
Chapter 1: The Tyranny of the Prefrontal Cortex

The "tyranny" of the prefrontal cortex

Our civilization is changing the climate of our planet. People kill themselves and others in the name of God. Species are going extinct at a rate not seen for 65 million years. A billion wretched people go hungry each day though their ancestors lived fulfilling lives. Our society makes astonishing advances in technology – yet our world seems to be careening out of control at an ever faster pace. While all this is going on around us, you and I sometimes feel strangely disconnected from everything and from ourselves. We all agree that we spend most of our time under constant stress – but for the most part, we adapt to it all and continue living our lives as though everything's normal.

What connects all of these seemingly unrelated phenomena of our modern world? I believe there is an overriding dynamic driving all these imbalances in our lives. It's so all-encompassing, so fundamental to how we think and conduct our lives that we don't even recognize its existence. And yet it's responsible for making each of us, and our world, what we are today. It's what I call the tyranny of the prefrontal cortex over other aspects of our consciousness. Acknowledging this tyranny and understanding its dynamic is the first necessary step toward achieving re-harmonization within our individual and collective consciousness.

The prefrontal cortex ("pfc") is that part of our brain that's primarily responsible for our thinking and acting in ways that differentiate us from all other animals. It mediates our ability to plan, conceptualize, symbolize, make rules, abstract ideas, and impose meaning on things. It controls our physiological drives and turns our basic feelings into complex emotions. It enables us to be aware of ourselves and others as separately existing beings, and to turn the past and the future into one flowing narrative.¹

Think of whatever we do that animals don't do. That's the pfc functioning – what may be called our *conceptual consciousness*. Then think of what we share with other creatures: hunger, sexual urges, pain, aggression, desire for warmth, caring for our offspring – we can call that our *animate consciousness*. While many of the pfc capabilities exist to some degree in other creatures – chimpanzees, dolphins and parrots, for example – their predominance in humans is overwhelmingly different in scope and magnitude, accounting largely for our current domination of the natural world.^{2*}

The pfc is the most connected part of the brain, linking directly or indirectly to all parts mediating our animate consciousness – those areas responsible for our sensations, instincts and internal metabolism. For this reason, many neuroscientists refer to the pfc as our "executive function". Like the CEO of a corporation or president of a nation, the pfc is seen as getting information, processing it and sending out commands. One neuroscientist, Elkhonon Goldberg, who has written a book on the pfc, views

the frontal lobes^{3*} as the brain's CEO, capable of taking 'an aerial view' of all the other functions of the brain and coordinating them; the frontal lobes as the brain's conductor, coordinating the thousand instruments in the brain's orchestra. But above all, the frontal lobes as the brain's leader, leading the individual into the novelty, the innovations,

¹ For summaries of prefrontal cortex function: Miller, E. K., and Cohen, J. D. (2001). "An Integrative Theory of Prefrontal Cortex Function." *Annual Review of Neuroscience*, 24:167-202; Fuster, J. M. (2001). "The Prefrontal Cortex - An Update: Time Is of the Essence" *Neuron*. City, pp. 319-333; Goldman-Rakic, P. S. (1996). "The prefrontal landscape: implications of functional architecture for understanding human mentation and the central executive." *Phil. Trans. R. Soc. Lond. B*, 1445-1453.

² These two forms of consciousness are sometimes referred to as primary and secondary consciousness or core consciousness and higher-order consciousness. In Part II, the distinction between animate and conceptual consciousness will be examined in more detail, as well as the contrast between human cognition and that of other animals.

³ The term "frontal lobes" is often used interchangeably with "prefrontal cortex" and describes the front section of the brain that incorporates the prefrontal cortex.

the adventures of life. Without the great development of the frontal lobes in the human brain (coupled with the development of the language areas), civilization could never have arisen.⁴

The pfc is clearly an essential part – perhaps *the* essential part – of what makes us human. But I'm suggesting that, over the last few thousand years, the pfc has staged a coup in our collective (and individual) consciousness. It's no longer like a democratically elected president. Instead, it's become a tyrant within our own minds, taking such control of our consciousness that we're hardly even aware that there are other ways to be.

The pfc has barely, if at all, changed from an evolutionary perspective since at least Upper Paleolithic times, forty thousand years ago. So the coup that I'm referring to came about from the impact of human culture on the developing mind of each individual. To understand this coup, we need to trace the growth in the pfc's power through history – all the way back to our prehistory.

