the Universe. Not because the concept contradicted passages in the Old Testament. But because, given the scientific knowledge of the time (which, remember, Copernicus had not added a single bit to), *the theory was simply not supported by the facts.*

Which isn't to say that the theory was rejected out of hand. After all, it had been kicking around for almost two thousand years. And having the Sun in the center of the Universe did make a lot of poetic and intuitive sense. So people kept working on the idea. And in 1607, 60 years after Copernicus, the brilliant mathematician and astronomer Johannes Kepler conceived of the incredibly elegant solution of plotting the orbits of the planets not as circles, but as *ellipses*. Immediately all the observed data fit perfectly into place. So perfectly, in fact, that it was impossible to deny. And two years later when Galileo added his telescopic observations of the moons of Jupiter and the phases of Venus, that was just so much icing on the cake.

And it is incredibly important for you to know that from this time on the main reason it took a

long while for the educated elite to fully accept the heliocentric theory had nothing to do with religion. Rather it had to do with the classical world's absolute conviction that the circle was the most perfect, mystical shape in the Universe. People just couldn't get their heads around the idea that planets could and would move in anything *but* a circle. They positively hated the idea of ellipses. Even Kepler spent the rest of his live being really uncomfortable with his findings. And Galileo went to his grave still totally rejecting the idea of ellipses.

Just to repeat: No one rejected the Copernican theory because of their superstitious or emotional attachment to the Earth as the center of the Universe. Nor did anyone reject it because it conflicted with certain passages in the Old Testament. As mentioned, Copernicus himself was a priest, and he had warm relations with the Catholic Church hierarchy. The pope himself, even in the middle of the Reformation, had been really intrigued by the heliocentric idea.

Anyway, so there you have two famous stories from history: The voyager of Columbus and the Copernican Revolution. Now with Columbus you may well have learned later on that some people back then knew that the Earth was round, but that most common people didn't. Baloney. Everyone everywhere knew that the Earth was round. Columbus was the ignorant bumpkin. Ferdinand and Isabella were beyond stupid. And by all rights he should have ended up dead in the middle of the Pacific Ocean.

And the 'The Earth is flat' thing? That's from a make believe story by the American novelist Washington Irving. From around 1820.

Now why would children be taught such nonsense? Well, for one thing, it makes Columbus into a brave hero instead of a glory seeking fool. More importantly, though, it plays into the narrative that way back then, before the Renaissance and the Reformation and the Enlightenment, existence was only mud and misery and ignorance. You know, nobody lived beyond the age of 30. Even though that Italian with his dumb map that Columbus used lived to be 85.

But tales for schoolchildren are one thing. The supposed Copernican Revolution, which almost every science presenter presents as just about the most important turning point in the creation of the modern mind, now that's lying on a whole other level.

Because Copernicus never angrily attacked received wisdom. He knew that he was reviving an old, discredited idea. And he thought that he was adding some new insights. But he was humbly aware that he wasn't that good in math. And, like the honorable gentleman that he was, he was fully prepared

for his ideas to be wrong.

In fact, until Kepler and then Newton came along, his ideas *were* scientifically wrong. And it is just through pure luck, and in hindsight, that we can see that his core idea, which wasn't even his, was correct.

Which brings us right back to that whole demonization of history thing that I keep talking about. Whereas, in reality, when you actually examine the thoughts and writings of people back then, you readily see how much love of learning they had in that era. And it's pretty easy to make an argument that the educated person of that era had a far deeper breadth of knowledge and a much sharper mind than does the typical college graduate of today.

Now it's true that only a relatively small percentage of people were educated back then. But this was because of the plain fact that over 90% of the population was required for agriculture. It would only be after the rapid expansion of scientific knowledge and technological know how in the past several centuries that this number would go down appreciably.

But, again, before your mind goes 'aha', that's because of the Enlightenment, once again: Baloney. For now I am going to tell you the true story of how what we now refer to as 'scientific thinking' and/or the 'scientific method' was conceived and developed. And this story will probably really surprise you.

First of all, what we now call 'science' back then was called 'natural philosophy'. And 'back then' doesn't mean the 18th or the 17th or even the 16th Century. It means the 13th Century. In Western Europe.

That's right, the 13th Century. In Western Europe. A time and place that you might much more readily associate with that darkness, barbaric warfare, and wholesale belief in superstitions that your history has taught you that the Middle Ages were.

