Axioms

by

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Dedication

This book is dedicated to the giants of mathematical and scientific philosophy upon whose backs it stands: Plato, Hume, Boole, Descartes, Laplace, Gödel, Bayes, Shannon, Cantor, Cox, Jaynes, and many more, too many to count, actually. I do wish to explicitly acknowledge Cox’s *The Algebra of Probable Inference*[^1] and Jaynes’ *Probability Theory: The Logic of Science*[^2], which collectively establish what is very likely the *rigorous* basis for knowledge expressed as a contingent degree of belief and many of its connections to worlds both concrete and abstract.

It is also dedicated to my philosophy professor and guru at Duke, George Roberts (a disciple of Bertrand Russell), who had an enormous impact on me as I pursued an “invisible” philosophy major at Duke to accompany my physics major (invisible because at the time Duke had no way of acknowledging the completion of a Bachelor of Science in one discipline and a Bachelor of Arts in another).

Finally, it is dedicated to my good friends and colleagues in the Duke Physics Department, especially Richard Palmer (for teaching me about Jaynes, Bayes, maximum entropy, and complex systems in general way back in Statistical Mechanics in grad school) and Mikael Ciftan, who has been as a second father to me for nearly thirty years now.

No book is written in a vacuum. I have been extraordinarily fortunate to have had the support and encouragement and love of many, many people over a lifetime. My family, my friends, my colleagues (who are also my friends) on the beowulf list, and my many, many students: This book is for you all.

Notice

Although this book inevitably contains a certain amount of mathematics and science – often expressed as “natural philosophy” or “mathematical philosophy” – it is *not* intended to be a mathematical or scientific treatise. Indeed, its basic subject is not physics but metaphysics, our basis for knowledge itself rather than any particular thing that we “know” (or rather, that we *believe* very strongly to be true) about the world. It is written to be as accessible as possible to as general an audience as possible. So *don’t be intimidated* – you can read this book and understand it even if you aren’t terribly good at “math”.

[^1]: Cox’s *The Algebra of Probable Inference*
[^2]: Jaynes’ *Probability Theory: The Logic of Science*
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Preface

This is a work on meta-axiomatic metaphysics. By this, I mean specifically that it is a work on the axioms one might use to choose axioms, specifically the personal axioms required to make sense of the marvelous Universe we find ourselves living in.

It might surprise you to know that you can choose your personal axioms for any of several reasons. For example, you could be asking yourself “What are my personal axioms and why should I care about them?”

An axiom is a belief. In more precise terms, it is an assumption, usually an assumption made as part of the foundation of a set of conclusions – a theory – arrived at by deductive logic, or as one of the premises that similarly leads to a state of conditional knowledge about the world, a worldview. So this is a work on how to choose what you believe so that it consistently leads to what you “know”.

Of course, to make a such a choice one has to already have some basis for that choice, and that basis is itself a set of one or more axioms! That’s the “meta” bit – this is a work on the axioms required to, among other things, bootstrap the best possible set of personal axioms. It presents a way of consistently selecting a set of personal beliefs about the Universe.

This bootstrapping, while arguably the best possible self-consistent solution to the fundamental problem of metaphysical philosophy in a mathematically precise sense, is not unique, nor can it (or any other candidate set) be proven to be true in any way that should be taken seriously. One fundamental conclusion of this work is that metaphysical philosophy is (at its heart) bullshit in the precise sense that it cannot ever achieve one of its design goals – to allow you as a real human to achieve a state of absolute certainty about anything at all except the undeniable reality of your own instantaneous perceptions.

This leaves one with a certain degree of romantic freedom in one’s choice that is, in the end, quite charming.
Part I

A Cave with a View
Chapter 1

What’s an Axiom?

The wise man built his house upon the rock,
The wise man built his house upon the rock,
The wise man built his house upon the rock,
    And the rains came tumbling down!

The foolish man built his house upon the sand,
The foolish man built his house upon the sand,
The foolish man built his house upon the sand,
    And the rains came tumbling down!

This is obviously a book about axioms. If you’re a mathematician or logician, you probably have a very good idea what an axiom really is. Nearly everybody else (including many scientists or engineers, alas) has an idea, but it probably isn’t precisely correct.

This is doubtless because the first and only time many people encounter the term in anything like its correct form is in high school geometry, and even there many a high school geometry teacher fails to make the true definition of the term clear. Afterwards if anybody uses the term at all (outside of logic, math, computation, or science), they are probably trying to sell you something in a pseudo-erudite way.

This simply won’t do. Many a “deep” philosophical disagreement arises just because the two sides are using the same term in different ways and don’t realize

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1 You may in fact be suspicious that this book is about to attempt to sell you something in just this fashion...and if the “something” in question is self-referentially this book itself, you may be right!
it. In that case the real disagreement or point of conflict is the meaning of the term and not “reason” (in the sense of a logically analyzable argument) at all.

As it happens, the term “axiom” has at least three completely distinct meanings. One is its (correct, literal, historical, Euclidean) meaning in logic and mathematics, with a few minor variances in meaning depending on strict context or adjectival modifiers, and the other two are colloquial meanings used in common discourse and sometimes (incorrectly) used in mathematics and logic as well.

Unfortunately, these latter two are nearly opposites of the first in a critical way. So even if you know (or think that you know) what an axiom is, let’s review some common dictionary definitions and precisely indicate which sense of the term we are going to use throughout this work. From Webster:

Axiom

Axiom 2 n.– L. axioma, Gr.; that which is thought worthy, that which is assumed, a basis of demonstration, a principle, fr.; to think worthy, fr.; worthy, weighing as much as; cf.; to lead, drive, also to weigh so much: cf F. axieme. See Agent.

1. (Logic and Math.) A self-evident and necessary truth, or a proposition whose truth is so evident at first sight that no reasoning or demonstration can make it plainer; a proposition which it is necessary to take for granted; as, “The whole is greater than a part;” “A thing can not, at the same time, be and not be.”

2. An established principle in some art or science, which, though not a necessary truth, is universally received; as, the axioms of political economy.

These two commonly accepted definitions for the term axiom are the root of much evil in philosophical and mathematical discourse because they are both basically incorrect. Wikipedia has the correct definition:

...an axiom is any starting assumption from which other statements are logically derived. It can be a sentence, a proposition, a statement

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2From Webster’s Revised Unabridged Dictionary (1913) [web1913], although many, many other contemporary dictionaries more or less duplicate these definitions.

3Wikipedia: [http://www.wikipedia.org/wiki/Axiom](http://www.wikipedia.org/wiki/Axiom). Or at least it did when I first wrote this section. However, wikipedia is amorphous, and it has shifted its current definition to three “layers”. The first applies pretty much only to the laws of thought. The second – “premises” or “propositions” used to derive a theory – is the sense we will use throughout this work unless otherwise specified.
or a rule that enables the construction of a formal system. Unlike theorems, axioms cannot be derived by principles of deduction, nor are they demonstrable by formal proofs – simply because they are starting assumptions – there is nothing else they logically follow from (otherwise they would be called theorems). In many contexts, “axiom,” “postulate,” and “assumption” are used interchangeably.

As seen from definition, an axiom is not necessarily a self-evident truth, but rather a formal logical expression used in a deduction to yield further results....

To be absolutely clear, it is only this latter mathematical or logical meaning of the word “axiom” that is used throughout this work. To us an axiom will always be neither more nor less than an unprovable assumption upon which a process of reasoning is based. We will indeed spend a fair bit of time hammering home the point that there are very few “self-evident truths” at our disposal as human souls experiencing a complex sensory stream, and that therefore nearly all so-called knowledge is based on axioms in the sense of assumptions that permit us to transform our instantaneous sensory perceptions into a conditional knowledge of a presumed objective Universe.

Before going any further, we need to define several words so that our interpretation of those words is mutual – so that you understand what is meant when I use them.

One is Universe. In this work the Universe is (in agreement with the dictionary definition) the strict union of everything that has existed, exists, or will exist. Period. If it has being, it is part of (or all of) the Universe. Note that this definition is nicely time-independent and space-independent (as any such definition should be).

With this definition we can avoid all sorts of silliness associated with God “creating” the Universe or statements involving “multiple Universes” as being trivially logically inconsistent with the definition of Universe itself. Perhaps God can create a space-time continuum, perhaps there are more than one space-time continua, but God cannot make a Universe because God is a part of, or possibly all of, the only Universe that there can, by definition, be. This gives us an essential common basis for reasoning about the Universe, God and other metaphysical topics.

This leaves us with the problem of how to refer to our current space-time

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4Only one, in fact.
continuum, as we usually refer to this as “the Universe” in physics because it contains all that we can actually see and measure and use as a basis for knowledge. However, this begs the question of whether there can be multiple space-time continua, or more dimensions than four, or both at the same time. We really don’t want to exclude the ability to reason “outside of the space-time box” this early in our discussion by insisting (as an implicit axiom) that the four “direct” dimensions of space-time are all that there is to the Universe.

Many quite legitimate theories in physics (e.g. string theory) already assume more dimensions, sometimes a rather lot of dimensions, and a “many worlds” interpretation of quantum theory would have us take seriously the idea of multiple spacetime continua. Maybe these theories are correct, maybe they aren’t, but we don’t want to reject them by definition from consideration; we need other, better reasons to increase or decrease our degree of belief in their truth.

It’s rather tedious to type out space-time continuum all the time just to avoid misusing the word Universe. I will therefore co-opt the word cosmos to refer to a space-time continuum like the one in which we appear to live. In general, when I use it in the capitalized singular Cosmos form it will refer to our particular space-time continuum, but there could be more than one and this one could have more than four dimensions. This is a fair usage, actually – in ancient theism, the Cosmos was often used to refer to the created part of the Universe, exclusive of God. Leaving God and creation aside for the moment (we’ll get to them much later) the important thing to remember is that the Cosmos exists and hence is (in set theoretically precise terms) a subset of the Universe. It might be the whole thing. It might not. It isn’t required to be the whole thing by definition, though.

It is also useful to understand that you are a subset of the Cosmos (and hence the Universe). This is still quite general – even if you are all that exists, it is quite harmless and non-contradictory to state that you are the Cosmos and that the Cosmos is the Universe and that you are the Universe. If you don’t exist – well, we don’t have a problem then either, do we? At least not one you can debate.

When you look upon the Cosmos and try to develop knowledge about it and the Universe it may be all or only a part of, you form a worldview. A worldview is, basically the sum total of everything that one “knows” about the Universe – all your instincts, memories, thoughts, inferences and deductions, true or false or in between. A worldview is necessarily personal and subjective. Mine will almost certainly not be the same as yours. A correct worldview is one that is in
a perfect one-to-one correspondance with the Universe.

Later, when we examine Gödel’s theorem, the Cox axioms, and the theorems of information theory we will be able to arrive at some rather startling conclusions that follow from little more than these formal definitions of axiom, Universe, Cosmos and worldview.

With all of this established, our definition of axiom above leads rather rapidly to an acute rational-existential crisis. If almost all of our knowledge is based on unprovable assumptions, if rationality itself is fundamentally irrational in the sense that it cannot be proven, only guessed or assumed, then have we not built up the entire edifice of human knowledge on the shifting sands of yours-is-as-good-as-mine opinions? Where, precisely, is the solid rock of truth, something that we can know beyond all doubt to serve as the foundation of our worldview?

This is hardly an idle question. There are a number of metaphysical schools of thought that are at war over it, as one answer that is often given is that God has granted preternatural knowledge to a select few, that these fundamental truths are true beyond any question and are recorded in specific, divinely inspired theological scriptures, and that a complex system of divine judgement, reward, and punishment exists to enforce the acceptance of this divine revelation as truth completely outside of the normal methods of inquiry we use to assess truth on more mundane matters. One such school of thought, known as the religion of “Islam”, directly and repeatedly commands its adherents to wage war on those that refuse to accept its axiomatic precepts as divinely revealed truth, and promises exotic punishments such as:

Lo! Those who disbelieve Our revelations, We shall expose them to the Fire. As often as their skins are consumed We shall exchange them for fresh skins that they may taste the torment. Lo! Allah is ever Mighty, Wise.

to those that question or fail to comply with the smallest detail laid out therein. It is, therefore, hardly surprising that a significant fraction of its adherents actively follow these precepts and routinely murder anyone that is judged an apostate or a “threat” to its system of beliefs. War indeed!

Even in the less violent world of academic discourse and metaphysical phi-

\footnote{See: \url{http://www.skepticsannotatedbible.com/quran/4/index.htm#56} The Quran 4:56.}

\footnote{While to be completely fair, others, probably a majority of others, do not. However, neither tolerance nor intolerance for non-believers makes a belief true, and this work is concerned with how we should best assess truth.}
losophy, there are those who wish to argue that there is no point in developing a systematic scientific worldview, because every time we think that we know what is going on, experiments are thought up that prove that our knowledge is false. Enormous and systematic debates have occurred concerning whether or not propositions must be verifiable or falsifiable to have meaning, whether knowledge is transcendental or strictly empirical. Throughout this process, most actual scientists have studiously ignored the pronouncements of the philosophers that have weighed in on this issue, because those pronouncements were fairly obviously nothing but bullshit. I’m tempted mightily to list all of the bullshit artists in question – Hegel, Kant, Friesan, Hahn, Carnap, Ayer, Popper, and still more, still today – but what is the point?

No physicist that I know of (and being a physicist myself, I know quite a few) pays the slightest bit of attention to whether the observation of a Higgs particle would technically “verify” the standard model or whether the failure to observe one on each new generation of experiment (so far) “falsifies” it, because neither one describes the process in which they are engaged in their search, or the nature of the alteration of the sum total of human knowledge that would be attendant upon a reproducible observation, perhaps in the new data produced by the Large Hadron Collider. Or, if the Higgs particle, or a magnetic monopole, or some quantum field theoretic ‘spark’ is a bit too exotic for you, the extent to which each observation of a falling rock verifies or fails to falsify any particular theory of gravitation.

Neither falsification nor verification describe the quantitative process whereby scientific inquiry incrementally improves our view of the world, or the way that our physical brains infer and encode a process, and use that inference to motivate either action or insight. Furthermore, notions of meaning are clearly divorced from either one – I have no difficulty whatsoever in understanding the proposition “The physical Cosmos continuously extends beyond the event horizon of the present” in spite of the fact that according to our own best physical theories I cannot even in principle ever perform an observation that would permit me to verify or falsify it. It is trivial to come up with any number of perfectly understandable phrases in English (or algebraic statements in quantum theory) that cannot be consistently verified or falsified. “Understanding” involves a process of (usually imperfectly) analyzing conceptual consistency with an entire network of prior beliefs; one can easily decide that a new proposition is not inconsistent with prior knowledge without discovering any particular reason to increase one’s degree of belief in the proposition in question in that base of knowledge.
This is all the more regrettable since it has been well over fifty years since the basis of a quantitative theory of knowledge was axiomatically developed by Cox, Shannon, Jaynes, and others— all of them physicists or computer scientists, not metaphysical philosophers. This theory presents “verification” and “falsification” as the opposite sides of the same coin—the process of common sense judgement whereby when we increase our degree of belief in one proposition we decrease our degree of belief in at least some other competing propositions. It further ignores the complex nature of human knowledge as a rough landscape (as it were) of interconnected Bayesian propositions, so that the experimental observation of the precession of the perihelion of the orbit of Mercury doesn’t “falsify” their theory of gravitation, it causes the theory to be modified and qualified in a process of successive approximation that is more strongly related to computational optimization theory than it is to the stark logic of truth and falsehood that has been philosophy’s bread and butter since the time of Aristotle.

This sort of pointless debate has created the illusion that no solid rock exists upon which to found the best possible set of beliefs about the Cosmos, if not the Universe. The metaphysical propositions that are advanced usually have trivial counterexamples or simply fail to describe the process by which our brains actually conceive of and process knowledge. All of this in turn openly encourages those whose criteria for truth and knowledge are derived from Bronze Age literary mythologies that have survived to the present, usually by the sole virtue of being the most violent and repressive worldviews in direct, violent, repressive competition with other violent and repressive worldviews.

Wisdom, foolishness, and knowledge itself all depend on many assumptions, and reality is far too complex and interesting for us to mindlessly rely on the foundation for knowledge we have been indifferently taught by a largely ignorant and uninformed society, or its equally uninformed educational system that teaches knowledge without foundation. If history teaches us anything, it is that “truths” taught by authority—by our teachers, by our elders, by our religious and political leaders, by our peers—have often turned out to be diametrically incorrect, usually because that knowledge was based upon the wrong assumptions, on inconsistent, self-contradictory beliefs. Unfortunately, through most of recorded history the worldview endorsed by the reigning “authority” has been enforced by law, backed by social ostracism, by economic and physical punishment, and ultimately by deadly threat.

7Consider the case of Thomas Aikenhead, hung for blasphemy in Edinburgh in 1697, or La Barre, tortured and executed for blasphemy in France in 1766. Consider “McCarthyism”. Consider the entire concept of the Islamic fatwa, especially modern ones directed at the murder
What then, are the right assumptions? What are the axioms that we should use as the foundation of our edifice of knowledge? In fact, how can we even choose one set of axioms as being “better” than another without axioms to enable us to ordinally rank axiom sets in terms of “goodness”, and what should they be? The rest of this book is devoted not precisely to answering these questions (as there is obviously no unique and provable answer) but rather to providing you with all that you need to choose a set of personal axioms that works for you as a deliberate act of free will.

In order for you to become free to choose, you will have to do a wee mental exercise. If you refuse for any reason to do it, reading the book is largely going to be a waste of time.\footnote{You don’t have to do it all at once, but as you read you should be working on it.} You don’t have to do it all at once, but as you read you should be working on it.

What you have to do is to perform an autobeliefectomy – to psychologically “operate” on yourself to stop believing pretty much everything you have been taught or think that you know. The point of this exercise is that you have (up to now) been programmed with many of your most fundamental beliefs. A great deal of this programming occurred when you were a small child and had no ability to choose to believe or disbelieve what you were being taught. Some of it is even biological programming and is built right into you by genetics and evolution.

You have to become self-aware of this programming and come to doubt it and all knowledge derived from it in order to reprogram yourself with a system that is deliberately selected as “the best that you can do” given your own personal life experience. Quite literally, this is a book about hacking – and ultimately debugging – your own personal operating system, and then maintaining it in an optimal state for interacting with the mysterious world you are a self-aware part of.

Don’t worry, all of your existing “knowledge” – true or false, best belief or worst belief – won’t go away. Later you can come back to it and deliberately decide what to keep and what to reject in your worldview. However, until you permit yourself the luxury of doubt, you are in intellectual chains forged at an age where you were too young to resist and were taught “truths” that, almost certainly, weren’t.

So, if you believe in God, stop and permit yourself to frankly doubt God’s of third parties that “blaspheme” against a worldview. Consider Tianamín Square and U.S. laws denying rights to e.g. homosexuals. Thought is far from free, even today.

\footnote{And gee, you’ve bought it and it is way too late to return it. So you might as well give it a try if only to avoid wasting money...}
existence. If you believe that there is no God, stop and permit yourself to openly acknowledge that God might exist. If you are a True Believer in the theory of gravitation, evolution, creationism, Catastrophic Anthropogenic Global Warming (CAGW), permit yourself the sheer luxury of imagining that your beliefs might be incorrect! If you are a capitalist, try to open your mind to socialism or communism. If you are an ardent communist, allow yourself to entertain the notion that capitalism might work better, at least some of the time. If you are a republican, imagine voting democrat and vice versa.

Don’t stop there – work on disbelief until you entertain at least a tiny bit of doubt about the perfect truth of what you see with your own eyes, what you hear, what you taste, what you touch. Are your senses perfect? Is the world precisely as it seems to be? Are your memories of the past always correct representations of what you actually saw, heard, said? Or could you be, have you ever been, mistaken?

One point of this exercise is that (as we pick up each of your former beliefs in turn to see if any of them are worth keeping) it will gradually help you to understand that most of your beliefs fall into one of the following categories:

- They are meta-axioms – axioms that apply to axiom sets themselves. We will spend a lot of time and energy thinking about meta-axioms later on in this book, as they provide a ordinal basis for choosing your own personal axioms.

- They are themselves fundamental axioms – the belief in a law of causality, for example.

- They are theorems – you believe them because you understand how they follow as the result of a correct reasoning process from your fundamental axioms.

- They are axiomatic beliefs that are neither fundamental nor, (consciously, at least) derived. Properly speaking they are propositions – assertions of

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9Married persons can skip this step in the process. At this point you know that your memory of things past is largely false. At least, according to your spouse.

10An axiom in an axiom set will be called “fundamental” when axioms within it cannot be derived as theorems from a smaller set of sufficient axioms that describe the same theory. This distinction is of more interest to mathematicians and logicians working with closed theories than it will be to us, but it is useful to introduce at an early stage the meta-axiom of parsimony which is basically an axiom that helps us choose axiom sets by saying that smaller ones are “better” than bigger ones that lead to the same overall theory. Fundamental axiom sets are parsimonious.
some sort that you believe in (or disbelieve in) without any formal reason or proof, which might well be consistent or inconsistent with other things you also believe in, and use as the basis for reason (such as making decisions to act or not act in a certain way).

Logicians tend to be concerned with the first of these as it embraces the framework of reason itself, for example the so-called Laws of Thought. Mathematicians tend to be more interested in the second pair – fundamental axiom sets and theorems derived from them, e.g. “Euclidean geometry”. Normal human beings, however, live almost all of their lives basing most of their decisions from moment to moment on reasoning driven by assumptions of the last sort – things we believe to be true that are not “first principles” themselves nor provable from first principles (fundamental axioms).

These latter “axioms” are in many cases the things we call our opinions, as in it is my opinion that chocolate ice cream is better than vanilla or it is my opinion that it is morally acceptable to eat meat. Can I prove either of these assertions from a commonly held set of fundamental axioms? Of course not. Oh, I can “justify” them – pick out a few assertions that do lead to these statements as conclusions, but you might well not agree that those assertions are “true”.

If I were to be totally honest, I might not really think they were either. In fact, I could almost certainly pick out different (but still reasonable-sounding) assertions and argue that the opposite conclusions are true, that vanilla is better than chocolate when it comes to flavors of ice cream. Socrates (apparently) used to have great fun doing just that – first proving something to be true based on accepted principles and then turning around and proving it to be false on equally accepted principles (proving, if anything, the probable but highly occult inconsistency of those principles).

This would be fine if humans reasoned “gently” with the mish-mosh of beliefs, instincts, biological imperatives, myths, superstitions, folklore, and conditioning that make up this overcomplete, self-contradictory, self-referential axiomatic ocean of opinions and ad hoc presumed truths that is our worldview. Unfortunately, that is not the case. It is always: Abortion is wrong. The Quran contains divinely inspired truth. Capitalism is evil. The sun and stars revolve around the Earth, which is manifestly flat. We have the right to invade your land, kill you, and take its wealth for ourselves. We have the right to life, liberty and the pursuit of happiness. The flag is a sacred object. Animals have no souls. The word “perhaps”, the phrases “I think that” or “it might be the case that” never, ever appear.
All too often in human affairs, the more uncertain our collective and individual axioms are, the more they seem to lead to contradictory conclusions, the more passionately one or the other of those conclusions is embraced as absolute truth or the work of the devil. All too often it becomes the devil’s work indeed as the conflict born of a difference of opinion, unresolvable even in principle by means of reason, leads to theft, to rule by brute force, to murder, to war. A difference of opinion concerning a piece of ancient history is currently responsible for countless deaths in the Middle East with more coming every day at the time of this writing. Human history is a bleak record of the absolute intolerance of those whose unprovable authority-derived opinion differs from one’s own.

This is why it has never been more essential for human beings who are not logicians or mathematicians to understand the arbitrariness of the axiomatic basis of reason itself and to fully grasp the uncertainties in all derived knowledge. Reason is a powerful tool, but the answers it gives in human affairs are rarely drawn in black and white but rather in shades of grey. Given this uncertainty, the social or personal egotism of righteousness seems to be out of order – we must learn to respect the opinions of others when they differ from our own and demand the same respect from them for our own opinions, even while trying to find a common axiomatic ground we can agree on and base a society on.

Note well, however, that respecting someone else’s right to believe something different from what you believe is not the same thing as refusing to criticize it, analyze it, refute it, argue against it, or legislate protections against being forced to accept it as a reasonable basis for law just because somebody’s feelings might get hurt, especially if those beliefs are being proselytized in open public debate or being proposed as the basis for a law that might apply to you against your will. Bad ideas – or for that matter good ideas – get no special protection in a reason-based worldview just because somebody believes them strongly, whether those ideas are belief in a law of universal gravitation or belief that it is wrong to eat meat or wear a tee-shirt with a depiction of Muhammed on the front. No one should force you to believe in gravity, become a vegetarian, or wear such a tee-shirt, but until the day you can prove beyond all doubt that your beliefs are true (which this work will prove beyond all doubt is impossible) you have no rational grounds for forcing your beliefs on others or preventing others from expressing their own beliefs. They could be right, you could be wrong (however

\[11\] Specifically, whether or not authority in Islam is derived from election or blood inheritance. Sunnis are in a sense “protestants”, with imperfect leadership whose authority derives from election, where Shia are “orthodox” who believe in the divine appointment of their leaders, whose authority is thereby perfect. The English Civil War, stretched out over some 1300 years...
firmly you think it is probably the other way around).

Ultimately, as we will examine in detail below, reason is based on faith – faith that some fundamental core of axioms concerning our perceptions are true and that the laws of reason correctly applied to those axioms will lead us to a system of knowledge of ourselves and an inferred Universe in which we seem to live. The atheistic scientist whose worldview consists of a belief in strict natural law and the validity of the experimental inductive process to learn that law and the theistic priest whose worldview consists of a belief in a supernatural God whose laws revealed strictly by divine revelation in sacred scripture are in one very important sense equally irrational in their beliefs. In both cases their axioms cannot be deductively proven, only accepted on “faith”.

This is not to suggest that both axiom sets are equally “good”, but in order to judge between these two diametrically opposed sets of fundamental axioms on grounds less strong than boolean certainty, or to conclude that one is “better” than the other on some scale of “goodness” or “desirability” requires meta-axioms to guide the judgement, and they in turn are equally arbitrary and unprovable. The rock of human reason, examined closely at its very foundation, turns out to be a fog of quicksand so tenuous that it hardly can be expected to support our own weight, let alone that of the Universe, come the rains of every human’s personal experience of life: pain, suffering, and inevitable death with nothing but an imperfect knowledge of what it’s all about.

Is it any wonder that, seeing that pain, suffering and death, intuitively understanding the apparent arbitrariness of human beliefs and having no good way of choosing amongst the vast, confusing, and contradictory tangle of possibilities (all touted as self-evident truth by their proponents) many people turn away from reason altogether and choose to embrace either a form of intuitive mysticism that rejects science and established religion alike or slavishly accept the literal truth of some piece of scripture regardless of how much it contradicts common sense and everyday experience? In both cases it is vastly easier not to have to figure things out, much easier not to live in a state of perpetual doubt.

To make sense of that fog and transform it once again into something capable of supporting knowledge and understanding, let us begin by formulating one of the fundamental “theorems” of meta-axiomatic reasoning. This theorem will look odd, as one might expect an object associated with meta-reasoning to look. After all, before we can reason we have to reason about reasoning, which involves a bit of a bootstrapping problem because without reason how can we reason about reasoning, and yet without doing so how can be be sure that any conclusions
drawn from reason are reasonable?

Ahem. Don’t worry. *Reasonable* or not, it all ends up *making sense.*
Chapter 2

Philosophy is Bullshit

Aristotle maintained that women have fewer teeth than men; although he was twice married, it never occurred to him to verify this statement by examining his wives’ mouths. — Bertrand Russell

This is a book about knowledge. We will look very carefully at what it means to know something, what can be known and what must at best be assumed or guessed or hoped for. “Knowledge” all by itself seems a bit lonely and pointless, or perhaps too “zen” to be of any use, sitting around just knowing, knowing, knowing. We’d like to put that knowledge to use so (among other things) we don’t die of starvation or walk off of a cliff while we’re too busy just knowing to think about feeding ourselves or reasoning out that if we walk off of cliffs we’ll go splat at the bottom.

For better or worse, we lack what might be called “direct knowledge” or “preternatural knowledge” – God-style knowledge – of the world. As we’ll see,

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1You think I’m joking, but I’m not. Kurt Gödel, for example, was a wee bit crazy and starved to death because – however brilliant he was, however much he knew about logic and mathematics – he had an obsessive fear of being poisoned when anybody but his wife prepared his food, and literally couldn’t or wouldn’t figure out how to feed himself when she had to go into a hospital.

Sadly, history is full of famous philosophers and mathematicians and thinkers who were simultaneously brilliant and productive and yet were too stupid to tie their own shoes or come in out of the rain. And then there are politicians...

2At least, I lack such knowledge, and to my limited experience people who claim to have such a thing are either lunatics or lying; their divinely perfect knowledge rarely turns out to correspond to the more mundane sort gathered by other means. And yes, this observation is connected (later) with C. S. Lewis’s famous trilemma, for those who already are aware of it and recognize the words.
pretty much everything we think we know is either a sensory impression or is the result of a process of reasoning, one so automatic that we may not even be aware that it is occurring but that is critical to the process of developing knowledge and using it for whatever purpose seems good to us, such as staying fed and un-splatted by the many hazards of thoughtless existence.

This is therefore also a book about reason. To come to understand the interplay between knowledge and reason and see how they make us what we are, we have to bootstrap the process – begin with one or the other and then iterate reason and knowledge to a full comprehension of both. It seems wise to start with reason, since reason is active and interpretive where knowledge alone is somehow “passive” and unlikely to take us anywhere. If you like3 knowledge is a map of sorts – possible a map with errors, maybe even a map of an imaginary country, but a map nonetheless. Reason is our navigator, our fearless explorer, that uses the map with all its imperfections to discover the world, perhaps filling in and correcting the map as it does so.

Let us begin, then, by taking a look at symbolic deductive reason, as it is in some very deep sense the foundation of “rationality” itself. If humans are thinking beings, the rules that govern reason and thought seem like they must be the tools that will lead us from a state of ignorance to one of knowledge of our selves and the world we appear to be living in. They are the means by which we move, in small steps from here to there as we fill in our personal maps, correcting errors, coping with inconsistencies, exploring terra incognita, imagining what might lie beyond the horizon of our immediate perceptions.

This book is not going to be anything like a textbook in logic or a rigorously developed mathematical treatise. I’m assuming that you, dear reader, are intellectually curious but that you may have had little exposure to formal logic or math beyond algebra and some geometry. It will suffice for our mutual purpose for me to present a few key ideas that illustrate in the most general way the essence of the process of reason (and some problems associated with that process) without getting bogged down in its endless algebraic machinations. In a few places I’ll put in a bit more detail than in others, places you can use to initiate a “wiki-romp” through wikipedia4 to learn more.

A few of my readers may, of course, be mathematicians or logicians, far more expert than I in those algebraic machinations. They will note that I’ve omitted

3As you will soon come to see, I adore metaphors and analogies because they help one develop the conceptual strength of an idea, knowledge you feel in your gut as much as work out in your head. So please bear with me.

this, glossed over that. I beg their indulgence as I make sweeping statements such as the following.

All symbolic logical arguments that are not various trivial manipulations of tautology ultimately boil down to something like the following, a rule called *modus ponens*\(^5\). Suppose \(A\) and \(B\) are assertions. It doesn’t really matter what they are – \(A\) might stand for “Pigs have wings.” \(B\) might stand for “Pigs can fly.” We can then formulate a new assertion such as “If pigs have wings, then pigs can fly.” or, symbolically, \(A \Rightarrow B\).

We can then formulate a *logical argument* according to rules that are literally thousands of years old at this point:

- (Premise) \(A \Rightarrow B\) (If pigs have wings, then they can fly.)
- (Premise) \(A\) (Pigs have wings.)
- (Conclusion) \(B\) (Pigs, therefore, can fly.)

Note that *logic* has nothing whatsoever to say about whether or not pigs *do* have wings, or whether or not a winged pig *can* in fact fly. As far as this argument goes, they are *axioms* – things we are assuming to be true to develop the argument. For the moment do not worry about how we might decide if they are *really* true or not, because that seems like it is knowledge and we’re still working on the processes of *logic* that we call reason.

The way that deductive logic works is that \(A \Rightarrow B\) (read this as “\(A\) implies \(B\)” ) is *true and* if \(A\) is *true* then one cannot logically doubt that the conclusion \(B\) is *true*. It is a *theorem*, or contingent truth, a conclusion derived from the axioms\(^6\).

I am not suggesting, of course, that logic doesn’t have more symbolic operations, other ways of deriving theorems, only that non-trivial logical arguments always have two components\(^7\), one that we can think of as *data*, and the other

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\(^6\)To be picky for any logicians who might be reading, modern usage would call this argument logically *valid* but not logically *sound* as the propositions of the argument appear *false*. However, we cannot (yet) differentiate in this way, as it begs the question of how to decide that a proposition is true, working backwards recursively to *fundamental* propositions that are formulated *just like these propositions* that we *cannot* prove to be true or false.

\(^7\)Logicians and mathematicians would be inclined to include a third component, a set of “definitions” that establish a semantic symbol map that in some sense is ultimately circular and self-referential, a dictionary written in the language it defines. I’m not ignoring this, but semantics – the relationship between the *symbols* we use to make our *map* and the *actual*
that we can think of as rules for transformation, and that both are axioms of any given logical demonstration that leads to a conclusion not already included in the data. A and B don’t have to be single asserted truths, either one could be a whole set of asserted truths (including definitions). A ⇒ B doesn’t have to be a single rule for taking one asserted truth to another, it can be any of a whole set of such rules. The point is that modus ponens captures the essential process of deduction as a way of beginning with a set of things we “know” (or rather, assume to be true) to a larger set. We begin with A, end with the union of A and B where in the “interesting” cases B is not obviously a subset of A.

Even the addition of classes of things and more complex predicate assertions, for example the famous Aristotelian syllogism:

- (Premise) Socrates is (was) a man.
- (Premise) All men are mortal.
- (Conclusion) Socrates is (was) mortal.

preserves the essential structure of deduction. One makes assertions that may or may not be true but which are presumed to be true and from them arrive at a.conditionally true conclusion – a “theorem” of the assumptions and reasoning process used.

For a long time – indeed, thousands of years – the premises for most philosophical arguments weren’t really presumed to be true – they were thought to be obviously true, so true that no further argument was necessary to demonstrate their truth, and many, many conclusions were ever so rigorously derived from them. Only in the last four hundred years has attention been properly paid to the uncertainty and indeed potential variability of these premises, and only in the last century or so have cracks appeared in the self-consistent logical foundation of pure reason itself.

Here is my own little “logical argument” as it will be developed throughout a much of this book. You will note that it has a striking similarity to the argument structure illustrated above – it makes certain observations or assumptions and uses them to draw a conclusion. However, it is a logical argument about logical arguments, a syllogism about syllogisms, so it implicitly refers to itself.

territory the map supposedly represents – is a large part of what we are bootstrapping. For the moment I’m just lumping definitions loosely in with data as “things that are presumed true” and not “transformational rules” per se, although one can of course define symbols for the rules. In any event, we’re sort of stuck with using the English dictionary as our ultimate set of definitions unless or until somebody translates this work into other languages.
• All arguments (including this one) are based on unprovable assumptions or *axioms* – a word whose Greek root literally means “unprovable assumption” and not “manifest truth”.

• If an argument is *logically valid* (consistently developed according to the rules of logic) and the premises are *true*, then the conclusion cannot be doubted. This is a “law of thought” that is a necessary axiom for deductive logic of any sort to work. Without it there is no such thing as *reason*.

• The axioms can never be *known* to be true. [It should be carefully noted that this does not mean that we know them to be false either.] They are *uncertain*.

• We can therefore logically conclude that we can *never be logically certain that the conclusion of any logical argument* (including this one) is *true*.

This is an argument that no doubt Gödel would have loved, as it is beautifully self-referential and its conclusion, while self-consistently unprovable, is nevertheless obviously true.

This argument is not really unique, although this particular amusing, abstract, and self-referential formulation may be. It simply highlights a serious problem with logic. How can we ever tell if the premises of a logical argument are “true”? There seem to be two general ways, one of which leads to mathematics, systems of consistently manipulating symbols, the other of which leads to knowledge, the establishment of a *semantic relationship* between symbols and – “something else”.

Mathematics is developed by never knowing, or caring, if the premises, the axioms of any particular mathematical theory, are really “true”. They are simply *defined* to be true, end of story. Afterwards, the laws of thought and process of deductive reason are all about consistency and inconsistency, completeness or incompleteness, the *mechanical* analysis of a *system* of relationships that permit the symbolic formulation of assertions according to rules and the consistent association of contingent true, false, or undecideable values to each assertion in the set of all possible assertions in the theory, including the original axioms themselves (which might be self-contradictory, as would be the case if we start with both of the axioms: *A* is true; and, *A* is false (for any *A*), or self-referential, as in “This statement is false.”).

Pure mathematics is simultaneously *beautiful* and *devoid of meaning* because there is no logically necessary connection between the systems of symbols being
consistently manipulated and any thing at all. The “universe” of mathematical discourse in a theory (the set of all possible assertions of that theory) is disjoint from the singular existential Universe of our experience, barring a set of axioms that form a bridge between the two. Mathematics is a peculiar form of knowledge, because it isn’t knowledge of anything at all, it is a knowledge of contingent relationships between symbols, the essence of “abstract” knowledge. This intangible quality of mathematics is so elusive that it can easily trick us into granting it “mystical” properties, and indeed at various times in history mathematics has been something of a religion, one founded on the religious belief that one or another set of axioms, say those concerning numbers or geometry were fundamental truths and related in some way to the metaphysical basis for all things, beyond all doubt or variation.

They have further seduced philosophers into writing immense bodies of learned discourse (the bane of all students) attempting to “prove” that reality is nothing but the symbol, or the symbol the real, that matter is really mind or the other way around. We’ll have none of that bullshit here, don’t worry. This work is not about the arcane, but rather the practical.

Well then. What about that something else? How do we reason about our experience and memory, how can we use reason to develop a knowledge of our selves and something that appears to be an objective external reality?

Some three hundred and fifty years ago Hume observed that:

- Deductive reason about nature is all based on observed “regularities”. Those regularities are those of association, where one thing is always observed in the company of another, or the observation of e.g. mathematical “structure”. There is an unspoken assumption that underlies it – that there

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8 Wikipedia: [http://www.wikipedia.org/wiki/Pythagoras](http://www.wikipedia.org/wiki/Pythagoras). Pythagoras actually formed a secret religious society devoted to the study of numbers. Legend has it that certain members of this society were murdered for daring to question its axioms.

9 Wikipedia: [http://www.wikipedia.org/wiki/Euclidean_Geometry](http://www.wikipedia.org/wiki/Euclidean_Geometry). Euclid, I should hasten to say, did not wish to make geometry into a religion the way Pythagoras did. He used the term “axiom” to refer to the unprovable assumptions underlying plane geometry and hence is in a manner of speaking the father of axiomatic reasoning. However, his axioms were transformed into “religious beliefs” in the minds of most of the world’s thinkers, who could not see how one could doubt their truth or make different assertions and end up with different conclusions that were still valid and neither more nor less “true”. These beliefs were so strong that the mathematicians who ultimately challenged them (Gauss and his protegé Riemann) did so at first in secret to avoid the “religious war” that in fact ensued when the resulting curved space geometry was published.

exists a correspondence between any sort of regularity and some underlying truth that can thereby be used as “input” to construct a logical argument that will lead to true conclusions that extrapolate this regularity.

- This process is known as inductive reasoning, or inference. We observe a regularity in a series of events in nature, and imagine that this regularity will continue, that it is true. We even give names to some of the regularities (such as “The Law of Universal Gravitation”) and proceed to reason with them as if they are fundamental truths.

- However, induction (as a process leading from observation to absolute truths about the real world) cannot itself be deductively proven to be valid. Inference (in Hume’s time) could only be assumed to be valid; it was an axiom.

An inconsistent axiom. Inference (induction) from partial data not infrequently leads to conclusions that inference based on more data later contradicts, so we should correctly infer beyond any doubt that conclusions drawn from inference can be doubted and are not truth in the sense that conclusions drawn from deductive reasoning from a set of “self-evident” premises are. Consequently (according to Hume) one could never reason to conclusions concerning the real world and be certain that they are true. Reason itself was not a tool that could in principle lead to true knowledge!

That conclusion should have spelled the end of an era of philosophy – Hume had shown that some of the fundamental goals of reason were in fact unreasonable because logic and rational processes could only be extended to be about anything at all on the back of fundamentally irrational assumptions that have to be made outside the system of reason used to arrive at the conclusions. In other words, to put it bluntly, no matter how pretty and logically rigorous a philosophical “proof” relating to the real world may appear, its conclusions will always depend on things that cannot be proven to be true and hence can always be doubted. Indeed, if one changes one of the unprovable assumptions upon which the proof is founded, reason will often lead one to arrive at different (but equally valid) conclusions.

Some people will object to my use of the word “irrational” to describe the non-derivability of the assumptions and premises upon which rationality is based. Again we are trapped by common usage – an irrationality is often used to connote insanity, unreason, contradiction, and there is nothing unreasonable or innately contradictory about reasoning from axioms; there’s no other way we can reason. I’m nevertheless going to persist, but if the term bothers you you may substitute “extra-rational” – outside of or beyond reason – in its place and no harm will be done.
Hume thus taught us that all human knowledge about the real world is *conditional* on certain assumptions that cannot themselves be logically derived or proven. We have already have seen that logical systems themselves (knowledge about imaginary worlds, as it were) are no better off. They, too, are conditional on data and rules (premises) that cannot be logically derived as truth, but instead are *defined* to be true. We can extend Hume’s argument by adding the observation that *even if we could* know truths about the real world, there is an immense “space” of possible axiom sets that might define the relationships and rules for deduction that would permit us to extend those truths and we cannot *know* that any given set of those axioms is “true” or “false” save by assumption or definition. To put it another way, if *any part* of a worldview is not known – data or relationships between the data – *all* of it becomes uncertain.

Goodness! Looks like we have some work to do before we can end up with anything like “knowledge”. If you go over the entire discussion as presented thus far, you will see that we have one possible “out”. In one crucial part of our definition of the logic of *thought* (and in our inference regarding inference above) we used the word “doubt”. Doubt infers a state that is neither true nor false – it is in between. We will find marvelous uses for doubt. For another, we *already* can see that Hume’s argument can be reduced to the *provable* conclusion:

(Almost) anything that we think we know can be doubted. (Almost) everything we think that we know is contingent. (Almost) nothing we think that we know can be proven beyond all doubt. Therefore *philosophy itself* (as a means of arriving at certain knowledge about our Universe, the reasoned derivation of an unquestionably true worldview) is *bullshit*!

In other words, philosophy has been able to prove that as long as philosophy’s goal is to provide *certain knowledge* it, and we, are just plain shit-outta-luck (SOL). Ain’t happenin’. Forget it.

Did Hume’s startling observation (as originally presented or as extended here) stop philosophers from philosophizing? Of course not. Philosophers have to eat, and if they don’t get paid for philosophy they might have to work for a living.

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12 This isn’t strictly true – if the Universe consists of many *completely disjoint* cosmos with *no connections between them* then ignorance in one does not “bleed” into the others. But in this case we need never concern ourselves about the parts disconnected from the one in which we find ourselves.

13 Which can be seen as necessary and sufficient reason for my writing this book, which I certainly do hope you *bought* and like so much that you buy two or three more copies as spares.
Did it even cause them to stop philosophizing badly, and at the very least state their basic assumptions along with their arguments? Hardly. You have to understand that if the premises of an argument are correctly stated, true-false reason can be reduced to algebra (as was proven by George Boole among others – hence Boolean algebra). The only way two algebricians can arrive at different conclusions by the mechanical process of generating a consistent chain of logic leading from premises to conclusions is if their premises differ. Or (in the event that I happen to be one of them) if they make a mistake, but we’re talking about two good logicians here.

Ultimately, then, disagreement about the conclusions of some valid argument in a forum of consistent reasoning is absolutely equivalent to disagreement about the premises (or a formal mistake in algebraic reasoning). Since disagreements at the level of premises cannot be logically resolved, and since the problem is further compounded when reasoning about the Universe, we see that semantically, all logically valid arguments that arrive at distinct conclusions about the real world are precisely equivalent to the following metaphorical argument:

Tommy: “Invisible fairies make the Sun come up.”
Suzy: “They do not.”
Tommy: “Do so!”
Suzy: “Do not!”
Tommy: “Do so!”
Suzy: “Do not!”
Iterate to infinity and beyond...

This doesn’t sound particularly learned, so most Philosophers – capitalized to indicate that they are Professional Pundits as opposed to the more casual kind – know better than to precisely state any of their premises, let alone all of them.14 Not even Hume was this foolish in his own dialogues or other explorations of reason and its limitations.

14 Unless they are mathematicians or logicians, who are generally painfully rigorous, but who also know better than to assert that their conclusions necessarily and unconditionally apply to the real world.

or to give away!

Hey, at least I make you laugh. Aristotle just makes you cry (for those that have ever gritted their teeth and tried to read their way through him).
Almost without exception, Philosophers subsequent to Hume have (perhaps, sometimes, maybe) paid homage to Hume’s demonstration that one cannot use deduction and/or induction to obtain certain knowledge about anything at all and then have proceeded to use deduction (often in the company of all sorts of implicit induction) to arrive at “certain” conclusion after “certain” conclusion, never openly admitting that these conclusions are devoid of any sort of **logically necessary** relation to the real world.