But before we begin our journey through history, let's spend a few moments on the notion of the pfc's "tyranny." After all, "tyranny" is a fairly extreme accusation to throw at any leader, not to mention the leader of our brain that's been responsible for making us human and building our civilization. Anyone making that kind of accusation has some explaining to do. Why a tyranny? What kind of coup are we talking about? Why are we using a political analogy about the brain, anyway? And come to think of it, how can a part of the brain even do anything without the rest of the brain? These are all fair questions, and while it might take most of this book to answer them thoroughly, any reader considering plowing on deserves at least a brief explanation upfront.

An exponential rate of change

Let's start by scoping out the magnitude of what the pfc has accomplished in a relatively short time. For most of us, busily managing the daily challenges of our lives, it seems that things have always been somewhat like this. Sure, technologies change from one generation to the next, and we all know that modern times are more frenetic than they used to be... but isn't that just what every new generation says? Because we live in the continually swirling events of our own age, it's difficult sometimes to stand back and see just how different our current age is from every other time in history.

Perhaps the most unique feature about our age is the very rate of change itself. It's getting faster and faster. At an ever accelerating rate. But how can we quantify something like that? One instructive approach is to look at just one particular changing technology, which happens to lend itself to some fairly good historical quantification: the measurement of time.

Long ago, the Chinese had time wrapped up tighter than anyone else in the world. Their clocks could track time with an error of just a minute or two per day. And they gradually improved on their time-keeping technology, so over a thousand years or so, the error was reduced to about ten seconds a day. That was about the same accuracy of the first pendulum clock in the West, patented in 1657 by the Dutch scientist Christiaan Huygens. But then, something very strange happened. The accuracy of Western clocks kept getting better and better. And the rate of improvement itself kept getting faster and faster. So in less than two centuries the Western clocks were a hundred times more accurate than Huygens'. And less than a century later, a hundred times more accurate still. And in the past century, they've become

⁴ Goldberg, E. (2001). *The Executive Brain: Frontal Lobes and the Civilized Mind*, New York: Oxford University Press.

ten thousand times more accurate than that. That's known as an exponential rate of change, which follows a logarithmic curve, and can be seen in Figure 1.⁵

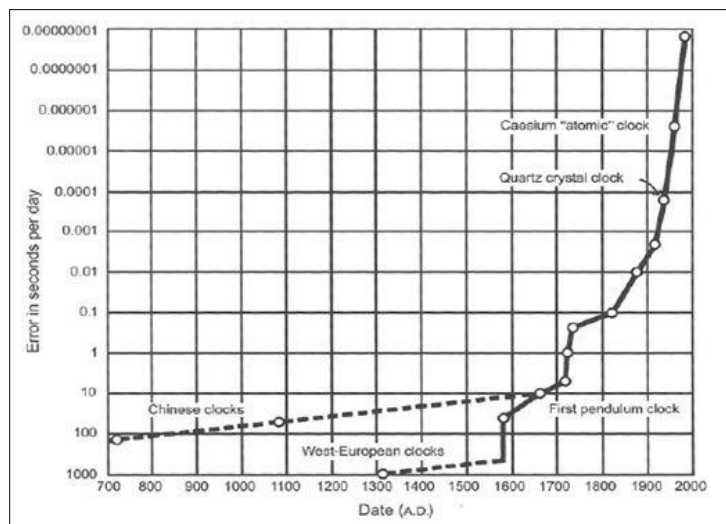


Figure 1: The exponential rate of increase in the accuracy of time measurement.

In fact, there are many graphs depicting human achievements historically that follow this same exponential curve. Perhaps the most fundamental and striking of them is the graph showing the rise in human population to its current level of nearly seven billion people, as show in Figure 2.⁶ The close match between these two curves and their inflection points, where they start going vertical, is no coincidence. It is, in fact, the dramatic increase in technological innovation that has permitted the human population to grow so rapidly.