Although the very fact that anyone would assign the beginning of' Science to any time or place might also strike you as strange. Weren't the ancient Greeks, from Pythagoras to Archimedes to Ptolemy, the first scientists? Weren't there important early discoveries in China and India? What about the Arab flowering of mathematics and science in the 9th and 10th Centuries?

Yes, it's true that quite a lot of the basics of what we now call science had been discovered before the thirteenth century. But those discoveries hadn't been systematic. Archimedes did indeed discover his principle that bodies displace other bodies of equal mass. But his 'Eureka' moment came

from getting into his bathtub, not through any preplanned experiment.

Moreover, the emphasis in ancient cultures was on deductive philosophizing from first principles, not from inducing hypotheses from the careful analysis of nature and then testing them. Thus Aristotle, the foremost 'scientist' of early times, made many acute observations. But he then concluded from them certain first principles about the nature of reality. And for the next fifteen hundred years no one ever questioned those first principles.

So, although Aristotle was brilliant, this was neither science nor the scientific method.

Unfortunately, it turns out that even today it is quite difficult to pin down a precise definition of what the 'scientific method' is. But most people would agree that it is systematic. It also implies an attempt to mathematically describe nature. And it arrives at truth primarily through the inductive method of forming hypotheses and then testing them.

Which brings us back to the 13th Century. Which, contrary to what you might have been told—and as we shall shortly see in our stroll through Histoy—was actually a cultural high point and the culmination of the period referred to by historians as the High Middle Ages. The Dark Ages had been over for several centuries, and Western Europe was wealthier and far more technologically advanced than it had ever been under Roman rule. Inventions as far flung as the wheelbarrow, the windmill, the water mill, glass windows, the clock, soap, the magnet, the mirror, eye glasses, and crop rotation had improved life immeasurably. This is when the great Gothic cathedrals, such as Notre Dame in Paris and the magnificent one at Chartres, were being built. And they were buildings which were far more sophisticated and complicated than anything the Romans or anyone else had ever even contemplated.

And not only was there prosperity, there was peace. Even with all the myriad kingdoms and dukedoms and whatever, from 1214 to 1294 there were no wars on the continent. Zero. Kings were pious and knights—with no battles to fight—mostly competed to see who was the most chivalrous with the ladies. So it is not surprising that the life of the intellect would flourish under such circumstances.

It is somewhat surprising, though, that the foundations of the scientific method should be laid by Franciscan monks. After all, they were the followers of the simple, pious mystic Saint Francis of Assisi, who devoted all of his life to devotion, not intellect.

But the other great Catholic of that time, Thomas Aquinas, had just spent his entire life attempting to fuse Aristotle's rationalist body of work with the dogma and doctrine of the Church. To him and his fellow Dominicans, by definition there could be no conflict between revealed truth and the truth of nature. It was a noble effort to find unity between Greek wisdom and Church dogma, but in the

end Aquinas ended up being just as deductive as the ancient Greeks. In the end, he was not scientific.

The Franciscans, however, believed that the religious experience was just that. An experience. And it didn't need to be confirmed or denied by nature. This freed them from the necessity of making sure that nature agreed with scripture. Or, by extension, with the previously received wisdom of Aristotle. They were now able to examine nature on its own terms.

Further, their belief in a loving God meant that this Being would not have given man a rational brain unless it was possible to rationally understand nature. Finally, such a God would also have constructed a Universe which had laws that were rational, universal and simple.

Such a hypothesis is breathtaking even to modern physicists. After all, it is not immediately obvious that the Universe should have laws of physics. Nor that the same set of laws should apply from one side of the Universe to the other. Nor that they should be mathematical, let alone elegantly so. If, as most scientists believe, Consciousness did not exist until happenstance developed it on this tiny planet 10,000 or so years ago, then why would the Universe have laws and relationships that only Consciousness could comprehend?

But from before Galileo to beyond Einstein, this hypothesis of the Franciscan friars—in short, the theoretical basis for the scientific method—has been breathtakingly confirmed.

Anyway, back to the thirteenth century once again. The scholar and devotedly religious Franciscan friar Roger Bacon is generally considered to be the first true scientist. He championed empiricism, experimentation, and independent verification. He was an expert in optics and mathematics. He foresaw, among other things, submarines, airplanes, and telescopes. And his personality was forthright and independent. But, as with Copernicus, he was neither a lonely beacon of rationality nor was he persecuted for his beliefs. Indeed, he was merely the most famous member of an intellectual movement called the Oxford School. Some of the others were Robert Grosseteste and William of Occam, whose principle, Occam's Razor, we'll be talking about later.