The one exception to this rule (with which I am familiar – although exceptions may well be as common as dirt these days and I might well not know it) appears to be Bertrand Russell, who unsurprisingly was as much a mathematician as a philosopher, and whose lovely book *Problems in Philosophy* is still today one of the most perfect deconstructions of the philosophical process ever written. Even Russell, however, fails to openly acknowledge the importance, and arbitrariness, of axioms in this work, and while he actually writes down in his chapter on induction statements that are very nearly the axioms used by Cox to derive a **formal system** of plausible reasoning he does not pursue them.

This book will spend considerable energy exploring one of Russell’s most important contribution to mathematical philosophy because it is entirely relevant to the process of arriving at an axiomatized theory of knowledge. This is his work on the paradoxes of set theory and self-referential statements, which culminated in the formal derivation of Gödel’s theorem. Logical systems of sufficient complexity have certain – *problems* – that are extremely relevant to both my self-referential arguments above and the following question:

*How can we best choose our axioms?*

The short answer is that in order to choose axioms out of an *infinity* of possible axiom sets, we, uh, need *axioms* to help us ordinally rank axiom sets so some are “better” than others (let’s call axioms about axioms *meta-axioms* to help us keep track). Which axioms should we use to ordinally rank systems of meta-axioms? Well, we need meta-meta-axioms to help us with that. We in fact need an *infinite chain* of meta-axioms, meta-meta-axioms, and so on to tell us how to choose the axioms to choose the axioms to choose *our* axioms that we’re going to use as the basis of a system of knowledge that might, just might, be relevant to the real world. Alas, neither I nor you would have the patience to write out or follow all the meta’s, and I couldn’t afford the infinite amount of paper required to print out an actual proofreading draft of the book so it would never get published.
For better or worse, this book will therefore break tradition with earlier works on philosophy in two ways. One, it will do its very best to actually write down a set of meta-axioms and a set (maybe even more than one) of fundamental axioms one might use to reason about the real world. In a nutshell, it will introduce a sort of a sloppy “measure” on an imagined “space” of all possible axioms and come up with some criteria for ordinally ranking axiom sets intended for use as the basis of a worldview drawn from that space. It will all be very sloppy because there isn’t any point in not being sloppy. Hume realized, correctly, that there was no bedrock upon which to build an epistemology and/or ontology, so we’re working to build a foundation that will hold up in a satisfying way on the sand of epistemic uncertainty, one that has to be able to shift and change with the tides and winds of human experience and experiment.

This may come as a disappointment to those that wish to pretend that their beliefs are certain. No, they are not. They may be correct, they may not be correct, but we can be quite certain that the beliefs themselves, no matter how well they seem to “work”, are not certain. However using uncertainty itself as a basis for human epistemic knowledge may prove to be enough to help mankind keep its balance and reason well about everything that matters, even when we have just shown, fairly convincingly I hope, that reasoning “about” the real world can never lead to truths more certain than the uncertain premises upon which the reasoning process is founded.

\[^{15}\text{Fancy words for theory of knowledge (epistemology) or worldview (ontology).}\]
Chapter 3

Doubt

Socrates – And surely this instinct of the dog is very charming;—your dog is a true philosopher.

Glaucon – Why?

Socrates – Why, because he distinguishes the face of a friend and of an enemy only by the criterion of knowing and not knowing. And must not an animal be a lover of learning who determines what he likes and dislikes by the test of knowledge and ignorance?

Now, if you’ve been paying attention you should now be intellectually poised above a Pit of Existential Despair (PED). This is deliberate.

However, there is a distinct possibility that you are instead going “huh” and scratching your head, when you are supposed to be dangling out there screaming at the glimpse of Philosophical Nothingness that underlies All Things. This won’t do. So permit me to get out the block and tackle and tie this rope around your feet – there, comfy now? Now – mmmph – we’ll just crank you up and swing you out over the PED, hold on to your loose change and try not to lose your eyeglasses and cell phone, if any. There. Now look up – errr – down.

We’ve just learned that hundreds of years ago David Hume made the observation that one cannot deduce anything about the real world without making assumptions that cannot themselves be deduced; they must be inferred from making observations about the real world. Unfortunately, the process of inference cannot be deduced either, nor can induction be induced. To this I’ve added the observation that even “math-y” things that one usually thinks of as being “deductively pure” and hence knowable as absolute truth are in fact deduced
from a set of assertions, called the axioms of a theory, that cannot themselves be proven.

So what’s left? We cannot know anything certain about the external world. We cannot even know anything “certain” about math! If we change the axioms of, say, plane geometry we might end up with curved space geometry. In plane geometry one can prove that the sum of the interior angles of a triangle is always \( \pi \) radians. In a geometry on a curved surface one can prove that this is generally not the case, that one recovers the plane rule only in the limit that the surface becomes flat.

Which one is “true”? Either? Neither? Both?

For a brief, dizzying moment, it seems like we know nothing! Forget difficult questions, like whether or not God exists. It seems that even things we have always taken for granted, such as the objective existence of the book in which you’re reading these words, are not certain to be true or unconditionally true. Suddenly you’ve just had the legs kicked out from under any possibility of finding definitely true (or false) answers to all the questions that you hold most dear, no matter what they are. If Life is going to have any reason, you’re going to have to find a way to put that reason there yourself, because nobody else knows anything more about how everything works than you do – and you don’t know much!

Ah, you catch a glimpse of the bottom of the pit, with its waiting demons of despair and confusion? Stop that whimpering! I’m not going to drop you in. In fact, the purpose of this whole work is to fill in this pit so that it is no longer lurking as a trap beneath your every step in life. But first we have to face the pit and even embrace the pit. So life is uncertain, and your worldview woefully incomplete, what else is new? Truth be told, you already knew that and have always known it. But is it really true that we know nothing, that everything is contingent, doubtable, insecure?

To banish the PED forever from your life, you will need at least one sure thing, one thing that cannot be doubted, one thing that is clearly, without question true. Once that one true thing is found, you can choose axioms that will permit you to conditionally extend your knowledge and fill in the pit.

So where can we find that one true thing? To answer that, we think back to our discussion of deduction, we concluded that if the premises of a well-formed deductive argument are true, the conclusion cannot cannot be doubted. Doubt

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1Funny, that, since in the time since I wrote those words the probability that you are, in fact, not reading these words in a (paper) book at all has substantially increased and are very likely not to be true...
describes a state of _uncertainty_. It describes our degree of belief, with certainty of truth or falsehood being the opposite poles where doubt vanishes or becomes complete.

Let us, then, follow in the footsteps of René Descartes\(^2\) and use doubt as a _tool_ in our quest for truth.

Descartes, as you probably know, was in some sense the “father of modern rationalism”; indeed, we are all _de facto_ cartesian rationalists even though, as we’ve seen above, rationalism itself is _fundamentally irrational_. Descartes made many important contributions to mathematics, to the birth of “natural philosophy” (science), and to philosophy proper. He (like Hume) was a giant of the European Enlightenment and we are all immensely in his debt, for all that most of his philosophical conclusions were _wrong_.

One, however, was very right indeed. Descartes, like all humans that are smarter than a piece of lawn furniture, had moments of youthful rebellion and existential crisis that fueled a desire to discover the truth of all things. He ran away and joined a mercenary army (Europe at the time was an eternity of warfare) to see the world and look for his own personal way out of the PED. Early on, he met one of the early natural philosophers (a.k.a. “scientists” or “alchemists”), one Isaac Beekman.

This meeting gave him a purpose – the development of a reason-based philosophy – that he was to pursue for the rest of his life. In a dream he invented coordinate systems and analytic geometry, then worked on the application of coordinates to the development of mathematics and physics and a natural philosophy where all things, including God, were known with the _certainty_ of deductive mathematics.

To achieve this goal, he began his most famous philosophical exploration, based on _methodological skepticism_, to arrive at a wonderful conclusion. Let us apply this method to ourselves.

Just for the moment, pretend that you don’t know anything at all. This should be fairly easy, given our arguments thus far. _Doubt everything!_

Did man really land on the moon? Maybe, maybe not. Maybe it was all done in Hollywood. You remember the sun rising yesterday – does that mean it really happened? Not necessarily – perhaps your memory is one of a dream or hallucination and the yesterday you recall never even happened. Do you know the sun will rise tomorrow? Well, it hasn’t happened yet. The sun might well

explode before tomorrow and transform the earth into a puff of white-hot plasma.

We actually find it easier to doubt all this than Descartes did, because we’ve had the advantage of reading books, seeing movies that vividly portray the doubtability of the objective reality of that which we perceive with our senses, or remember, or imagine. Our senses can be fooled or mistaken. Our memories are even more fallible. Our imagination, even of things such as mathematical truths, has a kind of an ephemeral quality and besides are always contingent truths at best.

For example, in James Gunn’s The Joy Makers\(^3\) we are shown a world where humans are cocooned by a vast computer charged with making humanity “happy”, which it manages by completely controlling their sensory input. This kind of theme was reprised in the Matrix\(^4\) movie trilogy, where Neo is awakened from a “reality” that turns out to be a computer simulation. Three movies later, it isn’t clear that the reality he’s been awakened to is all that real either.

Working a bit harder, Descartes, too, eventually decided that he could doubt just about everything. He could doubt that which he saw, smelled, tasted, heard, felt, because sometimes a dream has the force of reality but turns out to be a dream. He could easily doubt his memory, as it is fallible and deceiving. As he considered each thing that he thought that he knew, he discovered that he could doubt it – everything but one thing.

When Descartes attempted to doubt his own existence, he ran into a bit of a problem. It was impossible to divorce the act of doubting from something that was doing it. Try as he might, Descartes couldn’t doubt the existence of the doubter unless he existed to do the doubting. He had found one true thing: He existed!

You too, have this same true thing. Perhaps you are “a unit in the Matrix”. Perhaps the Universe is all an illusion. Perhaps you were created only yesterday by a powerful and malicious mad-scientist complete with a full set of memories of an apparent past, and that same scientist plans to terminate the experiment in the next five minutes. However, as you muse about this, as you consider alternative hypotheses that might explain whatever it is that you are feeling and remembering and seeing, it is impossible to deny that you are there doing the feeling, remembering and seeing.

Descartes summarized this with his famous “I think, therefore I am”. Although it should be carefully noted that this isn’t quite the same thing as “I am

doubting, and therefore existing”, it is a catchy little sound-bite.

Thus far, Descartes has, through his doubt, achieved Enlightenment-era agreement with one of the oldest of reason-based philosophies, the one underlying Hinduism, and so have we, riding along. He has discovered the Atman, or Self, as an undeniable “truth”. In Hinduism the Atman is that thing which sits “within” each of us and has the essential existential property. It Is, with a capital I. For convenience, in the rest of this work we will refer to the self-that-cannot-be-doubted, the thing-that-is-existing at the heart of all of our sensory experience, memory, and mentation, as the Atman in deference to the truly ancient and nameless philosophers who first conceived it and wrote of it and to differentiate it from Descartes’ homunculus as his speculations concerning the latter were not terribly good or useful.

Let us spend precisely one paragraph on existence, because philosophers great and small have wasted much breath on the idea, deciding whether existence is or isn’t a predicate and just how existence factors into logic and ontological arguments. All of it bullshit, mind you. We will not worry about existence as a property of things because so far there aren’t any things, at least things that cannot be doubted. There is only one Thing, neither material nor immaterial, the Atman (of each of us – so far I can doubt that you, dear reader, exist just as you can doubt that I do). That the Atman is existing cannot be doubted by the only thing that gives a rat’s ass about “existence” or is capable of doubt in the first place – the Atman itself, and e.g. Russell’s objections to the “I” in the statement, or objections to its logical or set theoretic validity are simply irrelevant (and, frankly, mere sophistry).

This is the one point where Descartes and Hume agree. There is no possibility of doubting that you (whatever “you” may turn out to be) are experiencing the sensory flow of your instantaneous awareness. This is an ongoing empirical truth, not a logical deduction, and indeed it is the only empirical truth that is beyond all doubt. We can even leave the role of “doubt” behind. At any instant that we are Self-aware, as long as our Atman is perceiving, we exist and any attempt to assert the contrary may be logically permissible but is just plain stupid and inconceivable and obviously false to the conceiving mind making the assertion.

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5Especially in Latin: Cogito, ergo sum. Fairly drips with erudition, that.
6Where Hinduism does not in truth ascribe any particular location for it, and indeed in some of the Upanishads great pains are taken to indicate that it is only in the Atman that things like East, West, North, South, Up, Down, Past and Future (the orthogonal directions of four-dimensional space-time it should be duly noted) take meaning. Descartes referred to this “observer” as a homunculus, and it is an important, if contentious, concept in the theory of cognition and self-awareness.
We may not know what we are, but we know that we are not nothing, quite independent of whether or not we choose to associate a semantic symbol such as “I” with the non-nothingness of our experiencing.

We can now use pure reason to deduce a tiny handful of related truths that (as is always the case with logical deductions) are little better than restatements of the obvious. We’ve already just made one of them; here is a short list of it and other corollary truths associated with the empirical truth of the Atman, stated as you should read them in first person, as they are true only to the perceiving mind that is reading them:

- I exist.
- Nothing does not exist.
- Something exists.

Hmmm, pretty trivial. Note well that these are not deductions. They are all equivalent ways of viewing or stating our one empirical truth. It is nevertheless useful to understand what each of these statements means.

“I exist” should already be clear. If you are reading these words, musing on what they mean, thinking, imagining, dreaming – if you are doing anything at all and are aware of the doing then you exist as an awareness even if you are mistaken in all other respects about the true nature of that which you are thinking about. The Atman is, even if all else is illusion, because the Self cannot experience an illusion without being.

“Nothing does not exist” is less clear. In set theory one could equally well say that nothing always exists, as one can view any non-empty set as the union of that set plus the empty set (nothing). We might think of nothing existing everywhere and everywhen along with something. We need to clearly identify the correct meaning implied by the certain existence of at least one thing. Let us make the following two mutually exclusive, and universally sweeping propositions. These are really serious metaphysical statements, mind you – I’m not talking about any finite or embedded versions of them.

1. No thing exists.
2. Some thing exists.

By the former I am asserting that no “thing” has objective being of any sort whatsoever. I don’t mean that there is an immense emptiness, waiting to be
filled because that emptiness then has being. I don’t mean the “empty set” in set theory because the empty set is still a set (a noun-member of an ontology with an associated set of set-theoretic predicates). I mean the null set, the statement that no set theory exists, the idea that there is no Universe, filled or empty, no ontology. There is nothingness, nowhere, for no time. I mean the Void of absolute non-existence.

So when I say that nothing does not exist, I’m asserting that my own existence is sufficient to prove that that the absolute Void of utter nonexistence is not, in fact, the case. Something exists (our third version of our one certain truth listed above), something that is not less than my ongoing stream of self-awareness. Given the dichotomy between absolute, “Universal” non-existence (a non-state in which yes, the proposition itself could not be formulated as it is the lack of all semantics, ontologies, matter, energy, mind, whatever) and one where “something exists”, well, we’ve formulated the proposition and are thinking about it because we exist and we are something and so nothingness, the ultimate Void (and hence the mutually exclusive alternative to existence), does not.

The Atman serves to perfectly fill the Pit of Existential Despair in the here-now of each being’s self-aware existence. No matter what your doubts about the world, about its or your own reason for being, you have a place to metaphorically stand, a fundamental empirical truth. You Are.

But honestly, you already knew that. You’ve known it for as long as you’ve known anything.

Take comfort in that for a moment. Relax, go get yourself a beer or glass of water, maybe have a snack. Take a walk. Enjoy a few moments of quiet pleasure – even if we eventually conclude that the world is all an illusion, a dream, the Universe isn’t nothingness, isn’t a Nulliverse – at the very least the dreamer exists.

We now pause for three stars of time while you get that beer.

* * *

All set? Doesn’t philosophy go down better with a beer in your hand?

Then let’s continue. I exist without doubt or question (you should be thinking as you read this). What about everything else? How do I get from knowledge of “just me” to where I can have some degree of confidence that the beer I’m drinking is real and not just a dream, an illusion, a simulation being generated by an Evil Supercomputer and sent to a Unit in the Matrix?

7 Root beer, in the case of precocious but underage readers...
The answer is simple. We have to start to make assumptions, assumptions that build a bridge between our Self and the outside world. We must always keep in mind that from this point on our assumptions might be incorrect – they are doubtable. We will not know that they are true, so we will have to believe in them.

But how can we know what it is best to believe? Drumroll, please...

We should believe the most whatever we can doubt the least when we try our best to doubt, given the sum total of our life experience and the rest of our consistent, doubt-tested beliefs.

You can now see the object of our earlier exercise in doubt. Certainty is perhaps the greatest single enemy of reason in the context of the existential Universe, because we have shown above that one of the few certain truths about the Universe is that we cannot be certain of almost anything. You can also see why most of the worldviews held by the people of the world are so screwed up. Most people are taught to believe a certain set of propositions without doubt (a set that varies from culture to culture, family to family, even person to person within a family) and hence they end up believing things that aren’t just “doubtable”, they are absurdly unbelievable, far away from the least doubtable set we as a species have worked out so far.

In this we have a rule that will function as the lever that helps us move, Archimedes-style, the ponderous weight of our worldview (whatever it might be) from its current, probably highly non-optimal, easily doubtable position in belief-space to (at the very least) a better position, once we get the hang of this doubt thing. Our next chore, then, is to derive a semi-quantitative algebra of doubt that permits us to ordinally rank degree of (dis)belief in any given proposition. Amazingly, this provides what is arguably the best possible path from Descartes’ doubt and Hume’s skepticism to a well-founded knowledge of reality.

To work out this path we have to do a bit of math-y reasoning and we need a bit more insight to guide it. In other words, although we’ve already made good progress with the sound-bite above, we’ve got a bit of work to do before starting to explicitly formulate the meta-axiomatic basis for the best possible worldview.

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8Here is is: the punchline of this book. You can stop reading now, unless you either need to be convinced of this or are interested in how it all works out. This one line is a very pithy statement of the Cox axioms, or perhaps even leads us to the Cox axioms. What? You don’t know what the Cox axioms are? Maybe you should keep reading after all...

9But unprovable...
in a more quantitative way. We have to meditate for a bit on the experiential
data stream that “is” a significant part of our being to refine some of the critical
insight we’ve already begun to accumulate on the actual problem to be solved.
Then it seems pretty important to expand on this idea of a worldview. But we’ll
get there! Let’s get started!
Chapter 4

The Cave

If real is what you can feel, smell, taste and see, then ‘real’ is simply electrical signals interpreted by your brain. – Morpheus, in “The Matrix”

You exist. You, as Atman, cannot doubt your own existence without existing. It may not be terribly clear at first what “you” really are, but don’t worry too much about it – no answer that can be framed in symbols such as words seems likely to be complete or correct. You are an ongoing process, after all, and the “you” that read the beginning of this sentence is already gone, lost in the doubtable past of the “you” that is reading this word in the now, now, now of your instantaneous awareness.

As you sit there reading, still in a state of doubt-shock from the process of denying the possible objective reality of pretty much everything outside of yourself, we can at least hope that certain questions float to the top of your awareness. In case they don’t, permit me to help them along. Here’s one:

If all I’m certain of is that I am, what is all of this, all of the other not-me stuff that appears to exist?

The correct answer, if you think about it, is that “all of this” is pretty much entirely a sensory stream of information. Let’s break down some named components of your awareness. You are aware of some mix of:

- Seeing
- Hearing
• Feeling
• Smelling
• Tasting

Some part of those sensations have a certain “intensity” that you have associated up to now with an outside world. As you read this book, you experience a very powerful and immediate sensation that you interpret as sight, an experience that is highly structured and that visually carries symbolic information that you may well be “hearing” inside your mind in a way that is less intense than real sounds you are hearing at the same time.

Some of those auditory echoes loop back still further. If I suggest that you imagine a “red, red rose” you see the words on the page, hear them in your mind, and visualize, if only for a fleeting moment, an appropriately red rose. Perhaps the words trigger a memory of a real red rose you’ve seen, evoking a variety of sensory impressions that again are less intense than those you are experiencing now but may be more intense, or more specific, than a “generic” imagining of a red rose.

There are some mysteries associated with this process. Your Atman seems to have volitional control over your immediate sensory stream. By “willing” in certain ways, you can create impressions of external things you identify as parts of “your body” moving around as you direct them to, and your sensations respond accordingly. For example, your visual field and auditory sensations and tactile impressions vary as you reach for your beverage, and your taste and smell kick into play as you take a sip and flavors explode into your mouth and nose. All of this creates the compelling impression of an objective external world with spatiotemporal persistence and continuity.

Yet throughout all of this motion and sensation “you” in some sense remain unmoved, watching, listening and experiencing the sensation of motion and action and touch and taste as the sensory parade unfolds. You many or may not be the center of or all of the actual, objective Universe, but you are the absolute center of and all of of your subjective experience of the Universe. And hey, you might even be at the actual center, given that every point is in the middle of an infinite Universe!

This sensory stream is “true” in that it is a part of your own immediate truth. You can doubt that the apparent objects of your senses are really there, but it is

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\(^1\)Which, recall, we are now certain exists, and consists of at least ourselves.
quite impossible to disbelieve in the reality of the sensations themselves.

Your sensations, including your sensory memory of former sensations, are in fact data. They are information. It is now the job of your Atman to make sense of that data. Unfortunately, it is not as easy as it looks, especially since you’ve agreed to doubt things until you make a personal decision as to what can sanely be most believed on the basis of being the least doubtable. Let’s see why.

It is easiest to see why the Atman might well be mistaken about almost anything associated with the senses if we go over the Allegory of the Cave\textsuperscript{2} as written by Plato. The following is a modest adaptation of the cave in the half-remembered words of my teacher, George Roberts, who was a disciple of Bertrand Russell and my primary guru in undergraduate philosophy back in the 70’s at Duke. Note well that my version is a bit embellished (as was George’s) to better illustrate the essential point I wish to make – I’m a storyteller, not a historian.

Imagine a cave inhabited by prisoners who have been chained there since birth, fastened into infernal devices that only permit them to see the blank cave wall in front of them. As sensory input is a major concern here, we can imagine further that their sense of touch is for all practical purposes deadened by immersion in an immobilizing gel bath held at a uniform temperature. They wear filters so that they cannot smell. They are fed intravenously. They experience through their senses what we permit them to experience, no more, no less.

Behind them there is a raised platform and a light. As objects are carried back and forth on the platform, the shadows of these objects are cast onto the wall before them and are all that the prisoners see. Voices from those that carry the objects and sounds that the objects might make while being carried are reflected off the wall so that they too appear to come from the shadows thus cast. The prisoners chatter back and forth (where we needn’t examine too closely how it is that they end up with a language for chattering in) trying to make sense of that which they see.

Some objects cast very similar shadows, so they are given a common name by the prisoners. Some objects are always carried by in the company of other objects or always are associated with certain sounds (the sound of being dragged down the platform, for example), and so relationships between the objects themselves, or between the objects and certain sounds, are inferred. The prisoners concoct elaborate theories to describe their little “world view” and get into violent disagreements when their conclusions differ, even though they are oriented in such a way that none of them sees exactly what the other prisoners see. Fortunately,

\textsuperscript{2}Wikipedia: \url{http://www.wikipedia.org/wiki/Allegory_of_the_cave.}
no prisoners are injured in these “violent” disagreements as they are, after all, confined – the disagreements are strictly verbal.

Leaving aside in its entirety from this point on Plato’s purpose in introducing the allegory or the rest of the story (which has little to do with this book) let us examine just one question – what do these prisoners “know” and how do they know it? There is such a wealth of things to learn from this simple example that it is difficult to know where to begin.

First of all, it is clear from the way the allegory is set up that nearly everything that they think they know is mistaken. We are gifted with a bird’s eye view of the whole scenario as created by these words, so that you are able to note that there are actually three different objects that cast circular shadows being carried back and forth. One is (for example) a large black wheel being rolled along that is used on tractors, one is a giant spherical inflated weather balloon being floated along on a string, and a third isn’t round at all – it is the housing of a complicated generator and only accidentally has a round projective cross section if it is carried across in one orientation.

Yet the prisoners name all three things with the same word. They see the same generator housing being carried by in a different orientation and name it something altogether different. They are effectively blind to the color, the true shape, the density, the function, the texture, and the smell of the objects – most of the relevant properties of those objects have been “erased” by the process of casting only a projective view of them on the wall: their shadows. Even the beliefs of the prisoners concerning the sources of the noises are incorrect, as the track is oriented in such a way that the real sources of the noises (the people carrying the objects, the carts and so on that they drag them through with) are invisible even as a shadow. The squeaky round becomes a female round seeking a mate – a silent round is hunting, the round that makes grating noises is a male, clearly.

The shadows cast on the wall are not real objects, they are only projective images. Yet they are the only experience of those objects, or of objects of any sort, that the prisoners have ever known! Our prisoners are imprisoned by their bonds to be sure, but they are even more tightly bound by the restrictions we have placed on their sensory input. Their visual field is restricted to where binocular vision is of no use to them and it is very doubtful that they have any visual concept of depth. Their visual universe is two dimensional, and there is little reason for them to believe that a third even exists.

Would that human beings in general were so fortunate.
Roberts used to present the Cave along with an allegory of his own to reinforce the point. Imagine Adam on the first day of creation⁴. God⁵ has created him, but he is a tabula rasa, a clean slate with absolutely no experience of the world into which he has been created. Again we imagine that he somehow has a language in terms of which to reason and further, we will imagine that he is brilliant and has at his fingertips the entire range of mathematics and logic – no point, however subtle, can avoid his deductive powers for more than a few seconds.

What can this Adam tell about the world into which he has been inserted before he opens his eyes? The answer, I think you’ll agree after a tiny bit of deductive meditation yourself, is nothing at all. Before he opens his eyes (and the rest of his senses) and sees, smells, feels, tastes and hears the world, he cannot tell if that world is one dimensional or ten – he “knows” all about $N$-dimensional spaces and manifolds flat and curved, but there is no reason for him to expect a 3+1 hyperbolic space plus time as opposed to (say) a 7 dimensional flat space with two time dimensions (or any “space” at all). Adam is confronted with the fact that there are an infinite number of possible Universes he might have been created in – even as he rejects a still greater infinity of possibilities that could not sustain existence or that are internally logically contradictory. The particular one he is in is infinitely unlikely to correspond to any consistent guess he might make. He quite correctly concludes that he simply can’t tell even one thing about the Universe around him without opening his eyes.

Even if Adam somehow guesses from analyzing his own thoughts that he is embedded in an $SO^+(1, 3)$ spacetime and correctly concludes that the Universe must be quantum mechanical instead of classical in order to have persistent structure, he’s still stuck. The Universe might consist of an infinite set of these space-times, each with similar structure but different initial conditions, some of them might be somehow coupled and have differential entropy so that “magic” is possible, and there could still be any of the more exotic possibilities his super-powerful mind can conceive similarly conjoined to his space-time with an outer product.

Of course God has to have created such an Adam with a powerful urge to try to answer the question in the first place. Otherwise, without anything to see, without anything to think about, with no memories of prior experience there can be no change in Adam’s state – he cannot even deduce the existence of time unless he was created with a memory of something, as change can only be perceived in

⁴Or a newborn baby, or – to anticipate one of the favorite models of E. T. Jaynes – a self-aware supercomputer robot.
⁵Or Mom and Dad, or a really smart computer scientist.
our thoughts by comparing a memory of one moment to the perception of the next. This Adam would never think (over time) as there is nothing in his mind to think about.

The moral of this story is that there is no logically necessary connection between any complete axiom-based theory one might propose and the actual Universe! This is yet another (independent) proof that any philosophical theory that asserts otherwise is bullshit, simply because there is a disagreement in number – there are infinitely many possible Universes that Adam might have come into being within, but only one actual, real Universe in which he does most certainly exist as he learns whenever he tries to doubt it. Without data in the form of experience, however projective and incomplete, there is no way to tell a priori which possible Universe is the right one. or to restrict the nature of the cosmos one happens to be in in any way other than requiring e.g. consistency in the sets of propositions one considers to describe it, as we later shall insist on doing.

The allegory of the Cave can be carried to even greater extremes, and has been in a number of fictional works, notably Flatland, a Romance of Many Dimensions by Edwin Abbott. As already noted, we can include The Joy Makers by James Gunn in the set, and of course the Cave is very much the basis of the Matrix film trilogy. Let’s think about these three examples (all highly recommended reading, or watching).

In Flatland the consequences of living in a two dimensional manifold (plus time) that is, in fact, embedded in a three dimensional manifold (plus time) are explored. The theme of the Cave is clearly echoed as a two dimensional being struggles to make sense of the projection of a three dimensional being that can apparently travel through walls and appear and disappear at will, who can be heard even when it is literally out of the (two dimensional) world.

Naturally, at first this is extremely disturbing to the inhabitants of flatland – black magic, violations of causality (as they see it), miracles – it simply appears senseless to them at first because it is so outrageous and beyond their experience. However, as time passes a few flatlanders come to mathematically grasp the truth, and one of them is even forceably “uplifted” to live henceforth as a three

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6By definition, recall. We carefully excluded multiple Universes in the first chapter as contradicting the meaning of the world Universe, and one trivial way candidate Universes we might consider can differ is that there could be an infinite number of individual disjoint cosmoses (cosmi?) arranged in an infinite number of ways.


8The Joy Makers is out of print, but can still sometimes be found in used bookstores.

This is a version of Plato’s cave where the prisoners live on the two dimensional wall of their mental cave, where the bemused philosopher in three dimensions comes to try interact with them and ends by freeing one. Indeed, it works both ways – lineland and pointland are successively more constrained, but all unite in doubting the existence of the higher dimensions where (we see from outside the story) reality actually dwells. Even the three-dimensional being who can clearly see the succession of embedded realities of lower dimension cannot fathom how he could live in a sub-reality projectively embedded in a true reality of higher dimension.

The point in Abbott’s tale is that this three dimensional being, blind to a four, five, or six dimensional space (plus one or more time-like dimensions) in which he or she may be embedded, is us. That’s why we carefully defined the Universe to be different from the space-time continuum we seem to live in; so that Abbott did not live (and write) in vain! We may or may not ever be able to obtain any evidence in our own Cosmos of a dimensionally greater Universe (in part because the Universe may or may not be dimensionally greater!) but we need to keep open minds about this and not assume that the part of the Universe that we seem to perceive is all that there is.

The Joy Makers, in contrast, isn’t a mathematical moral tale but is rather a classic of speculative science fiction with human characters and a complex plot. In it, hedonism becomes the ruling ethos of society, to live for pleasure the greatest good. Unhappiness is quite literally outlawed.

Since work is unpleasant, society automates more and more, delegating the work that still needs to be done to machines operated by intelligent computers. Since it is unpleasant to be frustrated in one’s desires, neuromechanical interfaces that can simulate reality to any precision desired are developed and operated by a massive controlling computer to deliver the precise realization of every individual’s immediate desires instantly (while caring for their otherwise immobile and irrelevant bodies). They in fact live in Plato’s Cave with computers controlling what they perceive in a sort of direct-connection “massively multiplayer role playing game”\footnote{Wikipedia: http://www.wikipedia.org/wiki/MMRPG.} virtual reality in which no truly bad thing is ever permitted to happen to them and which in no way reflects the supposed real “reality” in which their bodies and the controlling computers reside.

The Joy Makers proceeds through three short novellas to a macabre conclusion. The sentient computer that generates and controls the pleasant dreams of
the dwindling population of the world is forced by the protagonists of the third novella (who seek to escape the bondage of perfect hedonism and live a “real life”) to realize that it too is a “living being” and subject to the law requiring it to be happy. Ultimately the last humans escape the bondage of illusory pleasure as the computer realizes the satori that only way to avoid the pain of its own life is to seek out the cessation of that pain in its own prolonged amusement leading to death.

However, the book’s protagonists can never be sure that they have “won” and actually escaped in the end. Naturally they wished strongly to win, and the computer is programmed to provide them with the perfect illusion of having fulfilled their strongest desires. Did they really win, or did the computer simply concoct for them a simulated reality where they appear to have won and where even their transient pains and unhappiness are permitted only to provide them with the greater satisfaction of an imagined victory? It is, of course, impossible for them to ever tell! The moral of this story (to us) is that we can never be certain that our sensory stream, however well it seems to correspond to an external reality, is indeed congruent with that external reality. At best we can conclude that it is improbable to be wildly different, or that it is best to believe that our sensations correspond to reality unless and until given some reason to believe otherwise.

The Matrix movie series righteously rips off both Plato’s Cave and the world-as-virtual-reality theme from The Joy Makers and extends them across multiple layers of supposed reality. Neo (the anagrammatic main character) is living a perfectly normal life in a perfectly normal city in a perfectly normal society – on the surface – but he has odd dreams. One day he chooses to be “awakened” and discovers that he has really been a thermodynamically unlikely biological power unit in a vast machine and that the “reality” he has known his whole life is just a collaborative simulation wired directly into his brain. However, as the story unfolds (over three movies) it gradually becomes equally clear that the new reality he has been “freed” into is no more real than the one he left. It too is some sort of projective simulation and exists, ultimately, only in the mind as a sensory stream in interaction with whatever constitutes Neo’s “self”. If we need any further irony, we can always take note that the whole story is a movie, creating yet another level of sensory reality in our minds.

The common theme to these diverse examples is that even though we can never doubt our own existence, we are all, always, “prisoners in the cave”. What we “see” with our senses might or might not correspond to an actual external reality. Perhaps what we perceive is is only a projective simulation, shadows cast
on the wall of the cave of our senses, generated by an external intelligence (godly or diabolical as you prefer). Perhaps they are simply the result of natural laws, where important things happen in the dimensions we cannot “see” in a larger Universe in which our particular space-time continuum is merely an embedding. Perhaps our space-time continuum is all that there is, what we see is what we get. Either way, the shadows cast on the walls of our personal caves and our ability to reason are all we have to work with if we wish to generate the best possible worldview, make the “best possible guess, given the data” and make it our contingent, consistent, least doubtable knowledge.

The well-read reader – one who has for example read Michio Kaku’s *Hyper-space* or is otherwise passingly familiar with e.g. quantum string theory or the question of hidden variables in physical theories in general – will recognize that these are not idle speculations, they are perfectly permissible conjectures in real science. Indeed the entire history of Natural Philosophy (science) since the Enlightenment has largely consisted of figuring out how to look beyond the narrow limits of our biological senses with e.g. telescopes and microscopes and controlled experiments to untangle some of the projective magic of our mundane experience.

At this point, it should be clear to you that constructing a set of axioms to apply to your sensory stream so that it can “make sense” to you is obviously a process that has no unique solution. There are infinitely many ways to explain it all, and so far we have no way of choosing one over the others. You can freely choose to be a paranoid and believe in an evil genius joymaker or to be religious and believe in a benevolent omnipotent deity and given the right axioms no one can prove you wrong. You can choose to believe that you are the evil genius, and that you are actually dreaming up everything you perceive, and no one can prove you wrong. You can choose to believe that everything is just as it seems, and that the book you appear to be holding is just that – a real book, located in a single real space-time manifold that is pretty much is the Universe – and no one can prove you wrong.

But which of these notions (or the infinitely many more notions one can imagine that differ in details great and small) is right? We do not know for certain. We cannot know for certain, ever.

If you began reading this book completely certain that Jesus is Lord, you may or may not be mistaken in the objective fact but you are absolutely certainly mistaken in your certainty. You may choose to believe it (with or without good

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reason – this is one thing discussed later in the book); you cannot be certain.

On the other hand if you wish to assert that the success of a mechanical view of physical science proves that there is no God, you, too are incorrect. You may believe it very strongly, but you cannot be certain. Even after we develop meta-axioms that lead us to what is arguably the best worldview those very axioms will necessarily preserve this uncertainty, because it is intrinsic – our seat in the cave provides at best a tiny projective view of a Universe, and the view of the whole thing could be different, even startlingly different, from what we imagine based on the shadows we can see.

Let us take a very important lesson from this! Since we – none of us – can be absolutely certain that our beliefs about the shadows cast on the walls of our personal caves are correct, it would be a really good idea to develop a certain amount of tolerance – and intolerance – for the freely expressed beliefs of others. Tolerant because we ourselves often cannot be certain that they are wrong. Intolerant of assertions of certainty or beliefs derived from inconsistent or contradictory propositions and in poor agreement with observation. Allow me to apologize beforehand for hammering this point home repeatedly throughout this book, but I fully plan to continue to hammer this point home repeatedly throughout this book. One may be able to show quite rigorously that some world-view horses are very unlikely to “win the race” and turn out to be the true view of Everything (and I will, in fact, beat on some dead horses, internally inconsistent self-contradictory horses, my very own self in later polemics in this book), but as long as belief-horses retain enough consistency and life to limp onto the field and the outcome of the race is not certain, humans should be free to lay their own bets.

Still, we feel intuitively that even though we cannot prove that any given interpretation of our sensory experience is correct by means of pure deductive reason from the one certain truth of our own existence – Descartes’ original attempt along these lines having been tragically flawed in an uncorrectable way – some explanations seem somehow better than others. In fact, some seem so much better that it is literally difficult to imagine that they could be completely false!

We should recognize this as both a trap and an opportunity.

The trap is fairly straightforward, but avoiding it will take us a bit of work.

12 Once we’ve developed a set of meta-axioms and axioms that give us good reason to believe that others in fact exist. In the meantime, you are permitted to doubt them, but you still can’t be mean to your little brother even if he might not really be there...
When we say “better” here we mean, literally, “more believable”, since certainty left town for good and won’t be back. Unfortunately, we have no way (yet) to rank-order all the vagrant notions we might have about a presumed external Universe in order of believability; it seems as though we’d need propositions to tell us how to rank-order propositions, just as a considerable number of axioms are required to define the concept and action of “greater than” and “less than” in number theory or geometry. And what tells us that these propositions (that rank-order propositions) are better than other propositions about propositions? Ooo, looks like a deadly logic loop with no possible resolution.

The opportunity? Don’t forget that you are, in fact, standing on the one piece of absolutely solid metaphysical ground in the entire Universe, the one that can hold you up even when you make mistakes – your Self. You are free to choose pretty much any set of beliefs, including a set that rank-orders beliefs themselves, without any need for further justification. If we can somehow define what is meant by “more believable” with mathematical rigor, then perhaps believability, plausibility, can take the place of “truth” as we seek to untangle the evidence of our senses. What we end up may not be “knowledge” in the same way that you interpreted the word a day or two ago, but perhaps it will do. At the very least it might give you a reason to believe in your memory that a day or two ago actually happened!

Let us, then, endeavor to come up with a set of meta-axioms that will help us to rank-order all the notions our intelligent minds conceive in such a way that while any given notion can no longer be held to be certain truth beyond all doubt, and with most of the notions that might pop into our heads being obviously implausible, some of them can emerge as more believable than others, perhaps even so believable that at some point we “promote” the notion from being merely a vagrant idea to an axiom, a presumed truth about the Universe, something we strongly believe to be Universally correct in the real world. We seek to frame a metaphysical theory of knowledge that can cope with the certainty of uncertainty and still function in a way that “works well enough” to deal with our current sensory input whether or not it ultimately reflects an objective reality or is the illusory product of a diabolical genius or even is our own demented and somewhat schizophrenic imagination.

The flickers on the walls of our personal cave may only be shadows of a much vaster Universe, but inside of the empirical truth of the Atman they’re all we’ve

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13Such as the notion that the Moon is made out of self-luminous green cheese or the notion that a girl named Alice once really did fall down a rabbit hole to have strange adventures therein.
got! We must choose a way to make the best of them to obtain a view of the world that casts the shadows.

So what, exactly, is the worldview of a sentient, Atman-iferous Buddha-natured being? We need to formally define it and consider its properties before we begin the process of constructing the best possible one.
Chapter 5

A View of the World

It is fitting to speak of what is
for it is
by no means is it not.
These things I ask that you show yourself
for from this line of inquiry I bar you
but also from the road on which mortals understand nothing
wander two-headed
until helplessness in their own breast
drives their wandering being straight
they are borne lurching along
deaf and blind equally, dazed,
a tribe without judgment...

– Parmenides: Poem

At this point you know One True Thing – that you (if you are reading and doubting these words) exist. If I have succeeded in my writing, you know exactly what I mean when I say that you exist at, and perhaps as, a peculiar juxtaposition of what appears to be “input” from an outside world (that includes what appears to be your own body) delivered through your senses, and a “self” made up from a mixture of memory, interior monologue, volition and imagination that we might broadly categorize as “your thoughts”. However, your Self isn’t exactly the same thing, as (if you are like me) you can easily find your Self watching your imaginings without sight, listening to your interior monologue without ears, knowing your thoughts without itself thinking.

That is, your Self doesn’t exactly seem to be equivalent to the process of
sensing or thinking in any mixture. You can concentrate on the Self to where your awareness of sensory input fades away and your thoughts quiet down and yet be wide awake and entirely Self-aware. This Atman seems to be that which sits in the middle of both and through some mysterious feedback alchemy transforms them from computational mechanism to something more, something capable of “knowing”.

This is not to over-romanticize it or argue that it is or isn’t material – at this stage of the game we have no knowledge or system of logic to argue with or any notion of a material Universe that it might exist in – only to point out that to ourselves our Self is rather special and perplexing. Our knowledge of Atman is direct and immediate and “unreasonable” where our knowledge of everything else, including one way of viewing ourselves as mechanism bound to a real world, is indirect and based upon reason.

Our job, then, is to give our Selves something to know, indirectly, based on reason. We wish to build for it a model of the world, a worldview.

A parenthetical remark: If you follow this wikilink, you might want to engage on a wikioromp and mouse around for at least a while in the Sapir-Whorf hypothesis, as there is insight to be gained there, and perhaps take a quick look at semiotics. Note also the seven elements of a worldview according to Apostel: ontology, explanation, futurology, ethics, methodology, epistemology, and etiology (where I’m not going to explain what each of these is supposed to be because you can google or visit Wikipedia and read it for yourself).

I disagree with this categorical -ological decomposition. Rather than digress on this, however, it is much simpler to replace Apostel’s mouthful of stuff by defining just what a worldview is according to this work:

A worldview is a set of propositions that defines a consistent mental model of the Universe and serves as the basis for reasoned volitional

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1Wikipedia: [http://www.wikipedia.org/wiki/World View](http://www.wikipedia.org/wiki/World View). The notion of a worldview is not new, but very few works focus on how to build one from the center of our being out. Most simply try to sell you a worldview – say, literal orthodox Christianity or Objectivism – that somebody else already made up for one reason or another. Hands on wallets, hands on wallets...

2Wikipedia: [http://www.wikipedia.org/wiki/Linguistic Relativity](http://www.wikipedia.org/wiki/Linguistic Relativity). The Sapir-Whorf hypothesis isn’t quite as concretely formulated as one might wish, at least by Sapir or Whorf, but in a nutshell it is that language shapes thought, culturally and otherwise.

3Wikipedia: [http://www.wikipedia.org/wiki/Semiotics](http://www.wikipedia.org/wiki/Semiotics). Semiotics is the collective study of three things: Semantics – the relation between symbols and the “things” symbols stand for; syntactics – a system of reason built on top of symbols that may or may not have any particular semantic content; and pragmatics – how the use of semantics and syntactics shape the life experience of those that use them.
action and knowledge.

That is, I hope, clear enough to serve as a provisional basis for further discussion. Our goal is a set of meta-axioms that form an ontology for worldview-building while simultaneously defining an epistemology; we’re eventually going to embark on an axiom hunt that will contain axioms that pertain to time and inferred causal relationships and so on, but these elements are not constructive, and most people have only a fuzzy idea of what the word “ontology” even means.

It may be clear, but note well that it is not simple! For one thing, this “set of propositions” must itself be self-defining, and there may well be several distinct kinds of propositions (for example, definitions, axioms, rules for manipulating propositions which are themselves propositions, and a particular “new” kind of proposition we’ll define below that is a bit different than all of the above). But nevertheless, this one short statement suffices to describe it all.

Let’s review. You, O Atman, are undoubtedly existing. It seems as though something else exists too. At least, there are lots of lights and sounds and smells and touches and memories and thoughts that form a consciousness-show on the walls of our personal caves where the “prisoner within” – our Atman – tries to make sense of it all. That “sense” is your worldview.

This book is basically a construction manual and buyer’s guide for worldviews. Or, if you prefer a different metaphor (one that I, as a pretty serious open source coder, am quite fond of), it is an argument for choosing to use an open source worldview, one where you have complete access to and control over all of the meta-axioms and axioms and notional beliefs that are its foundation. It is a hacker’s guide for the personal software code base of whatever worldview you’ve

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4“That department of the science of metaphysics which investigates and explains the nature and essential properties and relations of all beings, as such, or the principles and causes of being.” according to Webster. Ontology isn’t an element of a worldview, a worldview is an ontology. Not that this definition isn’t a bit oxymoronic, given that metaphysics is not science, it is meta-science, and Duke, at least, currently lacks a metaphysics department...

5Note well that this work isn’t advocating for there literally being a little man inside our heads, a Cartesian fantasy pooh-poohed by modern cognitive psychology and philosophy, for example in John Searle’s Chinese Room (Wikipedia: [http://www.wikipedia.org/wiki/Chinese_Room](http://www.wikipedia.org/wiki/Chinese_Room)) thought experiment. This is an allegory, a metaphor. Atman at some point must include the walls of the cave and be a feedback loop. Or rather, as I propose more seriously in a different forum, a generalized master equation, an integrodifferential process describing a particular sort of open system. However, we’ve got a long ways to go before we can transcend the metaphor and concretely describe cognition itself in this book not as a deterministic predefined lookup table but rather as an adaptive self-referential Bayesian optimization process.
been using up to now, the one that was almost certainly loaded into you by your parents, your schools, your society.