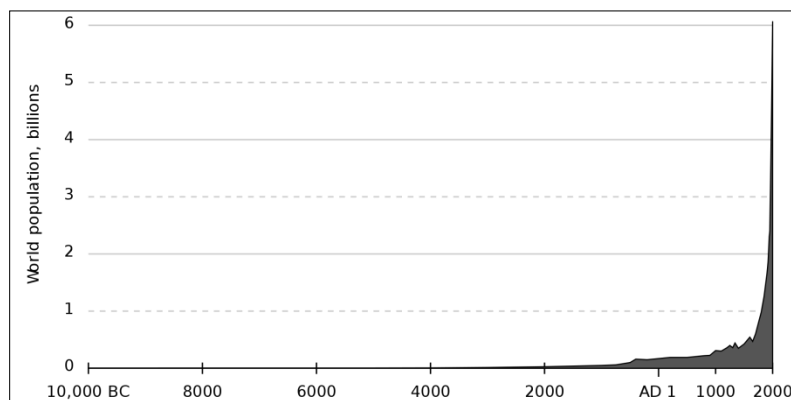


Figure 2: The exponential rate of increase in human population

If you look closely at Figure 1, you might notice a couple of interesting things. First, see how the Chinese rate of improvement (depicted by the dotted line) was very stable and consistent. It was only the Western rate of technological change that went exponential. And then, take a good look at the right hand side of the graph, representing our current age. In recent times, the line seems almost vertical. But how much longer can it continue on that course? And when you extrapolate this out to all the other areas of

⁵ Chart reprinted from Aveni, A. (2002). *Empires of Time: Calendars, Clocks, and Cultures*, Boulder, CO: University Press of Colorado. Additionally, see Needham, J. (1969). *The Grand Titration: Science and Society in East and West*, Toronto: University of Toronto Press, for an earlier version of the same chart.

⁶ http://en.wikipedia.org/wiki/File:Population_curve.svg.

technological innovation with similar exponential curves, it's difficult not to ask, where is this taking us? How did it all get started?

But why a "tyranny"?

So far, we can say this much: whatever has happened, whether you call it a tyranny or not, it's something very dramatic, and it's still going on right now. But why a "tyranny"?

First, let me explain exactly what I mean by "tyranny." I'm suggesting that the unique evolutionary expansion of the pfc in the human brain, combined with the dynamics of culture (itself a product of pfc activity) has created a positive feedback loop leading to an imbalance within the human psyche, both collectively and individually. Collectively, this imbalance manifests in the extreme characteristics of our global society, such as our unsustainable use of natural resources to fuel exponentially accelerating material growth. Individually, this tyranny refers to our unreflective absorption of fundamental values that prioritize pfc-mediated attributes at the expense of other aspects of our humanity. I believe that this dynamic is the ultimate source of a large part of the social and individual discontent we all experience on a daily basis.

Now, if you describe a part of the brain like a person, such as calling it a "tyrant," you can fall into dangerous philosophical territory. In fact, it's become common for popular books on neuroscience to give cartoon-like characteristics to parts of the brain, such as "my limbic system told me to run but my frontal lobes stopped me in my tracks." This approach has been criticized by a respected neuroscientist/philosopher team that has called it "the mereological fallacy in neuroscience."⁷ This, they explain, is the fallacy of ascribing human attributes like thinking, believing, understanding, etc., to the human brain or part of the brain, when these attributes can only reasonably be applied to the complete human being. "Only a human being," they write, "can intelligibly and literally be said to see or be blind, hear or be deaf, ask questions or refrain from asking."⁸ It's called the "mereological" fallacy because mereology is the study of relations between parts and wholes.

Does accusing the pfc of tyranny fall foul of the mereological fallacy? It's certainly true that a pfc can't actually be a tyrant – only a person can. But a tyranny doesn't necessarily mean "rule by a tyrant." As Merriam-Webster tells us, a tyranny can also refer to "a rigorous condition imposed by some outside agency or force," such as in the phrase "living under the tyranny of the clock."⁹ That's the way in which I'm using the word. Here's a definition of tyranny that best describes what I'm ascribing to the pfc:

Excessive control wrested by one particular agent disrupting a previous balance, in which power is maintained and used for the benefit of the controlling agent to the potential detriment of the group(s) being tyrannized.

So, when I refer to the pfc's imbalance as a tyranny, I mean that there's been a shift in power within our individual and collective consciousness, and the predominant pfc-mediated values that have arisen in our global society, as a result of this imbalance, work to the detriment of other aspects of our humanity.