Now you might consider all of this an interesting story. But you also might respond that not much science took place during the next three hundred years or so. So, as with the Viking 'discovery' of North America, if there was no follow up, then what's the point?

Well, as I will shortly outline in the next section, there are good reasons for this, primarily (and this might also surprise you) because of climate change. More importantly, though, the technology available back then was not nearly ready for the practice of scientific experimentation. The instruments needed for discovery and precise measurement, such as the telescope and a really accurate timepiece,

had not been developed yet.

But two centuries later, when the West's economy and political culture were re-established, and those instruments of measuring were developed, up until the eighteenth century it was fully believing Christians who did almost all of the important scientific work. For all of his troubles with the Catholic Church, Galileo was still a devout Christian. So were Copernicus, Kepler, and Newton. In fact, Isaac Newton, who is generally considered to be the greatest mind of all time, spent much more effort thinking and writing about theology than he did thinking and writing about science and mathematics.

So it is critical that you understand that this is how modern science got started. From Christian monks using their patient faith in their God given rationality to further understand their Creator's glory. From this humble beginning is how all our long disease free lives and all our inventions and gadgets and gizmos and all our comfort and ease have arisen.

It has nothing to do with our ideology, or with any other ideology for that matter. It just doesn't. I mean, significant scientific advances were made even under both the Soviets and the Nazis.

No, it is the accumulation of scientific knowledge alone which can explain pretty much all of the material progress of the last millennium.

Of course, there is a small caveat to mention. This is that *technology*, which is the application of science in the making of specific products, is somewhat dependent on ideology. There would be no need to create burglar alarms or handguns in a culture where people trusted one another. (As we shall see, fear and distrust are terrific for economic growth.) In a more egalitarian culture there would be no need to create more and more luxurious cars. Or stupid overpriced watches which signal your self importance to those lower down on the socioeconomic ladder.

But by and large we would probably be at the same stage of scientific advance if the Age of Enlightenment, 'free markets', and the like had never happened. Indeed, one could even argue that we would plausibly be much further along.

Although now isn't the time to be making that argument. Rather it is the point where I have to pound it into your head as to why we could still be so healthy and wealthy (if not wise) living under such an inherently wrong and corrupt ideological system:

It is totally a function of the advancement of Science.

It has *not* been our ideology that has caused us to live longer. To conquer disease. To create machines and industries which make our lives easier. To drive around the world and to fly to the moon.

It has been Science.

Ideology has had nothing to do with it.

Moreover, the Enlightenment was definitely *not* an outgrowth of the scientific method or the Scientific Revolution of the 1600's. It was *not* based on scientific thinking or scientific evidence.

It *was* based on what has been called scientism. This is basically the naive belief that human behavior can be modeled just as simply as in the physics of rolling a ball down a ramp. And that then putative 'experts' can take the place of the priests and the poets and the painters who formerly tried to give our lives meaning and worth. But scientism was and is a joke. And in reality it bears no resemblance to the actual scientific method.

Because the plain fact of the matter is that the scientific method, which is wholly responsible for the astonishing growth of scientific knowledge, was discovered and codified by, of all people and institutions, the Catholic Church. Further—as we shall soon see—there was absolutely no argument between Science and Religion before the time of the Enlightenment. In fact, until around 1750 the intellectual situation was exactly the reverse of what came afterwards. Because it was generally taken as truth that the newly discovered laws of physics and of nature were the most dramatic proof possible of the existence of God.

Indeed, it can even be seriously argued that science would have never arisen were it not for the particular characteristics of devotional Christianity. After all, China, India, Greece and Rome all developed highly educated and thoughtful cultures. Yet none of them produced anything approaching an organized scientific method.

Now this last statement might really surprise you. Especially if you are one of those people who prides themselves on their 'rationality' and their freedom from religious beliefs.

Although of course that doesn't stop it from being true anyway.

So at this point we'll stop. After all, that's probably enough for one session. Next time we'll get back into examining just how it was that our minds could get so manipulated in the latter half of the 20th Century.

But, in the meantime, thanks again for so far having listened.