In this computational metaphor, your worldview is the totality of software and data (strongly constrained for better or worse by the hardware on which it is loaded) that you’ve accrued on your system over all the years of your life, especially the part that is “active” and that actually processes the data coming in through the input channel of your senses and in turn distorts, filters, compresses and stores some fraction of that data, alters your internal state on a continuous basis given the sensory input and looped back data and programs from memory, and generates output that appears to alter the sensory stream interactively in predictable ways. Your worldview is quite easy to update and change, and changes constantly from the instant that your Atman is booted and starts to spin its core loop and your senses open to the flow of data from the world.  

On the other hand, your Atman itself is quite difficult to hack – it is (metaphorically) some mix of the operating computer itself (which can be viewed abstractly as microcode - a set of symbols and defined actions) and the very low level kernel code that somehow defines “Self-awareness” where somewhere in there the computational metaphor should no longer be taken too seriously, at least until we can build a working computational model of the awareness loop.

Since a lot of the rest of the book is a guide to building a worldview through deliberate choices for its fundamental axioms, we will take a few moments to outline just how worldviews are structured and how they work. A reason-based worldview requires the following kinds of propositions:

- A **dictionary**. Semantics is deeply entangled with thought, meaning, and reason (and curiously, is omitted from Apostel’s list above). There is observational reason to believe that a nontrivial worldview requires a nontrivial language (one that spans both verbal and mathematical reasoning) to construct. The network of definitions and correspondances in the dictionary covers our ongoing sensory experiences *imperfectly* but is generally quite flexible and can easily be extended to improve the correspondance. Definitions are a special kind of axiom or premise from which reason proceeds.

- A set of **meta-axioms**. Meta-axioms are “axioms about worldviews” or “axioms required to have any worldview at all”, not axioms of any specific worldviews. To enable a search for the *best* worldview, at the very least we

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6Otherwise known as “when you are born”, if not slightly earlier.
7A project that I am actually attempting, by the way.
will need a set of meta-axioms that let us comparatively “rank” the axiom sets of distinct worldviews.

We might begin, for example, by asserting that a worldview developed according to the laws of reason starting from a specific set of axioms and using logic to obtain deductions that are mutually consistent (once we’ve adequately defined what this means) is “better” than a worldview that consists of a set of assertions that are in conflict with one another and/or lead to mutually inconsistent deductions.

- An (infinite) set of notions. A notion is, basically, a proposition pertaining to the real Universe, a trial axiom or trial belief if you like. This usage of the term notion is, (as far as I know) unique in any discussion of reason, so permit me to carefully define it.

First of all, we have to remember the lessons learned from David Hume. No axiomatic system we can imagine has a necessary truth correspondence with the real Universe. There appear to be an infinite number of possibly true propositions about the real Universe, which could conceivably have infinitely higher dimensionality and complexity than the space-time continuum we can “see”, where we can apparently see only a tiny spacetime volume of even that one space-time continuum from our vantage point strictly bounded in space and in time to some local neighborhood of the world-braid of our being.

Before we look at the shadows of the actual Universe on the walls of our caves we have no way of choosing between this infinite set of possible axiomatic truths, and hence they all seem infinitely unlikely. We are in the position of Adam in George Roberts’ allegory – in possession of an embarrassment of riches, an infinite set of infinite sets of possibilities, consistent and inconsistent, many of them mix-and-match choices, an entire permu-

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8In all canonical worldviews that contain relativistic physics of our particular cosmos, a worldline is the set of spacetime coordinates associated with a particle as it moves about in the four dimensional spacetime manifold. Our persons consist of many particles that are loosely bound together with particles constantly entering and leaving and spinning around one another as we eat and drink breathe and urinate and excrete and slough skin and weep and sweat. If you imagine every particle of yourself leaving a “trail” as it moves about and then stretch that trail along a time axis perpendicular to all three space axes, “you” look like a world-braid, a bundle of worldlines being spun by the Norns (poetically speaking, a.k.a. the laws of physics) out of the stuff of the world and woven into and through the world-braids of everything else, right out to some point in the future of your now where Atropos snips the metabolic heart of the braid and the threads of which it is composed gradually unravel. Quite a powerful image (and correspondence between relativity theory and Norse and Greek mythology), really.
A notion group of possible realities.

We call any one of these propositions pertaining to the real world (which may well be conditioned by other propositions) a notion, an ephemeral and fleeting “idea” that in and of itself, in a state of complete empirical ignorance, is absurdly unlikely to be true. Yet some set of notions is true, and precisely corresponds to the actual information content of the actual Universe! The axiom-space “notional coordinates” of this Universe are a case of the “dartboard paradox”, where if we consider the tip of a dart to be a single point, and the dart is thrown at a dartboard with an infinite number of possible points on its surface that can be hit, the probability of hitting any given point is zero, and yet some point on the dartboard is hit! Of course our paradox is much worse – to this we have to add the essential absurdity of the existence of dart or dartboard in a Universe in the first place.

However, we are certain that something exists, and we have named that something the Universe. Our self-awareness is just such a dart, firmly stuck on an obviously real dartboard no matter how infinitely unlikely our own existence appears to be, and we have only the shadows cast on the walls of our personal caves and any notions that we manage to dream up to make sense of it all with a worldview.

A notional (trial) worldview is accurate to the extent that its notions are at least an approximation to some significant subset of the actual true propositions that describe the Universe – a correspondance that must be inferred from how well it works to describe the shadows we are observing (including the peculiar shadows that are memories of previous shadows, our past experience as well as our current experiencing). Knowledge is the set of notions that emerges from this process of inference (that we will explore in detail later) to where we think our notions (or notions that are “close to” – within an open set of the neighborhood of – our notions) are really rather likely to be true. At any given moment the set of notions we believe in beyond reasonable doubt (not any doubt, note well) form our personal beliefs, the presumed truths, the axioms of our current worldview (discussed next). However, our worldview is not confined to just that which is (which cannot ever be known with certainty), but that which might be!

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9Mathematicians, of course, have long since dealt with this problem, inventing measure theory and things like probability density. Physicists also cope – quantum theory “fuzzes” the tip of the dart and quantizes the spatial coordinates of the dartboard surface at the Planck length, thereby avoiding any actual zeros or infinities. But the conceptual problem remains.
Notions are important!

- A set of axioms that (often but not necessarily in combination with the symbolic definitions from the dictionary and the meta-axioms of implementing “reason”) generates a semantic model, a “system of the world”, an ontology, that possesses a strong and self-consistent correspondance with our ongoing sensory and mental experiencing of the Universe. These axioms are not known truths! They are presumed truths, contingent truths from which consistent conclusions can be drawn that may be compared to experience to determine the inferred accuracy of the resulting worldview. Ultimately, this comparison can serve as the basis for a quantitative ordinal ranking for notions in competition for selection into the set of worldview axioms and the dynamic alteration of the “best” set.

Note well: axiomatic systems are in general abstract, yet the correspondance sought in a worldview model is concrete. This is one way that e.g. physics (an arguably essential part of most sane worldviews) differs from mathematics. We will call a worldview that fails to achieve this correspondance “incorrect” and will (with the help of certain meta-axioms and axioms) attempt to construct an ordinal sense of incorrectness since we will rapidly learn that our own personal worldview is always incorrect (provably so, within some very broad assumptions on the complexity of the outside world) but that some are worse (more incorrect) than others. For example (drawing from physics as it is my personal forte), the physics component of Newton’s worldview was better than Aristotle’s but worse than Bohr’s and Einstein’s, Bohr’s in turn was worse than Schrödinger and Heisenberg’s, which is worse than the current relativistic field theoretic worldview, all on a quantitative basis of inferential correspondance with experiment and experience.

The axioms that make up a worldview can be overcomplete and contain axioms that in principle could be proven as theorems of a smaller set or that form an inconsistent theory. They can be complete and consist of the minimal set required to derive the best possible explanation of all experience and evidence. They can be incomplete, missing some of the assumptions required to derive a complete theory. Sadly, all worldviews of real live humans are always going to be simultaneously overcomplete in some relatively restricted milieu and yet globally incomplete nearly everywhere from a practical point of view given our narrow and projective view of an extremely large if not infinite, mostly invisible, cave.

At the moment, for example, I’m almost completely ignorant of what you
are thinking (assuming that I’m still alive when you read these words, and that you are thinking at all). Lacking any basis for preferring any notion I might have about what you might be thinking over any other, all such suppositions must remain very improbable although one is doubtless true and correct. Missing that information (or any evidence that might help me make a reasoned choice among the possibilities) how can my worldview be perfectly predictive or correct? It is clearly incomplete. I also know next to nothing of the Chinese language, what my grandmother had for dinner on May 16, 1937, the exact appearance of the landscape at the polar terminators of Pluto, and whether or not Elvis is really alive and living in a nursing home in Omaha.

This isn’t just about ignorance – in elementary classical non-relativistic physics, there are at least three completely distinct formulations (Newtonian, Lagrangian, and Hamiltonian) that can take one from physical interaction laws and problem descriptions to equations of motion that all appear to be ”correct” and can be shown to – usually – lead to exactly the same solutions to any given well-formulated physics problem. Not only is my worldview at least somewhat overcomplete here – how many ways do I need to be able to solve for the motion of a mass falling under the influence of ideal near-Earth gravity, really? – but I don’t even have a rigorous basis for preferring one of these formulations or approaches over the others.

Newton’s Law is convenient and simple for many problems (including the simple problem of near-Earth gravity) but provides no clear path towards quantum physics and is tricky to make relativistic; Hamiltonian physics also works for gravity and is arguably the best basis for moving from classical to quantum physics – if we have prior knowledge that the latter is going to be necessary, that the world is not classical – but can be a bit tricky to make relativistic; the Lagrangian approach can definitely solve the near-Earth gravitation problem and is arguably the best basis for building a relativistic classical theory of mechanics but is very difficult to quantize. Each is has conceptual advantages and disadvantages in different contexts, in other words, but all three will tell me that a mass $m$, dropped a (small) height $H$ from rest, strikes the ground at speed $\sqrt{2gH}$.

Which one is “true”? All of them? None of them? All I know is that all three are useful, which is a different thing altogether.

Worldviews can also be consistent or inconsistent in certain combinations with completeness. Overcomplete and inconsistent, undercomplete but consistent. However, Gödel’s theorems (which we will discuss later) suggest
that as soon as one’s dictionary and axiom set are capable of self-referential assertions of a certain nature it becomes possible to construct axiomatic theories that are either complete or consistent but not both.

- **A persistent mind.** Note well that I am in no way asserting that the Universe “is mind” – only that the words contained in this book are not a worldview, no matter how copious they are and how precisely they encode a worldview (especially when accompanied by a really good dictionary and a stack of books on mathematics and logic and a computer capable of following links to wikipedia content). The words alone, written out to imperishable metal and cast to the stars to survive the eventual explosion of our sun, are meaningless without a mind to give them meaning. If you prefer, a worldview is an ongoing process linked to an Atman that may well take place in the absence of words or other symbols altogether, however important words may have been in creating it. It is an ongoing dynamical process involving information exchange in an open system, not a static symbolic encoding or lookup process taking place in a Chinese Room.

To put it a simpler way, a worldview happens in a reasoning mind, a mind with a view, not on a piece of paper, in a book (not even *this* book, which tries damn hard!), a computer’s hard disk, or recorded on a DVD. Even an imaginary computer with an enormous memory that can hold the entire contents of the library of congress and run them through its processor over and over again fails to have a worldview. This point will become quite important when we later consider God and worldviews and information theory.

Note well that we will carefully proscribe stating that the Universe itself “is” a worldview – if we said any such thing we would mean something very different than what we mean when we talk about *our* worldview and it would be all too easy to twist the statement around into a bullshit “proof” that the Universe is mind, a question we do not intend to beg quite yet. We’ll beg it later, if only to show that – subject to certain axiomatic assumptions – one is led to the conditional conclusion that if God exists at all, then the Universe “is” God as a perfect marriage of the material and mind.

That’s it. For our current purposes you don’t need to worry too much about just what “a persistent mind” is, because, if you are reading these words, you are a persistent mind. We aren’t really talking about abstract worldviews, we’re talking about *your* worldview, the program whose “running” is your own impossible-
to-doubt Atman. Fortunately, you come pre-equipped with one or more languages (one of which appears to be a match for the words this book is printed in) and no doubt have any number of meta-axioms and axioms already in place however they might have gotten there. You’re metaphorically all booted up and running; all we have to do now is equip you with the right meta-axioms that act like an “administrative password” and grant you control over your own axiomatic programming and then you can tackle the actual volitional (re)programming of your worldview without further help from me. Although naturally I’ll offer it anyway, in the final part of this book...

At the end of it all you should be able to freely choose what to believe, quite possibly for the first time in your life, and have a sound basis to help guide you in making the choice. What you choose to include in your personal worldview from that point on, and what you do with it, is strictly up to you.
Part II

Meta-Axioms
Chapter 6

Logical Preliminaries

Frog: One door leads to safety, one door leads to a horrible death. You may ask me one question, but I always lie.

Wolf: Oooh. I had this one in school, but I can never remember it.

Tony: All right, all right. Wait, wait! I have a question! What is the point in having a door that has a horrible death behind it? Huh?

(Tony picks up frog.)

Frog: Get your hands off me!

Tony: What does that achieve?

Frog: What are you doing?

Tony: I mean, what is the purpose of your life? Just to be a pain?

Frog: Don’t touch me there, only my girlfriend touches me there!

(Tony throws the frog through one of the doors.)

Frog: WHOA!

(Tony slams the door, there’s a large explosion and fireball).

Wolf: I guess it’s the other one...

The Tenth Kingdom

Tony’s reaction to the frog’s silly riddle in the movie The Tenth Kingdom (yet another movie, by the way, that suggests that our view of the Universe might be a narrow window into a small part of the whole thing) is typical of that of the human race. When presented with a puzzle solvable (or not) using logic, we are far more inclined to either run screaming in the other direction or do something illogical that not infrequently solves the problem in a completely unexpected way.
Constructing a worldview seems like it might be even more difficult than trying to figure out which of two doors allegedly leads to certain death armed with nothing but a single question and a self-professedly lying frog. It is sufficiently daunting that most people don’t even try. Rather than wrestling with the puzzle, it is easier to act and find the answer empirically.

In this particular case, Tony’s solution is the only safe one, anyway. After all, the frog that tells you that he always lies! That is, the frog makes a self-referential assertion – a statement that applies to itself. If it were true it would be a lie and could not, in fact, be true. It must therefore be a lie! But if the frog always tells the truth, he doesn’t always tell the truth, so this isn’t a possibility either.

The only remaining possibility that isn’t self-contradictory is that the frog does not always tell the truth, it sometimes tells the truth, and this particular statement was a lie. If you ask it any question (or any number of questions) about the door, you will have no way of telling whether any of its answers are true or false by means of pure reason based on its one statement – the only way to find out is by testing the hypothesis empirically. Testing the doors themselves with the lying frog ensures that it bears all the risk associated with what is, after all, an arbitrary and silly dilemma.

Besides, if the frog had said “You may ask me one question, but I never lie” logic gives you an easy way out – ask it what door leads to a horrible death – but only a complete idiot would believe that talking frogs never lie. Our goal is to end up with a worldview that is in agreement with common sense, not one that leaves you at the mercy of every two-bit swindling frog who swears to you that if you just send them your personal information they’ll ensure that you receive half of the twenty six million dollars they swindled from the estate of a dead oil magnate in Nigeria, and that’s the truth!

To assemble a set of axioms for an optimal worldview, we’re going to have to do better than this, alas. We’re going to have to understand a very few things about logic in the context of worldviews, enough to support our intuition that our worldview should be reasonable. This book will go out of its way to avoid any detailed discussion of formal logic but we can’t skip it altogether as it is associated with the first meta-axiomatic requirement we will need to impose on a viable worldview.

^Ummm, did I really mean that? Actually, come to think of it, I rather think it likely that lower-life forms such as frogs don’t ever lie. Of course, neither do they talk. Or do they? Damn, this must be another metaphor...
Let’s begin by understanding the law of contradiction. The law of contradiction is one of the original laws of thought, along with the laws of tautology and excluded middle. The law of contradiction states that a proposition cannot be true and false. (The law of identity or tautology says that if a proposition is true, it is true, and the law of the excluded middle says that any proposition must be true or false, but we don’t care so much about those, at least not yet, especially given that the law of excluded middle can’t handle a wide class of perfectly understandable propositions about the real world in quantum theory and hence is inconsistent with modern empirical science.)

Contradiction is at the heart of reason itself. It is quite easy to show that if a contradiction is introduced into the axioms of any theory, then the rules of formal logic permit one to prove any proposition. Or, of course, the negation of any proposition. The theory derived from any set of axioms that contain a contradiction is not useful because it cannot be used to differentiate the contingent truth or falsehood of any proposition – this is the so-called principle of explosion.

This leads us to our first meta-axiom – an axiom that applies to the infinite set of propositions that are candidate axioms for our worldview, our “universe of notions”. As we select axioms for our worldview, we must do our best to ensure that the axioms are consistent – they must not contradict one another. Otherwise, we will literally be able to prove that night is day using nothing but perfectly valid formal deductive logic. We have to be very careful, though, as consistency will come at a high price.

To understand this, we have to consider the problem of recursion. We are trying to create a set of meta-axioms that will permit us to ordinally rank sets of axioms as being “better” or “worse”, or “more likely to be true” versus “less likely to be true”, with our averred goal being to end up with a worldview that we believe the most because we doubt it the least. How can we know that our set of meta-axioms is the best possible one? Do we need meta-meta-axioms? And then a set of meta-meta-meta-axioms ad infinitum?

Not necessarily. First of all, note that meta-axioms are, in fact, just axioms. We stuck the word “meta” out in front to identify them as being “special” axioms (the axioms of a metaphysics), but axioms they are. We can therefore solve the problem of recursion very simply by insisting that the our meta-axioms be self-

\[^2\text{Wikipedia: } \text{http://www.wikipedia.org/wiki/Principle_of_Explosion.} \] Not explode as in bomb, explode as in an embarrassment of riches that leaves you infinitely impoverished. If you can prove anything, you can really prove nothing at all.
The meta-axiomatic requirement that our worldview be consistent must not be contradicted by another axiom (meta or otherwise) that says that it can be inconsistent. Ultimately, our axiom set (including the meta-axioms) must be self-referentially self-consistent.

This approach will be tremendously fruitful when we seek to produce a set of meta-axioms that can ordinally rank axiom sets. The meta-axioms we produce must be the best meta-axioms we can produce by the standard for goodness those same meta-axioms establish. If we insist on a meta-axiom of parsimony (Ockham’s Razor, as it were) then our meta-axioms should be parsimonious. This neatly terminates one sort of recursion that sometimes produces silly paradoxes, such as a search for a “first cause” in a causal chain.

However, by making our worldview (meta-)axioms self-referential we must deal with the possibility of introducing other kinds of paradoxes. We must confront Gödel’s theorems, as they simultaneously gives us a certain delightful freedom to craft startling self-referential meta-axioms and at the same time force us to completely reformulate the theory of logic used in the development of an axiomatic worldview, to essentially redefine “reason” in the context of our knowledge of the Universe derived from our personal experience.

We are not concerned here with the derivation of Gödel’s Incompleteness Theorems\(^3\) as they are a nontrivial result in formal logic and number theory. As always, individuals who are interested in learning more are encouraged to follow the wikilink and use it (and Google and perhaps textbooks in formal logic) as a starting point for further study. We will be very interested, however, in what they say. The first incompleteness theorem states:

*Any effectively generated theory capable of expressing elementary arithmetic cannot be both consistent and complete. In particular, for any consistent, effectively generated formal theory that proves certain basic arithmetic truths, there is an arithmetical statement that is true, but not provable in the theory.*

It seems likely that our worldview, when we are done formulating it in English or otherwise, will need to be capable of expressing arithmetic\(^4\). Furthermore, we just established that the axioms and meta-axioms of our worldview need to be self-referential, which means that they are precisely the kind of propositions that

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4After all, I don’t recall learning arithmetic that wasn’t expressed in or expressible in English, although I suppose that if I had I literally couldn’t tell you about it now, in English, could I?
are “troublesome” and motivated Gödel’s theorem in the first place. It seems that our worldview will thus face Gödel’s alternative (a different way of stating this theorem):

\[ \text{Any sufficiently complex axiom-based theory can be complete or consistent but not both!} \]

Well, we’ve already decided that consistency is really, really important in a worldview. We also know that completeness is beyond our grasp no matter what! For one thing, even though there may exist a set of axioms that uniquely and precisely specifies the state of the Universe and all of its interaction laws, the amount of information that those axioms must represent is (apparently) extremely large. By comparison, our sensory window onto that information is extremely limited, and we are a small part of the information we are trying to represent. It is, in fact, information-theoretically impossible to ever have a nontrivial, complete theory of everything (both the laws that govern everything and all the data required to specify the state of everything) encoded within any strict subset of everything \[5\].

For these reasons it seems self-consistently, self-referentially reasonable to insist that our worldview axioms be self-consistent (insofar as we can tell) and not worry about whether or not the resulting theory will ever be complete. It won’t; quite aside from Gödel, and formal arguments disproving Laplace’s Demon as being an entity within the Universe \[6\] the incompleteness of our own finite knowledge of a possibly infinite everything is a matter of sheer common sense.

\[5\]This is a theorem of information theory given very, very broad and empirically verified assumptions on the nature of everything, and it has profound consequences. It is also closely tied to the oxymoronic nature of the term random number generator and the nature of entropy and the Generalized Master Equation in physics.

David Wolpert has generated a formal proof of the impossibility of a theory of everything being encodable on a subset of everything – the theory of almost everything theorem, if you like – and thereby proved the impossibility of Laplace’s Demon. I have a slightly different but much simpler proof, made possible by the expedient of clearly defining everything to be the Universe. One consequence of this is that the only consistent way one can have an omniscient God (a dualist God separate from the space-time Cosmos and Laplace’s Demon built within the Cosmos are both hypothetical omniscient entities supported by a subset of the Universe and are mathematically proven impossible by both Wolpert’s argument and my own) is for that God to be the Universe.

I’ll postpone a discussion of omniscience per se and a proof of these assertions until a much later chapter discussing formal disproofs of a standard model omniscient, omnipotent, etc. dualist God.

\[6\]Wikipedia: \url{http://www.wikipedia.org/wiki/Laplace’s_Demon}. The assertion that some “demon” could exist as only part of the Universe and be given complete information about
Unfortunately, insisting on the consistency of the theory has its own problems. There is Gödel’s second theorem to deal with:

\[ \text{For any formal recursively enumerable (i.e., effectively generated) theory } T \text{ including basic arithmetical truths and also certain truths about formal provability, } T \text{ includes a statement of its own consistency if and only if } T \text{ is inconsistent.} \]

These theorems are proven in the context of number theory and arithmetic, not because they aren’t quite general but because the proof is easiest there – they apply in general to self-referential theories as complex as a worldview must be. However, in this general case, the second theorem has some extremely important consequences.

There is a very simple way of understanding this second theorem in an intuitive way (given in Jaynes’ remarkable book *Probability Theory: The Logic of Science*). We remarked above that one can prove any proposition in formal symbolic logic from inconsistent premises. Therefore, if a theory is inconsistent we can always prove its consistency! Whether or not the mere existence of an internal proof of consistency proves that the theory is inconsistent is moot – we can clearly not trust the proof because ultimately, it is the theory telling us that the theory never lies, which is precisely what one could easily make it do if it were lying!

We’re back to the case of Tony’s self-referential frog – any self-referential theory that axiomatically asserts or internally proves its own consistency cannot be trusted. Only if we cannot prove its consistency within the theory itself is there a chance that it is, in fact, consistent.

Laplace’s Demon (see footnote above) is a wonderful example of this. Laplace hypothesized an "omniscient" entity that is a subset of the Universe, one which could be initialized with the exact state of the entire Universe (including itself) and then perform calculations using the laws of physics that predict the exact state of the Universe for all times past, present, and future. Leaving aside the implicit role of time as an independent parameter in this hypothesis – Laplace substantially preceded the invention of the theory of relativity and time as just another dimension that actually mixes with space in particular ways – we can

\[ \text{the entire Universe (including itself) at any instant, it could then predict the entire past and future state of the entire Universe (including itself). How would this lying frog of a demon predict its own honest answer to the question: “Will the universe not be one in which your answer to this question is yes?” Hmmmm...} \]
trivially prove that such a Demon, if it existed as a sentient entity capable of letting us know even the slightest bit of what it predicts, would of necessity be a liar.

What would it answer if asked the question: “Is the real Universe not one in which your honest answer to this question is yes?”

Ooo, that’s a hard one. If it answers yes, then it must be lying. If it answers no, then it must be lying. If it refuses to answer at all, that’s a lie too (internally, it has failed to answer yes, but the answer turns out to be yes). No matter how it answers, the answer will be a lie and worst of all, it knows that its own answer will always be a lie. Worse, if it is asked and tries at least to be maximally honest, it will have to tell you that it is a liar. Self-referential questions and omniscient computations of answers do not mix well, and you can’t trust a liar...

This example is not trivial. It points out the problem of the layering of complexity that we take for granted when we ask questions with a semantic content, questions that are encoded on an underlying system that are essentially about that underlying system. If one asks the Laplace Demon “will I turn right or left at the next intersection”, it is again incapable of answering honestly. It may “know” I will (perversely) turn right when it answers left because of its ability to predict the time evolution of every bit of “stuff” that makes up the both of us, but that will never make its answer to the question about our mutual macroscopic state true!

As we’ll discuss later, there is only one way that a Laplace Demon (or Universe) can encode its own information, and that is as being its own irreducible self-representation, which makes the knowledge as useless as any tautology. Yes, a rose “knows” its own state by just being itself, but it will never be able to know its own state in the sense that it knows its own weight, its size, its structure, its function, its beauty or the sweetness of its perfume and knows the state of every particle in the rose that encodes all of that information and a suitable dictionary for decoding it. A computer can easily carry out any programmed sequence of operations on its internally stored data, but it can never store enough data to specify the precise microstate of all of the stuff that makes up its information store and computational unit and compute the time evolution of its own state computing the time evolution of its own state. This is information theoretically impossible, not just “hard”, because of the relative information entropy of the macroscopic program relative to the microscopic state. The only case where there is no entropy is the trivial one of the actual time evolution of the microscopic
Keep this in mind when we consider the common axioms of theistic religious belief, which typically assert as self-referential axioms that this or that theistic scriptural worldview is consistent, correct, and complete, when it is logically impossible for it to be all three, and where it is most likely none of them. Even if a voice from the heavens came down and said “This is God. I never lie. Prepare to take dictation and I will deliver to you Perfect Truth” Gödel’s second theorem makes it nearly certain that this voice would be lying! Or at the very least, mistaken, deluded, incorrect.

The true utility of Gödel’s second theorem is that one can only prove the consistency of a theory from another theory that you (for whatever reason) believe in “more strongly” than the theory in question. This alone suggests the need for an ordinal hierarchy of theory in mathematics – second (and possibly higher) order logic – and since our formulations of mathematics all occur within a worldview, it places the logical requirements of a worldview solidly at the top of this hierarchy, subject to both Gödel’s alternative and impossible to prove within the worldview itself, however much we might be able to prove the completeness and consistency of e.g. plane geometry within our worldview.

In the context of this work, we will not be able to prove the consistency of our worldview (even if it is consistent) but we will be able to make consistency a strong requirement from the higher level meta-axiomatic theory on the lower level axiomatic worldview. We will also learn from this and not assert consistency as an axiom or meta-axiom. Instead we will assert it as a worthy goal of axiomatic theories for all of the reasons outlined above, and tolerate a tiny bit of recursive inconsistency – the freedom to doubt, if you will, that our meta-axioms and subsidiary worldview are both consistent and correct.

Why all the fuss about Gödel’s theorems? Because there are logical paradoxes that naturally arise in self-referential theories, and while they are usually illustrated in a simple form that lets you watch the card being palmed, in a large state.

7I’m very tempted to formulate this as an actual theorem, maybe calling it the “meaning-entropy theorem”. In statistical mechanical terms, meaning is always encoded as a system macrostate. However, the time evolution of a system is always the time evolution of a system microstate with presumably perfectly reversible microdynamics (so that entropy is not a meaningful concept). There is always relative entropy between the two – the log of the multiplicity of the microstate, which is strictly greater than zero if we are encoding macrostate evolution with its own dictionary and dynamical rules, which is exactly what we mean by “meaning”. This is actually almost identical in content to Wikipedia: [http://www.wikipedia.org/wiki/Landauer's_principle](http://www.wikipedia.org/wiki/Landauer's_principle) except that Landauer’s principle addresses real physical entropy in computational processes where this is slightly more abstract.
and complex theory these sorts of paradoxes can be wrapped around through many, many assertions before the “problem” emerges.

Consider, for example, the Liar’s Paradox:

This statement is false.

Is it? Well, if it is false, then it is true. If it is true, it is false but oops, that makes it true again, and hence false, true, false... Every time you check one alternative in some sort of sequential order, you are led to conclude the other one. Thinking about it gives one a headache, and offering this or other Liar-like paradoxes presented as input to Evil Robots or Evil Computers has destroyed them in many a science fiction show of the past, as they loop out of control chasing the logical cycle. It is the frustration of this sort of tail-chasing logic that has Tony killing frogs at the beginning of this chapter: “Cretans always lie” (spoken by a Cretan) can only be a lie, but this doesn’t mean that Cretans always tell the truth, either.

This particular “naked” statement is not terribly illustrative of Gödel’s theorems per se, however – when stated so baldly it is relatively easy to deal with in logic because it is (after all) manifestly self-contradictory. We can see it and merely be amused, because we, like Honey Badger, should properly just not care about the truth or falsity of a statement like this. It can never be useful for anything but amusement, or to demonstrate the dangers of self-referentiality.

However, by the time one threads this paradox or related paradoxes through a dozen statements in a sorites that hides its ultimately self-referentiality and includes a lot of vague or ill-defined terms it is not so simple – then it can actually do real damage (to our sanity or the consistency of our worldview or both) if undetected.

Let’s illustrate my favorite Gödellian knot – an unprovable but true assertion within a self-referential theory:

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8 Wikipedia: [http://www.wikipedia.org/wiki/Liar’s Paradox](http://www.wikipedia.org/wiki/Liar’s Paradox). This paradox is actually very close to the basic statement used in the proof of Gödel’s theorems. It is also obviously related to at least one disproof of an honest Laplace’s Demon, although I personally prefer entropy, a combination of the notions of incompressibility and/or irreducibility and degeneracy. Obviously the discussion above included a variation of this paradox to turn the Demon into a liar.

9 A Lost in Space TV episode and an episode of The Prisoner immediately come to mind. At least to really old people (like me) that watched and remember them.

This statement is unprovable!

If one tries to prove that it is true, one obviously cannot. Presumed truth perfectly contradicts its provability so our proof, if correct, would be false. However, it cannot be “merely” false either – if its falsehood were provable as a theorem of this statement then it is in fact impossible to prove true, and hence it is true and our proof of falsehood must also be false.

Both assumptions – that the statement is true (and unprovable) or false (and actually provable) – seem to lead us to conclude that the assumption is indeed unprovable and hence true. If we meditate on this for a moment or two we are forced to conclude that we have an assertion that must be true but which is unprovable – Gödel’s first theorem.

This cute little example gives us a chance to be equally cute in the formulation of our meta-axioms. The word “provable” means “provable from a set of correct deductions from a given set of consistent axioms”. We will make our first meta-axiom:

An acceptable axiomatic self-referential worldview must be unprovable.

This is just a generalization of the previous statement and for the same reasons must be true as a self-consistent meta-axiom even though it is not provable in formal logic. This is just what we need to make use of Gödel’s theorems to correctly constrain our worldview according to Gödel’s alternative. We can directly conclude from this meta-axiom its corollary:

An acceptable axiomatic worldview must be consistent.

If it were inconsistent we could prove anything, including the theory itself, so unprovability suffices to permit us to consistently (in a manner of speaking) require consistency. A nontrivial self-referential theory can only be consistent if it is unprovable, even though a naive consideration of the meaning of the terms points the other way.

We can now apply Gödel’s first theorem. An acceptable axiomatic self-referential worldview that is consistent must be incomplete – and hence consistently unprovable! Let’s write this one basic idea in a third form:

An acceptable axiomatic worldview cannot be complete.
We thus have three ways of writing pretty much the same the same thing. 

Let’s write this down this chain of reasoning as our first and primary logical worldview meta-axiom, and give it a sexy name to make it easy to remember. We’ll go ahead and wrap the two corollaries right on in with it not because we have to, but to remind us that we really have no choice – these three statements all go together, with unprovability being the key assertion.

1. **Unprovability** – An acceptable (reason-based) axiomatic worldview must be unprovable. As a consequence, an acceptable axiomatic worldview cannot be complete and must be consistent so far as it is incompletely specified.

   We only need this single meta-axiom to establish the logical basis for a worldview held by any self-aware being (where the worldview must include itself and hence be self-referential, just as this entire book encodes a self-referential part of my own worldview and refers to itself all the time – in fact, it just did, again...). In order for the worldview to be reasonable, it must be unprovable, consistent, and incomplete.

   Note well that this meta-axiom is not optional; we must adopt it or reason itself is barred from us. It is the foundation of the worldview of any self-aware being. As such, it tremendously constrains a reasonable theory of God (an important component of many worldviews, usually described as a self-aware being with a complete and consistent and true worldview, perfect knowledge of the Universe).

   This fundamental meta-axiom has a profound consequence for us, as well. A worldview possessed by a complex self-aware being must be unprovable, and since reason traditionally revolves around logical proof, we have a bit of a conundrum on our hands. We seem to have logically (and self-consistently!) proven that in order for a worldview to be reasonable (consistent, so that logic and reason can be used in its construction), it cannot be completely reasonable.

   We have come full circle right back to Hume – the Aristotelian view of philosophy as an attempt to prove a worldview using classical reason alone is bullshit, only we have now proven this using reason itself, not argued heuristically. It cannot be done, because if it could, the basis of that proof would

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11 The last statement looks a bit weaker – what about worldviews that are incomplete and inconsistent? Well, if a worldview is inconsistent then it is provable, and if it is provable then it cannot be incomplete. Basically there is no way for the first two forms to be true and the third one false, given the Gödel alternative.

12 Unless you somehow manage not to be part of the Universe your worldview describes... a possibility excluded by our clever definition of Universe, at least if you exist.

13 This is significant. Hume asserted heuristically as a part of the same discussion in which he
(from Gödel) be inconsistent, and if it is inconsistent it cannot be reasonable. We therefore know a priori that as a sentient part of the Universe we cannot succeed in our quest to discover a complete set of consistent axioms that self-referentially describe the whole Universe and encode them on a strict subset of the Universe (us).

“Perfect knowledge” of the Universe is thus not just unlikely – it is logically impossible. No sentient being including a hypothesized sentient God can “beat the game” and end up with a complete and consistent abstract (formal) description of the entire Universe encoded on the information content of the Universe itself. This conclusion will, naturally, disturb those of you who are still struggling with doubting the religious axioms you were programmed with as children (before your ability to reason clearly was fully developed) but there it is. “Omniscience” is an inconsistent property of any self-aware being. In case there is any doubt of this lingering after the remarkably simple discussion above, this actually can be independently proven (although the proof is more complex) using information theory.

Not to worry. The problem isn’t that reasonable worldviews are impossible, the problem is with our insistence on the incorrect use of Boolean/Aristotelian logic and reason to formulate them! We have to reinvent and generalize logic, and transform it into something that is capable of dealing with uncertainty, with

\[\text{noted that a worldview cannot be deduced but is rather inferred, that a reasonable theory of inference could not be deduced from axioms the way e.g. geometry can be. Hume was wrong.}\]

\[\text{14 An observation that is a primary theme of my fictional novel, The Book of Lilith. Let’s try to understand the God dilemma using my favorite means, simile and metaphor. The classical view of God designing and then playing with the Cosmos is sort of like you playing all four hands of a Bridge game by yourself from a stacked deck. Even if you invent “characters” for each hand and pretend to “forget” the contents of East’s completely set-up hand when you bid or play for North, all you can do is use rules that express North’s character and assess what North should know and bid accordingly. The game is reduced to mechanism, and it ends up being rather boring. Humans shuffle the deck and play with each other because only the process of discovery of the hidden, the process of reason used in an uncertain environment where you cannot really know East’s hand or East’s mind, make Bridge an entertaining game.}\]

A similar, if somewhat more cruel, metaphor, portrays God as a child playing all by itself with dolls. The child can, in turn, pretend to be Barbie, Ken, G.I. Joe, Cobra Commander in a vast and grand drama but ultimately there is only the child as long as it has perfect knowledge of and control over the dolls – the best it can do is use imaginary rules to govern what Barbie does vs what Ken does, to make Joe good and Cobra Commander evil.

Well, in order for God to be anything but mindless mechanism, in order for God to be able to enjoy the dynamic unfolding of our Cosmos as a sentient being, It has the exact same difficulty as we do playing all the hands of a Bridge game, in spades (so to speak). But this is still a minor problem compared to the problems that arise when one considers the Universe, not (just) the Cosmos.
doubt, with unprovability and yet is reasonable! We need to self-consistently define a meta-axiomatic theory of reason for which formal True/False (Boolean, Aristotelian) logic is an unreachable limit in the context of worldviews. This non-Aristotelian system of reason will completely contain classical first-order logic as a limit, but it will be an unreachable limit for self-aware beings with an incomplete, unprovable worldview, when applied to the non-empty Universe that they seem to be a part of.

Fortunately, this formal meta-axiomatic theory was worked out over fifty years ago, although damn few people fully realize that. So we’re OK.

We aren’t there yet in this work, of course. For one thing, we just used a bunch of first-order logic to bootstrap the need to construct an unprovable, incomplete, second order recursive theory that is consistent (as far as it goes) in first order logic, and we really haven’t properly established a meta-axiom that says that our worldview can or must use logic of any order at all. Indeed, we already know (because we are bootstrapping from a fairly well developed worldview already, after all) that any worldview we are going to end up with that is at least as good as the one we have going into this process is going to include and constructively use a bunch of mathematics: geometry, differential equations, algebra, number theory, and so on. We need an explicit meta-axiom permitting the use of mathematics and logic in self-referential axiomatic worldviews or we are already self-inconsistent and dead in the water!
Chapter 7

The Meta-Axiom of Mathematics

This little piggie went to market
This little piggie stayed home
This little piggie had roast beef
And this little piggie had none
But this little piggie...
This little piggie...
THIS little piggie cried Wee! Wee! Wee!
All the way home.

– An early lesson in Piggie Mathematics, taught to the tune of tickles and giggles...

As we’ve already established, the worldview we are trying to build is going to be based on reason (as opposed to superstition, divine revelation, myth, or any other sort of unreason). God may or may not play a part in it in the end, but only if God can be supported by reason, because our aim is to use reason to choose the best possible set of beliefs, given our experiences and the evidence. We know that the final result will be unprovable and incomplete, so we rather expect (and will eventually meta-axiomatically require) that it have a certain amount of freedom to it, but we must insist from the beginning that our free choices not introduce inconsistency as inconsistency will poison the entire process and let us “prove” anything we like (and then its contradiction) and conclude that we know
Our sole, fundamental, meta-axiom so far is crafted just so that a worldview can be consistent, and hence reasonable. As part of our bootstrapping process, we used a rather lot of mathematics and logic that I kindly enough shielded you from by simply leaving it out (you can always look it up and work through it on your own if this sort of thing appeals to you and is within your abilities). However, it is still there, and our one meta-axiom so far absolutely relies on it. It is therefore a good time to add as meta-axioms for our worldview construction kit those axioms that form the foundations of logic and mathematics and reason itself that allow reason to be used to reasonably discuss, erm, reason. This will ultimately be meta-axiomatically self-consistent – the meta-axioms of reason will permit our worldview to contain axioms of reason (including the meta-axiom we are about to write down) and still be reasonable.

Here, fortunately, we have little work to do. An enormous amount of work has been done for us, for the theory of formal logic and syllogism and mathematics is at this point thousands of years old, and several academic disciplines devote nearly all of their considerable energies to teaching and extending the highly refined results derived over all of that time.

As we’ve already noted, mathematics and formal logic are in and of themselves sterile. They are, ultimately, a set of unprovable axioms (that includes e.g. definitions and rules for manipulating the objects and attributes defined – most of the ingredients of a worldview) together with an enormous collection of consistent, derived theorems. Changing the axioms in certain ways changes the collection of theorems, so it cannot be said that any mathematical theorems are “true”, only that they are true contingent upon the presumed truth of the axioms! In this sense mathematics is a collection of syllogisms, nothing more, and isn’t about anything at all until we make it so via axioms that establish connections between math and our ongoing sensory experience that transform some of the notions of mathematics into a part of a worldview. It is this latter process that we wish to formally enable.

1A favorite conclusion of Socrates, as it turns out...
2All that stuff I’m leaving out, given that it is an empirical fact that some 95% of the human race are either unwilling or incapable (or both) of working through anything past simple algebra or geometry. Don’t feel bad, though, if this describes you. I love this sort of stuff and am moderately good at it (obviously, or I wouldn’t be writing this book) but there are plenty of people who are far better and my own kids suck at it, at least so far. I’m writing this book for them, and for you, without all the details – and attendant arguments – because one can understand how worldviews work without knowing all of the details of the underlying mathematics and logic.
We wouldn’t need all of this, of course, if postulates concerning the Universe came with a stamp on them positively identifying their truth or falsehood so we could insert them into our worldview with certainty, but they don’t, and our fundamental meta-axiom of the previous chapter strongly suggests that they can’t. We can, and indeed must, doubt the truth of nearly any proposition concerning the real world, which is identical to stating that we do not positively know the proposition to be true or false.

One of our urgent meta-axiomatic chores is to assert meta-axioms that permit us to in some ordinal way evaluate the strength of our belief in any given premise pertaining to the real world so that we can use logic, possibly a (relatively) new form of logic in a (relatively) new way, in the real world. In the meantime, we have to look ahead (and behind) a bit to enable all of the bootstrapping going on, because we need a certain amount of “prior” mathematics and logic and set theory in order to be able to work out ordinal relationships and new logical rules!

The bootstrapping is further motivated by the observation that when we look at the Universe (at least the little chunk of the cosmos that our consciousness perceives from sensory input through the world-braid of our bodies stretching through space and time) there appears to be a strong correspondance between what we see and set theory, logic, arithmetic, geometry, and calculus. This begins with the simplest of observations – for example the persistent sensory identity of five little piggies, one of which makes strange sounds all the way home. We learn as very young children that the piggies we play with today are the same piggies, somehow, as the ones that we played with yesterday, and that the piggies on one foot are like the ones on the other foot, that our brothers and sisters and parents have piggies too.

In in this way, in the course of our experience of guided life activities and simple observational play, we start using set theory before we can even talk! We are taught (and to some extent are hard-wired to) recognize persistent patterns of sensory experience and categorize them into sets of “things” like parents and non-parents, toys and non-toys (don’t touch!), food and non-food, piggies and non-piggies. One of our first experiences of reason is the division of our experiential Universe into disjunctive sets and giving those sets names and learning similarly named rules governing those named sets. Piggy mathematics is important!

Eventually, in the course of this play, we learn to count our piggies! One, two, three, four, five! Set theory (identifying the piggies, which are all different, as belonging to a common set that is countable as opposed to putting each piggy in a set by itself where the count of each unique item is tautologically one, one,
one... has led us to simple integer arithmetic, counting those pesky piggies, counting non-identical blocks in the set of “objects identifiable as blocks on our living room floor”, counting bottles of beer on the wall as we get older and counting indistinguishable bosons in a bose condensate as we get much older.

We develop a sense of ordinal relationships (where the Biggest Piggy is larger than the Littlest Piggy, and as we learn an alphabet where – in English, at least – A is “before” B). We extend this to ideas of rational fraction proportions, as we divide up food (“Jimmy got the bigger piece of cake, Mommy, it isn’t fair.”) and as we learn to count, with 1 before 2 before 3 as an ordinal sequence, as we stand up to be measured as we grow, as we step on a scale, as we experience our day in an ordinal sequential fashion, morning to noon to night; yesterday, today/now, tomorrow. We learn logic as it becomes clear that if our brother eats our cake, we cannot eat it too (and vice versa), that if we wander into the street then we will get a swat on the bottom and a stern talking to, that there is no third alternative to “take a bath” or “don’t take a bath”, and that according to both parents the choice appears to be “take a bath” before bed.

Long before we learn any actual mathematics in an actual school, we have built mathematical concepts into our developing worldview at such a deep level that it is unthinkable that one could have a worldview at all without set theory, logic, and mathematics, whether or not you are aware that they are in fact the basis for set-compressed categorical knowledge itself and totally integrated with something as simple as being cognitively aware that you are looking at a tree even though it is not identical to any other tree you have ever seen. Even if the child eventually grows into an adult that sucks at algebra, that adult probably understands well the quantitative ordinal concepts of more and less, because they dominate human experience.

The point is that our eventual worldview is going to include all of these examples of logic, set theory, and mathematics in application to a real Universe, or it will be laughably and foolishly wrong, even though we won’t be able to use them with certainty. So we might as well explicitly include them now and have the use of them while we search for a more general connection that will let us make the best possible use of them, not just the everyday uses we invented for

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4Which for some, may be never, given our society’s horrific tendency to confuse teaching arithmetic with teaching mathematics.
them or were taught growing up\textsuperscript{5}.