In fact, in spite of the "mereological fallacy," there's been a centuries long tradition in Western culture to use the analogy of a society when describing the mind. Cognitive philosophers George Lakoff and Mark Johnson describe how this "society of mind" metaphor works:

The Society of Mind metaphor is basic to faculty psychology. In the metaphor, the mind is conceptualized as a society whose members perform distinct, nonoverlapping tasks necessary for the successful functioning of that society. The

⁷ M. R. Bennett, P. M. S. Hacker (2003). *Philosophical Foundations of Neuroscience*, Blackwell Publishing, pp. 68-73.

⁸ Ibid.

⁹ Merriam-Webster's definition: <http://east.merriam-webster.com/dictionary/tyranny>.

capacities of the mind are thereby conceptualized as autonomous, individual people, each with a different job and each with a distinct, appropriate personality.¹⁰

While this may seem a little quaint, this approach wins a lot of support from modern researchers. In a highly regarded book called *The Embodied Mind: Cognitive Science and Human Experience*, three cognitive scientists say this about "the model of the mind as a society of numerous agents":

the overall picture of mind not as a unified, homogenous entity, nor even as a collection of entities, but rather as a disunified, heterogenous collection of networks of processes seems not only attractive but also strongly resonant with the experience accumulated in all the fields of cognitive science.¹¹

In fact, Sir Francis Crick, world famous for his co-discovery of the DNA molecule, turned his attention later in life to neuroscience, and offered a "framework for consciousness" in a paper in *Nature Neuroscience*, where he compared the process of consciousness to a continuous, ongoing election, with primaries, winning coalitions, journalists and pollsters.¹²

Given our "society of mind" metaphor and our definition of tyranny, the only issue remaining is why should the pfc's recognized executive leadership be described in such a pejorative way? After all, criticizing the pfc seems as nonsensical as criticizing the heart or the liver. It's a fundamental part of our existence and, as we've already seen, is probably the most significant part of our anatomy that distinguishes us from other animals.

Most people who study the pfc end up marveling at its awesome creative power. As noted above, Goldberg proposes that "without the great development of the frontal lobes in the human brain ... civilization could never have arisen" and I wholeheartedly agree with him. The prominent neuroscientist Antonio Damasio describes the "admirable" and "sublime" operations of the pfc in providing us the mechanisms for "consciousness, reasoned deliberation, and willpower," and I share his admiration and awe.¹³

But I'm not criticizing the pfc. Rather, I'm describing a dynamic that has evolved through the combined interplay of the pfc and the human culture it helped create with its network of symbolic representations, culminating in the culture that has arisen in the Western world over the past two thousand years. This is the dynamic that, in my view, has led to a tyranny, to an imbalance in our individual psyches and in our society that is both harmful and unsustainable. As anthropologist/neuroscientist Terrence Deacon – who's written a book on the pfc's role in human cognition – puts it:

... the symbolic universe has ensnared us in an inescapable web... and now by virtue of the irresistible urge it has instilled in us to turn everything we encounter and everyone we meet into symbols, we have become the means by which it unceremoniously propagates itself throughout the world...

[T]he invention of durable icons... was the beginning of a new phase of cultural evolution – one that is much more independent of individual human brains and speech, and one that has led to a modern runaway process which may very well prove to be unsustainable into the distant future.¹⁴

That's the tyranny we'll be tracing through Part I of this book.

¹⁰ Lakoff, G., and Johnson, M. (1999). *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought*, New York: Basic Books, 410.

¹¹ Varela, F. J., Thompson, E., and Rosch, E. (1993). *The Embodied Mind: Cognitive Science and Human Experience*, Cambridge, Massachusetts: MIT Press.

¹² Crick, F., and Koch, C. (2003). "A framework for consciousness." *Nature Neuroscience*, 6(2), 119-126.

¹³ Damasio, A. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain*, New York: Penguin Books, 123-4.

¹⁴ Deacon, T. W. (1997). *The Symbolic Species: The Co-evolution of Language and the Brain*, New York: Norton.