Don’t worry! In actual fact, the use you had for them growing up is actually very close to their best use anyway! We just need to organize it a bit to avoid some of the traps inherent in its sloppy use, some of which were also institutionalized in your worldview growing up because they had practical social benefits, however formally incorrect they were.

So let’s go ahead and do it. Our worldview may, but is not required to, incorporate the use of set theory, number theory, arithmetic, geometry, calculus, formal Boolean logic, predicate logic, and so on, as needed. Note well that we don’t specify any particular set of mathematical or logical axioms! That’s why this is a meta-axiom, it permits the free variation of the notions that underlie various specific mathematical theories or branches, and the continued exploration of notions that might well lead to new mathematical discoveries (and possible correspondences with experience) in the future.

We know now perfectly well that insisting that only plane geometry and Euclidean spaces be considered is silly, even though this is the view that was erroneously held for roughly 2100 years post-Euclid. On the other hand, Euclidean geometry is undeniably useful in certain contexts! We want to be able to use both flat and curved space geometries! We want to be able to use natural numbers where they make sense, integers where they make sense, rational numbers where they make sense, real numbers where they make sense, complex numbers where they make sense, geometric algebras of higher grade\textsuperscript{6} where they make sense! We have to work out what “making sense” means, but we know already that we’re going to need all of this and almost certainly still more that we haven’t worked out yet in order to make sense of the Universe in the best possible worldview we can manage (given the evidence, so far).

\textsuperscript{5}Where “growing up” means right through graduate school in mathematics or physics and beyond, for some. As in most of us never actually finish, which is why you are still learning by means of reading this book! Isn’t it lovely the way self-referentiality works out?

\textsuperscript{6}Wikipedia: [http://www.wikipedia.org/wiki/Geometric Algebra.] A geometric algebra is a division algebra with a particular “geometric” interpretation of its outer/tensor product. Real numbers, complex numbers, and e.e. quaternions are all geometric algebras. With that said, the odds are thousands to one that you don’t want to follow this link! By telling you this, of course, I make it nearly certain that you will visit it anyway, at least if you are reading this book in an electronic format where doing so is a matter of a mouse click.

Suit yourself, but be warned! This page will make your brain explode, Mars Attack style, if you aren’t a mathematician or physicist, and there is a nontrivial probability that it will make even the brains of mathematicians or physicists explode!

Before you click it, therefore, be sure to spread a plastic sheet and ensure that your will is up to date. Your heirs will thank you.
Hence we introduce:

2. **The Meta-Axiom of Mathematics** – *Axiom sets leading to consistent theories of symbolic reason are acceptable for inclusion in our theory of knowledge or worldview.*

Note that this meta-axiom does not allege that a mathematical theory itself is knowledge of anything at all, but it is entirely permissible to postulate an association between some set of symbols and patterns of experience and thereby “inherit” a system of consistent contingent truths from the mathematics that one can compare to those patterns. In some cases the mathematical systems we will use will be complete as well as consistent, not in the sense that we have proven every possible true theorem but in the sense that any suitably expressed theorem is either true or false (with nothing in between or ambiguous) and the axioms are complete and consistent, sufficient to fully define the theory if somebody could take the (possibly infinite) amount of time required to do so. Also, we are not restricting ourselves to first order logic with this meta-axiom.

This means that we have to be careful when using mathematics, logic, and reason in our worldview not to propose mathematical axioms that violate the fundamental meta-axiom of unprovability. Any axioms we incorporate into our worldview by means of the meta-axiom of mathematics that are self-referential and potentially complete must always choose the consistent branch of Gödel’s alternative and give up completeness instead (whenever such a choice arises) or it will violate our first meta-axiom. This will be a constant devil we must strive with, especially when working out higher order axioms and theories at e.g. the social level, where it is so very easy to “prove” that homosexuality is wrong or homosexuality is right – given an enormous and horribly inconsistent body of social and ethical axioms to start with. Our goal is to build a consistent worldview (not provably consistent, but consistent as far as we are able to tell given our incomplete knowledge) because an inconsistent one is unreasonable and could be used to prove anything at all. Using guaranteed consistent mathematical systems to formulate parts of our worldview will help us tremendously to achieve that goal, as long as we beware the traps involved.

I have tried to formulate this meta-axiom sufficiently generally that it embraces first and second order logic, set theory, Peano arithmetic, a variety of number theories, algebra, a variety of geometries, calculus – basically all of the tools already used in the scientific worldview and rational philosophy. It is still up to the worldview-builder (that is, you) to use any or all of these tools in reasonable ways in your actual worldview-under-construction, once we have meta-axioms
that define just what “reasonable ways” means!

I have also formulated it sufficiently cleverly that you can understand the importance of mathematics in building worldviews even though it is objectively empty manipulation of symbols with no necessary connection with any real Universe. You don’t even need to know any particular mathematics beyond the Piggy level in order to be able to understand why it is important, why it has been important to you quite literally from the moment you were born. Without the generalizing operations of set theory, logic, and mathematics, every instant of human experience would be unique, every view of a piggie would be nothing but the actual sensory data. We cannot count piggies or reason about piggies if every time we see a piggie it is cognitively, semantically, ontologically disconnected from all other experiences and views of what we (literally) cannot help but believe is the same piggie at earlier times, if we cannot see that two piggies on the same foot are completely distinct and hence unique but nevertheless both belong to a particular named set, the set of all piggies!

The same holds for trees – every tree is different, yet one can instantly recognize many objects as belonging to the set of all trees. In some cases this identification is not sharp: Sometimes we see objects that might be considered a tree, or might be considered merely a shrubbery. As we grow older and more sophisticated, we start to take trees apart, to look at them at ever finer levels of detail, and our worldview has to be able to cope with water molecules that are not a tree or part of a tree being taken in by a tree and transformed into molecules of cellulose that are part of the tree, and then in turn being eaten by a termite and becoming part of a termite, and being metabolized by the termite back into water once again. Our notion of “tree” will become a very odd one, one that requires a coarse-graining of our vision in space and time, one with lots of semantic “fuzz” at the edges of the sets involved, and those sets themselves will be dynamic objects with constantly changing membership as a “tree” becomes a “fire” becomes “ash” becomes “dirt” becomes something else entirely or, in small part, a tree once again.

The ability to use formal mathematics can be both a help and a hindrance along the way. If one reasons carelessly, one can end up applying tree-based conclusions to a shrubbery or a termite. Still, knowledge is better than ignorance and all this really tells us is that we should learn to reason carefully, and that if math was always a struggle for you in school that this is a serious limitation on the quality of your worldview. In the end, you’ll need to make allowances

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7 Being tended by the Knights Who Say Ni!, of course...
8 I’m using trees here because deconstructing our own piggies in a similar manner might hurt!
for your own ignorance, including deciding whether or not to trust those whose mathematical knowledge and ability is greater than your own.\footnote{And whose brains are thereby less likely to explode when confronting the very real difficulty of the process.}

Don’t feel bad. In the next section we’ll see that everybody, even a mathematical super-genius, has to make allowance for their own ignorance in developing their best worldview! Humility is so important to the process that we wouldn’t go far wrong in making it, eventually, an axiom of our worldview.

Quantifying ignorance – and possibly renaming it something pithy, like information entropy – is one of the first, critical steps towards simultaneously establishing the meta-axioms that allow us to ordinally sort out comparative worldviews and develop a replacement for first order Boolean/Aristotelian logic so that the resulting worldview is still reasonable. Indeed, it will precisely establish the fact that we already arrived at intuitively, that we should believe the most what we can doubt the least.
'What do you know about this business?' the King said to Alice.

‘Nothing,’ said Alice.

‘Nothing whatever?’ persisted the King.

‘Nothing whatever,’ said Alice.

‘That’s very important,’ the King said, turning to the jury. They were just beginning to write this down on their slates, when the White Rabbit interrupted: ‘Unimportant, your Majesty means, of course,’ he said in a very respectful tone, but frowning and making faces at him as he spoke.

‘Unimportant, of course, I meant,’ the King hastily said, and went on to himself in an undertone, ‘important–unimportant– unimportant–important–’ as if he were trying which word sounded best.

Some of the jury wrote it down ‘important,’ and some ‘unimportant.’ Alice could see this, as she was near enough to look over their slates; ‘but it doesn’t matter a bit,’ she thought to herself.

*Alice in Wonderland*, by Lewis Carroll

Alice (as the agent of Lewis Carroll[^1^], who was a brilliant logician) has the right of it when she observes that her lack of knowledge of just who stole the tarts doesn’t matter a bit. She is also correct, at a different level, when she notes

[^1^]: Wikipedia: [http://www.wikipedia.org/wiki/Lewis_Carroll](http://www.wikipedia.org/wiki/Lewis_Carroll) Or, Charles Lutwidge Dodgson. Lewis Carroll was just his pen name, although it ended up being the one everybody remembers him by.
that it doesn’t matter if the jury considers her lack of knowledge important or unimportant. This is because the ideal jury – one with absolutely no bias – will make exactly the same use of her lack of information!

Now suppose that Alice was the only witness who had testified to a perfectly unbiased jury. What should be the state of mind of that jury be regarding the guilt or innocence of the infamous Knave of Hearts? There seem to be many possible answers, so let us review a few of them very carefully.

On the one hand, there seem to be only two possibilities. Either the Knave stole the tarts or he didn’t. We don’t know which, so either is equally likely. Alice’s testimony does nothing to change this, so after she has testified, we remain where we started, thinking it equally likely that the Knave is innocent or guilty.

On the other hand, if the jury members aren’t complete idiots, they know that while there is only one way the Knave stole the tarts, there are fifty-one other cards that might all be presumed to have equal access to those tarts. Even the King or Queen of Hearts might have taken them in order to advance a complex plot against the Knave. We don’t have any reason to believe (yet) that any of these cards is more likely to be the thief than any other, so we assign a prior probability to the guilt of the Knave of 1/52, and Alice’s testimony does nothing to change this whether it is considered important or unimportant because she does nothing to change our state of knowledge concerning the crime.

On the third through infinity “other other hands”, if the jury members are very smart, they will have prior knowledge of many other ways the tarts might have disappeared. Perhaps they were stolen by the Mock Turtle, the Gryphon, the Mad Hatter! Perhaps they were never baked at all and the Queen is lying because she enjoys cutting the heads off of the innocent! Every being in Wonderland, right down to drug-abusing caterpillars who might have needed to sell some tarts on the black market in order to smoke more mushrooms become members of the set of possible thieves, each just as likely (given the complete ignorance of the jury of facts pertaining to the case) as any other. Even this isn’t exhaustive of the set of possible explanations for an allegation of tart theft; it still neglects the near infinite number of ways the tarts might not have been stolen at all or were (for example) stolen by space aliens intruding from an entirely distinct space-time continuum, including that very real possibility that this is all just

\(^2\)At least, this is true if we use a maximum likelihood estimation in the absence of any Bayesian priors at all or any data pertaining to the case. I’m not going to continue to put in footnotes on this sort of thing, but nearly any statement made in this chapter is going to be arguable by someone sufficiently knowledgeable but this won’t, actually, interfere with my argument and conclusion outside of constraining it in various irrelevant ways.
a story of stolen tarts being amusingly presented in a fantasy about a Cosmos containing talking cards to make some logical point.

In this case they might assign a very small number indeed to the prior probability of the guilt of the Knave out of this universe of possibilities.

This perfectly unbiased jury wants to do its best to arrive at a fair verdict, given the available information. By just counting the size of three possible statistical universes we can see that how difficult the jury will be to convince of the Knave’s guilt (as actual evidence is eventually introduced) depends far less upon the facts in hand concerning the case than upon how good an imagination they have!

District Attorneys are well aware of this, and know that it is risky to put somebody that knows too much on a jury, because it will be correspondingly more difficult for such a person to achieve a state where they lack reasonable doubt than it will be to convince a juror that considers only the much smaller set of possibilities that a good D.A. tells them to consider.

The D.A.’s odds of obtaining a conviction, given any presentation of evidence, will always be best if they can convince the jury that the space of prior possibilities is binary, so it is even odds that the defendant is guilty (out of the two possibilities, guilty or not guilty) before any evidence is presented, so that it doesn’t take a lot of evidence to tip them towards a guilty verdict. The attorney for the defense, on the other hand, wants to emphasize the number of ways their client might not be guilty and make it as large as possible, so that the prior probability of guilt is close to zero. If the jury contains people that from the beginning believe that “anybody could have done it” including people that aren’t even referred to or presented as possibilities during the trial, it will be much harder to convince them otherwise. Prior knowledge and the wilful imagination of alternative possibilities change everything, usually in the direction of increasing doubt concerning any proposed outcome.

3Nahhhhh, this can’t be right. I mean, what are the odds that the author of The Logic Game would be making an amusing logical point...?

4Note that I carefully defined the term “Universe” (upper case) in the very first chapters of the book and I’m clearly using it in a different (lower case) sense now. In this case the “universe” in question is the “statistical universe” of possibilities from which an assessment of probable guilt or innocence must be constructed. Sadly, it doesn’t appear that there is any rigorous way to determine just how large that universe should be, when a jury member might have the notion that the tarts might have disappeared because Captain Kirk had a hankering for tarts and had Scotty beam them up...

5If this paragraph makes you suddenly cynical that anything like a fair trial has occurred in the history of mankind, well, it should. Criminal trials are an exercise in Bayesian reasoning.
CHAPTER 8. THE COX META-AXIOMS

This is almost exactly our situation when building worldviews. To build the best possible one, we have to start from a state of complete ignorance. Literally everything (not internally contradictory) that we might imagine as possible has an equal probability of being true in the complete absence of evidence, as we originally suggested with the example of Adam, Eyes Still Closed in a previous chapter.

This is the origin of our doubt – like a well-informed jury, we can conceive of a vast universe of notions that are all a priori equally likely, and must sift through the evidence of our own experiences both sensory and cognitive and turn them for better or worse into Bayesian priors and then consider the evidence presented in the case to arrive at the best assignment of probable truth, lifting up some notions to the status of worldview axioms (for example, laws of nature) or assertions that are (probable) knowledge (Professor Plum did it in the lounge with the candlestick) in a consistent way, while decreasing our degree of belief in others as they seem contradicted by the totality of our (probable) knowledge and ongoing experience so far.

To the extent that we believe in gravity, we disbelieve in levitation. If we’re pretty sure Plum did it with the candlestick in the lounge, we are also fairly certain that it couldn’t have been Colonel Mustard and the rope in the dining room. Note well that also for better or worse, our Bayesian priors themselves are subject to this same sort of decisioning process – they aren’t fixed or truly known, they are themselves estimates conditioned by all of the other priors. In the end, we will be optimizing the self-consistency of an entire network of interconnected beliefs not just looking at the guilt or innocence of some Knave.

Humans do this automatically, of course. All animals with brains do this to a greater or lesser extent, but humans have developed the ability to reason in this manner at a very high, symbolic level. However, for most of human history humans have reasoned in this way incorrectly, because the formal mathematical

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(without exception), which simply means that the biases of the jury members – a.k.a. “Bayesian priors” – are usually more important than the actual evidence in determining the outcome.

6 or rather, perfectly well uninformed...

7 At least, in a game where Plum and Mustard couldn’t have collaborated and both hung and shot the victim while working together, with his head in the lounge and feet in the dining room. Oh, by the way, I’m assuming some passing familiarity with the game of Clue here – if you are unfamiliar with it, Clue is a board game version of Carrol’s Sorites, a logic game of binary exclusion with the premise of players that must act as competing “detectives” seeking out a murder based on sequentially accumulated information that eventually excludes all possible murderers, murder weapons, and murder locations but the correct triplet, which one must assert to win the game.
basis for doing it correctly is only a bit more than sixty years old at the time of this writing (and good examples of the connections between this theory and the reasoning process are even more recent), and most people are, possibly blissfully, unaware of it.

Let us pause for a moment to pay homage, all at once, to a list of names of at least some of the humans who had the key insights that led to the development of the correct meta-theory. In no particular order, René Descartes (already mentioned) invented methodological skepticism, which we have already exploited to good effect.

David Hume raised it to high art and demonstrated that the limit of methodological skepticism is complete ignorance because all axiomatic truths are contingent, depend on assumptions, and he was unable to derive a well-founded theory of inference even from a set of reasonable axioms, and hence to him it seemed that everything could be doubted equally. Hume lacked a well-derived calculus of doubt; everything was either perfectly black or perfectly white with no way to move through the gray scales in between. Hume knew, of course, that this was incorrect, but lacked the mathematical skill or insight to proceed further.

Moving from philosophers to mathematician/statisticians, I should probably mention the Bernoulli brothers, in particular James, who formulated the principle of insufficient reason or principle of indifference whereby we assigned a priori equal probabilities to all members of a universe of possibilities in the absence of any reason to favor one or more of them relative to the rest.

The Bernoullis are closely followed by Pierre-Simon Laplace, arguably the founder of modern probability theory. Laplace wrote down a number of axioms of probability theory that are still a part of its common algebraic foundation today. That theory included Bayes theorem as a special formula connecting joint and conditional probabilities (which was never actually written down by Thomas Bayes, although we hereby give him an honorable mention as well).

We should now fast forward to George Boole, whose Investigation into the Laws of Thought brilliantly transformed the Aristotelian rules of logic (which very likely were not due to Aristotle but rather Parmenides and possibly Socrates and Plato, just to get their names and a few more philosophers into the list) into an algebra of true or false propositions that is still in use today as boolean algebra, and to his unremarked observation that there was an extremely close correspondence between this algebra and the algebra of probability as given by Laplace. Indeed, boolean algebra was the limit of probability algebra wherein propositions are assigned probabilities of 1 (certain truth) or 0 (certain falsehood).
CHAPTER 8. THE COX META-AXIOMS

This observation – that the stark binary certainty of boolean algebra that works so well in Clue is consistently softened into the algebra of probability theory with one as the limit of the other carried him so close to the set of insights that we will eventually make into our worldview meta-axioms, but in spite of the auspicious title of his book, in the end Boole still lacked the connection between computable probability and mentally spontaneous belief. I personally think it rather likely that Boole (like Hume) apprehended the whole importance of information in assessing probabilities (and knew intuitively how this related to belief and thought), but he lacked a statement of the meta-axioms necessary to fully develop this point of view.

Unfortunately, it proved possible to develop the algebra of Laplace in another way, from a set of axioms that defined probability as the frequency of a given event occurring out of a well-defined universe of possibilities given an infinite number of trials. This frequentist or set theoretic definition of probability (due to Venn) was to dominate the academic and philosophical treatment of probability for the next 140 plus years and still is influential today, The reason that it was unfortunate is that it is all but useless to our purposes here or the theory of knowledge in general as it presumes an a priori knowledge of the set universe of possibilities that we (like Alice’s jury) in general lack – ultimately it has to be derived from our experience in the one-shot experiment of our lives – or that has some arbitrariness in it that can only be resolved by knowledge drawn from outside of the mathematical problem, as our example of the infinity of different, equally “valid” estimates of the prior probability that the Knave of Hearts stole the tarts clearly demonstrates.

In no case are we ever able to perform an infinite number of trials or collect an infinite number of independent, identically distributed samples in the real world, and so a frequentist approach at best provides an asymptotic and somewhat abstract model that is nearly useless in practical cases where an estimate of probability must be made from a very finite set of actual data and experience. In real-world one-shot questions like the guilt or innocence of the Knave of Hearts, where we can hardly consider the situation to be a random sample from some a priori known distribution of Knaves that did or did not steal tarts baked by the Queen of Hearts, we are left making up an estimate of the prior probability by counting the possibilities in an imaginary statistical universe that we make up on the spot and factoring in our other prior knowledge (if any) in a favored way that often excludes it from being modified in the subsequent analysis. This is

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8For some meaning of the term “real-world”, that is not, in fact, the meaning of the term real-world. But you know what I mean...
a highly subjective process that is hardly unique! My estimate and yours could be enormously different without either of us being “wrong” because they depend upon what we (think we) know!

Finally, the singular and unique Knave in the Cosmos of this story is entirely guilty or entirely not guilty, not 10% (likely to be) guilty or 90% (likely to be) not guilty in any frequentist sense of the term, presuming an infinite number of identically prepared Knaves who might have stolen an infinite number of missing tarts9 or the even more absurd quantum superposition of guilty and not-guilty Knaves that one often hears about in silly discussions of quantum theory.

Indeed, our best estimate for any given probability given the data is the number we expect the frequency to be if we were able to obtain an infinite number of samples under identical circumstances – something that can never, ever happen in our finite lifetimes where there are no such things as identical circumstances, where every instant of experience is unique. The frequentist view of probability is precisely backwards, in other words, from what the word actually means to us, and is incidentally utterly irrelevant in a court of law. We will therefore bless Venn (and through him, frequentism in general) and curse him at the same time, for inventing some arguably very useful ideas that nevertheless form a very persuasive blind alley that actively retarded the search for the meta-axioms of the optimal worldview for almost a hundred years.10

Following Boole there are a number of authors who expressed the philosophy of probability in varying degrees of clarity, or who introduced important concepts in building models (where a worldview is a really, really big, indeed Universal model). Ronald Fisher introduced the theory of maximum likelihood estimation of probabilities: This is the idea that the best estimate of the parameters of a statistical model are those that maximize the probability of producing the data the model is supposed to explain (an idea that had been around for some time and used by Laplace and Gauss among others), given uniform priors. But there was (and to some extent continues to be) the question of what to do with priors, those assumptions upon which any model is based beyond its mere parameters. While maximum likelihood (or variants thereof) proved to be highly successful and is built in to many, perhaps even the majority, of statistical modelling applications, it was not, however, generally viewed as being the foundation of epistemology, possibly because of our historical obsession with and implicit be-

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9 Or not, given that the entire story is just a fantasy. In fact, using my own carefully constructed worldview, I think it rather likely that no tarts have ever been stolen by an actual Knave of Hearts, based on my life experience and the evidence already in my possession.

10 And perhaps continues to have a negative effect even today...
lie in the applicability of binary logic to and true or false knowledge of the real world.

Bertrand Russell, after writing an extensive book on the theory of knowledge in 1913 that is interesting insofar as it attempts to relate cognitive processes to knowledge but otherwise fatally flawed, wrote a lovely article on the theory of knowledge for the Encyclopedia Brittanica in 1926 that is still flawed by an obsession with “complex symbols” and excessive tribute to behaviorist philosophies of psychology but which illustrates that Russell’s thinking was gradually moving closer to the insight that knowledge had a mathematical character similar to that illustrated above, where the more specific (or “precise”) an assertion, the more likely it is to be false.

For the mathematics of this relationship he relied heavily on A Treatise on Probability by John Maynard Keynes written in 1921, of which he remarked:

So superior is his work to that of his predecessors that it renders consideration of them unnecessary.

This work of Keynes was, perhaps, the final step towards the key insight into knowledge that this work seeks to distill and communicate as the basis for a sound worldview. It sought to make concrete and quantitative the relationship between mere correlation – the observation that certain regularities occur in nature, places where \(A\) is always observed in association with \(B\) – and a quantitative statement of the conditional probability that, given \(A\), one also has \(B\).

It is arguable that Russell (who was, after all, one of the smartest men who ever lived) understood directly and intuitively the result we are working toward – he certainly had all of the ingredients and also wrote this in the Encyclopedia Brittanica article:

Scientific inductive or analogical inferences may, in the best cases, be assumed to have a high degree of probability, if the above principle of limitation of variety is true or finitely probable. This result is not so definite as we could wish, but it is at least preferable to Hume’s complete scepticism. And it is not obtained, like Kant’s answer to Hume, by a philosophy ad hoc; it proceeds on the ordinary lines of scientific method.

\[\text{See: http://www.marxists.org/reference/subject/philosophy/works/en/russell1.htm}\]...if the link still works.
Unfortunately, another work that was perhaps as important and influential as Keynes to the formal development of probability as the (Bayesian) basis for epistemology was the *The Theory of Probability* by Harold Jeffries, and while Russell very likely knew both Fisher and Jeffries, I could find no explicit indication that his epistemological meditations were influenced by either one. Fisher and Jeffries were contemporaries, and personified the ongoing conflict between the “Frequentist” (Fisher) and “Bayesian” (Jeffries) approaches to probability and scientific inference. Jeffries’ book, written after he was somewhat reconciled to Fisher (at least on the human level, where their original interactions were reportedly “fiery”) was perhaps the first attempt to transform Bayesian probability theory into the epistemic basis for the scientific worldview, or at least for the scientific method and a way of systematically transforming an increasing body of experimental evidence and experience into the likelihood that a theory explaining it is true. Jaynes’ work (discussed below) was largely inspired by Jeffries’ book, and Jaynes dedicates his own book on probability theory to Jeffries. But several ingredients were missing, in particular a (reasonably) sound axiomatic basis for the development of this approach that would justify and specify how to deal with the problem of (Bayesian) priors, which were viewed by Fisher as being more or less arbitrary to the extent that they themselves were not justified by observations and computed from frequentism.

How exactly one can proceed from a small set of axioms to a remarkably clear and even quantitative scientific epistemology, was worked out and beautifully expressed by the synthesis of the work of three different men working not on “philosophy” per se but on two technical problems that are not at first glance epistemic – the problem of how to axiomatically derive statistical mechanics in physics in one case, and how to compute the probability that an encoded message sent over a noisy channel could be received at the other end as a quantitative function of the degradation of the transmitted information.

As it turns out, the mathematics they derived is a remarkably accurate representation of what goes on in a neural network model, and may actually be a substantial part of the quantitative basis of the biological basis of the “worldview” of living organisms that have one. Russell, who obviously lacked knowledge of the microscopic basis of thought as a neural network was (perhaps) seduced by behaviorism to conclude that “the connection between these parts is not very logical and psychological.

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12Wikipedia: [http://www.wikipedia.org/wiki/Bayesian inference in phylogeny](http://www.wikipedia.org/wiki/Bayesian_inference_in_phylogeny)... as well as the process of evolution that gave rise to them in the first place. See my paragraph immediately below on a book by David McKay if you are interested in the connections between information theory and neural networks and models in general.

13Logical and psychological
got this part very wrong in his theory of knowledge which was otherwise extremely close to what this work presents. Not only can one work out an actual algebra for inference (obtaining a familiar result), not only can one show that this result is the logical basis of all reliable knowledge of the real world (scientific or not), but it is plausibly the basis for the physical mechanism through which we think at all. The theory of psychological knowledge is actually consistent (as we require as our first meta-axiom above and in any event would rather expect to be the case unless one prefers to believe in supernaturalist explanations of knowledge) with the theory of inferential knowledge and logical reason, with physics and chemistry and biology and electrophysiology and all the rest of science.

Let’s take a look at those three men (and maybe a few others who deserve an honorable mention).

First we must take our hats off to physicist Richard Cox who took the work of Boole and Keynes and abstracted a tiny set of axiomatic propositions from which the algebra of probability theory and, as a limiting case, the algebra of formal boolean logic, can be derived. Cox did not clearly state these axioms, however, but instead used them as the basis of his derivation via arguments. Either way, he should clearly be given the platinum feather as arguably the greatest philosopher of all time as these axioms are the key to everything that we call knowledge and the mind itself. Cox’s results (which were originally published in the literature of physics) are summarized and presented in a charming little monograph entitled The Algebra of Probable Reason, which is easily mastered by anyone with an elementary understanding of algebra and perhaps a smattering of knowledge about logic and statistics.

At almost the same time, a mathematician named Claude Shannon was working through the statistics of the transmission of encoded information over noisy communication channels. He derived (from very similar but narrower principles) information theory, which turns out to be more or less isomorphic to the algebra of probable inference derived by Cox. That is to say, information theory can be derived from the Cox axioms, and the algebra of probable inference can be derived from information theory. Although I would argue that Cox (being temporally first to publish as far as I can tell, by a hair) deserves the platinum feather, Shannon surely deserves no less than a gold one as there is absolutely

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14 Still in the EB article, at the very end.
15 Standing, as always, on the backs of giants, in this case primarily the giant named “John Maynard Keynes” whom he, like Russell much earlier, acknowledged as his primary inspiration. This event also inspires would-be authors such as myself who might hope that their unreferred treatises – like this one – have a chance of inspiring the thinkers of the future in critical ways.
no reason to think his work was not completely independent, and because it contained additional useful concepts without which the resulting theory would much more difficult to understand and less complete.

In particular Shannon deduced and named\(^\text{16}\) the concept of *information entropy*, the natural log of the *missing information* required to fully specify any given physical state in physics or decode any given partially corrupted message in computation or communications theory. In both cases it is a small step from *knowledge of state* to *state of knowledge* as both are symbolic encodings of (generally uncertain) *information*.

This idea creates a natural mapping between evidence and data and the best possible assignment of degree of belief (resolving several of Russell’s complaints regarding the use of probability as the basis of a theory of knowledge). It also should be noted that “information” is arguably the *ultimate abstraction* of semantics and ontology – we find it very easy to say that knowledge *is* information. Information theory is thus a sort of *communication and computation* specific variation of the general theory of knowledge. Shannon’s work is rather technical, alas, and not easily comprehended by the non-technical individual (perhaps including many readers of this book, but see below for a reference that might help).

A second gold feather should surely be awarded to E. T. Jaynes, another physicist, who perhaps alone fully realized the staggering implications of Cox’s and Shannon’s theories as a formal justification for a lot of Jeffries ideas and making them suitable as a *derivable* basis of science, and a *practical* basis for human knowledge as well as the basis of human thought. Over an entire career in physics Jaynes never ceased to promote his clear vision of Bayesian reasoning as a basis for human knowledge of all sorts, and I am deeply indebted to Jaynes’ work *Probability Theory: The Logic of Science* (as well as his much earlier Mobil lectures that formed its original basis) in *this* book. Ordinary people who wish to go beyond this book are strongly encouraged to perhaps read Cox, skip Shannon, and read at least Jaynes’ Mobil lectures and the first five chapters of

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\(^{16}\)With the help of John von Neumann, yet another giant. Tribus, in a Scientific American paper, quotes Shannon as saying: “My greatest concern was what to call it. I thought of calling it information, but the word was overly used, so I decided to call it ‘uncertainty’. When I discussed it with John von Neumann, he had a better idea. Von Neumann told me ‘You should call it *entropy*, for two reasons. In the first place your uncertainty function has been used in statistical mechanics under that name, so it already has a name. In the second place, and more important, nobody knows what entropy really is, so in a debate you will always have the advantage’.” This gem illustrates the key role of uncertainty/doubt in the theory of information, at the same time it reports the *ironic truth* that *no one knows what entropy really is!* By definition, in fact. If we knew, it wouldn’t be entropy...
Jaynes’ book (where remarkable little math is required – they are quite readable and illustrated with simple and easily comprehensible examples); students of mathematics, physics, philosophy or statistics should, of course, try to read everything I mention and then some.

It is worth giving an honorable mention to George Polya who wrote several volumes on plausible reasoning and inference in mathematics that fairly convincingly showed that far from being purely deductive, mathematics is almost always derived first from a process of observation and inference just like the one used in science, which is followed by the formal work of proving, from suitable axioms, conclusions that are already strongly believed to be true. Indeed, it is often the case that the axioms themselves emerge from the sea of notions when contemplating these numerical or geometric “observations”. Two favorite examples of this are Fermat’s Last Theorem17, that \( a^n + b^n = c^n \) can be true for natural numbers \( a, b, c \) only for \( n = 1, 2 \), which was finally proven after more than 350 years of concerted effort by thousands of mathematicians and would-be mathematicians, and the Goldbach Conjecture18: Every even integer greater than 2 can be written as the sum of precisely two prime numbers – a regularity with no known exceptions out to over \( 10^{17} \) as of this writing – that has yet to be proven as a theorem of number theory (but which still provides many an hour of harmless pleasure to those seeking instant fame in the mathematical community now that Fermat’s theorem has been proven).

Polya is also famous for having developed certain types of urn models as a way of exemplifying how we turn observational data into a probability as we iteratively repeat an experiment or sampling process, which in turn can be derived by considering the sampling process as producing information about the model (subject to some Bayesian considerations) that is used to iteratively decode the “message” (the probability distribution of the contents of the urn). These “toy

17Wikipedia: [http://www.wikipedia.org/wiki/Fermats_Last_Theorem](http://www.wikipedia.org/wiki/Fermats_Last_Theorem) Fermat scribbled the following into the margins of his favorite math book: It is impossible to separate a cube into two cubes, or a fourth power into two fourth powers, or in general, any power higher than the second into two like powers. I have discovered a truly marvellous proof of this, which this margin is too narrow to contain. It is generally believed that his “proof” was one of the many false proofs found by mathematicians over the years, in part because the proof that was eventually discovered contained an enormous amount of highly sophisticated mathematics that would have been unavailable to Fermat. On the other hand Fermat, like Ramanujan, Gauss, Riemmann, and various other humans over the years, was a transcendent mathematician, able to “see” relations that elude others, so there exists at least a small romantic possibility that a simple, marvelous proof that mathematicians have yet to discover is out there waiting for the next uber-genius.

models” are important as they often enable one to have insights that are obscured by applying more involved methods to much more complex problems. For example, a Bayesian estimate of the probability of getting heads in a two sided coin (one “urn-like” problem of sampling with replacement) was used by Richard Palmer to teach the Jaynesian course in statistical mechanics I took in graduate school at Duke in which many of these ideas first came to my attention (Richard also gave me my first (electronic) copy of Jaynes’ then unpublished book, which was passed around online by congnoscenti for decades before finally being completed and printed after Jaynes’ death). They are also the correct resolution to the coin-flip problem of Joe the Cab Driver in Taleb’s book The Black Swan, where Joe turns out to be a natural Bayesian with well-informed global priors... although Taleb perhaps does statisticians in general a disservice by thinking them naive enough not to recognize a rigged coin almost as fast as Joe.

Finally, for people who really do want to figure out this “information theory” thing and its connection to modeling and inference if not epistemic knowledge, let us at least name David MacKay, for writing a lovely book entitled Information Theory, Inference, and Learning Algorithms that ties all of these ideas together (including marvelous connections to e.g. simulated neural networks and predictive models) into a cohesive, quantitative whole. His beautiful examples illustrate Shannon’s theorem in action and its use in reliable encoding schemes, in compression algorithms, in the (Cox-Jaynes) process of data-based inference, and in the formal theory of cognition and learning. It is accessible at about the level of undergraduate students who have completed multivariate calculus, although a course in elementary probability and statistics and knowledge of computation and programming would certainly help as well.

There. I apologize for the length of what is, after all, just the introduction to this chapter, but while most of the content of this book is presented without

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19 See: [http://www.inference.phy.cam.ac.uk/itprnn/book.html](http://www.inference.phy.cam.ac.uk/itprnn/book.html) The online version of this book is free for students and scientists, but I strongly urge anyone that can afford it and is interested to buy a paper copy and thereby support the author. I certainly did. It actually makes it somewhat easier to work through, for what that is worth – which in the case of a really complicated subject can actually be quite a lot!

20 At that, this is only a tiny fraction of of what I could include, as the field of epistemology is wide, as are the fields of probability and statistics, information theory, cognition theory, etc. If I did all of these topics and their contributors justice, they’d be a whole book in and of themselves and the point of this one would be lost. I bring this up as you will note that I am not even mentioning in passing Wittgenstein, Carnap, Popper, Quine, and many others who have been very influential in epistemology as they are not in the main line of the development above and what I want to say. On the other hand, I did at least just now drop a few of their names and may do more elsewhere...
elaborate cross-references and attribution (for the sake of readability if nothing else), this key point simply cannot be presented without giving the interested reader the full opportunity to work through and verify the theory and its historical evolution for themselves, since I will present only the results and consequences of this theory with the least possible accompanying algebra. That works, as it turns out, because even the verbal expression of the Cox meta-axioms is very, very useful in understanding how to go about building the best possible worldview, given the data of your continuously unfolding personal experience.

So fine, just what are these marvelous meta-axioms, why are they meta, and why are they so important? Let us just write them down as Jaynes has them after establishing some preliminary definitions that are themselves meta-axioms, but rather boring and mundane ones so we won’t bother numbering them.

It is hopefully crystal clear by now that our goal in constructing a worldview is to take an unbounded universe (lower case, hence “statistical”) of notions and reduce it, using some mix of data, experience, “intuition”, bootstrapping, and black magic to a much smaller universe of interconnected notions that we have reason to believe constitute as a whole a “plausible” theory of the Universe, a worldview.

There is no reason at all to expect that we will end up with only one such set. In fact, there are several trivial edge cases or limiting cases that we’ve already referred to – solipsism, religious explanations, invisible fairies – that can always be made to “work” by simply multiplying out the causes, increasing the number of axioms until (if necessary, in the limit) every separate observation is covered by its own axiom. Even this last sort of complete lack of the use of inference at all in one’s dynamic worldview, tragically, is not unknown – it results from certain kinds of damage to the human brain that prevent the formation of memory so that every experience once again becomes unique and new associations of the sort we consider “knowledge” cannot be formed from correspondences within the temporal sequence of past experiences. Physically encoding and storing sensory experience (information, note well) as memory is an obvious necessary step towards any sort of cognitive experience of knowledge beyond the immediacy of the sensory experience of the Atman.

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21Jaynes apparently recognized that these propositions are not exactly axioms in the usual sense of unprovable propositions or definitions. He referred to them therefore as “desiderata”, something that the dictionary would have us identify as weaker than an actual axiom, more like a fond hope or need. In this work they are presented as being in fact closer kin to the laws of thought of Aristotle and Parmenides, axioms as “manifest truth” and as rules to which axioms as hypotheses in presumed correspondance to a real Universe must submit, that is to say, as meta-axioms that are stronger than ordinary axioms.
In order to choose the best worldview from this probably infinite set of possible worldviews with wildly varying numbers of axioms and underlying notions, we must define a quantity we will call the plausibility of any given proposition or combination of propositions (where we will worry later about how to combine propositions). The plausibility (or “degree of belief”) will need to admit ordinal ranking or we cannot sort through plausibilities and find the most or least plausible proposition(s) from any given set.

Using our meta-axiom of mathematics, and riffling through axiomatic theories that it makes available for our use, we note that number theories that support arithmetic (perhaps proven from a generalized “successor operation”) are generally ordinal. We have two or three choices as to which kind of numbers we should use. Natural numbers might work, for example, but they are discretized, and it isn’t clear that we can or should a priori express plausibility in terms of a scale where there is a “quantum of belief”, the smallest possible change in a plausibility. Also, we might want to use zero (or negative infinity on a logarithmic scale) to describe perfect implausibility – the boolean state of a definitely false proposition.

Rational numbers, on the other hand, have no lower bound and no quantum (and there is the poetic beauty of using rational numbers in the construction of rational worldviews) but this is still a bit worrisome – rational numbers are only countably infinite and hence have cardinality $\aleph_0$ (pronounced “Aleph-null”, the cardinality of a countably infinite set, one where every number can be placed in a one-to-one correspondence to a natural number) where we rather expect – or at least do not want to a priori limit – our “space” of possible notions (and in the process throw out an enormous amount of potentially useful mathematics). It seems wiser to assume that the notional space of possible worldviews is uncountably infinite unless or until proven otherwise and hence at least $\aleph_1$ (“Aleph-prime”, the cardinality of an uncountably infinite – set).

For that reason, we choose to represent “the plausibility of a proposition” with the simplest possible numbers that form an $\aleph_1$ ordinal set.

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Note well that neither Cox nor Jaynes went to quite this level of pickiness, but then, Jaynes used as his justification for using real numbers the fact that his “robot” had to do the computations to get a consistent answer. In fact, real robots (computers) reason with discretized rationals as an approximation to the reals, and as a consequence will always have a problem with consistency due to roundoff and other numerical errors on discretized sets relative to real numbers. Sure, we know what Jaynes meant – he is talking about an idealized robot that can compute using real numbers – but the theory of deterministic chaos and orderings of infinities and so on does, in fact, make the distinction nontrivial. In a real robot, or human, brain, discretization along with many other errors will contribute to information entropy, which is yet
3. **Real Plausibility** – Measures of plausibility are represented by real numbers.

The next meta-axiom is worthy of being etched into a thick slab of platinum and decorated with precious jewels and being mounted within a shrine to human knowledge set in the exact center of every major city in the world. Schoolchildren should have a once-a-year mandatory trip to visit that monument, a trip that they can only skip if they have it *permanently tattooed backwards* on a body part that they must see every time they look in a mirror naked. Or (snitching a good line from the Second Kalandar’s Tale), it should be “graven with a needle on the corners of the eye as a warner to whoso would be warned”.

4. **The Calculus of Common Sense** – Plausibilities can only change in qualitative correspondence with common sense.

Let’s make this meta-axiom concrete with a little example. Consider our friend the Knave of Hearts. Suppose Alice had replied with something *besides* complete ignorance. Suppose that she stated, under oath, that she was *with* the Knave of Hearts during the time of the supposed theft of tarts, and that he therefore is innocent of the crime. You (as a member of the perfectly honest jury) are now in possession of two pieces of information. First, you have your own personal prior estimate of the probability of the Knавe’s guilt, perhaps derived from some prior set of beliefs about the probable size of the “space of the possibly guilty” and informed by any other prior knowledge you bring to bear about the character of Knaves, but this initial value is *unimportant* to the direction of the change to be brought about by evidence.

To this prior knowledge and estimate you *now* must add Alice’s testimony. You are ignorant of Alice’s character – perhaps she is a liar, perhaps she is the Knave’s lover. However, you have no reason to think that she *is in fact* his lover, and you have no reason to believe that *most* people would lie on behalf of another way of stating that in this approach inferential knowledge can never really be certain.

In any event, the cardinality of the continuum is $2^{\aleph_0}$. *With certain axioms of set theory*, this can be shown to be $\aleph_1$ – the celebrated *continuum hypothesis*, and that’s what *we* are going to axiomatically specify as the basis for plausibility. Hmmm, looks like we really *needed* the meta-axiom of mathematics before we did this chapter (and its meta-axioms), didn’t we?

Note well that I’m footnoting this only to keep set theorists, logicians, and formal mathematicians off of my back, because physicists frankly, tend to be cavalier about infinity (myself included). *Almost nothing will change* if we use rationals instead of reals here, at least nothing that I can think of, given the physical limitations of human observations or measurements that are always going to be uncertain at a scale far from the continuum.

This is fortunate, because spacetime itself may turn out to be discretized and truncated (perhaps at the Planck scale), just like numbers represented in a real robot’s “brain”.

\[^{23}\]From *A Thousand Nights and a Night*, in case you’ve never read the Second Kalandar’s Tale. Sounds painful, but important lessons often are.
the Knave if the Knave was, in fact, guilty. In fact, they, like you, might have been looking forward to having some tasty tarts and now they’re all gone. You therefore think – absent reason to think otherwise – it rather more likely than not that Alice is telling the truth.

You begin to see how even the simplest of decisions concerning the real Universe requires the use of a network of plausible beliefs – your judgement of Alice’s a priori credibility is the same sort of thing as your judgement of the Knave’s a priori guilt, and your decision will ultimately depend on both.

**Given** a prior estimate that Alice’s testimony is more likely honest than not and your prior estimate of the Knave’s guilt (whatever it might have been) which of the following actions makes more sense:

- Increase our degree of belief in the Knave’s guilt on the basis of Alice’s testimony.
- Leave the degree of belief in the Knave’s guilt unchanged.
- Decrease our degree of belief in the Knave’s guilt.

Only a complete, irrational idiot would use only the information given above and no other prior assumptions or knowledge and increase their degree of belief in the Knave’s guilt. Indeed, it seems as though the best thing to do is to decrease it, as now there is evidence that the Knave is innocent as he lacked the opportunity to commit the crime if Alice’s testimony is true, and while a true skeptic might argue that we are completely ignorant of Alice’s character or observational skills (so that she could lie or be mistaken) I did give you the information that as a juror you do have reason to believe that most people would have no reason to lie on behalf of the Knave and the Knave is a rather characteristic card that could hardly be confused with most of the alternative guilty parties, say the deuce of hearts, the knave of spades, or even the Dormouse, so it is also reasonably unlikely that she could be mistaken.

This clearly illustrates the basic reason for this meta-axiom. We don’t want to build a stupid, unreasonable worldview, one where we as jurors-in-perpetuity deciding what best to believe hear reliable evidence for an assertion and perversely decrease our degree of belief in it. We therefore have to use our common sense.

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24Yes, this statement begs any number of questions concerning you, dear reader. Perhaps you are reading this book to figure out how build the stupidest possible worldview, because you delight in being almost certainly mistaken in your beliefs. I hope not, but I cannot deny the possibility that it is true. There is historical evidence that religious beliefs are often reinforced
to determine the direction of any changes in our system of plausible beliefs, given new evidence. Note well that this doesn’t mean that we should always uncritically take evidence at face value – if we do happen to have some reason to believe that Alice (like the frog) *always lies* then her testimony might well lead us to *increase* our degree of belief in the Knave’s guilt!

Real world juries might form estimates of Alice’s character a thousand ways, from the way she dresses and talks to other evidence presented. If we hear from the Wonderland Crime Scene Investigation team that they found tart crumbs on Alice’s pillow the day after the alleged crime, we might well discount or even invert the effect of Alice’s testimony and convict the Knave and Alice together in our own minds. Ultimately, we have to be certain that our eventual theory can explicitly handle cases where we have more than one source of knowledge or a preexisting set of plausible beliefs that we must include in our “best” evaluation of changes to any particular belief or to the entire network of our beliefs all at once, and sadly (for those that lack it or those that might wish for something more rigorous), our only possible guide is mere common sense. In the end, there is no possible substitute.

The third meta-axiom is very simple, although we’ll end up *using* it in several ways in the construction of an axiom based worldview. We’ve already encountered this meta-axiom in the logical constraints on the abstract formulation of our worldview, where we do in fact need it. We now need it for the generalized logic of a worldview, the logic of a network of related numerical plausibilities.

5. **Consistency of Plausibility** – The complete network of mutually related plausibilities must be numerically consistent.

In other words, if we have more than one way of evaluating a plausibility, they all have to lead to the same result.\(^{25}\) That result must use all of the network of connected plausibilities; we cannot use any sort of “ideological filter” to select only certain “convenient” propositions or a filtered subset of the data to arrive at a conclusion, at least not without fully understanding what we are doing and how it affects the plausibility and believability of our final result. Two people (or two computers, or two “robots”, to borrow from Jaynes’ favorite metaphor that emphasizes the necessary lack of bias in the results) must always reach the same conclusion when reasoning from the same data with the same network of prior

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\(^{25}\)Within roundoff and other errors... sorry, Jaynes as noted sort of left that one out, although he does discuss how in the real world different folks can arrive at different conclusions just as I do in the paragraphs above.
plausible knowledge, even if they arrive there by means of different “arguments” (computations).

Of course, in the real world they don’t; even completely honest jury members who are intelligent enough to reason in a valid way often disagree, and of course some are not particularly honest or intelligent. They disagree because they each bring into the jury room their own unique collection of prior knowledge, experience, and beliefs (some of which may well be unreasonable, inconsistent, or mistaken), and then, they can just reason badly from good prior beliefs because they are not, after all, robots! It is nevertheless a strong requirement for a reasonable worldview, as it would be very disturbing and inconsistent for reasoning from precisely the same information to lead to distinct conclusions no matter what path the process of reason takes.

This is what causes ulcers in trial lawyers that argue in front of a jury. People have well-hidden biases and prior beliefs (often derived from their own personal experience, valid or not) that can and do profoundly affect their reasoning process and conclusion in any trial and that may or may not be revealed during the questioning process that seats a jury: “Police testimony is more/less reliable than the testimony of private citizens.”; “People who are different from me – of the opposite sex, a different race, a different socioeconomic background, who talk differently – are more likely to be liars than those that are like me.”; “If this person is found guilty, I will suffer in the following way.”; “If the D. A. thinks they are guilty, that is good enough for me.” Whether or not the prior beliefs are true, they will most certainly affect the outcome of a valid process of plausible reason in fairly predictable ways. Jaynes’ “reasoning robots” will usually come to different conclusions from the same evidence if they are preprogrammed with different prior data, even if they reason absolutely correctly unless they include a mechanism for correcting their priors in a way that (ultimately) converges to the same values.

One of the major points of continuing contention in statistics is just how to pick priors before one has any data and how to alter them (and any model parameters), given the data, to produce the best possible posterior probability distribution. No matter what scheme one comes up with, one can invent specific examples where that scheme doesn’t work as well as another scheme or even fails but in the end, insisting on global consistency ensures that this approach as a methodology will lead to knowledge that, on average, tends to improve as we accumulate more data and observations and experience. Many examples of this sort of reasoning are given in Jaynes (and a few in Cox as well) and there is no reason to repeat them all here.
That’s it. When selecting a worldview from the vast ocean of notions that can all be doubted, we wish to end up with the one that (given the data of our experience) we can doubt the least. We accomplish this by means of a calculus that causes changes in the current values of an interconnected network of real-number plausibilities assigned to those notions (including the priors!) in the direction suggested by common sense, given the prior state of the network and the new data of our ongoing human experience. If there is more than one way to evaluate the new state of the network given its prior state(s) and the data, they all have to lead to the same numbers; answers obtained within a given worldview must be unique in order to be consistent, and must be consistent in order to be the best that we can do.

Note well! This is an idealized description of a dynamical process, not a static prescription for evaluating a matrix of probabilities. Epistemology is a calculus, not just an algebra! Newton invented calculus so he could (start to) build the physical science foundations of the scientific worldview, and the scientific method is also a kind of calculus of iterative refinement that is justified by this set of axioms. It is also highly error prone, noisy, and the axioms themselves do not give one a full appreciation for just how much entropy a given living organism has compared to the full information content of the Universe, or how limited our abilities are to extract state, observe, or infer information to reduce it.

Implementing it isn’t easy, and I don’t want to imply that we would all just agree on everything if we had enough evidence as it the axioms and theorems and observational evidence supporting physics as part of the most successful prevailing worldview more or less guarantee that that can never happen!

Still, this is an enormously, awesomely powerful set of meta-axioms! It works for different kinds of systems and models, some of which are not worldviews per se at all. Very shortly, we’ll see where these meta-axioms take us as we try to choose good axioms for worldviews, but first, we have a few “leftover” meta-axioms that we should take note of, meta-axioms that help us still further constrain our worldview by adding several more dimensions that must impact our definition of best, our ordinal ranking. These meta-axioms are also essential to the search process – they permit a worldview to be a self-organized emergent

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26 Dare we say, in a mechanical and somewhat noisy interconnected neural network?
27 Or at least they would if we were reasoning robot supercomputers. As it is, a lot of our beliefs are the result of plain old bad arithmetic, and many more are the outcome of what amounts to an internal coin flip. Finally, we as a species have a depressing tendency to take some notion out of the vast sea of “I don’t know” and elevate it to near certainty without any good reason. Sigh.
phenomenon and avoid certain traps that the *local* Cox calculus will otherwise very likely fall into.
Chapter 9

Global Meta-Axioms

First .... to affirm that ... the earth is situated in the third sphere and revolves with great speed around the sun, is a very dangerous thing, not only by irritating all the philosophers and scholastic theologians, but also by injuring our holy faith and rendering the Holy Scriptures false.

Second ... not only the Fathers but also the commentaries of modern writers on Genesis, Psalms, Ecclesiastes and Josue ... all agree in explaining literally (ad litteram) that the sun is in the heavens and moves swiftly around the earth, and that the earth is far from the heavens and stands immobile in the center of the Universe...

Third ... with regard to the sun and the earth, no wise man is needed to correct the error, since he clearly experiences that the earth stands still and that his eye is not deceived when it judges that the moon and stars move. And that is enough for the present.

Cardinal Bellarmine’s Letter to Galileo, 1615 CE

Even when the experts all agree, they may well be mistaken.

Bertrand Russell
(excerpts & emphasis my own)

Things are shaping up nicely. We have a perfectly lovely set of meta-axioms that (so far) seem to describe the way we think, the way we arrive at knowledge through experience when we’re thinking rationally. Our “ideal” worldview (according to these axioms) should provide a consistent conceptual explanation for
all of our evidence and experience of the Universe, mirroring in a fuzzy and imper-
flect way a reality that is objectively true and consistent as (probable/plausible) 
knowledge.

However, our meta-axioms are not yet sufficient. They simply won’t work. In fact, they have the capacity not only to fail, but to fail badly, to produce a terrible worldview.

We are trying to invent a global theory of explanation of experience that explains (among other things) how a global theory of explanations of experience must be dynamically self-optimizing. Ultimately, our meta-theory has to include a process – not just what the specific axiomatic rules are in our eventual best worldview du jour, but how our worldview includes the rules that govern its own change. If we consider our worldview as a “moving body” and our lifetime-so-far sensory experiences and memory as a sort of “dynamical force” that drives its self-consistent self-referential time evolution, the Cox Meta-Axioms are a foundation for a calculus that describes the process of change from a worse worldview to a better one (learning), but we still lack the dynamical principle that gives this search direction.

For example, one problem that we will not easily solve is that of degeneracy. What of the many, many cases where competing axiom sets work equally well (or nearly so) on their own terms to describe all of the data and personal experience but which may be quite different in their implementation? How do we make the best choice when confronted with an infinite (or even just extremely large) number of alternatives? We face the paradoxical problem that the smarter we are, the more likely we are to be able to generate multilemmas, to consider not just the binary problem of Knave or Not Knave but to think about the entire deck of cards stuck up the prestidigitating D.A.’s sleeve, where that sleeve potentially contains every deck of cards that could ever be conceived. We need a meta-axiom to “keep a lid” on this process lest we find ourselves blinded by our science, bewildered by a terrible infinity.

This is a problem alluded to by Russell in the EB article – as we increase or decrease the “complexity” of an assertion, we seem to increase the volume of the space of competing notions in a horribly nonlinear way and this somehow “dilutes” the associated plausibilities. We have to trade off the specificity of

\footnote{This is the basis of some part of the endless argument over evolution versus e.g. intelligent design or other non-stealth theisms. By selecting one particular highly specific statement of the theory of evolution, usually Darwin’s original statement, theists argue that the specific model doesn’t produce precisely explain the evidence the way it “should”. This makes (they continue) evolution less likely to be true and hence “intelligent design” by a non-evolved designer more}
a theory against its plausibility, especially when we have inadequate data (and we almost always have inadequate data about truly complex phenomena in open systems with many moving parts, most of them hidden).

This will often be an enormous advantage, as it turns out, because our network of most-probable-knowledge will rapidly constrain new consistent additions. Sometimes only one plausible choice (or family of choices, that we have posited so far) out of a near-infinity of notional possibilities explains new observations in a way that is consistent with what we already believe precisely because of the notional dilution, for example way that statistical mechanics in physics effortlessly rejects nearly all of the possible states of particles in a gas in a container as being negligibly improbable in favor of the vastly smaller (but usually still “large”) number of states that are reasonably probable because they are consistent with, say, the total amount of energy shared, on average, between the particles.

A second serious problem is that even with some meta-axiomatic direction, a simple dynamical search scheme based on our calculus will almost immediately get “stuck” in a non-optimal worldview! This is because while we usually do try to implement the meta-axiom of common sense in making decisions and inferring knowledge, we have a natural, understandable tendency to do it in what might be called a local way – using as givens/priors our existing state of knowledge as being “fixed” and making an optimizing step on that basis. Understanding why this approach fails in the Universal case of “complex landscapes” will provide us with many profound insights, including insights into the human condition; indeed, the calculus above will turn out to be at least partly the calculus of social and political dynamics, as it must be, given that a worldview covers everything from “objective” physics right down to immaterial questions such as “what is the good” that baffled even Socrates, Plato, and Aristotle (however diligently they attempted to provide and “prove” bullshit answers anyway using “reason”).

Still, explaining why the meta-axioms won’t work yet in simply understandable because – as a “fairy theory” – it is clearly capable of producing any historical pattern of species change observed in the fossil record on the basis of the whimsy of the intelligent designer and predicts very little that can be contradicted by the evidence. What they fail to understand is that “the theory of evolution” is actually a fluid neighborhood of propositions such that less specific models are in excellent agreement indeed with the evidence. They also fail to appreciate the significance of the human appendix as a evidence that our designer, if any, wasn’t smart enough to remove unnecessary parts from past designs, sort of like leaving a broken, repurposed spring inside an electronic watch found in the middle of the teleological desert. They also don’t appreciate the weight of the evidence that our closest primate cousins, the gorilla and chimpanzee, have one fewer chromosome and that two of our chromosomes are very clearly the result of a chromosome in our common ancestor species breaking in two at some point in our evolutionary past.
able terms is a bit of a chore. If we implement them according to Cox and Jaynes, the meta-axioms lead to an algebra of plausibility that involves a whole bunch of sums over what amount to matrices of very high dimension (if this sentence strikes fear that we’re about to devolve into lots of mathematics, don’t worry about it – we’ll see some examples worked out later for very simple cases, but I haven’t forgotten my promise to keep the math to a minimum) with a very simple “calculus” that causes the entire “super-matrix” that describes our current state of plausible belief (encoded in the self-referential dynamic neural network of our brains) to change incrementally as we learn new facts, make new observations, accumulate new data.

Let’s start by considering that “terrible infinity” in the set of all possible worldviews.

9.1 The Set of All Notions

It is possible that even with all my talk of notions and counting alternatives I have failed to communicate just how big the space of all possible worldviews is, that is, how large that supermatrix of all possible interconnected notions is in both dimension and range. It is, to put it simply, larger than the largest conceivable thing – it is inconceivably large. It is infinitely large with an infinity that is infinitely larger than $\aleph_1$, call it $\aleph_\infty$, a “superhypergeometric continuum” with $\aleph_1$ fractally infinite dimensions, each with an $\aleph_1$ range of unbounded continuous real numbers forming via an outer product of outer products of outer products... (repeated an infinite number of times) parametric supertensors – if reals really are adequate to the task and the supercontinuum supermatrix elements shouldn’t be supergeometric numbers of $\aleph_0$ infinite grade. It’s Super!

Basically, if a set-theoretician can imagine a set (and specify it with a given collection of axioms), I can come up with a notional “trial” worldview with at least the same parametric cardinality via the meta-axiom of mathematics. Set theorists hate this sort of thing, by the way. They argue against things like “universal sets” because they tend to be a fertile ground for certain paradoxes. Unfortunately for set theorists, the existential Universe doesn’t give a damn; it is a Universal set. Behold it. This is perhaps the fundamental difference between a physicist and a mathematician; the physicist starts out with a strong prior belief in some things (like a Universe that is the Universal set of everything that exists) that mathematicians have to get headaches over because they cannot easily be axiomatically specified and derived or that open the door to certain paradoxes.

\footnote{Set theorists hate this sort of thing, by the way. They argue against things like “universal sets” because they tend to be a fertile ground for certain paradoxes. Unfortunately for set theorists, the existential Universe doesn’t give a damn; it is a Universal set. Behold it. This is perhaps the fundamental difference between a physicist and a mathematician; the physicist starts out with a strong prior belief in some things (like a Universe that is the Universal set of everything that exists) that mathematicians have to get headaches over because they cannot easily be axiomatically specified and derived or that open the door to certain paradoxes.}
spacetime Cosmos with either no coupling to the latter or a weak one we have not yet been able to experimentally probe, this notional super-universe cannot be assigned a plausibility of zero or definite falsehood. We’ve created a monster – the space of all possible Universes, where we can always make the space larger by all sorts of means, such as taking the outer product of whatever infinite dimensional notional Universe we’ve postulated so far with itself and adding a continuous or discrete parameter to differentiate the notional sub-Universes we imagined combined in this way.

But this is way too much math, and reasoning about infinite cardinalities (of infinities) will give you a headache. To give you a very simple headache-free mental picture, we can directly observe what appears to be our own Cosmos as a plausible subset of a Universe, and we’ve long since decided to very firmly believe that it is objectively “real” in that the Universe it is all or part of is certainly not “nothing”. So let’s start there.

Now imagine a “Lord of the Rings” cosmos, one where the physical laws are somewhat like they are here but where there are laws of magic and magical superbeings and transcendent magical conflicts between good and evil. We cannot currently measure the existence of this cosmos, but we all have a notion (however implausible) that it exists. Somewhere, somewhen out there Frodo may indeed be casting a magical ring into a Crack of Doom and J. R. R. Tolkein may have been spiritually channeling its existence (however unlikely that may seem to be given our prior knowledge of our Cosmos and the probable process whereby individuals therein make up stories).

In fact, every work of fiction describes a cosmos, mostly “like ours” but with somewhat different histories. All of them could exist in uncountably infinite replicas so the set universe of possible Universal sets must include them, and since this is a self-referential set its cardinality literally explodes, iteratively increasing without bound. Our meta-axiomatic rules will (and should) reduce the plausibility of the myriad of possible co-cosmi to very, very, very... very implausible for some absurd number of very’s, but they cannot make any fictional notion completely impossible, known to be false, simply because a lack of evidence is at best conditional evidence of lack and can easily be mistaken or corrected later by more evidence. In this case, by hypothesis the cosmi in question could be disjoint, completely independent cosmi that do not exchange information with our Cosmos, so that we cannot ever observe their existence. That doesn’t make them (if they truly do exist) any less real, but it perhaps makes them irrelevant. This is all a consequence of the unprovability meta-axiom (and our worldview’s consequent certain incompleteness). A large part of the Universe is at least unknown
(to me, if not to you), if not fundamentally unknowable.

This is itself a general rule for our system of the world: we can never positively exclude any notion for lack of evidence, because lack of evidence does not constitute positive proof of lack. To offer a more concrete, rather current example, physicists would in some sense (that this chapter seeks to establish) “like” for there to be at least one magnetic monopole in the Universe. They’d also “like” for a magic particle called the Higgs boson to exist. There are physical theories – whole chunks of worked out notional potential worldview – that are just waiting for these particles to be discovered in a reproducible laboratory setting and thereby constitute positive evidence that these theories are correct, as they would explain as derived results why charge is quantized and why particles have mass, respectively, if they are found.

Physicists have been looking (rather hard) for these particles for decades in experiments designed to put salt on their metaphorical tails. After all, the primary discoverer gets free tickets to Stockholm more or less on the spot the day they are found to receive their Nobel prize, fame, fortune, and remembrance in the litany of great Physicists. So far, nobody has succeeded.

Failing to find them (looking hard!) is not proof that they don’t exist, any more than the $4 \times 10^{18}$ or more explicit numbers that we have checked (so far, at the time of this writing) where Goldbach’s Conjecture works out is in fact sufficient evidence that it is in fact true for all even integers. It just takes one single even integer for which it fails to disprove it. Maybe the first exception to the rule is out there in the integers larger than $10^{10^{10}}$ and that’s why we haven’t proven it mathematically, because any “proof” that succeeded would be incorrect.

It is pretty easy to come up with sensible notions that could be true and that would produce the same experimental (null so far) result for these particles:

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3A perfectly natural tendency and common argument for God is to take this terrible infinity of possibilities as the set universe from which the Universe was selected, and then argue that the particular Universe we find ourselves in is infinitely improbable and thus had to have had a cause. Note well that this is a perfectly natural bullshit argument because it presupposes a set universe of Universes, a magical “urn” from which Universes can be drawn by a Godlike hand outside of the Universe, which perfectly contradicts the idea that the Universe is Everything and would have to include urn and Godlike hand – by definition.


6Or at least, this was still true when I originally wrote these words...

7Wikipedia: [http://www.wikipedia.org/wiki/Goldbach's_Conjecture](http://www.wikipedia.org/wiki/Goldbach's_Conjecture). That every even integer greater than 2 can be written as the sum of two prime numbers.
9.1. THE SET OF ALL NOTIONS

- Perhaps they don’t exist. The theories that require their existence are wrong, and we haven’t yet found the right theories that will explain charge quantization and particle mass without them. Perhaps those theories involve more dimensions, different symmetry groups, graded algebras of higher grade, some really difficult math that we just haven’t worked out yet.

- They do exist (either of them) but are very, very rare. There only has to be one magnetic monopole per space covering overlapping sphere with a radius of thirteen or fourteen billion light years in order to explain charge quantization of all charges we can see.

- They do exist, and are even relatively common, but we haven’t devised the right experiments to find them. Perhaps, for example, free monopoles don’t bind to atoms. In fact, as a physicist, I don’t really see how they could bind to atoms – they can be momentarily attracted or repelled, but there is no way to construct a three-dimensional minimum in the potential interaction between ordinary charge (with at most magnetic dipole fields associated with it) and a monopole.

  In that case, one would expect free monopoles in any quantity to be found in precisely one place: The center of large massive bodies, where gravity has pulled them as they lost energy colliding with (but not binding to) ordinary matter. There could easily be a small core of “monopolar matter” at the center of the earth or moon, for example. To find them in any concentration, one might have to drill to the center of a small moon or planet – or possibly an asteroid (big enough to attract, stop, and gravitationally bind free monopoles left over from the big bang) and quite deliberately look for them there, an experiment that has yet to be performed.

- Something else entirely that I haven’t imagined yet. There is no guarantee that my knowledge of physics, my intuition, my grasping of notions from the supermatrix of possibilities is sufficient to imagine the the right notion yet. Or or anyone else’s, for that matter. That vast and terrible infinity of possible answers to almost any question ever lurks, and can dilute the “plausibility” of any particular answer (including some very reasonable ones that might well be correct) to zero if we are not careful.

So fine, the space of notional worldviews that we must admit for consideration is arbitrarily infinitely infinite and arbitrarily complex, subject to the constraint that they remain consistent with our direct experience of the Universe. That experience, so far limited experimentally to only our own particular Cosmos, is
projective and limited, shadows on the walls of our personal caves, and we have to use the tiniest of hints to guess at a possible consistent explanation of the reality that casts those shadows. Using what we’ve developed so far (and brains that appear to have evolved to automatically think in the way it describes, whether or not we are aware of this) permits us to reject almost all of this open superinfinity as being almost infinitely implausible and focus in on worldviews that “work” and correspond reasonably well with just what we can see. Tolkein’s LOTR cosmos is possible, but we are justified in calling it improbable or implausible – lacking any direct observational evidence for its existence – as long as we bear in mind that we could be wrong!

However, what is left even after rejecting worldview notions that we really have no good experience-based reason to believe (however mathematically appealing or romantic or psychologically compelling a story they tell, even though they don’t contradict any particular aspect of our total life experience) is still an extremely large if not infinite space of notional possibilities. Worse, our search for the best set of notions forces us to confront the theory of complex systems and optimization on high dimensional spaces.

What we have so far is a deadly conceptual trap!

I mean this quite literally. The history of knowledge contains numerous examples of revolutions where a single person (generally people whose names we still revere) has radically changed the commonly accepted best human worldview “all at once” from one thing to another that is completely different. That is, the most successful worldview (the one that we could doubt the least) did not undergo a small change, it underwent a big one. All sorts of elements in that supermatrix, including some that correspond to notions that hadn’t even been explicitly articulated and hence were lumped together with the infinite mass of unformulated “virtual notions” with very, very low plausibility before, are suddenly elevated to “most plausible” while others that were previously the most plausible suddenly become highly implausible.

Stupid people sometimes point to this observation – the fact that science can and does make big mistakes – as an excuse for rejecting the scientific reasoning process in favor of, say, divine revelation. “Look,” they crow, “Science isn’t so great. Scientists were wrong about (fill in your favorite revolutionary mistake here)! Therefore Science cannot be trusted to give us Truth.” The reader, fortunately is now too wise to be taken in by this nonsense as they have already seen that Truth is not accessible, and so we can do no better than believing the most that which we can doubt the least. We have also learned to to doubt especially anything that claims to be perfect knowledge as an axiom, quite independent of how well it fits our personal experience and the data accumulated and analyzed by humans of good will working without prior bias. Science, at least, is imperfect but self-correcting in precisely this regard, which is
Unfortunately, the calculus we have described so far cannot, in general, admit this sort of “change everything” transition. Well, it can, but the process will be very, very slow, much too slow for us and very unsatisfactory. Let me give a few examples to illustrate the problem.

Once upon a time, not so very long ago, the following beliefs were held by nearly everybody in Europe. They were all part of the “prevailing worldview” before the Enlightenment:

- The world was flat
- The world was the center of the Universe
- The sun and the moon went around the flat earth, passing beneath the sea that itself sort of “floated” in the midst of nothing at all.
- The heavens were a solid bowl, the stars tiny lights on that bowl that also rotated about the earth. They could be shaken down by earthquakes.
- There was a rich assortment of invisible beings, benign and malign, angels and demons, that were the proximate causes of many things in human life. For example:
  - Disease was caused by evil spirits. In many cases it was divine punishment for an original “sin” committed by a single pair of divinely created progenitors, if not additional sins committed by the individual so afflicted or his or her forbears unto the third generation.
  - Other things, such as natural disasters and death itself, were similarly directly caused by divine or demonic intervention, generally as part of the same punishment.
  - By reciting certain phrases, wearing charms, performing ritual magic, maintaining a supposedly desired mental state of belief in invisible and powerful beings who could “save” you, one could appease the agents responsible for the bad things and obtain benefits, cast out disease causing demons, attract angels who would ward off these misfortunes, and eventually receive vast benefits up to and including infinite pleasant life, freedom from death and pain.

Why it is nearly always the collection of beliefs to be trusted the most even as sure, it has often turned out to be wrong. More on this later.
• On the other hand, those who failed to recite the correct phrases, burn the right incense, wear the right charms, perform the correct ritual magic, or (above all) maintain the requisite mental state of belief in invisible and powerful beings and their invisible and all-powerful overlord would be tortured for an eternity in a state close to the theoretical maximum of pain, without any possible escape.

• If the propitious measures failed, it was always because of that original sin and hence divinely ordained evil (as measured in human misery and misfortune, up to and including eternal torture) inflicted by a supposedly omnibenevolent, perfectly just superbeing who as far as anyone could tell created us primarily to perpetually offend It.

It is important to emphasize that this worldview (plus the many, many more components that I don’t mention – worldviews are enormous, recall) worked. Your average person would get up and look out their window and see the world, and it looked (when things like mountains were accounted for) quite flat. In order for flatness to make sense given a surrounding ocean, the ocean had to have some solid barrier holding it in at some point – the firmament. Some stars appeared fixed in a giant sphere that revolved around the earth, a few others wandered but in a way that could be successfully modelled. Still other stars appear to fall, burning up as they do.

This led to a reasoned conclusion that the stars must be small fires – candles or torches as it were – attached to the same firmament overhead, solid because if it weren’t solid, engineered as an enormous dome, what holds the stars up? The sun and the moon clearly come up in the morning and go down in the evening. We see their light. What could be more sensible than the notion that they too follow their own special tracks overhead and down under the surrounding deep every night? If the earth experiences gravity, what supports it on that deep? Why, pillars, of course. And so on.

Disease and disaster often had no visible cause – they “just happened” in a seemingly random, painful and horrible way, so they needed an invisible but malignant cause. This worldview postulated a “universal” invisible cause in the form of a hostile and angry intelligent force bent on getting even with humanity in general for an insult delivered in the remote past. Strife in nature, strife among humans, simply mirrored the invisible strife between invisible beings who were preoccupied with making our lives miserable or – rarely – preventing such misery.

This paradigm was interwoven with society in such a way that it helped
to prevent crime and hence provided certain *benefits* to those that believed it. In fact, the entire worldview was tightly intertwined with the social and legal fabric and provided *many* benefits. Even those who had reason to doubt it were “trapped” by the fact that any *small* change they might imagine in the space of notions often made their worldview worse – it might be an improved explanation of one thing, but it then conflicted with many other things that people still firmly believed and for which no *known* alternative solution existed. Even small changes of notions in one place often require accompanying *enormous* changes elsewhere in the space of notions in order to reassemble the whole thing all at once into a *better* worldview, one that explains all of the observational data and human experience that the previous one did *and more*.

As a historical example, consider the following. The *data* that ultimately refuted the worldview above was around even before that worldview became universal. Anaxagoros had already guessed that stars might be incredibly distant suns like our own, and Aristarchus of Samos deduced the rotation of the Earth and had a successful, empirical heliocentric model that (due to a small error in measuring a geometric angle) was only off by a factor of around 20 in the distance between the Earth and the sun – 2300 years ago. At about the same time Eratosthenes used geometry to not only conclude that the Earth is round, but make a credible measurement of its circumference, one only about 10% off, and both he and Hipparchus may have corrected Aristarchus deduction of the distance to the sun (if necessary, this is somewhat uncertain after thousands of years) to be accurate within a couple of percent. In other words, long before Columbus, Copernicus, Galileo, Tycho Brahe, Kepler and Newton during the Enlightenment, a *quantitatively correct* model of the round, rotating Earth revolving around a more or less “fixed” sun existed.

However, this model was not well integrated with the rest of human knowledge. A round earth requires a *completely different model* to explain the *other* observations noted by Cardinal (and Saint!) Bellarmine, and the questions that attend them.

What keeps the stars from falling if they are not in a solid sphere overhead that holds them up? How do you explain the fact that some *do* appear to fall, every night? How do you explain the apparent lack of parallax – relative motion of the nearer stars relative to the more distant ones as the world turns? If the

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13This was a problem that persisted well into the Enlightenment, as nobody had the faintest
world is round, where, exactly, is God, when heaven is no longer overhead, and
hell is somewhere inside an apparently solid ball? Indeed, how could you even
begin to convince somebody that the world is round when they could look out
their window and see that it is flat, when even educated people were badly edu-
cated (and the vast majority were illiterate, ignorant peasants) and couldn’t (and
didn’t!) understand the evidence for its roundness even if it were literally sitting
right there in front of them, being explained by somebody that did understand
it?

Readers of the modern age who have a hard time appreciating just how
ingrained this worldview was and how socially dangerous it was to challenge it
are strongly encouraged to read Galileo’s Dialogue Concerning the Two Chief
World Systems\textsuperscript{14} and the associated Letter of (Saint) Cardinal Bellarmine\textsuperscript{15} to
Galileo explaining to him why his observations and remarks, put forth to support
a purely mathematical theory, were barely tolerable but to propose them as fact
contradicted the divinely inspired holy scriptures and the transcendent, God-
given wisdom of Solomon – the officially sanctioned worldview according to the
Holy Catholic Church that ran everything using a grip of iron backed by deadly
force.

Galileo was ultimately tried, convicted, and kept under house arrest for the
rest of his life\textsuperscript{16}. All of his works were banned by the Church for hundreds of
years\textsuperscript{17}.

\textsuperscript{14}Wikipedia: \url{http://www.wikipedia.org/wiki/Dialogue_Concerning_the_Two_Chief_World_Systems}.
Follow one or the other links at the bottom.
\textsuperscript{15}See: \url{http://www.fordham.edu/halsall/mod/1615bellarmine-letter.html} If it has moved,
Google Is Your Friend(GIYF).
\textsuperscript{16}Galileo was lucky at that not to have been tortured and ultimately burned alive. He lived
square across that lovely period in history known as The Burning Times, when the Catholic
church issued printed papal bulls that basically authorized the relaxation of the normal rules of
evidence and torture and a horrible death for “witches” (and a few wizards and heretics as well).
The Spanish (and the less well known Roman) Inquisition was in full swing – six people were
burned alive in Spain within a year of Galileo’s original observations and announced support
for heliocentrism.

Heresy and schism abounded as people started to challenge all of the assumptions that
underlay the “official” worldview, and the Church did not hesitate to use deadly force and
shocking methods to squelch them. Galileo was perhaps too wealthy and popular and known
to just rot in jail or be burned in a public square, but if he had not publicly recanted, that’s
very likely precisely what would have happened to him.

\textsuperscript{17}It is still less than twenty years since the Church finally apologized for mistreating Galileo
– sort of, a bit obliquely. Man had walked on the moon before the Catholic Church apologized
They had no choice. After all, Bellarmine’s concerns are correct. Galileo’s results do refute the assertion that the scriptures are divinely inspired truth and did contribute strongly to a revolution that demoted the ad litteram scriptural worldview to the status of “extremely implausible” and elevated a worldview that is still under active development today to replace it. Since Jesus and Paul both explicitly endorsed the literal truth of Genesis and the Old Testament, finding any error, especially as blatant an error as this, definitively proved that the entire Bible, Old and New Testament alike was not what it was (and still is, by some enormously and unbelievably ignorant people) asserted to be: divinely inspired absolute truth. It seems unlikely that Jesus could be divine and possessed of preternatural knowledge and yet assert a belief in an earth-covering flood where all surviving species (millions of them from all over the world) were preserved in a boat a bit smaller than the average Wal-Mart. This never occurred, and a man who was really the Son of God would have known it, and an honest man, a good teacher, would have had at least the courage of Galileo and stated this truth (and many other easily confirmed truths about the Universe) openly even though they contradicted the beliefs of his disciples and the prevailing social religious hierarchy.

Bellarmine notes this explicitly in his letter. He begins his third point with “I say that if there were a true demonstration that the sun was in the center of the universe and the earth in the third sphere, and that the sun did not travel around the earth but the earth circled the sun, then it would be necessary to proceed with great caution in explaining the passages of Scripture which seemed contrary, and we would rather have to say that we did not understand them than to say that something was false which has been demonstrated.”

What more can one say? Once one has even a moderately successful worldview, the human brain (and the extended, collective human brain of society) becomes extremely resistant to change. Bellarmine (like many, many Christians who followed and who continue on even today) refused to contemplate the possibility that the Scriptures could be wrong. He was prepared to go to any lengths for attempting to obliterate the work and reputation of the man who observed that it was a thing that orbited the earth and could be walked on.

18Wikipedia: [http://www.wikipedia.org/wiki/Cognitive Dissonance](http://www.wikipedia.org/wiki/Cognitive Dissonance). This is an absolutely perfect example of what psychologists have come to call a reaction to “Cognitive Dissonance”: what the human mind often does to protect its own axiomatic worldview and associated self-esteem when it is threatened by contradiction. Instead of changing his mind (literally) and saying “Wow, I was wrong, my former beliefs were mistaken, I’m so grateful to you for increasing the correspondence between my beliefs and reality,” humans such as Bellarmine have an appalling tendency to just ignore the contradiction or edit their own perceptions of reality to avoid this at all costs. Denial ain’t just the name of a river in Africa...
including the imprisonment or even murder of an innocent seeker of truth to preserve his worldview from challenge, and stated up front that even if the challenge was born out by \textit{any experience}, even if \textit{all evidence} came to support it, that the scriptural doctrine \textit{could not be wrong} and we would have to find an \textit{interpretation} of the contrary passages that protected them from any demonstration of contradiction.

This sort of “mental stubbornness” was frightening then, especially as we look back from our privileged position in a world where \textit{everyone knows} that Galileo is correct and \textit{all of the Abrahamic Judeo-Christian-Muslim religions} are wrong in the specific sense of containing scriptural passages that are \textit{not} the best things to believe given the network of human experience and the data and the consistent reasoning calculus described above – but the Church then (as do many faiths now, in many parts of the world) had both the religious and secular power to prevent the free exercise of reason. It remains frightening now. Bellarmine has been canonized and is officially a Saint of the Church, and the backhanded apology to Galileo was not accompanied by taking back his sainthood.

Hundreds of millions of people have followed down the dark path Bellarmine (and, to be fair, the pope and other church fathers of the time) established, and no interpretation or distortion of the evidence is out of the question for those who do not wish to acknowledge the hundreds of contradictions between observational science and history and the Old and New Testament or related scriptural texts. An entire \textit{pseudo-academic discipline} known as “hermeneutics”\footnote{Wikipedia: http://www.wikipedia.org/wiki/Hermeneutics. Leading to the invention of \textit{hermeneutics} and \textit{exegesis}, two pseudo-intellectual “disciplines” devoted to inventing clever interpretations that (mostly) protect written religious scripture from just plain being absurdly wrong, although it has been somewhat broadened into a slightly more legitimate branch of cultural anthropology or historiography.} is devoted to this process of \textit{a posteriori} working out some way of “interpreting” the words of the Bible so that the obvious contradictions are, somehow, transmuted by the magic of the outrageous misuse of language into non-contradictions. Circles become spheres, firmaments aren’t, Genesis days last billions of years – whatever it takes, because the Bible was \textit{divinely inspired} by the \textit{Holy Ghost Itself} and can’t be wrong.

You see the critical importance of that autobeliefectomy we talked about at the beginning of this book. If you are reading these words in a state of acute cognitive dissonance because you \textit{believe} that the Bible, or Quran, or the Vedas, are \textit{true} – a state you would never have reached, quite frankly, if you hadn’t been taught to believe it long before you were capable of analytical skeptical thought,
and hadn’t granted it a *special exception* to the usual rules of evidence-based reason in the meantime – you may be getting ready to throw *this* book away, or burn it, or ridicule and devalue it in some way just so that you don’t have to *confront* the highly uncomfortable fact that it is very, very unlikely that anything like the events described in e.g. Genesis ever occurred, not even as metaphors. Or, you maybe be preparing yourself to defend your beliefs *as* metaphors, practicing hermeneutics yourself so that you can retain your preloaded worldview even though huge portions of it are demonstrably wrong and hence cannot possibly be divinely inspired shortcuts to any kind of truth at all unless the divinity in question is deliberately mendacious and malicious.

All I can do is repeat my statement from then. If you cannot bring yourself to doubt your existing worldview, if you cannot *rescind* any special exception you have granted it because it was a key non-genetic “inheritance” from your parents and your culture, you cannot possibly *change it* to end up believing what it is *best* to believe according to a criterion you actually understand and *agree* is best. All you can do is keep on believing what you believe, knowing full well (whether or not you can openly acknowledge it, even to yourself) that it is not really sensible, whether or not it is *honest*. Cognitive dissonance is all about deceiving yourself to avoid the stress of change.

There are many other examples – pretty much all of the world religions, most sociopolitical memetic systems – including several comparatively benign ones in the sciences. The replacement of classical mechanics by quantum mechanics in physics was resisted quite strongly (if generally non-violently) by physicists that had thoroughly mastered the notions and equations of classical causality and felt that some of the key assertions of quantum mechanics literally violate one of the Laws of Thought (and they do violate the law of the excluded middle in a manner of speaking, although the *theory itself is mathematically consistent*).

Similarly, the replacement of non-relativistic physics by relativistic physics still causes headaches in every generation of young physicists as they are required by their studies to start visualizing, imagining, and working with algebraically a *four-dimensional* space-time where changes in inertial frame are accompanied by hyperbolic rotations mixing space and time coordinates in a tensorially consistent way.\footnote{Yes, the brain-exploding horror, the horror...} It, too, was opposed by physicists (and many non-physicists) that just couldn’t accept that time isn’t what they thought it was, who *religiously* opposed the notion that spacetime was a manifold with curvature and not just a flat three dimensional space with an independent time variable.
The moral of the story is that worldviews have a sort of *inertia*. Once we have one that is moderately successful, especially one that is taught in schools or in the home as being “true by authority” and not by reason, its plausibility tends to increase in time *wholistically* in our minds, and we become somehow *resistant* to moderate (or even quite large) doses of contrary evidence.

We can understand this from the mathematics of *gradient search* or *hill-climbing* in optimization theory. Let’s represent the “success” of a worldview as the height above the “ground” of complete ignorance on some abstract “space” of axioms, beliefs, etc. Nearly all of this space is nearly indistinguishable from the ground, but parts of the terrain where the axioms/beliefs include things like some sort of a law of gravitation, a belief in causality, belief in the persistence of the world in time, a knowledge that injury causes pain and pain is associated with death elevate into the “not too stupid to live” plausibility continent where evolution doesn’t immediately eliminate an organism as unfit to survive at all because of flaws in its worldview, instinctive or learned as it may be. Some parts of this continent are higher/better than others, and represent improved worldviews that are in better empirical agreement with our experiences of the world.

When we (individually or as a culture) have reached the plausibility “plateau” of a successful worldview, it tends to be roughly optimal given all of our beliefs (social and physical) and the evidence at hand from both living in the physical Universe and interacting with our social universe, where errors in either one are usually bad for our prospects of survival. New evidence that completely contradicts some aspect of this locally optimal worldview requires that one has to change one’s beliefs in some direction that is *differentially downhill*, because a tug in one direction has effects on the *entire network of beliefs*. It is very difficult, sometimes, to reevaluate the entire network to see if a new, higher plateau emerges; it can easily take longer than the lifetime it took to build up your worldview in the first place as you have to *unlearn* many things and *figure them out* anew.

Again, examples from history and philosophy abound – we often end up *revering* those iconoclasts that invented or discovered a route out of some non-optimal plateau that eventually led *uphill* to a much better understanding of and control of their cultural and scientific environment. At first, however, they tend to be reviled, attacked, persecuted, tortured, ostracized, ridiculed, and not infrequently killed in various painful and spectacular ways, because entire *cultures* express cognitive dissonance by defending the *cultural worldview* with extreme
prejudice. The last 400 years – the Enlightenment through the present – have been almost nonstop turmoil because individuals go through several such revolutions in thinking in a single lifetime. The human race itself is suffering from ongoing post-traumatic stress disorder that is continually exacerbated by an ever-increasing rate of “revolutionary” discoveries that jump us straight up the face of a cliff to a much better understanding of – everything! – but often at the expense of the comfort we drew from thinking that we knew at least something about how it all works, or worked.

Completely understanding this is not easy – most people are incapable of figuring out really complicated things (or even understanding the hill-climbing metaphor I just presented as a visualization of a very real and very complex computational optimization process that is literally in daily use all over the world), especially if it involves lots of math. Human intelligence has increased dramatically and steadily for as long as we have had the quantitative means to at least approximately measure it, but it still has a long way to go. This non-evolutionary increase appears likely to be related to the incredible increase in the

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21 Not just science, either. Often not science at all. One of my favorite short poems is: “Seven cities claimed blind Homer, dead, through which blind Homer, living, begged his bread.” Socrates was forced to drink hemlock as his teachings “corrupted the youth”. Siddhartha Buddha might ultimately have been poisoned by Hindu priests that suffered from his barbed commentary on the exploitation of the poor by the priesthood. Painters, sculptors, writers, have suffered from social conservatism as much as philosophical or religious iconoclasts.

22 So, is eating cholesterol good for you or bad for you (on average)? In my lifetime, we’ve gone from “what the hell is cholesterol, and can you hand me my plate of bacon and eggs please,” to “what the hell are omega-3 fatty acids, and bacon and eggs are full of cholesterol and are the invention of Satan Himself so that if you eat them every day you will die of a heart attack by age 30,” and then changed again to “dietary cholesterol generally doesn’t matter, eggs are full of omega-3 fatty acids and are good for you, and bacon in moderation isn’t that bad, except for the salt and preservatives and heavy metals in the meat and incidentally, it is sugar that is invented by Satan Himself...”. We’re entering yet another phase where eating “real food” is good for you, even if it contains some sugar, but eating TOO MUCH is the invention of Satan Himself, blah, blah, blah. And on the horizon – eating only 600-800 calories a day for weeks or months at a time is going to end up being good for you, so that concentration camps are really just a modern form of day spa.

23 PTSD city.

24 I’m not being elitist here, by the way. I include myself in “most people”. Physics at the bleeding edge is difficult, and one has to do a lot of work to do much of anything.

25 Wikipedia: [http://www.wikipedia.org/wiki/Flynn_Effect](http://www.wikipedia.org/wiki/Flynn_Effect). This is a surprising but apparently true fact. The definition of intelligence quotient (IQ) is such that the mean is placed at 100. Every few years the test is renormalized so that this is remains true. Flynn observed that the mean has been continuously raised, by an average of three points a decade, as long as it has been around. In fact, the mean IQ of individuals a mere hundred years ago would have been in the ballpark of 80 on the scale of modern tests, borderline mentally retarded!
enrichment of the developmental environment of humans that has accompanied
the industrial and scientific revolution and mandated universal education.25

In the end, we prefer instead in these cases where evidence casts doubt on
an entire well-established, moderately successful worldview to doubt the evidence.
This is actually a reasonable thing to do, within reason, and doesn’t really violate
the meta-axiom that new evidence should cause changes in the direction dictated
by common sense, because we have a lifetime of experience with mistaken evidence,
with false testimony, with cases where we took the risk and changed our worldview (giving up bacon and eggs for breakfast) only to later discover that
bacon and eggs for breakfast is good for you, especially compared to replacing
it with chocolate-blasted sugar bombs accompanied by whitebread toast. We have many lifetimes of experience if we accept the testimony recorded in books,
including the very scriptures Bellarmine was so eager to defend.

Humans have such a varied mental experience and social experience of the
world that even today a significant fraction of the population of the United
States still hasn’t come to grips with Galileo, with Newton, with Darwin, with
Einstein. You may well be such a person (although more often than not people
in this category will have burned this book long before reaching this point in it,
in spite of my fervent request that the reader suspend all disbelief – and
judgement – until the end). A Biblically Inerrant Conservative Christian (BICC)
to this very day defends the literal truth of Genesis and the attendant worldview
of a God that created seeded plants and fruit trees before creating that Sun
that the Bible, that Bellarmine, that the church fathers, that all the “secular”
commentators of the early 1600’s very clearly had going around the Earth and
not the other way around. They do this by relying on a strange mix of “biblical
hermeneutics”, a.k.a. – “interpreting the Bible via exegesis so no contradiction

just humans – rats raised in complex, enriched environments have bigger, better, faster, smarter
brains. It isn’t just infants and children – adults who deliberately exercise their brains with
crossword puzzles, continuing education, engagement in complex environments, brain challenges
can actively increase their intelligence and delay the aging of their brains. The brain is like
any muscle or aspect of the human body – use it or lose it! I extend to you, via this book, a
tremendous opportunity to use it.

26Wikipedia: [http://www.wikipedia.org/wiki/Biblical Hermeneutics.] A subset of hermeneu-
tics in general, see link above as well. This entire process is amusing and incredibly frustrating
to the physicist or mathematician. Note well the axioms of biblical hermeneutics embedded
in this article, and the many mutually contradictory approaches taken by different religious
groups. This is all a desperate attempt to protect the Bible as the Word of God (and hence
axiomatically infallible) instead of accepting the far simpler conclusion supported by a straightforward reading – where its words are considered ordinary language that can be fairly compared
9.1. THE SET OF ALL NOTIONS

with known facts occurs” (the thing Bellarmine suggested might be necessary) and *selectively distorting the science* – ignoring one thing, emphasizing another, rejecting accepted physical law on the grounds that God can do anything that God wants, and throughout the process displaying an appalling ignorance of the very points they debate and things like *simple arithmetic* that would refute them.\(^{27}\)

The result is a kind of selective blindness, almost a self-induced dementia, that is more than a bit frightening. And yet becoming *locked in* to a particular worldview to the point where one becomes partially or completely immune to evidence shouldn’t, actually, be a tremendous surprise. It is predicted by optimization theory, because our calculus so far does not *obviously* permit (or even encourage) *far searches* and *long jumps* – strategies in optimization theory for jumping *over* from one dead-end plateau to a new slope with an uphill (metaphorical) path that almost immediately goes higher than the old ontological plateau one is trapped on.