Archaeology of the mind

As we all know from reading the newspapers, one universal characteristic of tyrannies is that they control the press. And in the best run tyrannies, the media is so well controlled that most people aren't even aware that they live in a tyranny, and aren't too concerned about it even if they do know. This is particularly true of the tyranny of the pfc, which has achieved its dominance by imposing on us a worldview so ingrained in our minds that the vast majority of us – intellectuals as well as the rest of us – barely recognize that the world could be seen any other way. Worldviews as a rule are like that: most people would remain completely unaware that they even had a worldview unless they're presented with a contrasting worldview for comparison. Here's how a group of environmental scientists have described them:

Worldviews are broadly defined as our perceptions of how the world works and what is possible, encompassing the relationship between society and the rest of nature, as well as what is desirable (the goals we pursue). Our worldview is unstated, deeply felt, and unquestioned. These unconscious assumptions about how the world works provide the boundary conditions within which institutions and technologies are designed to function.¹⁵

The historian Edgar Zilsel once said about ideologies that they "are extremely conservative. They never can be explained by present conditions alone, but mirror the whole past too."¹⁶ That is even more true about worldviews.

It's helpful, in this regard, to think of a worldview as an edifice, a construction built layer by layer upon older infrastructures put together by generations past. Imagine our worldview as a house we live in comfortably, which was built in a place inhabited by humans from time immemorial. One modern philosopher, Mary Midgley, has disarmingly taken this analogy of a house to describe her philosophy as a form of plumbing, saying:

People think of philosophy as a special and rather grand subject cut off from others, something you could put on the mantelpiece. I think it is much more like plumbing – the sort of thinking that people do even in the most prudent, practical areas always has a whole system of thought under the surface which we are not aware of. Then suddenly we become aware of some bad smells, and we have to take up the floorboards and look at the concepts of even the most ordinary piece of thinking.¹⁷

The amount of digging we have to do depends, of course, on the scale of the problem. If you have a plumbing problem, taking up the floorboards is a good place to begin. But what happens if a hurricane or earthquake threatens? In that case, it may be necessary to dig deeper, to examine the very foundations of the edifice. As those who live in regions susceptible to earthquakes (as I do) know well, there are retrofits that can sometimes be done to those foundations which can make your home far more resilient and able to survive "the big one" if and when it comes. In the case of our current civilization, there's a growing awareness that our society may be creating its own "big one" in the form of global climate change, resource depletion and species extinction. If our worldview is built on shaky foundations, we need to know about it: we need to find the cracks and shore up the weaknesses.

But unlike modern houses, where the foundations are part of the blueprint and constructed specifically for the house, the foundations of a worldview comprise the earlier worldviews of previous generations. It's as though our house was built directly over an archaeological mound, or "tell", made up of the detritus of countless generations before us. And as we go further into history, we excavate deeper into the cognitive layers of our ancestors. That's why we can think of this exercise as an "archaeology of the mind."

¹⁵ Beddoe, R., Costanza, R., Farley, J., Garza, E., Kent, J., and Kubiszewski, I. (2009). "Overcoming systemic roadblocks to sustainability: The evolutionary redesign of worldviews, institutions, and technologies." *PNAS*, 106(8), 2483-2489.

¹⁶ Zilsel, E. (1942). "The Genesis of the Concept of Physical Law." *The Philosophical Review*, 51(3: May 1942), 245-279.

¹⁷ Quoted in Else, L. (2001). "Mary, Mary quite contrary." *New Scientist* (3 November 2001).

Cognitive history

In recent decades, real archaeologists have made use of new technologies such as carbon dating to greatly improve their understanding of the fragments they find. Similarly, our archaeology of the mind will use of some of the recent findings of neuroscience to try to make sense of what we dig up. Specifically, as already noted, we will examine our findings through the lens of the pfc's functions, enabling us to understand the evolving stages of cultural thought in terms of the pfc's ever-increasing power over the rest of human consciousness.

In the broadest terms, the analytical study of the workings of the human mind is known as cognitive science. This is an interdisciplinary tradition that began in the decades following the second world war and has since expanded in many different directions. Cognitive neuroscience is the name given to the discipline that analyzes the neurological substrates of human cognition, and is a major source of the findings mentioned frequently in this book about the pfc's functions. However, cognitive science has also branched out into other disciplines that, traditionally, have been less involved with the functioning of the mind. One area, for example, that has achieved great breakthroughs is called cognitive linguistics, which focuses on the conceptual underpinnings of specific languages, and of language in general.

Another emerging area is known as cognitive anthropology, which interprets patterns of human behavior in terms of the evolutionary and neurological drivers of people's thought structures. Here is the view of celebrated anthropologist Bruce Trigger on the need for a cognitive approach to anthropology:

What is needed is a better understanding, derived from psychology and neuroscience, of how the human brain shapes understanding and influences behavior... Social scientists must cease analyzing human behavior without reference to humans as biological entities. Evolution, both biological and cultural, is a process that adapts humans with specific but as yet poorly understood biological, social, and psychological predispositions... It would appear to be in [evolutionary psychology and neuroscience] that anthropologists must seek explanations of certain cross-cultural uniformities in human behavior.¹⁸

The approach of this book seems to fit within the parameters of what Trigger is calling for, with one notable difference. Trigger refers to "certain cross-cultural uniformities in human behavior," and in the early sections of this book, that's exactly what we'll be investigating. However, once we reach the period known as the Axial Age, roughly twenty five hundred years ago, we'll begin focusing on increasingly divergent conceptualizations of the world between different cultures. We will, however, continue to analyze this divergence through the lens of pfc attributes, and examine how different cultures responded to these attributes in very different ways, defining the future directions of their histories.

For this reason, I view this book as attempting a foray into a field that I would call "cognitive history." Like other cognitive studies, cognitive history analyzes its subject with reference to the conceptual structures of the human mind. In this case, however, it attempts to interpret historical events, such as the rise of monotheism or the scientific revolution, from a cognitive perspective. It is hoped that this somewhat unprecedented approach to history will permit insights that might otherwise not be achievable.^{19*}

¹⁸ Trigger, B. G. (2003). *Understanding Early Civilizations*, New York: Cambridge University Press, 683.

¹⁹ I see this book's attempt at cognitive history as ground-breaking, but not unique. For another example of cognitive history, see *The Master and his Emissary* by Iain McGilchrist, which traces the development of Western philosophy, art and literature in terms of conflict between the right and left hemispheres of the brain.

Four steps in the pfc's rise to power

No good archaeologist would dream of entering a dig without having some kind of plan in place and preferably a map of the area showing what to anticipate. Similarly, before diving into our cognitive history, it may be helpful to chart out where we expect to go.

Our cognitive history correlates different phases of human cultural evolution with different levels of the pfc's power of the rest of human consciousness. These are very briefly summarized as follows:

Pfc1: Stirrings of Power

The pfc's stirrings of power began with the emergence of modern *Homo sapiens*, around 200,000 years ago. These ancestors of ours were all hunter-gatherers. Basic tools and fire had already been mastered by previous *Homo* species (such as *Homo erectus*). But *Homo sapiens* began a symbolic revolution which erupted around 35,000 years ago in Europe, comprising symbolic communication in the forms of art, myth, and fully developed language.^{20*}

Pfc2: Ascendancy to Power

Roughly ten thousand years ago, in the Near East, some foragers stumbled on a new way of getting sustenance from the natural world and occasionally began to settle in one place. Animals and plants began to be domesticated, evolving into forms that were more advantageous for humans and relied on human management for their survival. Agriculture was born. Notions of property and land ownership arose. Hierarchies and inequalities developed within a society, along with specialization of skills (including writing). Massive organized projects, such as irrigation, began to take place. Cities and empires soon followed.

Pfc3: The Coup

In the Eastern Mediterranean, about 2,500 years ago, a unique notion first appeared: the idea of a completely abstract and eternal dimension in the universe and in each human psyche, which was utterly separate from the material world of normal experience. Humans had always posited other-worldly spirits and gods with different physical dynamics than the mundane world. But these spirits were conceived along a continuum of materiality. Now, for the first time, the idea of a universal, eternal God with infinite powers arose, along with the parallel idea of an immaterial human soul existing utterly apart from the body.

Christianity merged the Platonic ideal of a soul with the Judaic notion of an infinite God to create the first coherent dualistic cosmology. Islam absorbed both of these ideas into its doctrines. Together, Christianity and Islam conquered large portions of the world and brought their dualism along with their military power.

Pfc4: The Tyranny

In the 17th century, a Scientific Revolution erupted in Europe, leading to a closely linked Industrial Revolution, beginning a cycle of exponentially increasing technological change that continues to the present day. Although the seeds of scientific thinking could be traced back to the 12th century (and even to ancient Greece), a radically different view of mankind's relationship to the natural world caused a uniquely powerful positive feedback cycle in social and technological change, leading to increasing destabilization of this relationship.