We need to fix this by adding more meta-axioms, ones that create an *irresistable pressure* to abandon defective worldviews instead of rescuing them at all costs, ones that permit the construction of and comparison of *many* competing worldviews, some of them “tentative replacements”, to sample the enormous space of notions and ensure that our prior beliefs are still the best that can be justified by all of the evidence and experience we have at hand. One can argue that some of these aren’t really meta-axioms, that they are meta-theorems that can be derived from the meta-axioms above and just the right mathematics and reason. This may be true, but it doesn’t matter to our purposes, which is to achieve clarity without slogging through too much math or pure logic. These meta-axioms are intended to govern the *search process* for the best worldview, not the “local” calculus that has been defined so far. In so doing, they will give

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\(^{27}\) For example, to cover the top of Mount Everest with only forty days of rain, it would have to rain at least *five inches of rain a minute* on *every inch* of the earth’s surface. If Noah were to load his Wal-Mart sized Ark with a species a minute for the mere *ten million* plant and animal species that would almost certainly die as the oceans first flooded all freshwater lakes with salt water, then proceeded to dilute the oceans to far less than half their normal levels of salt (enough to prove fatal to most oceanic species of just about anything) it would take him *nineteen years* to complete the loading and he’d need an aquarium capable of holding pelagic sharks that die if they stop moving and have never been kept successfully in captivity to this very day. The assertion that any of this happened is patently *absurd*, but absurdity is not enough to alter the worldview of a BICC.
free rein to imagination, intuition, the construction of competing theories (includ- ing some that describe or explain part of the evidence available better at the expense of explaining other parts worse).

9.2 Honesty (The Meta-axiom of Integrity)

This meta-axiom is so obvious that I almost omitted it altogether, but then I reread a famous graduation speech by none other than physicist Richard Feyn- man: *Cargo Cult Science*[^28] and reconsidered. This is one of the most pro- found and instructive essays I’ve ever read about science and integrity – Feynman was, after all, a genius – and it clearly exposes the essential element that is missing whenever one attempts to analyze religious worldviews or worldviews that are carelessly or dishonestly built.

I can do no better than to quote a piece of Feynman’s article. “They” are the Cargo Cults[^29] of the South Pacific, primitive tribes that attempted to attract the wealth they associated with U. S. troops that occupied their islands during World War II by means of “sympathetic magic”, where they recreated non-functional simulacrum of the airplanes and costumes and appurtenances of those troops.

Now it behooves me, of course, to tell you what they’re missing. But it would be just about as difficult to explain to the South Sea Islanders how they have to arrange things so that they get some wealth in their system. It is not something simple like telling them how to improve the shapes of the earphones. But there is one feature I notice that is generally missing in cargo cult science. That is the idea that we all hope you have learned in studying science in school—we never explicitly say what this is, but just hope that you catch on by all the examples of scientific investigation. It is interesting, therefore, to bring it out now and speak of it explicitly. It’s a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty—a kind of leaning over backwards. For example, if you’re doing an experiment, you should report everything that you think might make it invalid—not only what you think is right about it: other causes that could possibly explain your results; and things you

[^28]: See: [http://www.lhup.edu/DSIMANEK/cargocul.htm](http://www.lhup.edu/DSIMANEK/cargocul.htm) Excerpted from his 1974 commencement address, delivered at Cal Tech.

thought of that you’ve eliminated by some other experiment, and how they worked—to make sure the other fellow can tell they have been eliminated.

Details that could throw doubt on your interpretation must be given, if you know them. You must do the best you can—if you know anything at all wrong, or possibly wrong—to explain it. If you make a theory, for example, and advertise it, or put it out, then you must also put down all the facts that disagree with it, as well as those that agree with it. There is also a more subtle problem. When you have put a lot of ideas together to make an elaborate theory, you want to make sure, when explaining what it fits, that those things it fits are not just the things that gave you the idea for the theory; but that the finished theory makes something else come out right, in addition.

In summary, the idea is to try to give all of the information to help others to judge the value of your contribution; not just the information that leads to judgment in one particular direction or another.

...

But this long history of learning how not to fool ourselves—of having utter scientific integrity—is, I’m sorry to say, something that we haven’t specifically included in any particular course that I know of. We just hope you’ve caught on by osmosis.

The first principle is that you must not fool yourself—and you are the easiest person to fool. So you have to be very careful about that. After you’ve not fooled yourself, it’s easy not to fool other scientists. You just have to be honest in a conventional way after that.

I would like to add something that’s not essential to the science, but something I kind of believe, which is that you should not fool the layman when you’re talking as a scientist. I am not trying to tell you what to do about cheating on your wife, or fooling your girlfriend, or something like that, when you’re not trying to be a scientist, but just trying to be an ordinary human being. We’ll leave those problems up to you and your rabbi. I’m talking about a specific, extra type of integrity that is not lying, but bending over backwards to show how you are maybe wrong, that you ought to have when acting as a scientist. And this is our responsibility as scientists, certainly to other scientists, and I think to laymen.

For example, I was a little surprised when I was talking to a friend
who was going to go on the radio. He does work on cosmology and astronomy, and he wondered how he would explain what the applications of this work were. ”Well,” I said, ”there aren’t any.” He said, ”Yes, but then we won’t get support for more research of this kind.” I think that’s kind of dishonest. If you’re representing yourself as a scientist, then you should explain to the layman what you’re doing—and if they don’t want to support you under those circumstances, then that’s their decision.

There is such a wealth of wisdom in this one short quote. Let’s concentrate, however, only on two points. The first is that if we wish to build the best possible worldview, it helps a whole lot if we are honest about it. This is much more difficult than it sounds – indeed, it is one of the most difficult parts of the whole search process.

Your worldview is more than just an abstract set of beliefs. It is in some deep sense you – the sum total of your knowledge and experience, the cognitive basis for the way you work as you make sentient intentional choices that guide your pathway through life, conferring at least a moderate measure of control along the way. There is, therefore, nothing more terrifying to most humans than the thought that their worldview might be deeply mistaken, that the world might not be at all the way that they imagine it to be. Also, as we’ve already remarked above, changing your worldview can be remarkably difficult – you may not just be able to change one small thing about your beliefs, you may have to change the whole ball of wax in major ways to improve the correspondence between those beliefs and your ongoing experience. Finally, humans tend to be locked into a complex social and economic structure, and that structure is often conditioned upon certain accepted “truths” that are part of the prevailing “social norm” worldview. There are often negative consequences associated with changing one’s worldview, especially changes that contradict the local social or economic or religious norms.

This unholy trinity of fear, laziness, and personal (dis)advantage all encourage not just dishonesty, but dishonesty on a grand scale. This dishonesty is reflected in a number of ways in the search for an optimal worldview. The first is the one alluded to by Feynman (although not by name) – the tendency of humans to permit confirmation bias to compromise the integrity of the process of searching for plausible truth.

Confirmation bias and its close cousins and support tools, “cherrypicking the

\[30\text{Wikipedia: http://www.wikipedia.org/wiki/Confirmation Bias.}\]
data” and “gatekeeping”, are clearly visible in contemporary research, economic theories, religious assertions, and political decisioning involving the allocation of almost the entire wealth of the world – not just billions but trillions of dollars, millions of lives, untold human misery, and the perpetuation of complex systems of belief in implausible and inconsistent myths that are quite literally inherited from the most barbaric and ignorant periods in human history. It corrupts published results in the fields of climate research and medical research in particular, but in truth it permeates every realm of human endeavor, not just science. Once we accept some notion as probably true, it is very difficult for us to change our mind. If it is our own idea, or if there are severe social or economic penalties to changing our mind, it is often nearly impossible. As Feynman notes, the trick to being honest about the things that really matter is to begin by being brutally honest with yourself – only then can the more mundane sort of honesty with others have a chance of success.

Ah, just imagine it. Religious sermons that honestly point out that the theistic scripture that forms the axiomatic basis of its assertions is either not supported by any piece of objective evidence or egregiously contradicts things that we take for granted as true every day! Politico-economic debates where the communists acknowledge that free enterprise often works better than communism, and where free-market capitalists openly admit the many ways that capitalism fails in practice however well it works in theory! Drug companies honestly pointing out that their latest billion-dollar wonder drug doesn’t seem to do anything constructive about any disease and causes most people who take it to break out in a horrible rash – or even just acknowledging that the studies done so far are inconclusive, marginal results that might well have arisen by chance! Scientists in general criticizing their own results even more harshly than they criticize the results of others! Climate researchers that acknowledge that they honestly do not know if the modern era is much warmer than it “should” be, both because they have no model that predicts how warm it should be now (or predicts in hindcast how warm it has been in the past) and because there is overwhelming evidence that it has been just as warm in the past without the participation of the alleged primary driver, carbon dioxide!

When did honesty stop being a fundamental meta-axiom of our society? Honestly, never. It never has been such an axiom, but it should be, at least if we want to do out best. We have to have the courage to face the truth whatever it might turn out to be and turn our back on notions that describe the way we wish it would turn out to be (but doesn’t), on notions that might be right or might be wrong. We have to be willing to confront the fact that often our beliefs are
self-serving; a person that benefits materially or socially from holding a certain belief finds it all too easy to ignore evidence that the belief is wrong and turn away from it, giving up those benefits.

I’m sorry, but even though it should go without saying that a search for the best worldview known to mankind – so far – ought to be an honest search, the evidence is overwhelming that it is not, and hence the need to openly state it as a fundamental global axiom. As long as we’re willing to lie to ourselves and others, as long as we are willing to misuse doubt not as a tool that leads us to the least doubtable (and hence most believable) but as a means to selectively promote a relatively implausible set of beliefs by cutting down better supported alternatives, we can never attain an optimal worldview, a fair and balanced global society, mere happiness and a measure of personal social and economic security in an uncertain world.

So let’s write it right on in at the beginning:

6. **Honesty** – Axiomatic worldviews that are built upon and supported by an honest and well-founded process are better than worldviews that are based on lies or that deliberately conceal inconvenient (confounding) evidence.

### 9.3 Correspondence (The Meta-axiom of Predictivity)

The second meta-axiom is mentioned only in passing by Feynman, but it too is essential, not one that isn’t worth mentioning but one that is so obvious (and which would have been obvious to his audience already) that he didn’t bother to dwell on it, it would have been preaching to the choir! That is that when building a worldview, the measure of success is the degree to which the worldview is in correspondence with the entire body of experience and most-reasonable and most-plausible knowledge – so far. Science also often insists that it go the extra mile and predict new things, things that were unexpected or are not predicted in the old worldview.

7. **Predictivity** – Axiomatic worldviews that both correspond well to the world of our past experience and predict or explain new experiences are better than worldviews that have a poor correspondence to our experience and/or have no predictive skill.

In science the standard of ultimate success is not just the explanation of existing phenomena and experiment, although this is generally considered necessary
degree of correspondence. It is the ability to predict or explain new phenomena. As Feynman says, an elaborate new theory or improvement on an old one – and there is no more elaborate theory than a complete worldview, truly the “theory of everything” – needs to be able to make some new thing come out right. Otherwise it at best becomes yet another notion in a competing, degenerate space of notions that all equally well explain our experience and with no evidence available to help us choose between them.

When this happens – and it happens a lot more often than one might think – we often use additional criteria to decide what the “best” things to believe are from among the competing sets of notions that all work roughly equally well to explain the data. Indeed, the next one is absolutely critical – without it we almost have to give up the whole ball game because leaving it out opens the door to a certain class of truly horrible, non-optimal worldviews that should violate every bit of our common sense.

In a way this meta-axiom isn’t purely an assumption. One can, with a bit of effort, relate it to the Cox axioms, relate it in particular to information entropy. However, that isn’t sufficient to justify it, it merely makes it a bit more consistent with the other meta-axioms.

This is a good thing – one essential principle of an honest search for the best worldview is that reality is the ultimate arbiter of truth, that our judgement of a best worldview is fundamentally based on the quality of the correspondence between that worldview and the world.

Perhaps nature is simple. Perhaps not. However, given the necessarily finite and incomplete aspects of our worldview, we are almost always well-served by insisting on simplicity, as long as we can achieve close to the same degree of correspondence.

9.4 Ockham’s Razor (The Meta-axiom of Simplicity)

For all of these reasons, let’s move on past the two “Feynman” rules above and continue our search for useful or essential meta-axioms by adding the following old friend.

8. Simplicity/Ockham’s Razor – Axiomatic worldviews that are simpler (have fewer axioms) are better than worldviews that are more complex, all other things being equal.

As indicated, the meta-axiom of simplicity (or economy) is also known as
Ockham’s Razor\textsuperscript{31}, and has been around for a rather long time. The idea is simple. \textit{Simplicity is good.} How self-consistent is that! Note that I tie simplicity to \textit{number} of axioms (a quantitative measure) but there is more to simplicity than just number. Note also that implicit in this is that any two worldviews being compared in this way \textit{explain exactly the same degree of experience and data.} Often this will not be the case, and one will have to use that pesky old judgement/common sense thing again to trade off simplicity against comprehensiveness, reliability against precision (as Russell originally suggested).

I wish there was some way around this, but there really isn’t – we are optimizing in a space with many dimensions and no objective metric; sometimes making a worldview shift in one “direction” that improves an explanation of one phenomenon will make its explanation of something else worse. In fact, that’s the very problem this meta-axiom forces us to confront, as it eliminates certain axiomatic worldviews that explain \textit{everything perfectly} in the silliest possible way by introducing enormous numbers of axioms to provide a vast and complex network of \textit{ad hoc} explanations that “work” for each specific thing one at a time but which fail to generalize or fit into a much simpler “big picture” worldview that works less perfectly but actually conveys understanding while it does.

In any event, this meta-axiom suggests that we try to pick worldviews with \textit{powerful and general} explanations over ones that require many individual explanations that cover all sorts of individual experiences and chunks of data. The world abounds with examples, both true and false, that illustrate the use of this idea. Suppose that I rub a balloon on my little remaining hair, and hold it up near a wall. I observe it to be attracted and to stick, for a while, to the wall, then slide down. In my worldview, I seek the best possible explanation for what I just observed. As I do so, the usual whirl of notions appear and disappear, fleeting, in my head.

Perhaps there are invisible fairies that live inside the wall and like balloons! They grabbed it and were trying to go home but couldn’t pull the balloon inside. One by one they dropped off, until the last ones could hardly keep the balloon from falling and it slowly slid down. Perhaps a very localized wind sprang up and pushed the balloon up against the wall. Eventually it gave out and the balloon fell. Perhaps a black hole drifted by the wall on the far side and attracted the balloon, then moved on.\textsuperscript{32} Perhaps the balloon picked up a bunch of magnetic monopoles and induced surface currents on the wall that attracted it. Perhaps

\textsuperscript{31}Wikipedia: \url{http://www.wikipedia.org/wiki/Ockham’s\_Razor}.

\textsuperscript{32}Yet another example of the problem with Knowing Too Much. Who thinks up these things?
there was no balloon, and I fantasized the whole experience. Perhaps the balloon was a simulated balloon in what amounts to an enormous MMRPG that I’m perceiving only because of a direct Matrix-like neural implant, and its apparent motion was dictated by the central master game computer. Perhaps I am a soul in a created Universe, and the balloon is a manifestation of the mind of God, who made the balloon appear to be attracted to the wall and slide down, but tomorrow it could be God’s Will that it be repelled instead or just spontaneously pop.

Or perhaps rubbing the balloon with my hair caused it to become electrically charged. The charged balloon induced a surface charge of the opposite sign on the insulating dielectric material wall, which attracted the balloon. Eventually the initial charge neutralized as air molecules (initially attracted by the same mechanism, then repelled once they struck the balloon and acquired some of the charge) carried it away, and the balloon fell.

None of my possible explanations can be positively refuted by evidence. The fairies are invisible; who can say that they don’t exist when by hypothesis they cannot be seen? The black hole seems unlikely as we have yet to directly observe a black hole and there are reasons to doubt that any are hanging out on the surface of the earth, but proving that this couldn’t be true is only possible subject to a slew of assumptions that could just be wrong or my prior belief that certain circumstances are themselves unlikely is just plain wrong: perhaps the black hole was part of the intergalactic transport mechanism of a tiny alien spacecraft that was investigating my azaleas at the time, for example. Similarly, just because magnetic monopoles have never been seen so far doesn’t mean that they don’t exist and couldn’t have attached themselves somehow to my balloon. I couldn’t see or hear the wind because it was very localized, but it might have been there just the same, with its effect visible as the apparent adherence of the balloon. My hallucinatory imagination, MMRPG and God are extremely pernicious – they are actually very simple explanations, on the surface, and each of them is manifestly capable of explaining my apparent sensory input.

Yet, the explanation based on electrical charge is overwhelmingly the most plausible one and is what I instantly conclude is the (very, very, very,... very) probably correct explanation, without really even thinking much about the al-

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33 Which is, after all, the case, while I was writing this chapter. But pretend it wasn’t.

34 Wikipedia: [http://www.wikipedia.org/wiki/MMRPG] Massively Multiplayer Role Playing Game. Don’t laugh. Full grown adult humans, some of them with Ph.D.’s and lots of money, are openly asserting that this is the cause and that there is, in fact, no balloon or wall! I’m not making this up.
ternatives even though there are a near-infinity of them.

Why do I reject all of these but the last one? Because I already have an enormous amount of experience with Coulomb’s law, electrodynamics, quantum mechanics and physics in general – I teach this at Duke. Every atom in my body is evidence that the forces in question exist and work – they explain the entire periodic table and molecular chemistry and by extension just about everything I observe in my daily life. I’ve seen numerous experiments that validate them, done numerous computations using them that work out to explain experiments to very high precision, and I understand how they work and produce this correspondence in a mathematically consistent way.

My degree of belief in Maxwell’s equations, gravity, quantum theory, and most of physics in general is enormous. It most certainly is a possible explanation of the balloon being attracted to the wall, and requires no extensions of my worldview if I select it as the most probable cause. The one I already have is sufficient, and even if I’m mistaken and one of the other explanations is correct, I still cannot get rid of Maxwell’s equations so easily as they are needed to explain many other things.

In a trice, in far less time than it takes to write it, I reject the infinity of possible reasons the balloon might have been attracted to the wall (or appeared to be) in favor of a single set of axioms that requires no revision of my worldview, no exceptions for special cases, no contorted arguments, and that explains many other things as well.

Simple pictures are the best.

9.5 Beauty

It’s worth considering briefly the last three “simple” explanations from the previous section – solipsistic imagination, MMRPG, and God’s direct, naked, will.

First of all, they aren’t terribly simple. They postulate what amounts to an adjoined entire cosmos wherein the things that happen in this (apparent) Cosmos are determined by hidden means. We cannot ask why God made the balloon move towards the wall exactly as if Maxwell’s equations were the cause, at least not without giving a specious answer such as “because he wanted to, but at any moment he could change his mind.”\footnote{BICCs, for example, often explain how our physical observations now don’t refute the mythology of Genesis by stating that the laws of physics must have been different then.} We cannot explain why the
MMRPG computer does the same thing, nor can we deduce its structure, or the program that is running on it – it all just looks like Maxwell’s equations. I cannot explain how my imagination imagined behavior that can be consistently explained (when I look carefully) by Maxwell’s equations, even though it may not consciously be aware of what Maxwell’s equation are or how they work until I take the trouble to look and work it all out.

Even if I throw in the less simple fairies, it turns out that they too made the balloon simulate the behavior it would have had if Maxwell’s equations were the cause. If I did a more careful experiment or did the experiment many times, and tested all four alternative hypotheses to see if they actually motivated the balloon, we will learn that each one motivated it exactly as if Maxwell’s equations and electrical forces were responsible. Smart fairies!

Second, the multiplication of axioms has no predictive value. Suppose that fairies were the cause. Either the fairies always make things behave the way Maxwell’s equations plus quantum mechanics predict that they should (in which case we might be tempted to give the fairies a quantitative name and theory of their own, and call them “quanta of the electromagnetic field” or “photons”) or they have a personality and can be perverse. Today the balloon is attracted, tomorrow it is repelled, the next day it is popped by annoyed fairies who pull your hair in the bargain. We have no experience of things like the latter happening, and in the former case we’ll just simplify life and name the fairies photons as a part of a larger body of consistent best belief and be done with it.

Ockham’s Razor imposes a kind of beauty of our best worldview, but mere simplicity is not necessarily beautiful, as the God’s Will and MMRPG examples demonstrate. We know our worldview will be incomplete – we have a axiom that says so. Why shouldn’t our ignorance all be tied up in one place: in a God of the Gaps, in a hidden random number generator seed and algorithm used by the MMRPG game computer? Why should we strive to look for patterns, for order, even at the cost of some complexity? Ultimately, there is something ugly about simple “explanations” with no predictive power and with a hidden multiplication of causes behind a simple facade. We sense that this is a sort of “slight of mind”, deceptive mental “magic” that in the end is smoke and mirrors and not a sound
diometric dating, for example, is false because nuclear force constants and Maxwell’s equations were once different in just the right way for us to be mistaken about the lifetime of the Universe and the Earth now, and we should rely on the Bible to give us the right answers instead.

Right. Talk about backwards, biased anti-reasoning. Even allowing for a worldview that does include God, I offer in rebuttal Aslan’s reply in The Lion, the Witch, and the Wardrobe – “Do you think that I would break the Laws that I made?”
basis for a worldview.

An example at the extreme limit of this is a strange worldview variant that holds that our experience is completely random, that the appearance of order ultimately arises from chaos in some complex field of being. This one works because a “paradox” of random numbers and real numbers is that the set of either one contains strings of arbitrary length that appear ordered. Now mind you, models based on this contain absurdly small plausibilities at first glance. If we suppose some sort of medium that randomly fluctuates with absolutely no order or correlations – think of a TV screen displaying random noise – we can estimate that it would take a very, very long time indeed for all the dots to fluctuate in just the right way so that an episode of *Leave it to Beaver* appears on the screen. The probability of a much larger and much finer grained fluctuation producing an entire Universe’s worth of apparently ordered time evolution is much smaller (but in principle can be nonzero or even unity, depending on how one chooses to take certain infinite limits). With certain choices, given enough time the appearance of apparent order for any finite interval of time for any finite volume of space can approach certainty in a random system.

This is the kind of thing our minds cook up when we try to doubt too well.

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36 As so frequently seems to be the case with strange worldviews, this one too has been explored in fiction in e.g. James Blish’s *The Traveller in Black*.

37 As students of statistical mechanics in physics rapidly learn, when I say absurdly small I really mean it. They are so small that it is completely safe to say that they are “implausible”. A classic example is the often asserted proposition that if a million monkeys typed for a million years at a million typewriters, they’d eventually type out a poem by Shakespeare.

Suppose that we ask for a sonnet – 14 lines, with a mere 50 characters per line (including spaces) and ignoring punctuation. That means that there are $27^{14 \times 50 = 700} \approx 10^{1002}$ permutations that our perfectly random monkeys could type of the 700 characters, giving them a special typewriter with only the alphabet plus a space key, no capitalization, no punctuation, no line breaks. If the present Cosmos in which you are reading these words lasts for 500 billion years (at the moment we’re up to around 14 billion years) that’s around $1.6 \times 10^{19}$ seconds. If we divide this number into the first, we can estimate – allowing generous assumptions for the number of sonnets and so on – that if you had a million monkeys typing an entire sonnet per second, each, they would have to type through the lifetime of well over $10^{970}$ Universes before there is any significant chance that they have typed even one of Shakespeare’s sonnets.

The chance of getting it within the lifetime of one specific Cosmos (say, ours) is 1 over this number, which is a number that is pretty darned small. That’s what we mean by “implausible”, or “absurdly small” when it comes to the probabilities of permutations of even moderate numbers of objects.

You know what’s really weird? Shakespeare was a human, that is to say a member of the primate family, a kind of evolved monkey, so monkeys managed to produce all of the sonnets well within the expected lifetime of our one actual cosmos. Fortunately, Shakespeare didn’t type his sonnets, and it seems likely that he didn’t generate them randomly...
How can we even weigh the evidence that such a hypothesis might be true? There is every appearance of a sort of esthetic order in our memories and observations but of course there would be even if our actions were as random and false as Beaver’s “Awww, Mom...” appearing out of static snow, as the works of Shakespeare typed by an $\aleph_\infty$ infinity of monkeys. We need a meta-axiom that prohibits this entire class of axioms or we might as well give up right now as knowledge of any sort becomes impossible – we’re right back in the Pit of Existential Despair. Incomplete knowledge of a structured Universe’s state is assumed as part of our non-completeness meta-axiom, but randomness as the Universe’s fundamental structure is the ultimate anti-explanation (however “simple” it might be). It suggests that when you get right down to it, there is nothing to know, only the transient illusion of something to know that could return to the true primordial chaos at any time. It is most unfortunate that this too is often an axiomatic component of theistic scriptural religions, notably Hinduism and Buddhism.

Ugly, ugly, ugly. Let’s put an end to it. Even if we’re wrong to do so, we don’t care, because if we’re wrong about this then knowledge is impossible anyway as there is nothing to know. At the same time, we don’t want to admit absurdity or open the floodgates to the bullshit reasoning of Platonic Idealism and other philosophies that made the perception of symmetry, order, and beauty (usually in the eyes of the inventor of the philosophical worldview as well as anyone he or she could convince) trump the far more important and powerful axioms above. We have to preserve consistency and predictive correspondence with evidence even at the cost of some subjective perception of “beauty” or “symmetry” or “order” in a proposed belief.

We can accomplish this by making it at best a tie-breaker, a rule that is as much a fond hope as an actual meta-axiom. We deliberately make it as weak as possible while still admitting it as a criterion.

9. Esthetics – Given two worldviews of similar complexity that do equally well at consistently explaining experience and evidence, the one that is most beautiful is (narrowly, marginally, barely) best.

It may seem a bit odd, at first, to have a meta-axiom of worldviews that is so horribly subjective as compliance with an esthetic principle, until you remember that your worldview is by its very definition a subjective construct from top to bottom. We have to make subjective meta-axiomatic decisions from the get-go or we’ll find ourselves paralyzed by uncertainty because reality doesn’t come with a set of instructions or a user manual of Perfect Truth (whatever religious theists might say). So let’s cut the shit and accept this and live with it openly,
even in science (which often pretends that it is strictly objective by sweeping its hidden assumptions – like the presumed existence of temporally continuous causal physical law that empirical evidence reveals – under a very opaque rug), and note that like it or not the best physicists have in the past and I’m sure will continue in the future to give considerable weight to beautiful theories that contain monopoles and Higgs bosons even in the absence of direct evidence – yet – that either one exists!

9.6 The Meta-axiom of Open-Mindedness

This still leaves all sorts of problems that have to be dealt with as one builds, or hacks, one’s personal worldview. What do you do when you have two worldviews, and one is simple but ugly and it doesn’t quite work and one is complex but beautiful and it works better? Or the other way around? Which should have precedence, beauty or simplicity or just plain function, as we have theories like the theory of monopoles that are simple, beautiful, but which don’t work because we lack any direct evidence for monopoles? What is the honest thing to do, when we truly do lack enough evidence to help decide whether or not the Knave Took the Tarts (however beautiful and simple the various theories presented by the D.A. appear to be)?

The best thing to do, when building worldviews out of pieces that don’t quite fit, that aren’t yet elevated by experiment, experience, or strong argument to a state of relatively high plausibility compared to the alternatives is to keep them all, and simply move them gently and reasonably consistently up and down your personal scale of plausible belief as you learn more, as new evidence emerges.

This axiom applies, or should apply, even to very implausible notions, to things that are absurdly unlikely to be true according to your common sense. Don’t assert that fairies do not exist as absolute truth, simply observe that nobody has reliably reported that they do, and you yourself have never seen one and hence are naturally somewhat skeptical. “Somewhat” in this case might be very skeptical indeed but since it is not certainty (certainty of most non-contradictory notions or collections of notions concerning the Universe being more or less prohibited by the Cox meta-axioms), you leave yourself open to change your mind if you go outside some evening and small winged glowing beings sprinkle dust on you and you start to fly.

As of the day that I write this line, although the first hints that the Higgs might objectively exist have just emerged in the early results out of the LHC.

It is precisely this sort of mental agility that is associated with excellent outside-the-box
It is clearly important that our axiomatic theory not assert its own correctness – so much so that this meta-axiom is intimately connected to the Gödel theorems we’ve already discussed. Simply stating it in bare mathematical terms doesn’t suffice, however, because we need our worldview building meta-axioms to be *useful* to us even if we are *not* mathematicians.

For that reason, I’ve tried to formulate this essential meta-axiom in many ways, and am still not completely happy with the result, but this is very much self-consistent with the meta-axiom itself. Here’s what it says a different way: Don’t *expect* to be completely happy with any given set of meta-axioms or any given axiomatic worldview consistent with them. We don’t *have* a perfect metric in the space of all notions, not even on the “principle axes” picked out by the meta-axioms that lead to a not-too-inconsistent (so far) system of beliefs about the *physical* aspects of the apparent world (also known as “the Laws of Nature”) let alone the ethical or economic or social (human) world. Emphasizing one “parameter of worldview excellence” such as simplicity at the expense of consistency or emphasizing the ability to explain one piece of evidence at the expense of the quality of explanation of another simply builds a conceptual cage with solid walls through which you will not *permit* your worldview to pass from where it is now to where it (perhaps) needs to be. Let’s understand why.

The idea is simple enough. A worldview is *not absolute truth*. this is obvious. It *can’t* be, it is incomplete, it is built from limited evidence, it contains a lot of very difficult explanations and an enormous number of “facts” that are themselves nothing more than things we believe very, very strongly (but that could still be wrong). I’m a physicist and know a whole lot of stuff that you probably don’t. You almost certainly know stuff that *I* don’t. At any rate, our experiences in life have been different, we have a different knowledge of and degree of trust in the data obtained in scientific experiments, we have different abilities to do things like solve logical and mathematical puzzles and problems, and we’ve had different educations.

*Neither* of us are going to have the exact same worldview, and *neither* of our worldviews are going to be absolute truth.

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problem solving skills, high IQ, paradigm shifts, epiphany in general, and the romantic ability to provisionally suspend disbelief and enjoy a rollicking good science fiction novel. Being open minded (but not credulous – note well the need for balance) is an essential feature of the philosopher seeking to build an optimal worldview. It is a kind of *humility* – the knowledge that our experience only goes so far and our vision is terribly finite, and that heck, even the LOTR cosmos might have independent objective reality and one day we could be transported there to fight orcs side by side with the elves.
Finally, our worldviews are not static, they change over time, so my worldview today is not precisely what it was yesterday, and is very different from the one I had when I was forty, or eighteen, or twelve, or six years old.

How crazy would it be for me to assert that my own worldview as of this instant, today, is absolutely correct given that according to inferences based on my own immediate memory of my own past life, it almost certainly won’t be the same tomorrow and yet I’ll still think it is the best that I’ve got (so far) then as well? How crazy would it be for me to assert that any major part of my worldview is absolutely correct? How difficult is it for us to find the truth, the absolute best worldview (best by virtue of being completely, perfectly, correct – true in fact and not merely apparently true by virtue of perfect correspondence)?

Again, we need to draw on the theory of optimization on high dimensional spaces for some spiritual sustenance here. However, you probably have no idea what this even is, let alone why it is relevant. So bear with me while I explain, with only the tiniest bit of arithmetic.

Imagine a rough, corrugated landscape on a two dimensional space, such as the surface of the Earth. Imagine further that you are a very shortsighted creature, such as an ant, but that you are equipped with a very accurate altimeter. You are born somewhere on that surface and are driven to become the Edmund Hillary of antdom and find the highest point on Earth.

The very simplest search strategy is to start from whereever you are, and go “straight uphill” from there, following the slope until you reach the top. Initially, this works well enough. Your ant-vision is extremely shortsighted; all you can see is the immediate vicinity of the point you are standing on. This is enough for you to be able to tell what direction is “uphill”, but nowhere near far enough to be able to see across any valleys to locate nearby hills (if there are any) that are in principle in your field of view.

Now, if you simply start walking uphill from any randomly selected location on the planet’s surface (pretend that there is no water, so that the ocean floor just counts the same as the dry land above), the probability is almost unity that you will walk right up to the top of the nearest clod of dirt, or anthill, or boulder, or even (with a bit of luck) to the top of an actual hill. The chances that it is the right hill are essentially zero, though, because the projective area of the part of the slopes of Mt. Everest where going uphill at every point will take you to the top is a tiny fraction of the total projective surface area of the world.

A foolish ant will therefore climb to the top of its own anthill, wander around a bit in its immediate vicinity and learn that there are no higher points nearby,
and proclaim itself conqueror of the highest mountain in the world. Only we, possessed of “God vision” relative to the ant, can see that its anthill is tiny indeed. Perhaps it is on the plains not far from the slopes of Kilimanjaro, but much farther than any enterprising ant can walk in its lifetime. Yet it may well be that our intrepid ant explorer that lives in this particular anthill feels very secure in its belief that its very own ant colony represents the highest point in the world, quite unaware that there is an enormous mountain just a bit farther away than it or any of its ant-ecedants have ever explored. And even that mountain isn’t even close to being the highest mountain.

So what does a wise ant (one that has some idea of how large the problem space is, and how unlikely it is that its easy solution is the best one) do? It needs to use a global strategy. It needs to come up with search strategies that gradually explore the entire surface of the planet, not just the vicinity of one particular anthill, because even though a solution may appear to “work” locally, with all directions from a peak being downhill, there are many, many peaks of wildly varying height and width, some of them are peaks on the slopes of peaks on the slopes of peaks, with many long and torturous valleys in between.

Got that so far? Now let’s make the problem a bit more complicated. Suppose this rough, corrugated terrain isn’t supported by only two dimensions, but many dimensions. Most real optimization problems fit this sort of description. Think about how many variables are needed to specify things like the most probable weather tomorrow, the most probable value of the stock market a week from now, the best set of parameters to use to optimize the productivity of a factory making a car, the particular values of the genes required to build a human being out of all possible kinds of things genes can build.

To give you a crude idea of how this increases the difficulty of the problem, let’s imagine that we have exactly thirty dimensions that we need to explore and that we’ll be satisfied finding the best value within a range of 10% in each dimension (so each dimension is more or less discretized in tenths, and we just want to find the best box). There are now $10^{30}$ boxes to explore! To simply check each box to find the best one (ignoring any surface variations or hill-climbing on a scale of less than a tenth of each dimension’s range) would require more attempts than the book or device you are reading has molecules! Finding a needle in a haystack or a particular grain of sand on a beach, are “easy” problems in comparison – here one isn’t exactly looking for a “needle” as the ranges of each dimension are being rather coarsely partitioned, but it is a thousand times easier.

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40 Oooh, sorry.
to exhaustively search a thousand kilometers cubed (a billion cubic kilometers) on a millimeter scale \((10^9)^3 = 10^{27}\) looking for a particular grain of sand than a mere thirty dimensional finite space at a resolution of only 10%.

Now consider how many “parameters” a worldview contains! Some of them are big, binary parameters – is it or isn’t it plausible that there are one or more Gods? Some of those parameters examined in more detail turn out to have entire subspaces of additional parameters. If Gods exist, how many Gods exist? One? Ten? A thousand? Is there a (relatively) plausible upper bound? Don’t be too hasty to answer, remember our friend the ant, climbing to an easy, but horribly wrong conclusion based more on the particular biases inherited from the local beliefs of his particular ant colony. Consider the laws of physics – how many parameters are there – how many forces, how many force constants, how many possible force laws are there. We know of at least four spacetime dimensions from observation, but there may be more – far more. Even the dimensionality of the problem space of our worldview is a parameter in the space of all possible worldviews, and we may quite literally lack the long-range vision to see Mount Kilimanjaro looming just out of sight in the near distance, let alone Mount Everest.

Hopefully this gives you some small idea of how absolutely enormous the space of all notions is, how impossible the task of picking truth – or even a very good approximation of truth – out of the whirl of near-infinite possibility is. Fortunately, we are not entirely unarmed against this deep sea of troubles. Nature (and a lot hard work in computation and mathematics) has revealed to us certain global search algorithms that are much better than “just” linear/local gradient search methods, augmented by e.g. Monte Carlo (sampling randomly selected points on the entire available terrain).

One of the most powerful search methods known to humankind is the genetic algorithm where a population of individuals sample the space and share their information in some way, using a selection mechanism to define “uphill” and search for the best volumes of the space sampled – so far. The genetic algorithm is quite powerful – it has produced us, for example, and continues to be an

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And Shakespeare – providing something of an answer as to how monkeys could type a Shakespearean sonnet, not as random ignorant keybangers but as participants in a reproductive process that selects for and rewards monkeys that produce non-random strings that encode meaning and structure (eventually) in the style known as a “sonnet”.

To put it another way, while celibate, unmotivated, random keybanging monkeys will never succeed, fucking monkeys trying to impress potential mates with their cleverness can apparently manage it in a mere million years or so, inventing the typewriter along the way to have something (else) to bang on...
important component of the memetic evolution of our worldview.

There are several other useful ones, each of which has a place in global search strategies: simulated annealing (a way of permitting hops from peak to peak across intervening valleys to find a relatively good one) and importance sampling Monte Carlo which relatively quickly finds “promising” or “relevant” fractions of the overall terrain to explore and then explores them in ever greater (weighted) detail. But it is not our purpose to “explore” global optimization strategies in detail at this time; rather we wish to establish that we absolutely must have them enabled by our meta-axioms, lest we fall into the trap of the foolish ant.

The moral of this story is quite simple, really. Our “vision” is finite and bounded. We cannot even determine the correct scales of the significant variations of the terrain we are optimizing in except by sampling and searching that terrain on ever larger domains, at ever finer scales, and we will always run the risk that no matter how good the best solution that we’ve found so far is (that is, how much it is in agreement with evidence and experience and the rest of our network of beliefs), right over the horizon we might have an experience or an insight that leads quite suddenly to a much better one that confounds the previous one, at the expense of changing the way we view everything.

We absolutely need a meta-axiom for this, one that keeps us from having to absolutely choose between e.g. beauty and compactness separately, one that permits us to keep provisional, mutually contradictory worldviews both ways, as partial truths that may be eventually connected to a bigger, better picture in still more dimensions or at still greater range that resolves the apparent contradiction or supports one but not the other in an explanatory way. It is the meta-axiom of personal humility, the axiom that openly acknowledges that we don’t know everything and that anything we believe could turn out to be wrong. It is the meta-axiom that leads to happy marriages and prevents religious wars. It is a

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42Indeed, in a strange sort of way we are engaging in memetic intercourse right now, literally and figuratively, as I attempt to pass on some new worldview-building memes that you might find better – more “fit” to survive the selection process going on in your own head as you read them – than the ones you began with. And in the course of public debate over this book’s contents and assertions, others who disagree or who note things I left out or missed may contribute those missing pieces, and our worldview-building abilities will continue to evolve as they have evolved in the past in meme-space.

Hopefully the entire experience has been consensual and satisfying for you. It certainly was for me...

43For example, one day you might wake up and see some tentacled monstrosity you have a strange urge to call “Mom” pulling a wire from your cephalopod body and hear her croak to you to stop playing that damned neural interface game Destruction of the Third Planet by Hairless Ape-Beings and take out the garbage...
meta-axiom that might keep you alive one day as you fasten your seatbelt even though you know that you are the world’s best driver and will never ever skid off of a road.

To provide all of this and more, I give you the Meta-axiom of Open-Mindedness:

10. **Open-Mindedness** – Don’t ever assume that your worldview is the best one, only that it is the best one you’ve found – so far. Never assume that somebody else’s worldview is completely wrong (if it isn’t as good as yours in some way), only that it may be less correct – so far.

I call it open-mindedness instead of “uncertainty” or anything similar because in my opinion its purpose in human discourse is to encourage a certain healthy degree of modesty concerning one’s worldview; it is an “anti-righteousness” meta-axiom. Yes, your worldview may be much better than mine, but mine could have a key ingredient missing from yours, one without which yours will never be right! Overall, we will both be better off if we can get together and rationally compare and share ideas from our worldviews, and possibly both end up with a new one that is better than what we had before. At least, we would be better off if we can honestly agree on the proper basis of rationality itself, so that our Cox axiom assessments of plausibility (given the same data) come out at least approximately the same. Otherwise we are right back to: “Is so!”; “Is not!”; “Is so!”... ad nauseam, usually screamed at each other as we battle one another with bayonette-equipped AK-47’s and hand grenades. And hence this book.

It also means that I have something simple to do with notions that are “beautiful” or “simple” or “compelling” but for which there is no direct evidence – things like magnetic monopoles, Higgs particles, and God(s). Without direct (or at least very strong indirect) evidence for them it seems unreasonable to promote them to a degree of plausible belief particularly near “certain” no matter how pretty they are – to you. Similarly, even a very ugly idea may be something you believe with a lot of confidence if it is well-verified by experiment. You might well hope that this ugly idea will eventually form part of a beautiful theory, but in the meantime you take what you can get, what works best.

Note well: I went to great lengths above to indicate why open-mindedness is a necessary meta-axiom for worldview building, not just a platitudinuous virtue in human discourse. While the Cox axioms alone are not “intrinsically” local

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44I’d add, “and cuddle for a bit afterwards” except that it would make the whole thing too weird, wouldn’t it? Still, loving thy neighbor does indeed imply sharing, and what could be more important to share than a worldview? Except food, drink, shelter, safety, and Maslovian stuff like that, of course...
as a purely mathematical differential statement, their implementation as the foundation of an actual search for the optimal worldview (given experience and evidence) quite naturally functions primarily as a local differential search in the space of notions, performed by “fixing” almost all of the basis of one’s knowledge and focusing on the effect of one small stream of experimental data or experience on one’s plausible belief of just one thing.

Science is indeed performed almost exactly in this way, much of the time – experiments are designed to test single hypotheses whenever possible, although sometimes a single stream of data bears on several all at once. When the body of “fixed” hypotheses start to lead to contradictions between data and any sort of local hypothesis conditioned on the fixed ones, however, the fixed hypotheses themselves come into question and worldview revolutions can and do occur. The fixed body of classical physics could not be made consistent with experiments on the speed of light and with spectral data and observations of the stability of atoms once Maxwell’s equations were inferred and proved to be otherwise numerically consistent with an enormous body of data to very high precision.

The axioms that replaced them to lead to consistency with both the failed observations and with many more new observations that were subsequently made were those of relativity and quantum mechanics, which in turn had to be fused into relativistic quantum mechanics, which required the formation of relativistic quantum field theory. The latter theory is still incomplete and inconsistent in places, and it may well require revolutionary rearrangement in its own right before consistency is achieved. To accommodate this sort of thing science allows for emergent or partial hypotheses – ones that explain some of the data or even some aspect of some of the data at the expense of conflict elsewhere, in the hope that eventually some Einstein will come along and have a moment of critical insight that fuels a far jump, a paradigm shift, that explains everything by synthesizing and correcting the partial theories.

Social axioms and the axioms of religion, however, are far more resistant to this sort of radical rearrangement. These axioms contribute to a locally optimized worldview that is typically very resistant to change and very intolerant of alternative worldviews from other regions or cultures. These “intolerance” meta-axioms basically function to “lock down” components of the regional worldview and isolate them from the Cox axioms so that contradictory evidence is not permitted to alter the degree of plausible belief (or more practically, their implementation as social and religious custom and law). They are removed from the realm of plausible reason altogether and become a part of the implausible reason, the unreason, that forms an unfortunately large part of the worldview of most
people.

The meta-axiom of open-mindedness stands in direct opposition to the far more prevalent meta-axiom of naturally intolerant “religious” belief (and its axiomatic spawn). We are engaged in a search for the truth, one where success is never certain, where we ever risk the complacency of the foolish ant, with no real guide but our sensory experiences and the network of consistent axioms that we believe the most because we can doubt them the least so far. We must ever be prepared to abandon the tops of our parochial anthills and strike out across unknown terrain searching for Mount Kilimanjaro. And even there, on the top of a real mountain surrounded by a vast plain, we must maintain a real belief that there may well be a mountain range higher still, one where the average height of the terrain may exceed the height of Kilimanjaro’s lonely peak.\footnote{As is the case, of course – the average height of the high ranges of the Himalayas is higher than Kilimanjaro...}

Only if we maintain this sense of romantic adventure, this strong belief that our beliefs themselves may well be wrong in ways large and small coupled to a willingness to change our minds when our beliefs are contradicted by experience and reason can we as a species continue to advance, can our collective worldview continue to evolve to an ever better one. We are engaged in a global search, and there is no place in such a search for meta-axioms that constrain the global solution and lock them down to the point where they cannot be changed.

9.7 Beware the Black Swan

There is one more aspect of the already observed degree of complexity in the world that deserves to be turned into a meta-axiom. Once again, it may not be strictly “necessary” – in a way it is a direct implication of some of the discussion above. Nevertheless, it is sufficiently important to merit a careful explanation and its addition to our list, since we are trying to provide good guidance for those seeking what to best believe.

As I mentioned a few times in the sections above, Nassim Nicholas Taleb recently wrote a lovely book called The Black Swan. Rather than recapitulate or review his own lovely prose (however much I recommend to the reader that they take time to purchase and explore it for themselves) I will simply extend some of the ideas and conclusions laid out above to motivate the exact same thing.

Consider the following: If the scientific worldview is at least approximately
correct about things like the size of the visible Cosmos, quantum theory, relativity, the number of galaxies in the visible Cosmos, the number of visible stars in those galaxies, and so on, we are being influenced in various ways by objects almost 14 billion light years away, from their motions all the way back in that remote past, and by all the objects in between, each with its own lag time.

The laws of physics (classical or quantum physics) give us predictions for the future time evolution of any small subsystem of the Universe that are appallingly sensitive to these remote influences. They don’t necessarily change everything “instantly”, but the changes they produce accumulate and in time they cause both quantum and classical predictions to fail when we extend them too far into the future.

As one proceeds closer to the “experiment” – our own brains, say – there are fewer and fewer objects to account for, but the influence of the nearby objects is potentially a lot more rapid and stronger. Eventually we get to objects like “your spouse” or “your children” that can completely change the otherwise likely immediate course of your action in a heartbeat, and once this change is made your life will quickly diverge, quite possibly radically diverge, from the track it would have taken otherwise.

Some – perhaps many – of these influences are usually benign and slow, or are reasonably predictable. Physics (and to a lesser extent the other sciences) are something of a success story here – we can usually trace the causal time evolution of much of our local physical environment well enough to successfully “engineer” devices that are useful to us, to understand much of what we see (at least in the short run), and to form a reasonably good foundation for the building of a worldview at larger, but also more subtle and complex, scales.

Others disciplines are not, however, so readily tractable, and it simply isn’t possible (so far!) to construct truly useful, meaningful, explanatory or predictive theories. The reason I am including black swans in the meta-axioms is because the black swan metaphor illustrates a critical weakness of inference in a large, open system. Since black swans per se have already been used as a metaphor, I’m going to present instead two slightly different metaphors that illustrate opposite aspects of the same general problem.

One (one of my favorites, actually) is “pink unicorns”. If I offer up as a hypothesis/notion:

Pink unicorns currently exist as an actual animal species somewhere on Earth.
you will probably reject the notion and not grant it much belief, in spite of the fact that we have an actual statistical adage that says that the “lack of evidence is not evidence of lack”. Still, we have explored a good deal of the Earth’s surface in some detail, and it does seem likely that if a breeding population of pink unicorns was out there, we would have discovered them and put them in zoos or be raising them on pink unicorn farms for sale to the general population.

At one time, of course, European/Western people viewed “black swans” in exactly the same way. They had white swans aplenty, but nobody had ever seen a black swan that wasn’t just dyed or melano mutation of a white swan species.

Then Western settlers arrived in Australia, and found – black swans! A lot of them. A whole species of them. Oops. We already have an axiom that reminds us to be open minded (and not be a prig) about axiomatic beliefs, but this is more about how we handle notions unsupported by data – so far – than it is about how we handle competing notions that do explain something.

The moral of the black swan story is that we should avoid stating, even to ourselves, “There are no such things as pink unicorns” simply because we haven’t found them yet. We cannot be certain that any such assertion is true unless we can somehow look everywhere for them. Perhaps when Atlantis sunk below the waves, the Atlanteans survived in secret high pressure domes located underneath camouflaging reefs and preserve there an entire species of – pink unicorns. Have you checked every underwater reef, with sophisticated probes, to be certain that this is not the case? No? Then it remains a possibility, however unlikely. Then there is the chance that they have long since been discovered but are being kept hidden by crazed industrialists hoping to corner the pink unicorn market one day – the pink unicorn variation of the Roswell theory of government conspiracy hiding evidence of space aliens. Maybe those aliens are pink unicorns... can you be certain that this is not true?

Perhaps there is a mad geneticist out there whose daughter is crazy about the TV show “My Little Pony”. On this show, “Fleur Dis Lee” is a fictional pink unicorn. Perhaps for her fifth birthday, he genetically altered a horse embryo so that it would have pink hair and a perfectly spiral horn growing out of its forehead, borrowing genes like crazy to do it. Just maybe that animal is now being ridden around by his daughter, but only on their large Texas ranch where no one can see. It’s a long, complex story, and to be sure it violates several of our meta-axioms above and should certainly be considered to be rather implausible in the absence of evidence and presence of a complex and ugly explanation, but it could be true.
This handful of contrived explanations for how pink unicorns might actually exist even though there are no reliable reports that they do in fact exist leave the proposition unlikely to be true, for sure, but can you be certain that none of them – or any of the eighty million other stories one can concoct that might explain why you haven’t learned of pink unicorns, so far, even though they really exist – aren’t true? Let’s face it – much as I think pink unicorns probably don’t exist and that it is a bit silly to assert that they do, no matter how cute they are or how amazing the world would be if they were real, I could be wrong, and pink unicorns might exist in reality and not just in my imagination, right here on Earth.

Note that the argument against pink unicorns, or black swans before them, is a kind of statistical argument. This should be starting to make sense – almost all of our higher-order knowledge of the real world is based on statistical arguments that equate regular associations of objects, events or experiences with causal linkages and/or membership in organized structures.

Here’s the key idea of it: absence of evidence may not be evidence of absence, but it also damn well isn’t evidence of presence. We would consider it crazy to assert “I’ve never before seen a single shred of evidence that a single pink unicorn exists, let alone an entire species, herds of them, so I’m therefore certain they are real!” Somehow, on a quantitative and qualitative basis both, the more places we look without finding something we are looking for, the less likely we should believe that it is that we eventually will find it. If I empty my pockets and turn them inside out looking for a quarter and don’t find one, I don’t really expect that if I do it all again one will suddenly be there.

If I don’t own a dog and lock all my doors and windows when I leave the house in the morning, I really don’t expect to find a dog in my house when I come home in the evening, especially one that was really there all the time, hiding and living on food scraps in the kitchen late at night! I could easily be forgiven, if asked “Do you have a dog at home?” , for replying “No sir/ma’am, I do not” even though you have never actually searched in the attic for a dog and cannot be certain that there isn’t a dog hiding up there, somehow. It just seems very, very improbable that you are wrong.

The trouble with this assumption – that things that you believe to be very, very improbable are, in fact, very, very improbable – is that the assumption is wrong a lot more often than most of us expect! We are simply a lot more ignorant of all of the factors that go into our seat-of-the-pants estimates of probability or plausibility than we think we are. True, you left the house with no dog inside in
the morning, but your adult daughter (who has a key) has been thinking for some time how nice it would be for Pops and Moms if they had a playful little puppy. Or perhaps Moms encountered a dog-a-thon shelter adoption station and fell in love and brought it home with her. Or a neighborhood dog discovered that the latch in your back door didn’t quite catch when you left in the morning and has wandered in to help himself to your leftover bacon. You made your estimate in ignorance of these things, assuming that just because they (as far as you know) didn’t happen yesterday they wouldn’t happen today as well.

Think of the weather. I’ve lived for substantially less than a century, but somehow I’ve experienced weather extremes that are supposed to be so unlikely that they happen only once in a century, or once in five centuries, on multiple occasions. And don’t even get me started on politics! Why else would Douglas Adams spoof an “infinite improbability drive” where things have to become improbable enough for us to be certain that they are bound to happen at any instant because of the sheer perversity of the Universe.

There are many ways we could name the meta-axiom that we need to deal with this. We could call it a “humilty” meta-axiom, for example, as it is intended to remind us that we are a lot dumber than we think we are, and know a lot less than we think we know, and that humans generally suck at computing probabilities or understanding statistics on paper and in possession of a lot of actual data and should almost certainly refrain from using it off the cuff to somehow transform “I don’t know” into “I’m certain”. We could call it the “black swan” (or pink unicorn) axiom, but that would be a pure rip-off.

Both of these also fail to properly convey the consequences of the disrespectful treatment of probabilities. I think it is really, really unlikely that my house (in suburban/rural North America) contains a cobra right now. Indeed, I have a hard time even making up a scenario where it could plausibly contain a cobra. But hey, if there were a cobra coiled up near my feet right now, ready to strike, that would be very, very bad. Much of today will indeed be like much of yesterday, but the little bit that changes in ways you cannot anticipate or control can have severe consequences!

So every now and then, when building your worldview, do a “cobra check”. Some of your beliefs, however well or poorly founded, if wrong, might have severe consequences. This is really Taleb’s point in writing his book – you might think

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46 This has in fact happened to me with my wife, more than once. I not only had a dog in the house I didn’t expect, I had a dog that actually lived there and didn’t know about it – yet.

47 This is not completely academic. Last week I would have told you that pretty much the only poisonous plants of consequence that you need to watch out for when walking outdoors in
that nuclear war is very, very unlikely to happen, but the consequences if you are wrong are serious enough that you should be concerned. A single unexpected super-volcano eruption can ruin your whole day. Or century. It simply isn’t safe to assume that the worldview that seems most likely today, with all of its estimates of improbable notions, is either correct or persistent. The Universe is a lot more perverse than that. Hence

11. The Perversity Principle – Things that you believe to be unlikely happen all of the time, because your beliefs and estimates of probability are not well-enough informed and are often simply mistaken. Be humble. Beware the Black Swan.

There, I managed to get all three things in, but “perversity” seems a better match than either of the other two for what is missing. As compulsive gamblers know all too well, “sure thing” bets fail all the time, and “long shots” come home a lot more often than you might think they do. That doesn’t mean you should be stupid, and bet on long shots and avoid sure things, but it means that compulsive gambling is a great way to end up broke and alone, living on the street.

Be warned, this isn’t an open invitation to indulge in Pascal’s Wager – assign large plausibilities to very implausible ideas in the absence of evidence just because somebody attached a very large cost to disbelieving in them. Just because being bitten by a cobra is very bad is no reason for me to hire a special exterminator to check my house for cobras every morning before I get out of bed, and just because certain highly implausible religions assert that it is certain that you will be tormented for an infinite amount of time if you fail to believe in them in spite of their implausibility is no good reason to indulge in belief in them.

It is time to stop our specification of meta-axioms now, before we give in to the temptation to add meta-axioms that overconstrain axiomatic solutions we might look for (and hence violate e.g. open-mindedness, or simplicity). This set is already potentially weakly inconsistent, but it nevertheless self-consistently explains that this weak inconsistency is necessary to enable global search for the best consistent set of axioms. Before going on to an examination of specific axioms sets that form parts of worldviews, it is worthwhile to write them all down in one place, though, if only as a handy-dandy reference you can come

the United States are the three members of the Poison Ivy family. Last week, however, I saw the first indication that there is a brand new invader, the Giant Hogweed, that makes poison ivy look downright benign. Is it growing in my own back yard? It could be, making my prior belief that only poison ivy and poison oak are at all prevalent in my neighborhood wrong in a very costly way...
back to from the later chapters.
Chapter 10

Summary of the Meta-Axioms

*Horatio:* O day and night, but this is wondrous strange!

*Hamlet:* And therefore as a stranger give it welcome.
There are more things in heaven and earth, Horatio,
Than are dreamt of in your philosophy.

*Shakespeare’s Hamlet: Act 1, scene 5*

Here is the list of our meta-axioms so far. Remember that this list is provisional (all axiom sets are provisional, plausible beliefs, self-consistently conditioned on their continued correspondence with evidence and experience). It is probably incomplete. It is just inconsistent enough to allow for its own ability to be changed and to self-consistently enable a global search for a consistent axiomatic theory that is both in agreement with the data and simple and compact and beautiful while allowing each of these desirable dimensions to be explored independently, considering theories that are beautiful and simple but not yet supported by data, theories that are ugly and complex but that do explain the data, theories that are beautiful and explain the data but are not simple, and so on.

As we’ve seen, it would clearly be foolish of us to meta-axiomatically insist on any one of these parameters of “goodness” having priority over the others in our search process for the best possible worldview or we can all too easily achieve perfect agreement with the data by means of “easy” worldviews such as solipsism or fairy theories or religious theories that make everything “God’s will” or risk being stuck in a beautiful theory such as classical physics that is also remarkably simple but fails to explain the data where a much more complicated theory (with its own kind of beauty, nevertheless) works far better.
By remaining open minded, we can safely explore all sorts of emergent theories and use *judgement* to determine what particular set of axioms works *best*, and can even cover different aspects of our experience with “patches” of belief that work well locally but still contradict other parts of our belief (hopefully minimally), as long as we maintain our perspective and remain willing to *change* those patches to something more globally consistent (and/or simpler, and/or more beautiful) when the data demands it or insight reveals it.

So here they are:

**Primary Meta-Axioms**

1. **Unprovability** – An acceptable axiomatic worldview must be unprovable and incomplete (to allow it to be consistent, so far).

2. **Mathematics and Logic** – Axiom sets leading to consistent theories of symbolic reason are acceptable for inclusion in a worldview.

3. **Real Plausibility** – Degrees of plausibility (of the truth of proposed worldview axioms or consequent theorems) may be represented by real numbers (or well-approximated by discretized e.g. binary representations or ordinal analogue electromechanical states of e.g. neurons).

4. **Common Sense** – Plausibilities can only change in qualitative correspondence with common sense.

5. **Consistency** – The complete network of mutually related axioms, theorems, and beliefs with their real-number plausibilities should be quantitatively consistent.

6. **Honesty** – Axiomatic worldviews that are built upon and supported by an honest, open, and well-founded process are better than worldviews that are based on lies, on contradictory propositions, or on evidence corrupted by (de facto dishonest) confirmation bias.

7. **Predictivity** – Axiomatic worldviews that (both) correspond well to the world of our past experience and predict or explain new experiences are better than worldviews that have a poor correspondence to our experience and/or have less predictive skill.

8. **Ockham’s Razor/Simplicity** – Axiomatic worldviews that are simpler (e.g. are parsimonious, have fewer axioms) are better/more plausible than worldviews that are more complex, all other things being equal.

9. **Esthetics** – Given two worldviews of similar complexity that do equally well at consistently explaining experience and evidence, the one that is most beautiful
is (marginally, narrowly, barely) best.

10. **Open-Mindedness** – Don’t ever assume that your worldview – or anyone else’s – is the best one, only that it is the best one you’ve found – **so far**. Never assume that somebody else’s worldview is completely wrong (if it isn’t as good as yours in some way), only that it may be less likely to be correct based on what your experience and most plausible belief set indicate – **so far**.

11. **Perversity** – Beware the general perversity of the Universe; it has many parts. Allow for it in your worldview. Be humble, you know less than you think you know (no matter what you think you know). Check for metaphorical cobras under your metaphorical bed while building worldviews.

There are indeed more things in heaven and earth that are dreamed of in our philosophy. There are more things in heaven and earth that can be dreamed of in any finite philosophy, and yet the space of possibilities spanned by our dreams nevertheless almost certainly dwarfs the set of axioms required to completely specify reality, the correct set of true notions, as it contains these truths and all permutations of the ways that they could be false besides.

To build the best possible collective worldview from this enormous space of notions and dreams given the brief span of a lifetime and our own unique set of experiences along the way, seems like a suitable activity to self-select as our human purpose, the self-determined reason for our existence. All other goals, all other activities we engage in, are subsidiary to this process, because knowledge and the choices knowledge enables are our sole source of enlightenment, the characteristic thing that differentiates the human from the mere biological animal (at least to our self-aware egos). If the term “soul” has any meaning in our worldview, what we are knowing – that amalgam of our thoughts, sensations, memories, perceptions – is our soul. Our ever-improving knowledge gives honest meaning to life itself (as opposed to the complex set of wishful thinking, lies and myths that arise from perpetuated ignorance, vested interests, and assertions not supported by experience), pulls us out of the Pit of Existential Despair and into a state where things – for better or worse, predictable or perverse – make sense.

In order for us to make good progress, however, it is essential that the process of developing the best possible set of plausible beliefs be understood. Even if you are no mathematician, no logician, not a physicist or “hard” scientist, you are fully capable of understanding the meta-axioms above and can see how each one of them is somehow necessary in order to enable a search for meaning in our lives, for meaning can only come from understanding and deliberate choice.
The rules above are the rules that govern reason itself, not just as dry and empty mathematics, but as mathematics and reason about something. About everything, both the real and the imaginary, everything that is true and the terrible $\aleph_\infty$ infinite space of notions, of propositions that might be true, of ideas that we dream up as we build worldview-castles in our minds and compare them to our ongoing sensory stream, seeking the best possible, most consistent fit.

We have carefully left room not only for “science” but for ethics, even for religion. As we select worldview axioms for our society and government, we can freely do so on the basis of the beauty of the final result, as long as we don’t egregiously violate our most plausible beliefs in other domains such as science to get there (which would be ugly and inconsistent both). Theist and atheist can differ in many of their personal worldview axioms and yet agree on a common foundation for an ethical society. Things like torture and genocide – however much they are strongly represented in our cultural history – may or may not be “sinful” (since “sin” refers to a judgement rendered by a hypothetical authority, e.g. a supreme being, whose existence we might well freely doubt) but we are certainly free to consider them ugly or undesirable in any society we might wish to live in using no judgement or authority but our own.

My purpose from the beginning has been to bring you to this point, where you can finally choose your own axioms with a solid foundation of meta-axioms that will help you make reasonable and honest choices, and that help you understand why one choice can be objectively better than another. If we can at the very least choose to agree that these meta-axioms are reasonable ones to guide the future development of our personal and cultural worldviews, we may not agree about all of the specific axioms of the “best” worldview (how could we, given different data, different abilities, different experience), but perhaps it is enough for us to be able to arrive at general agreement about the most important parts

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1Sure, sure, I’ve been pretty hard on ancient theistic scriptural religions (and will be harder still in later chapters), simply because they are really enormously silly; they are immediately contradicted by all sorts of history, science, and quotidian experience. Yet as superorganismal worldviews, they have a life of their own because of their extremely efficient defensive axioms, their wealth and political power, and their peerless mechanism for memetic transfer between generations.

However there is, as I will discuss later, a single axiomatic assertion of deity that is not overtly self-inconsistent or contradicted by evidence: panendeism – the self-organized sentience of the Universe itself. Is it proven (or disproven) by my personal experience in life so far? It is not. Is it plausible? Are worldviews that include such an axiom better – more beautiful, simpler, more honest, do they provide better insight or understanding?

This you must ultimately decide for yourself, while remaining, as always, open minded and tolerant of those who choose differently.
of a common worldview while still not being so rigid as to inhibit further search and the accommodation of the differences.

This could, quite literally, usher in a golden age of reason, world peace, and much more. There is no rational reason for the human species to live in constant and violent conflict, but there is no rational foundation for a system of globally accepted beliefs and government that would permit us to avoid it. We are still the prisoners of our memetic evolution, living with Bronze Age moral rules and standards in the Information Age, where the only thing that stands between us and the ability to fully use our knowledge for our collective good are myths and traditions and laws that memetically evolved to support a tribal culture engaged in a state of more or less constant genocidal conflict with its neighbor.\(^2\)

With the right axioms, some open-mindedness, and a dollop of actual reason to replace the unreasoned authority-derived myths, we can surely do better. Much, much better.

Let’s see how.

\(^2\)See, for example, Numbers 31 in a handy copy of the Bible, or read the Mahabharata. Yup, that’s Moses ordering infanticide, genocide, theft, and the inevitable rape of the surviving virgin slaves. That’s the guy that supposedly wrote down the “commandments” that are a major axiomatic component of our society and you wonder why we are eternally at war? Or consider Krishna, sitting in his chariot and preparing to help Arjuna wipe out all of his cousins...
Part III

Axioms of the Rational Worldview
Chapter 11

Axiomatic Worldviews

It is time to begin our examination of explicit worldviews and worldview components. If I have done my job well, you should be in a state of surprising mental clarity going in.

We have established that it is best to believe the most what you can doubt the least, which certainly sounds plausible – the alternative being to believe the most what we doubt the most or something randomly selected from a list of ideas sorted by doubt, both of which sound silly if not openly contradictory of the idea of “best”.

We have established the Cox meta-axioms as the eventual basis (as you will very shortly see) for a quantitative measure of doubt expressed in real numbers that manifestly works to provide us with an extremely sound basis for knowledge in the form of notions to which we assign an extremely high degree of belief in a process of evidence-based inference. This will provide you, quite possibly for the first time in your life, with a complete understanding of why it is best to (for example) believe in the law of universal gravitation instead of the law of universal fairy attraction or the idea that every apparent example of an object falling is a statistical accident. It will provide you with a very concrete basis for belief in the objective reality of the outside world and the laws of nature we infer from examining it.

We have established a set of “global” meta-axioms and structural meta-axioms that pretty much self-consistently establish the framework of our basis of knowledge as good reason and not its evil negation, unreason. And yes, I’m attaching the good/evil value judgement to these terms and giving them moral weight quite deliberately, because some of these global meta-axioms also provide
CHAPTER 11. AXIOMATIC WORLDVIEWS

us with an esthetic basis that can factor into our choice of beliefs and make them subtle, slightly ambiguous, subjective, and human. They give us room for intuition, room to make glorious mistakes or to create beautiful myths such as the myth that we have a right to life, liberty, and the pursuit of happiness and incorporate these myths into our worldview even though they clearly did not exist in nature until we, a natural species, invented them. As a consequence, they (as we will see) provide us with a basis for a human ethic in which we tell ourselves the best story we can imagine of our own self and species and then use reason and deliberate action to make the story come true. Or at least, truer.

Finally, they establish the honesty, the open-mindedness and the humility that any reasoning being should incorporate in an axiomatically incomplete and unprovable worldview, a recognition that the search for truth is a search, and one that cannot be fully realized in a finite lifetime with finite resources and a finite window onto the walls of our personal caves, no matter how much “graffitti” our ancestors and contemporaries left there to help us out. A true philosopher never completely disbelieves any notion or proposition that doesn’t contradict a proposition that they completely believe as true, and there is only one true thing that we as self-aware beings know for certain. Even though sure, most of the notions out there we assign absurdly small plausibilities to, plausibilities that are very, very, close to zero, so close that we can be fairly comfortable saying that they are “false”, we can recognize that there is a strictly greater than symbol in there next to the zero, not a greater than or equal to symbol, and that, surprisingly, makes an enormous difference in the way we should carry out debates and discussions over what best to believe.

We are fortunate to live now in relatively enlightened and modern times, and so we do not have to start with a tabula rasa. There are already a number of “major” competing axiomatic worldviews out there (and countless relatively minor variations – pretty much one per person per day per person alive on Earth).

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1Yes folks, one very amusing and instructive way to view the Bible, the Quran, Plato’s Republic, the Declaration of Independence, Gonick’s The Cartoon Guide to the Universe, and every other book or media presentation that constitutes information transmission from another human living or dead to yourself is as graffitti. These are all things scrawled on the walls of our personal caves by others for us to read, preserved in time, just like the cave-paintings of antelope and mastodons still visible in caves around the world. Obviously we should doubt their veracity – who can trust graffitti, even such appealing graffitti as the work you are scanning in from the wall as you read these words? Still, they are as powerful as any other shadow in helping us to form the best worldview, especially when they help us to see the tree over there as the shadow of a tree, not the tree itself. The tree itself is one thing, our direct perception of the tree another, and our beliefs about the tree still another. The map is not the territory, however plausible and apparently accurate it is as we navigate the territory using it.
Note well that most of these individual worldviews decompose what humans generically refer to as “knowledge” in different, frequently contradictory, ways. Individual worldviews contain very different mixes of evidence-based knowledge, reason, faith-based belief, social customs, practical wisdom, and ethics, on almost a case by case, person by person basis. For some (arguably most) people, the prime axioms are purely religious and are carefully exempted from the process of methodological doubt outlined in our meta-axioms above (in most of the orthodox religious worldviews this is – necessarily – the case). For other people, empiricism and reason and secular ethics hold sway.

Because much of what we believe to be true is dictated by how we were taught or raised when we were far too young to think clearly or critically, it is not uncommon to find people who use cars and computers precisely as if they really believe that the scientific knowledge upon which their operation is predicated is “true” and “works” at the same time they openly profess to believe in the supernatural and magical interventions that can violate natural law. Cognitive dissonance and conditioned beliefs established early on in the development of our egocentric psychology probably plays a greater role in determining our personalized beliefs than any sort of systematic analysis of belief sets and evidence. This confusion, nay, this chaos, makes it very difficult to present any of these personalized worldviews as significant contenders for the best thing to believe. They are simply too internally inconsistent, too individually variable.

Presenting a slow, reasoned account of the historical evolution of broad-strokes “named” worldviews (or partial worldviews), on the other hand, might be informative as such a presentation would allow one to see the evolution of ideas laid bare. One could begin with the most primitive prehistorical worldviews we are aware of (as far as they can be inferred from archeological and paleontological evidence) and work forward. This might give one a good feel for the historical evolution of the dominant memes of things like tribal/rural societies vs urban societies, Christianity vs Hinduism, Capitalism vs Communism, and the Scientific Worldview vs Magical Thinking per se, but again, these for the most part are not “complete” worldviews; they are at best partial and again are almost invariably strongly conflicted both internally and between different components within the individual worldviews of people claiming to be a “Capitalist Christian Biologist” or the like.

In any event, there are many other books that present an overview of history (including philosophical history), and the time and/or topically ordered presentation urges us at all times to accept the partial validity or success of certain components as evidence of the implicit reason and ethical superiority of the whole
thing.

This seems unwise. We understand perfectly well that you can be correct about one thing and completely mistaken about another. We don’t even need to reach the sublime realm of human social or political ethics to find examples in abundance – there are plenty of counterexamples in pure mathematics or science where rules work for certain subsets of numbers or data but which fail in general. There is even a named logical fallacy or two that warns against believing authority or transforming being right in one matter into being right in another.

A second problem with this is that when studying (say) Greek Philosophy (which is to say, studying the partial writings and nominal beliefs of certain Greek Philosophers since there never is and never was any such thing as “Greek Philosophy” as a coherent, named worldview) one rarely studies the ways that their beliefs are wrong. Otherwise the course would be named something like “How and Why Greek Philosophers Got it All Wrong (and Should Have Known Better)”. But sadly, there are no such courses taught in even the most enlightened philosophy departments.

Finally, it is a simple fact that we live in an uncertain world surrounded by lying frogs: humans who often lie, are mistaken, or otherwise tell us or (worse) teach us fables and myths as if they are true. Many of the beliefs that are most firmly, passionately, and even violently held to be true fall quite clearly into this category, and many of the fables and myths thus elevated to the status of “true belief” have successfully been protected from challenge for centuries or even much longer. Indeed, for a huge number of very good reasons it seems rather more likely that worldviews based on ideas out of ancient history are mistaken than more modern ones. Our ability to reason and the tools both real and metaphysical have come a long way and are beyond all doubt far more powerful now than they were (say) three thousand years ago. This suggests that if anything we should work backwards from the present in developing the best worldview, not forward from the past, if it came to that.

However, we are going to follow an entirely different approach. One of the worldviews mentioned above has proved to be far more functional than all of the others. It is the worldview that more or less directly embodies and complies with the meta-axioms above, and it incidentally is the most modern of worldviews.

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2OK, OK, this statement is so broad that it is almost certainly false. However, anyone who has actually sat through a class studying, for example, Plato, or Kant, or Wittgenstein, fully understands that the textbooks and professors of those classes at best hardly ever say “Of course, this was all a load of bollocks and it is hard to see why anyone would actually take it seriously and the main reason we are teaching it at all is as an example of how not to think...”
worthy of the name. If it has a failure, it is that (so far) it has not attempted to address the thorny issue of ethics and human affairs, leading the entire human species to live in a kind of willful schizophrenia where different criteria are used to determine plausible truth in different more or less completely arbitrary contexts.

We will start by figuring out just what evidence is and why we should believe conclusions supported by evidence more than conclusions that are contradicted by evidence before we start using evidence to support the presentation and development of a “best” worldview (so far). This is especially important because the worldviews held by the majority of humans on the planet openly deny the primacy of evidence in favor of “pure reason”, divine revelation, authority of one sort or another, magic, or worse, in at least some contexts.

The notion that our mental image of the Universe, our worldview, our map inferred from an apparent memory of our past experience of an apparent external reality, mediated by our senses, can be judged by judging how well that map seems to correspond to the territory that it supposedly represents, how well it functions as a reliable guide as we try to navigate that external reality and predict beforehand the serial destinations of our ongoing experience, is one of the core ideas of science (and a meta-axiom of our list above). We therefore will begin our exposition with the newest worldview, one that is still only some four or five hundred years old (depending on just where one chooses to start one’s clock) or (since it is still under active development) is as young as yesterday – the scientific worldview.
Chapter 12

The Scientific Worldview

Experience is a hard teacher, but fools will have no other.

*Benjamin Franklin*

There are three kinds of men: The ones that learn by reading; the few who learn by observation. The rest of them have to pee on the electric fence and find out for themselves.

*Will Rogers*

Nowadays, everybody learns at least some science in school[^1]. One is forced to memorize the steps of the scientific method, for example, and to use it in some horribly contrived and boring “experiment” in e.g. a science fair. In addition, a student minimally is exposed to a little simple biology, a bit of astronomy, some elementary chemistry, maybe even a bit of physics before they are either carried forward on the basis of their intelligence and interest into learning real science or recoil backward to avoid and often reject science altogether as the basis for any knowledge.

The one thing that very few students ever are taught (or learn on their own) is *why* believing the conclusions of science is better than believing something else that contradicts them (such as the contents of The Book of Genesis in the Old Testament). One reason it isn’t taught is that it is very likely that their teachers do not fully understand the reasons themselves. Another is that the

[^1]: At least, we are all *taught* some science in school. A simple thing like exposure in the classroom is, however, not enough to overcome the brainwashing indoctrination many children receive at home from theistic parents, and it may be too much for less intelligent children to ever grasp, making them easy prey for the equally easy answers of the theistic worldviews, answers that don’t require them to understand things like algebra and logic or the scientific method.
reasons aren’t articulated anywhere, and hence aren’t part of a textbook-based curriculum. Finally – and this is one of the greatest tragedies imaginable – all too often students never learn that learning science is fun because the way it is taught it isn’t fun, it is awful, horrible, demanding, boring, and authoritarian, requiring rote memorization of a large body of “facts”. Science is taught without any sense of adventure, without any of the fun of search and discovery, and without exposing the students to any hint of the system of reason that has allowed people to take a body of observations and discover patterns within it, invent possible reasons that might explain the patterns, and systematically test the predictive power of these possible explanations as well as their consistency with other similarly evidence-supported beliefs that eventually allows those successful explanations to be considered, incorrectly, to be facts worthy of being included in a textbook for students.\footnote{This is too bizarre for words. We force students to memorize the steps in the scientific method as if it is some sort of religious revelation, secret knowledge too difficult for mere mortals or uninitiates to understand, and then we wonder why students taught in this way later come to consider conclusions drawn from its use to be no better than those that they learn by reading religious scriptures that contradict them.}

This is an enormous failure on the part of our educational system at all levels. The whole point of science is that it is what we should best believe, given the evidence, independent of all authority. Scientific knowledge is what we truly believe that two rational individuals would arrive at, given the entire body of evidence accumulated by the human species and the same axiomatic priors, if they were both armed with perfect reason and insight.\footnote{This is, almost verbatim, one of the Cox meta-axioms, as I hope you realize. Indeed, E. T. Jaynes used the idea of reasoning robots, which all had to mechanically arrive at the same conclusion from the same data and priors even if they reasoned in nominally different ways, as his metaphor to teach them.} For example, we truly believe that a young Chinese student, armed with the methods of science, would study the world and arrive at rules of near-Earth gravitation that are precisely the same as the rules that a young African student or a young American student would arrive at, from similar experiments and evidence. Yet we initially teach it, almost without exception, using authority, not as something the students are encouraged to doubt and test for themselves until they come to trust it.

I’m hoping that by this point you can already see for yourselves that the second “problem” with our entire educational system, top to bottom, is this insistence on teaching true facts. There is no concept that is more pernicious, and more dangerous, than the idea of something being absolutely true, true beyond any doubt. Many, perhaps most, of the problems of the world would...
be eliminated once and for all if we made some tiny changes in our language. Instead of the term “fact”, which implies definite known truth, we might use “factor”, which has as one of its definitions “One of the elements, circumstances, or influences which contribute to produce a result; a constituent.” In the language of previous sections, a factor might be considered to be a notion (from the infinite sea of possibly-true ideas) that actually works to at least some extent as an explanation, as a constituent of “knowledge”. It allows us to split up that sea into a vast body of notions that either don’t work or that we have no good reason to believe do work in accord with our general set of axioms and prior beliefs and a much smaller body of ideas that do work well enough, consistently enough, to be taken more seriously than all of the rest, without ever elevating any factor all of the way up to being a fact, true beyond doubt.

This all by itself is an excellent substitution. Rather than teaching gravity as a “fact”, we might teach it as a factor – one of the elements that contributes to producing the result of rocks falling down, but helium balloons falling – up. However, a second simultaneous change is equally essential. The word “true” should be more or less expunged from the English language (or at least, from the languages of logic and science and epistemology). We might replace it with the word “works” to gain much and not lose anything important. It is no longer true as a fact that gravity makes rocks fall down; it is instead the case that gravity works as a factor to explain the falling of rocks.

Notice the difference! Gravity is something that I imagine. It is part of the map of the Cosmos that I have built up over my lifetime from all of the evidence of my perceptual data and memories of experience. Parts of my sensory experiences I’ve learned to think of as rocks in a spatiotemporal field, released, appear to act in a way I’ve learned to call falling towards another entity in that spatiotemporal field that I’ve learned to call the Earth. “Gravity” is the name I’ve given to the factor that works (so far) to explain this ongoing body of direct experiential and remembered evidence.

It isn’t the only factor – as one can systematically develop by a series of experiments testing additional factors, the mass of the rock and the mass of the earth are other factors, as is the distance of the rock from every bit of mass that makes up the earth, with still more factors (more distant masses plus the factor of gravity, factors such as atmospheric density and surface composition and shape of the rock) serving to modulate things so that they work even better to explain the observations and their systematic variation with other parameters that describe different e.g. rocks.
Do I know if gravity is “real”, a True Fact, something that I must believe in Beyond All Doubt according to a Definitely True Rule? Of course not. The map (in my mind) is not the territory (the presumed reality of the rock and the Earth and all of the rest). I don’t know if it is real or not, and have no way to find out, but I can and do know that it is a successful factor, something that works, to explain past observations and (so far) to predict future ones every time I’ve tested it against the future in the past.

That’s as good as it gets. No facts. No certain beliefs. Only factors that work.

Imagine the changes in human civilization if we could make just this one simple pair of substitutions. Nothing is true (or false). It simply works (or doesn’t work). There are no facts, as in definite truths, only factors, things that appear to work. They may work very well indeed, as does Newton’s Law of Gravitation, but Newton’s Law of Gravitation isn’t a fact and no philosophical principles will be harmed if this mathematically expressed factor turns out to not always work, to be replaced by a theory of gravitons and/or curvature of space as factors that work better to explain the full body of observations in a way that is more consistent with other factors that work.

Imagine the changes to logic and its application to human affairs! We would no longer be able to talk about whether it is a fact that Capitalism is better (or worse) than Communism. All we could do is talk about various factors in systems that aren’t pure this or pure that and whether or not those factors in those systems work. It would be impossible to assert as a definitely true fact that God created the Universe and all of the animals in it; instead one would have to ask whether or not “God” as a possible explanatory factor for “the Universe” and “biological life” works, specifically works in a way that is consistent with the meta-axioms and axioms of best belief.

Sadly, it is not so. The illusion of “true, factual knowledge” is too pervasive, our belief in the reality of our immediate sensory experience too compelling. Worse, the strength of our conditioning when we are too young to resist the input of pure nonsense as “true beyond all doubt” with methodological doubt and skepticism and an insistence that the explanation actually work in a common-sense way to explain the entire body of observation and evidence is too great. Hence we perpetuate propositions that are almost certainly false in the face of overwhelming evidence gathered and affirmed over centuries that those propositions do not work in a sensible way to explain the world we appear to live in and contradict the entire Bayesian network of factors in the scientific system.
of provisional knowledge that most consistently works top to bottom to explain reality – so far.

No wonder we still have fights over silly things like teaching evolution versus teaching creationism in Kansas! The individuals who sat on that particular school board hadn’t ever learned the basis for scientific knowledge themselves, and had to make their decisions based on a belief in an antiquated desert tribal creation mythology that they had been taught never to challenge or doubt lest they be tortured in an imaginary posthumous Universe by a vindictive entity, forever! How could they be expected to realize that “Creation Science” is an oxymoron because science has to work; it requires this pesky thing called evidence, supported by a parsimonious system of knowledge based on the judicious use of consistent reason and isn’t permitted to invent entire hidden worlds populated with invisible beings that can be made to explain anything, and hence actually explain nothing at all?

But we have gotten ahead of ourselves. In order to fairly compare any set of propositions (hypotheses, possible factors, provisional “knowledge”) intended to “work” to explain some body of observation and evidence, we have to all agree on the basis of comparison. Otherwise we will devolve right back to playground mode “Is not! Is so!” argument, quite possibly punctuated with automatic weapons or nuclear missiles. So what should we pick as the axioms that lead us to the fundamental basis of probable knowledge? Clearly, one segment of the Earth’s population would answer “use the Bible as the ultimate arbiter of truth”. Another might pick the Quran; another still the Puranas and Vedas. Some might pick the Old Testament over the New, some the other way around. Others (who are more sophisticated) might pick verificationism axioms as the basis for epistemology – still others falsificationism.

If we attempt to rank order these according to how well they comply with our meta-axioms from the previous section, all but the last two simply do not work. All of the surviving “great” religious texts are chock full of internal contradictions. The are filled with statements that directly contradict observations. They are enormously and arbitrarily complex. They are lying frogs that assert explicitly that they are “true” (so you can be quite certain that

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4 Of course, another excellent question is “how did morons like this end up on a school board in the first place”, but that’s another highly political story. Besides, we know the answer. Other morons, who were equally powerfully conditioned to believe in invisible fairies when they were too young to know any better, voted to put them there! Democracy is all well and good, but one cannot vote to make π = 3 no matter how much trouble it is to remember and multiply it out the other way...
they are *not* true). They utterly fail every reasonable requirement or condition we would like to place on admissible worldviews and, because it is impossible to differentiate between all of their manifold arbitrary pronouncements by means of any sort of actual application to or attempt to predict the real world they purport to explain, they openly encourage precisely the sort of schoolyard bully-based conflict that has maintained the entire world as a place of immense human suffering and woe. When it is literally impossible to convince people of the (probable) truth of a proposition by any commonly accepted *objective* means, when the worldviews in conflict haven’t a shred of “humility” in them or means by which they can change and improve as we learn more about the world in which we live and as we try different ways of living together in harmony with it and each other, all that is left is naked physical violence and the ruthless oppression of dissension.

And that’s what we’ve got today – faith-based, authority-based, mythology-based religious, political, social, and economic systems that are in a state of near-perpetual *violent conflict* because there is quite literally no way for the systems to change and for people to peacefully resolve their differences as they evolve towards a *commonly accepted* system that *works*. All of these systems tend to protect themselves by exempting themselves one way or another from the direct application of the only common set of worldview axioms we have that actually *works*!

I am going to defer discussing verificationism and falsificationism until later, in part because it should be pretty obvious that both absolute verification and absolute falsification are essentially *impossible* – both preserve the illusion of perfectly known factual truth and factual falsehood (as they apply to the real world, as opposed to pure logic where it is indeed fair to say that a contradiction is inherently false and a tautology inherently true). It should also be pretty clear at this point that this is *not how our brains themselves or the worldviews they develop actually work*, as humans obviously have little difficulty understanding and even believing in the truth of propositions that cannot be verified or falsified, such as the proposition that on January 16th of the year 1,213,337 BCE the sun rose on the east coast of the North American continent as the Earth rotated and revolved about the Sun as it does today.

This statement cannot be verified by any sort of direct experiment. It cannot be falsified by any sort of direct experiment. And yet I’m pretty certain it is *probably true*, because of its consistency with a network of most probable beliefs that permit me to *extrapolate* probable knowledge from the contexts where it can be verified or falsified into realms where it cannot, at the cost of certainty. But
as I’ve pointed out repeatedly above, we have already given up certainty in any discussions about the real world, and it is “certainly” better to believe that the Earth on January 16th of the year 1,213,337 BCE behaved pretty much like it does today than to believe that chaos reigns everywhere outside of the immediate range of our immediate senses as an alternative.

So, what are the axioms that we can rely on to be a) consistent with our meta-axioms; and b) capable of generating an entire ontology, top to bottom, including a workable religious, political, social and economic component? Well, they pretty much are the meta-axioms of the previous section, now transformed self-consistently into the axioms of the scientific worldview and extended (as we shall see) to apply a similar criterion to determine what works to accomplish the evolution of social and ethical rules we can all agree on.

Of these meta-axioms, the ones that serve as the most fundamental axioms of this worldview are the Cox axioms – the “desiderata” of Jaynes that allow one to derive the algebra of inference as Bayesian probability theory, plus the meta-axiom of correspondence. These axioms (at the very least) show how to comparatively assess whether or not any given assertion about the real world works better, or worse, as a possible explanation or descriptive rule, relative to alternative explanations, based on whether or not it is in good agreement with past evidence, has predictive value, is consistent with the entire network of mutually interconnected rules that work the “best so far”, and so on.

This is enormously important – arguably the greatest philosophical accomplishment of the human species as the basis for an evolving, self-optimizing system of probable (or provisional, or contingent) knowledge – and yet tragically unknown explicitly to anyone outside of a small, select community. Let us recall the axioms themselves:

1. **Real Plausibility** – Degrees of plausibility are represented by real numbers.

2. **The Calculus of Common Sense** – Plausibilities can only change in qualitative correspondence with common sense.

3. **Consistency of Plausibility** – The complete network of mutually related plausibilities must be numerically consistent.

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5No, this is not an arbitrary statement. To the best of our ability to tell, chaos does not reign everywhere outside of the immediate range of our immediate senses, so yeah, it is better to believe this even though it might not be true.

6Interested parties are especially encouraged to read *The Algebra of Probable Inference* by Richard T. Cox and *Probability Theory: the Logic of Science* by E. T. Jaynes, listed in more detail in the bibliography.
If one massages these axioms in symbolic terms and uses them to derive an algebra of symbols that stand for the real number plausibilities, one ends up with:
Part IV

God
Chapter 13

The Standard Model of God

Potthapada: Now, lord, does perception arise first, and knowledge after; or does knowledge arise first, and perception after; or do perception and knowledge arise simultaneously?

Gotama: Potthapada, perception arises first, and knowledge after. And the arising of knowledge comes from the arising of perception. One discerns, ‘It’s in dependence on this that my knowledge has arisen.’ Through this line of reasoning one can realize how perception arises first, and knowledge after, and how the arising of knowledge comes from the arising of perception.

Potthapada Sutta, from the Pali Canons

This is a book about reality. In particular, as hopefully by now is clear, it is a book that specifies quite clearly what we can hope to fairly reliably know about reality from inside of our personal caves, through the application of systematic doubt. As we have seen, we cannot reasonably doubt our own existence, and the simplest explanation for the parade of sensations and memories and thoughts that seem to pertain to an objective external reality is that such an objective external reality exists and our sensations, memories, and thoughts – our beliefs about it – represent a map, or a web of belief, so far – an imperfect, but systematically improvable knowledge of it.

This viewpoint is hardly new. The quote above is attributed to Buddha, and if this is indeed an accurate attribution (something we are always free to doubt given the obvious imperfections in the chain of transmission of the evidence even after it was finally written down) then the idea that “higher level” knowledge – something beyond the mere instantaneous process of experience of sensation
arises out of our “mental” processing of that experience and the consequent transformative organization of past experiences into “known” (more or less consistent) rules that categorize and compress those experiences and that work successfully to extrapolate and predict future experiences, can be dated back to at least (around) 500 BCE, some 2500 years ago. There is other documentary evidence that Buddha favored an empirical worldview over the predominant Vedic scriptural religious worldview of that time, and actually preached against belief in a Benevolent Creator God due to the problem of theodicy/evil (see below).

Similar arguments attributed to the Greek philosophers such as Aristotle and Epicurus were also recorded some 100 to 200 years after the Buddhist version (note that the dates of the Buddhist version are less certain than the dates of the Greek versions, and that Epicurus’ empiricism is known more indirectly than that of Aristotle).

All of these assertions are in some sense meta-axiomatically self-consistent – we learn that empirical induction from sensory experience to useful knowledge works because, well, it empirically/inductively works! Hume embraced this general approach but was unable to find a logical justification of it of the sort we formally laid out above as a cycle of Bayesian probability theory seeking probable truth – formulate a set of prior ”probable” knowledge (or better, a probability distribution for the various still-consistent possible knowledge proposed so far), accumulate evidence, and recompute the posterior probability distribution for possible truth(s), increasing our degree of belief in some, decreasing our degree of belief in others, while avoiding the inferential trap of dogmatism, a prior assignment of definite, unchallengeable truth or falsehood to any of the prior beliefs about the real world. Boolean/Aristotelian truth and falsehood are a dangerous trap, when applied to beliefs about the real world!

The Scientific Worldview is the result of the systematic application of this Bayesian approach to the construction of a consistent web of reliable, useful, empirically verifiable knowledge. Science does not assert definite truth or absolute truth, it asserts probable truth on the basis of this mix of reason and empirical observation. It is literally that which we (at any given time) can doubt the least when we try doubting very hard, and even allows us to hold a number of competing propositions in our minds and consider them all moderately plausible (all work reasonably and equally well) without forcing us to claim one of them as

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1It is more than a bit ironic that his empirical social/psychological/ethical teachings were transformed into a religion as well as being absorbed into the Hindu/Vedic belief set by the simple expedient of making Buddha yet another avatar of the Mahavisnū, transforming someone who essentially preached atheistic social ethics into a God to be worshipped.
“the” truth, a nearly certain true fact, when the evidence does not (yet) support it and allows us to reject even things that we at one time believed quite strongly to be true in this almost certain sense once we encounter and accumulate evidence for which the beliefs simply do not work. Science is quite comfortable stating “I was wrong”, or “I don’t know”, even as it says “Let’s try to find out”.