²⁰ The precise timing of these developments continues to be fiercely debated. The biggest open issue of all is the timing of language (anywhere from one million to one hundred thousand years ago), and whether a proto-language existed for a long time before modern language developed. Some of these timing issues will be discussed in more detail in the relevant chapters.

These stages in the pfc's rise to power may also be mapped out in the form of a conceptual graph, as seen in Figure 3. The horizontal axis (approximating a logarithmic scale) represents the time in years before the present day. The vertical axis is a conceptual measure, representing the increasing levels of the pfc's power over human consciousness. If you follow the curve of the graph, you will note four inflexion points, with the curve's steepness increasing at the beginning of each new phase, such as the first use of symbolic communication and the beginning of agriculture. This represents the notion that, not only does the pfc's power increase in each phase, but the rate at which it gains power also increases. If you compare this curve to the two earlier graphs, you'll see that they all share the characteristic that the curve starts going almost vertical a few hundred years ago, around the time of the Scientific Revolution in the west.

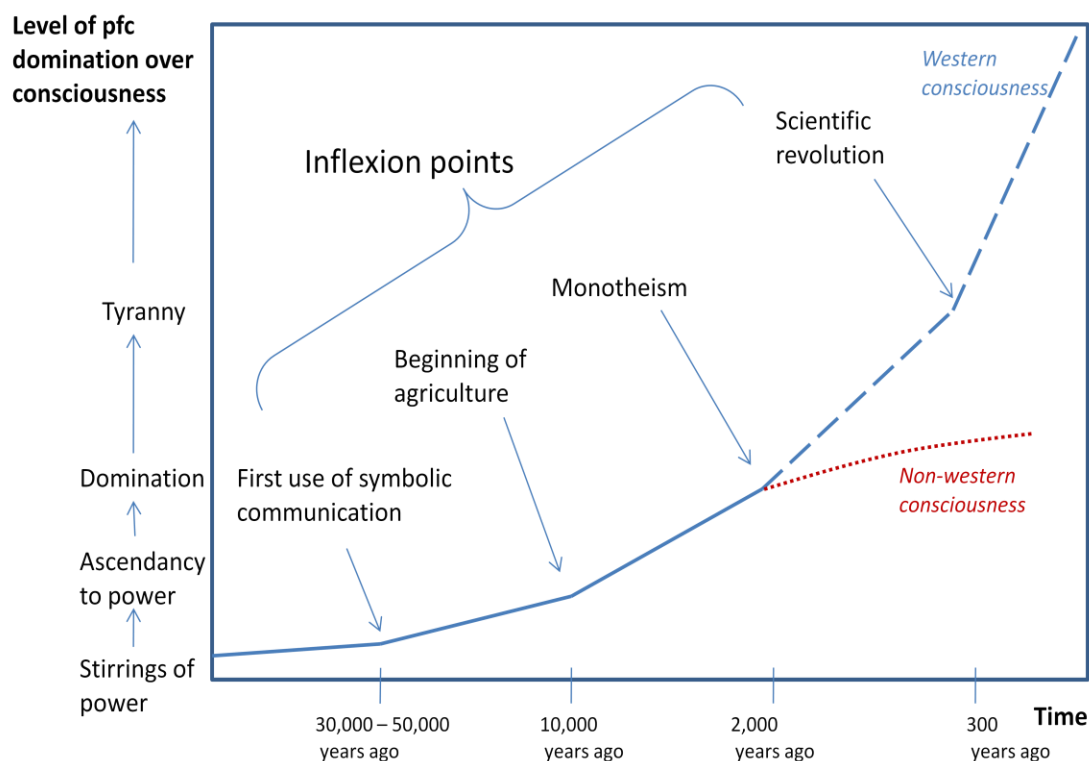


Figure 3: Graphical representation of the pfc's rise to power

You may also note that the line bifurcates at the beginning of monotheism. This reflects the thesis of this book that, with the dualist cosmology of monotheism, the Western mind became more subject to the pfc's power than the minds of other cultures. This gap continued to increase after the Scientific Revolution in Europe. Finally, you'll notice that the curve for "non-Western consciousness" doesn't quite make it to the present day. This signifies how, in the era of globalization, what was originally a "Western consciousness" has really now become a global consciousness. While there are some groups living in remote parts of the world who still hold a fundamentally different worldview, they are few and far between, and for all practical purposes, the pfc's tyranny has become a worldwide phenomenon.

So now, with map and instruments in hand, it's time to begin digging.