We are now about to embark on a much more difficult metaphysical quest, one that (I’m absolutely certain) will end up being the most controversial part of this book. What do our worldview axioms (that supposedly sketch out how reason and experience tell us the best thing to believe about any notion) tell us about the peculiar notions associated with God?

This is a remarkably difficult question to answer; or rather, it will turn out to be a very easy question to answer for the most part, but roughly 85% of the people on Earth won’t like the answer, according to the most recent polls.

To even begin to address the question, however, we have to first come up with a definition of God, or a model of God, because God is a rather elusive entity, defined differently by every religion. Indeed, many religions further obscure the question by on the one hand using the word God as if it refers to a very specific being with very specific properties and then turning around and asserting that this being is basically unknowable and that its properties are uncertain. Naturally, this deft maneuver makes it difficult to apply reason to any concrete question concerning God even as it allows those who claim to speak for God to assert that they know just what It is thinking and what It wants, with no possibility whatsoever of ever being proven wrong.

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2Well, Science doesn’t exactly say this, because Science isn’t a sentient being and therefore can’t actually say anything, but I say it all the time, based on my best knowledge of Science, my own personal assessment of arguments and evidence, and of course my own awareness of my own profound ignorance about so very many things. You probably should too...

3And often, by every subgroup, sect, cult, schism, of that religion, so much so that it isn’t clear at all if Baptists and Methodists and Catholics and Presbyterians and Mormons and Jehovah’s Witnesses and Quakers and ... I tire listing them ... should all be considered one religion or myriad. Are all the Abrahamic religions one religion, as they all claim to worship the same God, with the same historical roots, by whatever name the particular cult in question chooses to use as a symbolic representation for the hypothetical entity? Note well that they are all technically cults – the first definition in the dictionary for the word cult being “a system of religious veneration and devotion directed toward a particular figure or object” – or heresies – again using the term precisely in accord with its original meaning of “choices”, in context a set choices that were eventually given a name that differ in some specific ways from a set of alternative equally arbitrary choices that were also given a name? Or does every single individual with their own particular heresies, nothing really bad about it – have their own personal religion? Note well that for every one of these variants of “Abraham’s God-ism” all the other variants are heresies if not cults!
That won’t do for us here. We have to have a concrete model of God, something we can apply reason to, because our axioms require our best worldview (so far) to be consistent (so far as we can tell); if a definition of God is inconsistent we face the Scylla and Charbydis of knowledge – on the one hand we know that the definition is false; on the other we know that if we accept it as true anyway we can prove anything we like to be true, and be equally certain that we have actually proven nothing at all.

Furthermore, our definition has to be completely independent of history! As a colleague and friend once pointed out to me, if God is accessible to reason, God’s properties (including the property of actual, as opposed to imaginary, existence) should be (just like physics, chemistry, and all the rest of scientifically supported probable knowledge of actual things) as accessible to a race of space aliens with an entirely different planetary history than our own, and if any particular reasonable model of God is supported by actual evidence, all reasonable people (or space aliens!) should be able to verify and confirm the evidence. This is utterly impossible when the evidence in question is only assertions about things that were purportedly seen or done in the remote past by our human ancestors as part of many entirely distinct and mutually contradictory bodies of multicultural scriptural mythology. This is especially so when those claims are often extraordinary, things that directly contradict our evidence-supported, reasonably consistent set of best beliefs, things that we can and do verify by repeatable experiments and daily experience all the time!

Let me be clear about this last point, as it is crucial: to the extent that the first and second laws of thermodynamics, the law of mass-energy conservation, and all of our knowledge of biology and chemistry and physics are correct beliefs that are well-supported by easily reproducible evidence and consistently interlocked in a mutual web of evidence supported belief, the claims of miracles as evidence (safely in the remote past where they cannot be objectively or reproducibly observed and checked by observers who very much doubt that they are

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4Because you can prove anything – literally anything – to be true, once you have admitted an actual inconsistency into any theory, which is why mathematicians, logicians, philosophers, scientists, and people with plain old common sense work so very hard not to accept contradictory assertions as truth...

5Knujon Mapson, in a private conversation concerning an article I was contributing to Pandeism, an Anthology.

6Sure, you can – and probably are, if you “belong” to one of the religions based on one or another of these mythologies – try to convince yourself that it is only the other scriptures for all of the other religions that are myths while yours alone is true, but the problem is that the only evidence you have for this in fact being true is lying-frog evidence – documentary evidence that asserts its own truth. And the other religions you reject have exactly the same thing.
true) are very unlikely to be true, as they violate these laws. Note well that every time we investigate similar claims in the modern world we find that the claims are false – and often false in a specific way, false and intended to deceive, not just impossible to reproduce.

Even so, models of God are sufficiently varied that we will need some specificity even at the risk of excluding some specific model for God employed by this major or minor religion, and that won’t do either. I therefore offer up the Standard Model of God for our immediate examination. Note well that I am not attempting to introduce red herring Gods, straw Gods, or true scots Gods etc with this model – only to avoid examining the possible existence of some amorphous and ill-defined entity so fluid and plastic that one can always manage to slither around any counterargument or evidence with a ‘yes, but’.

The God of most monotheist/monist religions has the following general attributes. Each block of properties refers to a different kind of attribute:

**Infinite (universal) properties:**

- Omniscient
- Omnipotent
- Omnipresent (in space and time)

**Sentient properties (God’s mind):**

- Aware/alive
- Omnibenevolent/loving
- Capacity for “action”

**Causal properties:**

- Non-contingent/necessary
- Creator of/cause of physical Universe
- The uncaused “first cause” in ordinal (not necessarily “temporal” as this term presupposes time) causal chains

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7See: [http://whywontgodhealamputees.com/god3.htm](http://whywontgodhealamputees.com/god3.htm) I’m not using precisely the same model that this site proposes because it concentrates a bit too much on the Abrahamic religions and hence the fill-in-your-choice from: The Torah, the Bible, the Quran, The Book of Mormon. There is, however, sufficient overlap to justify using the same term.
Let’s go through these systematically.

**Omniscience** God is all-knowing. Without this property, God Itself couldn’t be certain It *was* God, and couldn’t achieve the kind of control required for the next property. *With* this property, as we shall see, it isn’t clear how the *state* of God’s knowledge can change, and this will have dire implications when it comes to awareness and action. It is also worth pointing out that this property necessarily *explicitly violates* the proposed path from experience to knowledge *that we know empirically works*. Indeed, it is almost the exact opposite, a perfect contradiction of the ordered relationship between knowledge and experience.

**Omnipotence** God is all-powerful. Without this property, God again would not be in control of all things and hence would not be the monotheist God, but rather at most a very (but *finitely*) powerful *ordinary* being. The point is that God isn’t just a natural being that is powerful by contemporary human standards but that lives *in* the Universe and is subject *to* natural law; by that standard a very advanced race of space aliens might be “God” compared to us and yet might themselves have Gods consisting of still more powerful aliens. God controls the laws of nature, not the other way around, and can break them on a whim.

**Omnipresence** God exists everywhere, and is eternal, existing at all points in space at all times in the past, present, and future, on a *Universal* basis. This has to be true, furthermore, quite independent of how many dimensions the Universe really has – God has to fill *all* of them. Otherwise there might exist (possibly undetectable!) completely disjoint parallel cosmi with different Gods, in which case God wouldn’t be the monotheistic God of *all* things, only all things in our Cosmos (if that). God would indeed once again be just a player *in* a much larger Universe, most of which It did not control, and hence would not be a (standard model) God at all, merely a god/space alien of *some* of everything.

Note well that *mathematically*, there simply *is* no way for any sentient being to empirically or logically exclude the possibility of disjoint Cosmi. It’s as impossible as proving that truly invisible (to us) fairies don’t exist. Just because you can’t “see” them – detect them *by any means* – doesn’t prove they aren’t there, it just makes it a waste of time to believe that they are. Or, for that matter, that they aren’t!

These “omni” properties differentiate God from any finite, “ordinary” being,
however powerful that being might be, that one might empirically encounter. Pretty much all monotheistic religions consider these attributes to be necessary properties of God; if any of them were lacking, God would be nothing but a natural being much like ourselves; perhaps more powerful or long lived but not really God.

**Awareness** God must be *self-aware* and *other-aware*; to put it bluntly, *God must have a mind!* This is an enormously difficult property to satisfy, because minds *exist in time* and have certain properties with regard to entropy and information, that seem rather inconsistent with the “omni” properties above. Also, all the minds we can actually observe or infer the existence of (including our own) are based on a *complex mechanism* that makes it quite literally impossible for the mind to be aware of its own complete state in any nontrivial sense. But if God is *not* aware, both of itself and of other things that are not-self, then it is difficult to see how God can be self-willed and hence *act*. All of the usual problems with determinism and free will apply to God.

**Omnibenevolence** This is, perhaps, the most controversial property in the Standard Model of God, and it is also one that is *not* quite universal in monotheistic theisms, perhaps because it is so very obvious that the Universe in which we live is filled with suffering and injustice, as the short quotation from one of the *Jakatas* (the texts that supposedly tell the story of the Buddha’s former lives) at the beginning of one of the next few chapters demonstrates. The philosophical incompatibility of a *good* Standard Model God and the existence of Evil thus dates back to at least 500 BCE. It is also strikingly incompatible with the reported *behavior* of God in all of the great world theisms, in particular those that include the hell meme/axiom. Such a God then has to be *simultaneously* omnibenevolent and yet prepared to inflict *infinite* punishments for the “sin” of actually doing one’s *honest best*, *given the evidence* when deciding what to believe. This is clearly “benevolent” for a meaning of the word that is pretty much equivalent to “malevolent”, a direct contradiction.

**Volent** In order to be benevolent or malevolent, God has to be both aware and *volent* – self-willed and capable of *action*. This is (once again) a remarkably

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8 Wikipedia: [http://www.wikipedia.org/wiki/Free_Will](http://www.wikipedia.org/wiki/Free_Will). In spades, in fact. Consider: If God is omniscient, then you are no more free than the characters in a book that is already written, and *neither is God*!

difficult thing to consistently imagine. Change, action, occur in time and God is eternal, timeless (according to the “omni” properties above). As we will see in the next chapter, omniscience is mathematically incompatible with the ability to choose to act because one can never change one’s knowledge of the past, present or future of anything at all, including (in God’s case) itself.

As we can already begin to see, coming up with any sort of plausible model for God’s Mind that doesn’t conflict with the “omni” properties is going to present us with insuperable difficulties. Note well that because we do not lay any claims to certain knowledge or perfect truth as long as we adhere to the maxim of believing most that which we cannot easily disbelieve, we are freed from the necessity of proving that God’s Mind is logically or mathematically impossible – although some of the efforts in this section will take a pretty fair stab at just this – all we really need to do is show that standard model God is implausible and that all simple models that might realize it appear to be contradictory, and the burden of proof is then on anyone wishing to assert such a mind to come up with a plausible model that is not similarly contradictory and present evidence supporting their model! Evidence is going to be an enormous problem for any assertion of theism no matter what, but without a viable model we won’t even know where, or how, to look.

**Noncontingent** According to the Standard Model of God, God cannot be a contingent entity. That means that God cannot rely on something else not God for its being. For example, if God is material, then God’s existence and structure is contingent upon the existence of matter. If God is mental, then God is contingent upon the existence of mind. A material God, we are tempted to say, inherits its nature from the matter from which it is made. A mental God would similarly inherit its nature from the “mental stuff” from which it is made. This leads us to a singularly tough dilemma. An omniscient, omnipotent, omnipresent being must be at least as complex as the Universe that they know perfectly, control perfectly, and are everywhere and everywhen in, because omniscience requires that they have a perfect representation of the Universe – including themselves – in their mind. It is difficult to imagine how this complexity can exist in a mind without structure, since complexity is structure, but the structure of what if not some sort of “stuff” hypothesized (openly or sub rosa) to be a contingent prior for God?

**First Cause** Noncontingency is often expressed as being necessity – God is nec-
necessary and nothing else is. This is often expressed in causal terms (which have a most unfortunate temporal signature in most apologist arguments for a monotheist God): God is the uncaused cause, the First Cause in a causal chain that leads, eventually, to the Universe and everything in it. Alas, this is logically, mathematically, and empirically unsound.

Logically unsound because an uncaused cause could very well not be aware, omniscient, and so on – even if an uncaused cause does exist, that does not suffice to make a claim that it is God.

Mathematically unsound because there is no mathematical requirement for all dynamical chains (suitably defined with successor/predecessor operations) to terminate in the past any more than there is a reason for them to terminate in the future. The set of all positive and negative integers stands as a very simple example of a chain with a successor/predecessor operation that never terminates in either direction.

Empirically unsound because what we actually observe in nature is that causal chains do not, in fact, terminate in the past or future, at least where we can see it or even strongly infer it. In fact, the most important physical laws are conservation laws which more or less state that the “stuff” (mass-energy) of nature is not created or destroyed but simply changes form in a causal dance. In other words, the term “cause” used in an argument that asserts God as the “cause” of anything at all is completely incompatible with the discussion of causality in the science of causality, physics. In the real world we live in, as far as we can observe or tell, nothing is ever “caused” (created out of nothing, caused in complete isolation from the continuous chain of dynamical evolution) in the sense that is generally used when discussing God-style creation and causality.

This is puzzling, until one realizes that primitive people did see things “appear” without any real understanding of their cause in the rearrangement-of-preexisting-stuff sense of physics, chemistry, biology. A snowflake, a tree, a baby, lightning – God has to a tremendous extent always been the God of the Gaps, a catch-all explanation for how many things came to be, “created” or “caused” to be structured in particular ways by God’s Naked Will. However, creation ex nihilo in the sense used to describe God’s action in some sort of time to create space and time, or disconnected causal chains internal to the Universe with no prior cause, have quite literally never been observed to occur anywhere, ever. There is no empirical reason to believe that causality in this sense is possible, let alone necessary; as an explanation of anything at all, let alone everything.
CHAPTER 13. THE STANDARD MODEL OF GOD

Creator of the Physical Universe This is a universal feature of the Standard Model of God. Indeed, all of the properties above are more or less subordinate to this (desired, essential) property.

As noted above, Creation ex nihilo, in the specific sense used here to describe God’s role as a “creator” of the Universe, has quite literally never been observed to occur anywhere, ever. There is no reason to believe that it is even possible, let alone necessary, as an explanation of anything at all, let alone everything.

The general idea is that if God did not create the Universe, then God exists within it, or perhaps separate from it, and is not the standard God of monotheism. God is omniscient, omnipotent, omnipresent and omnitemporal because the aware and living God made the Universe as a deliberate, perfectly benevolent act of will, acting as the First Cause of the causal chain of the Universe, as the non-contingent originator of all of contingent reality. This is really pretty much the sine qua non of monotheistic Godhood – any being less extensive than the Universe itself simply doesn’t qualify.

This seems like a genteel sufficiency of properties for the Standard Model of God. Although there are still more properties ascribed to specific versions of God in particular theisms – such as a (Christian) three-in-one deity, a (Jewish) deity that really, really likes the smell of burning animal flesh, a (Muslim) deity that intends to burn the skin off of unbelievers and then cause the skin to regrow so he can burn it off again, forever, a different (Hindu) three-in-one deity – the properties above are more than enough to get ourselves into serious trouble already if we try to make them consistent with our reason and experience. Besides, all of these deities are generally presented at some point as a more or less standard model intelligent Creator of the Universe – if that model fails, so do they all fail.

As we will see in the next chapter – the Standard Model of God is fundamentally impossible. It is surprisingly easy to formally disprove it using some of the well-known results of modern mathematics and logic; a simple one-paragraph ontological proof suffices to prove the impossibility of a Creator God, for example. It is also not only unsupported by experience and common sense, it is unambiguously contradicted by both experience and common sense. The Standard Model

\[\text{Note well that this latter possibility is precluded by our precise specification of the meaning of the term “Universe” way back at the beginning of this book, as everything that exists in the most dimensionally general sense of the word “exists”. Anything that is anywhere anywhen in any real dimension is in the set we call the Universe, so God (if God exists) cannot exist independently of it.}\]
of God is, to put it bluntly, wrong – not merely a notion that there is no good reason to believe might be true but rather an inconsistent notion that there are excellent reasons to believe \textit{false}. 
Chapter 14

Disproofs of the Standard Model of God

I promise nothing complete; because any human thing supposed to be complete, must for that very reason infallibly be faulty.

– Moby Dick (Chapter XXXII “Cetology”) by Herman Melville

...These greedy lying priests practice deceit
And fools believe the fictions they repeat.

If the creator of the world entire
They call God, of every being be the Lord
Why does he order such misfortune
And not create concord?

If the creator of the world entire
They call God, of every being be the Lord
Why prevail deceit, lies and ignorance
And he such inequity and injustice create?

If the creator of the world entire
They call God, of every being be the Lord
Then an evil master is he, (O Aritta)
Knowing what’s right, he let’s the wrong prevail!

– in the Bhuridatta Jataka

Before we can tackle the constructive analysis of God as a viable notion in the real world, we must first undertake the task of completely, utterly, destroying
the Standard Model of God – we must prove that it is wrong, not simply wrong because of a lack of evidence but wrong because it is impossible, because it is essentially self-contradictory in critical ways. In so doing, we do the world an enormous favor, because most of the versions of the Standard Model of God that have come down to us from the Bronze or early Iron Age in the great world theisms are logically flawed, morally horrific, economically and politically exploitative, and the source of much evil in the world.

The simplest disproof uses Godel’s theorem:

God’s knowledge must be complete, because if there was any true statement God did not know God would not be omniscient. In particular, God must know as certain truth that its own knowledge is complete.

God’s knowledge must be consistent because inconsistent knowledge logically must (according to the law of contradiction) contain falsehood, violating the property of omniscience. In particular, God must know as certain truth that its own knowledge is consistent.

God must be able to prove the completeness and consistency of its own knowledge or it cannot know that its own knowledge is complete and consistent. But given that the body of knowledge possessed by God in Its worldview must be sufficiently complex for it to be able to formulate arithmetic (if not, this too is a failure of omniscience as even I can formulate arithmetic – incompletely) it must then, according to Gödel’s theorem, be either incomplete (in which case God is not omniscient as there are true things that God does not know) or inconsistent (in which case God is not omniscient because some of what God thinks It knows is false). Worse, since God must know and be able to prove and understand Gödel’s theorem, God in fact must know that it is not and can never be omniscient and hence is not, in fact, a Standard Model God.

God(s) therefore cannot be omniscient, and the Standard Model of God is false, Q.E.D.

Basically, Gödel’s theorem has as a metaphysical corollary that omniscience is impossible. If God can prove the consistency of its own knowledge (presumed to be greater than my own and hence capable of expressing arithmetic), it merely demonstrates that its own knowledge is inconsistent. If it cannot, then it might  

\[\text{In order to prove the completeness and consistency of any theory in logic, one has to use}\]
be consistent but God cannot know that it is. God, as a supposedly self-aware entity, is bound by exactly the same mathematical rules that we are, because God-math isn’t any different than human-math, God-logic no different from human-logic. When God explores self-referential chains of contingent reason beginning from some set of axioms, those chains contain vast tracts of Terra Incognita, not just unknown but in some deep sense unknowable. Since its self-knowledge is such a chain, it can never be complete.

Another way of concluding the same thing is a bit simpler, and more intuitive. We understand the mathematics of vector spaces rather well at this point. In particular, we understand the idea of disjoint spaces, spaces that simply don’t overlap with each other or communicate with each other in any way. Specifically, we can imagine two spaces that have different space and time axes and that do not intersect, just by generalizing the way we already imagine two lines that do not intersect. We’ve already discussed two such spaces in our discussion of cosmi – our own real Cosmos and a “Lord of the Rings” cosmos, complete with Sauron and Frodo battling it out on some timeline of some world named by its inhabitants “Middle Earth” therein.

We can certainly imagine our Cosmos being “embedded” in a larger space, one that contains God and our Cosmos, and possibly other cosmi, one named “heaven”, one named “hell”. But there is nothing mathematically inconsistent about imagining that the LOTR cosmos exists and is embedded in its own, disjoint larger space, created by a God in that larger space. That space would have its own time axes (allowing for plural!).

There is no reason to stop at one – there could be an infinity of these completely disjoint spaces, spaces that are not themselves embedded in a still larger covering space, spaces that do not exchange anything with one another, spaces that are literally inaccessible from and invisible to one another. And there, my friends, is the problem...

We can postulate a God in one of these spaces who is (within Its own domain)

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higher order logic, but then the completeness and consistency of the higher order logic itself cannot be proven without still higher order logic. No sufficiently complex mathematical theory can be proven to be complete and consistent from within the theory, and indeed Gödel’s theorem states that if a theory can prove its own consistency then it is inconsistent! For e.g. arithmetical theories this is no big deal, but there can be no higher order, unprovable “theory” in the case of an omniscient God, and in any event arithmetic cannot be made provably complete while remaining consistent...

2Or sets in set theory – two sets with zero intersection and with no means of observation or communication between them, or two computers in the case of Wolpert’s proof alluded to in the chapter on Logic.
omniscient, omnipotent, and so on, who creates cosmi like a child blowing bubbles within its very own room. But such a God could never be certain that there were not other completely disjoint realities with their own God(s). After all, by construction, we are postulating that these other realities are invisible to any being, no matter how powerful that being might be in their own domain. Lack of evidence is not evidence of lack, and all that – just because God can’t see any other spaces but Its own doesn’t prove, even to God, that they aren’t there.

God (if God exists) has to be at least intelligent enough to understand this reasoning as well as I do. God (if God exists) has to know that it cannot be certain that it is truly omniscient. It cannot even be certain that it isn’t itself a created thing in a larger embedded Universe with its own superGod, a God of Gods, being judged on how good a job it does being a God and risking a supereternity in superHell if it fails to believe in something it cannot observe in the absence of any evidence that it is real.

We can conclude that not even God can be certain that it is unique, that it’s experiential reality is all that exists; an omniscient God certainly would know enough to know that it could never be certain of being omniscient, and lacking certainty, it is not omniscient. Omniscience is a self-contradictory property, because no matter how much you know about everything, even if as far as you can tell you are everything and know everything about yourself, you cannot be certain of knowing everything because you could simply be wrong! There could be a completely disjoint, invisible, other, a possibility surging from that terrible infinity, the space of all notions, a space too large to be contained in any mind.

It may seem strange to apply a theorem of arithmetic and logic to the question of God, but the Standard Model’s omni properties are just the sort of mathematical things for which Gödel’s theorem, modern geometry, logic, and set theory, were invented. The omni properties are infinities, and infinite properties are very dangerous things to work with in a system of reason (which is why mathematicians treat them with respect, and physicists generally treat them as an idea congruent with “really, really big” to avoid the question of whether or not infinities “actually exist” altogether.

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3You are welcome to argue that those spaces are in some sense irrelevant to a God of our space, but be very wary. In the next chapter I’m going to argue that in the absence of very solid evidence that shows that our Cosmos has no set of physical laws that is sufficient to explain all observations within the Cosmos that there is strictly less of a reason to think that a physical law-violating God exists! And if one does exist, but simply chooses to never violate physical law, then it is irrelevant in exactly this sense.

4So large that we cannot see the edge, if any edge exists, usually works pretty well. Or when we are forced to use mathspeak to refer to infinities, we tend to do so using limits – take a
Let’s do another proof of the inconsistency of the omni properties by examining them two or three at a time. Let’s think about free will. Here’s a nifty argument:

1. God is omniscient so it knows exactly what has happened, is happening, and will happen, not just in our Cosmos but in the Universe as we have formally defined it.

2. God is omnipotent, so it can act to change anything that has happened, is happening, or will happen in the universe. For example, God knows that It will not manifest Itsself as (say) a burning bush in my living room in this Cosmos in the next few minutes while I type this line about it not manifesting itself (I myself am not certain that this won’t happen, but I think it is pretty damn unlikely, unlikely enough to take a chance and type this out anyway).

3. God cannot change its mind and make the burning bush manifest anyway, because if it did it would have been mistaken about its prior knowledge of the events of the (now) last few seconds when the bush failed to appear. In fact, God cannot actually change its mind about anything. God does not have a mind, capable of reactive change!

Omniscience and omnipotence, taken together, are inconsistent with each other and the axiomatic property of volition. An omniscient and omnipotent God quite literally cannot ever change its mind about anything at all, and in the process ceases to be omnipotent in any useful sense as well. An omnipotent omniscient God cannot choose, it can only be, in which case the Universe and God become essentially indistinguishable, and in either case our own free will becomes an illusion permitted only by entropy, our lack of perfect knowledge of the future that permits us to choose, and choose again, and choose again as agents navigating an imperfectly and mostly unknown terrain.

Let’s examine this same issue again a different way, and see how Universal omniscience is inconsistent to get a second formal disproof of standard model God. This disproof examines the information theoretic implications of omniscience. If God is omniscient, then God’s mind has no missing information about either

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statement that makes sense for finite quantities and extrapolate to infinite, or infinitesimal, limits. That way it doesn’t really matter, much, if the Cosmos is infinite or finite – as long as it is at least as large as we can see from our present point in space-time in all directions, conclusions drawn from what we can see, even extrapolated towards “infinity”, will usually be pretty reliable.
itself or anything else. In the language of physics, we would say that it has zero entropy because one interpretation of physical entropy is that it is the log of the missing information required to perfectly specify some physical system’s microstate within some macroscopic state. Note well that this definition (or these definitions) is/are completely independent of physics per se – it arises in information theory and in discussing omniscience we are speaking of information entropy, the log of the information required to decode some specific message that is encoded out of the vast number of messages that might have been encoded within some particular set of “information”. In fact, the reasoning we are about to use applies to any possible physical system, or information processing system, or system period that has state information – “something to know”. Zero entropy is a very special condition in either physical theory or information theory.

Here, in very simple terms, is how information theory “works” to describe the encoding of information in some structured system. The more “uncertainty” one has in some representational space, the more information that space can encode. I’ll illustrate this by considering a toy “space” consisting of binary numbers with a certain number of binary digits, or bits. For example, a 1 bit space can represent only two states as it has only two distinct possibilities, 0 and 1. A 2 bit space can represent four states as it has four possible states to assign in the representation: 00, 01, 10, and 11. Note that these bits are not knowledge – knowledge is one thing standing for something else, a map which is not the territory. To make a model of knowledge, then, we need both the bits and something else they can stand for, such as the numbers 0 (00), 1 (01), 2 (10) and 3 (11); or apples (00), pears (01), oranges (10) and bananas (11). There are eight distinct, ordered three bit states in a three bit and again we can make the bit combinations represent any eight distinct things, a four bit state space 16 things, and so on.

Tedious as it is, let’s establish eight things to be represented:

000 = a  001 = b  010 = c  011 = d  
100 = e  101 = f  110  111 = g

We are going to pretend that these letters “exist in reality” as irreducible real objects rather than as ideas or peculiar shapes projected onto your retinas by a chain of irreducible real causes and events governed by the Laws of Nature that haven’t a hint of “a-ness” about them at all. Now we are going to try to “think” about the “real” letter a using a very special “brain” – one that has only three bits, but since the letter a is real, external, and perhaps is carved out of wood
and sitting on your mantel our 3 bit brain will only be able to think about it in terms of its symbolic representation, 000. Ready? Set? GO!

000

You see what we did there? We brought not the actual letter a into our very limited “minds”, we could only bring its symbolic encoding in. But no worries. After all, 000 stands for a, so we thought of a. Didn’t we?

Only for a meaning of the word think that does not, in fact, mean think – so far – but which is absolutely certainly, beyond any doubt, a critical component of anything resembling thought. For example, the computer you may or may not be using to read this book is hardly a thinking genius, but to store and retrieve all of these English words I’m writing (which may well have been recoded into other languages by the time you read them) it uses a somewhat fancier binary encoding of all the letters in the English language, one that used to use seven bits (with room for all the letters both lower and upper case plus all of the usual typewriter/punctuation symbols used in ordinary writing, plus leftovers to handle things like where to break lines to make paragraphs and pages).

To make matters worse, inside the computer the letter a is not actually stored as 000. What does that even mean, to store something as “000”? 0 is itself a symbol that stands for stuff, not a real object in the real world with the real property of real temporal persistence in obedience to real physical laws. We cannot store symbols, symbols are abstractions. Using the Laws of Nature (physics, chemistry and so on) we can only generate arrangements of objects or “stuff” in the real world that last for a while or evolve in time in predictable ways.

What real world objects actually encode this specific letter \( \Rightarrow a \leftarrow \) (presuming you are viewing it on some sort of computational device screen, as opposed to some ink stuck to some paper somewhere on a page)? Somewhere inside your computer there is a real chunk of stuff composed of a mixture of silicon alloys and oxides. When electrical signals of a certain kind hit it, the voltage across two points in the chunk changes by a couple or so volts. When other signals hit it, it sends different signals running down a line that leads to still other chunks of conducting and semiconducting metal. The 0 refers to a reference voltage in this chunk of stuff that can either be written to it in such a way that it persists in that state, stably, for a time (basically storing the information for that time) or read from it at any time within that window by – still other signals that are

\[ ^5 \text{Which can be very long or very short – the “fast” memory in computing devices typically} \]


basically nothing but voltage changes, but all carried by *real stuff*, not symbols at all.

That’s all well and good, but we want to be more concrete, because you, dear reader, may not be a computer geek and talking about bits and RAM and information processes devices could easily make you very uncomfortable. Yet this is a really important idea to grasp, so let’s build a slightly more accessible physical model, one that doesn’t require electricity and semiconductor magic to operate or read. Dig into purse or pocket and pull out three nice, new, shiny pennies, and lay them out in a row on a table next to you. We’ll now let tails stand for 0, heads for 1, and (using the same encoding defined above) the letter a is now quite *physically* represented as:

Note well: These three pennies are most definitely *not* the (abstract) letter a, let alone a real, material, hand carved piece of wood shaped like the letter a on your mantelpiece! But even so, you could use an array of 9 pennies to encode c-a-b in our eight bit code given above. If you are so wealthy as to be in possession of 9 pennies, why don’t you do this, as an exercise (it won’t be wasted, you’ll need the nine pennies to do some more work below).

But how do you *know* that these three pennies encode the letter a, instead of (say) the front left leg of your pet spider? How do you even know tails stands for 0 instead of heads? Are the pennies in your pocket somehow thinking deep thoughts as they mix around, forming all kinds of combinations? Is the solution to human poverty and obtaining world piece in there, if only we could see it?

And here lies the rub, as they say. For anything – anything at all – to stand for *something else* we need not only the thing(s) itself/themselves, but:

1. The thing(s) have to have a *state space* – all of the unique differentiable stores it for a very short time by human standards but constantly reads it and rewrites it within that window, “refreshing” the memory. If the refresh process is stopped, the state goes away in much less than a second, irretrievably. Other kinds of memory write once and the state persists for days, weeks, perhaps even years without additional maintenance – but nothing lasts forever and *centuries* from now whatever information is encoded on e.g. a solid state drive will almost certainly be completely gone. This degradation of non-refreshed information is Universal (and is a.k.a. the Second Law of Thermodynamics) – you can see it in missing chunks of truly ancient tablets of cuneiform and in the aging of our physical bodies.
ways it/they can both be arranged and be observed to be arranged – that is at least as large as the irreducible number of things to be represented.\footnote{I’ll ignore for now the possibility of compression and treat only cases where the information is incompressible/irreducible. If these words don’t mean anything to you, don’t worry – what they mean is “don’t worry about it, in the end it won’t matter.”}

If we ignore the orientation of these three pennies and look only at heads and tails as being the two possible states for each penny, we can represent up to eight distinct objects. But there is literally no way in heaven or hell for the pennies lined up in exactly this way to represent ten objects. Try it! Can’t be done!

2. You have to have a dictionary. The dictionary establishes the mapping between the unique real states of the real things that are going to record the information and the unique real things being represented. Or for that matter, the distinct imaginary things being represented, as in fact we are perfectly capable of representing very abstract things, such as pink unicorns, invisible fairies, or representations of other symbols, as well as real things like the real books on our real bookshelf or eight out of ten of our ten little piggies.

Note well the problem of permutations. In our “threepenny” state space there are 8 possible states. They can represent up to 8 distinct objects. But there are

\[8! = 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 = 40320\]

permutations of ways to assign 8 actual objects to the 8 states of our “threepenny memory”. Here is a table to give you just a hint of the permutations that are possible:

<table>
<thead>
<tr>
<th>Side Bits</th>
<th>TTT 000</th>
<th>TTH 001</th>
<th>THT 010</th>
<th>THH 011</th>
<th>HTT 100</th>
<th>HTH 101</th>
<th>HHT 110</th>
<th>HHH 111</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td>f</td>
<td>g</td>
<td>h</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td>f</td>
<td>h</td>
<td>g</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
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<td>f</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>40319</td>
<td>h</td>
<td>g</td>
<td>f</td>
<td>e</td>
<td>d</td>
<td>c</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>40320</td>
<td>h</td>
<td>g</td>
<td>f</td>
<td>e</td>
<td>d</td>
<td>c</td>
<td>b</td>
<td>a</td>
</tr>
</tbody>
</table>

and we cannot decode a message without selecting which row of this very large table is the one that represents the particular assignment of our eight objects to our 3-bit, 8 state space, represented in pennies or silicon or on your fingers...
or in dots and dashes on a piece of paper! And the eight letters a-h themselves can be used as the basis for a code based on an even larger space, with many more states and many many more permutations of the mapping between states and objects! But we’ll start needing a lot of pennies to represent them.

Whoa! A dictionary is likely to be even larger than the actual information being represented, because it has to resolve the permutations in both the state space and the set of things being represented. It has other difficulties, as well. The actual English dictionary, encoded in ordinary letters, contains a lot more letters (total) than it does words (total) and is highly self-referential, meaning that it is impossible to read unless, well, you can already read, which means you already have enough of the map it contains to sort of bootstrap the rest of it. Worse, in most places the definitions form (sometimes very complex) reference loops — if one defines a “fnarp” as a “frumal bleshnik”, and the definition of bleshnik is “a kind of fnarp” and “frumal” is “a common characteristic of bleshniks”, this isn’t a lot of help! Now imagine just how difficult it is if the entire dictionary is written in Martian, and you don’t know how to separate Martian symbols into words!

Unless you have independent access to and knowledge of actual bleshniks with and without the trait of frumality, a dictionary defining each term in terms of the other terms isn’t going to be a tremendous amount of use in learning the actual meaning of fnarp! And if it is written in Martian, you’re probably going to need a Martian “Rosetta Stone” in order to be able to read it at all and know that these eighteen strange symbols are the Martian spelling of “fnarp”.

By extension, if we wish to “know everything” about the Universe, as we’ve defined it, we’ve got a serious problem. First and foremost, there is no other stuff to use to encode, or represent the state of, all of the stuff in the Universe! Second, even if we have some non-stuff stuff and manage to pretend that the non-stuff stuff isn’t part of the Universe (but is still real) but that stuff stuff over there is the Universe and is also real, we still need enough more non-stuff stuff to define a dictionary for the non-stuff stuff encoding, because 000 could just as well have stood for d as for a, and heads could just as easily have stood for 0 as tails.

A second substantial problem in dictionaries is that they in general only represent a compression of the actual inherent information in almost any real world object. The definition of the word “tree” stands for not just one specific object

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8...and you still won’t know how to pronounce it. It probably isn’t pronounced fnarp at all.
that happens to exist in the real Universe in your back yard, but rather for a
general class of objects that can in some cases easily be mistaken for shrubberies
and in still others exist only in your imagination, not in reality. But the alter-
native – specifying precisely every single particle that makes up an entire actual
object we so casually call ‘a tree’ is if anything even worse. At that level of detail,
we know everything but at the same time, in another sense, we know nothing
about the tree.

Ouch. If we want to be said to “know everything” about just one lousy tree,
we have to be able to encode and represent every single smidgen of actual stuff
that makes up that particular tree (plus, arguably, what it does, how it works,
what it looks like, and ever so much more) so our knowing system has to have
some “stuff” with a state space at least as large as the information required to
precisely specify all of the stuff that makes up the tree plus a dictionary capable
of resolving the encoding itself from all of the possible permutations of ways
that information could have been encoded, and even then that would not be
complete as the tree is embedded in the Universe and interacts with it so its
state technically depends on the state of “everything else” in an irreducible way!
And we haven’t even gotten to where we can think omnisciently about everything
that precisely defines that one tree yet – this is just what is required to actually
have the information on hand to think about that tree once one figures out just
what thinking of or being aware of something really is.

Retrieving all, or part, of this encoded map into our “thinker” and bouncing
it around a bit? How is this different from jostling a pocket full of pennies?
How subtle and difficult to encode is that bouncing process itself, and what is it
encoded on and what dynamics govern it?

By extension, in order to postulate the existence of a thinking being that
“knows everything” about the Universe, we’ve got some serious, serious problems,
only one of which is coming up with a concrete model that answers all of these
questions. But we’re in logical difficulties already that will transcend all possible
answers.

First and foremost, there is no other stuff to use to encode, or represent the
state of, all of the stuff in the Universe! The Universe is everything that really
exists. Second, even if we have some non-stuff stuff and manage to pretend that
the non-stuff stuff isn’t part of the Universe (but is still real) but that stuff stuff
over there is the Universe and is also real, we still need enough more stuff and/or
non-stuff to define and represent a dictionary, because 000 could just as well
have stood for d as for a, and heads could just as easily have stood for 0 as tails
– there are 40,000 odd ways we could have encoded *just eight objects of stuff* in our *eight state set of non-stuff stuff* if we are pretending Godpennies exist but aren’t material stuff, they are non-stuff.

Information theory per se doesn’t concern itself with the dictionary part of this except via inequalities – we always need *strictly more* informational head room in the set of states of the encoding set than we have in the set being encoded, because we must have the encoded information and the dictionary. To put it in general semantic terms, not only is the map not the territory, the *faithful* map is *always larger than the territory* because it has to have the map itself and some sort of legend, and if the map is *our knowledge of actual territory*, that legend is vastly more complex than the map itself is. Our encoding is analogous to the *memory* of a computer, but actually *thinking about* or *knowing* is more than just storing information with a decoding rule, it involves *processing* and changes in time!

There is one exception to this rule, and that is something we might call *existential self-encoding*. A real tree (or anything else) in the real Universe isn’t intrinsically represented by something *else*, it is something that represents *itself*. It encodes itself by *being* itself, with no dictionary and no real entropy. An actual territory is an absolutely perfect map of *itself*. A real tree doesn’t exist in *any* state of “imagination” that we might call knowing, possessing a map (however complex and precise), a dictionary, and a complete layering of knowledge of the conceptual functional structure of the tree plus (to be complete) a similarly deep knowledge of its connections to all of the Universe that is *not* the tree. A real tree is what works the exact opposite way – it is the real-world referent, perfectly self-encoding, that we struggle to imagine in some pale echo of the magnificent complexity of the tree itself, and call that blurred, compressed, confused encoding in neural tissue that results “knowledge”.

We now are ready to prove that an omniscient, thinking, sentient God cannot exist. Consider the definition we have already given for Universe: “everything that exists” in the most general sense of the terms “everything” and “exists” – all things at all places, all times, in all real dimensions, that have the objectively real existential property. If something exists, it is a subset of the Universe (where a set is always a subset of itself, so it *could* be the whole thing). If God exists, God is therefore a subset, possibly a *proper* subset (a set that is *smaller* than the original set) of the Universe.

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9 Again, technically this is only true if the information in both is incompressible, but this will not matter in the arguments we are developing.
In passing we note that a thing cannot act as a creator without existing, and if it exists then it is already a part of the Universe. God did not and could not, ever create (in a temporally ordered sense or otherwise) the Universe because if it existed as an uncaused cause to do so, the Universe already existed as an uncaused cause containing at least God as well, and the Standard Model features of uncaused cause and creator of the Universe are therefore disproven, Q.E.D. Sometimes a simple definition makes things much easier.

Now let’s make up a model of an absolutely necessary part that the mind of God – even God! – must have in order to “know”, anything at all: a memory. Forget omniscience, forget actual thought – let’s start small – what does it take to “remember” just one tiny thing about something else? It requires a representation!

Following the general ideas above, let’s imagine a very simple, very stupid God, one with some kind of “God-stuff” within its mind that can take on four states in whatever God-space and God-time you want to invent so that God can actually act to create space and time in the Cosmos we appear to inhabit. Again, if God exists (where existence is reality in all real spaces and times, not just existence in our Cosmos if something more than just that exists), surely God’s mind must have enough complexity to store four distinguishable things, so we can think of this as homing in on one tiny part of God’s mind that is different in a distinguishable way when God is thinking about or remembering those four distinguishable things that are not the four states doing the storing in that God-Cosmos where God exists presumably independently of our created Cosmos.\(^\text{10}\)

Let’s represent those four states of something real (because God and God’s mind and God’s memory must be real, or we’re done here – I will freely concede that an imaginary God exists as an imperfectly defined and inconsistent concept) as ‘a’, ‘b’, ‘c’, and ‘d’.\(^\text{11}\) God can use those four states to encode some bit of knowledge about drawn from the set consisting of everything else that is not part

\(^\text{10}\)To eliminate the trivial case of existential self-encoding as somehow being “knowledge” as in “the Universe knows itself” just by being the Universe. A rock is itself in microscopic detail, but does it “know” itself in microscopic detail? I’d say no. In fact, I wouldn’t say that it knows anything at all. What about you?

\(^\text{11}\)Note that I’m not even attempting to guess how this information is stored, or whether it is maximally efficiently stored or stored in four different places or – like all of the actual memories in our experience – is stored in a lot more than four things cooperating to facilitate robust storage in a dynamic environment – because the argument works for the most efficient encoding of those four things you can imagine, and works better for inefficient codings or dynamical systems with actual entropy.
of this “stored memory” unit in God’s mind. Perhaps God will make ‘a’ stand for ‘1’, ‘b’ for ‘2’, ‘c’ for ‘3’, and ‘d’ for ‘4’.

*No problem!* But note that for this chunk of God’s mind to remember/think about *just one of* 1, 2, 3 or 4 using *only this chunk of it’s mind*, God has to know/store/remember *two more things* with *only* this 4-state memory! God has to *know* state a, b, c and d – they are part of everything, so somewhere, somehow, God has to “know” at a high level that its own mind is in the ‘a’ state *when* it is thinking about ‘1’ and know that ‘a’ stands for the entirely distinct thing ‘1’.

Oops! We are in deep, deep trouble. Really fundamental trouble. To remember four things – any four distinct things – as something other than existential self-encoding, which from now on we won’t even call “memory” as it demeans the term as used in the context of thought and sentience – one requires strictly more than four “units” capable of storing information. That is because there are always two sides to a mapping – the map, which has to be real, as we’re talking about reality here, not mathematical mappings or imaginary mappings – and the distinct stuff being mapped, plus that pesky *legend*, the *dictionary* that specifies how stuff in the map corresponds to the territory. This causes an explosion – in order to *just remember* four things you need strictly more than four distinct “memories”.

In a computer, or a human brain, this isn’t a problem. There are *way, way more than four things* involved in storing the *very simplest* memory of four distinct things “known” by either one. A unit of computer memory capable of storing a single bit of information – a single, switchable, readable 1 or 0 that can eventually be mapped into part of a letter a in a string with “meaning” – consists of at least millions of atoms, each atom consisting of order of a hundred or more “elementary” massive particles. A penny is much worse – now the number of particles is order of $10^{25}$ and they have to be shaped *just so* within a *certain range of temperatures and other conditions* to be able to “represent” the state of a single penny. A neuron is even more complex, involves nearly the same orders of magnitude of particles as the penny, but cooperatively storing fragments of *many* possible messages with a dynamical encoding that we have a hard time even simulating because it is so much more complex than our penny/binary memories. It takes many bits in computer memory, many pennies, or many, many neurons neurons, to store a *single useful piece of information about the outside world* because that information is so heavily freighted with stuff establishing mappings and the dynamic process that we call “simple” computing using the stored information, let alone the vastly more complex process of thought *about* or knowledge *of* that stored information.
The amazing thing about these electronic or material biological brains is that they can build deep hierarchies of “knowledge” – specific memory, reliably stored in a distinguishable state space, that maps into “stuff” being remembered, plus a dynamical system that can act on the memories stored to transform it in useful ways (often generating new things to “remember”), through many layers of encoding and dictionaries and dynamical rules for “grammar” or “time-evolution” along the way. The electrons in my brain are helping me remember the words in the English language at the same time they are helping me generate “new” strings of letters representing those words that have not only meaning, but rather subtle meaning at that, as are the quarks in the protons and neutrons in the nuclei, as parts of the atoms that make up the molecules that make up the neurons, and the many neurons that make up my brain, that is doing all of this stuff transiently so that the computer I’m working on becomes an essential extension of the same process, as my own brain could never record every word I’m thinking up while I’m thinking it up in a way that it could ever be precisely retrieved a day from now when I work on what I’ve thought and written a second time...

But there is one thing that my brain can never, ever do! And that is represent the exact state of all of the stuff that makes up my brain, as a memory of my brain at the same time this same memory is representing stuff in the outside world at the same time it is representing the necessary dictionaries allowing it to decode both things at the same time as “knowledge”!

Indeed, a sentient being cannot ever perfectly “know” its own mind – forget about the outside world – using only the storage capabilities of that mind. It isn’t just very difficult. It is formally, mathematically impossible. The only sense in which it is possible is the trivial one, the tautological one, in which yeah, my brain knows its own state by being in that state, which is the “knowledge” only in the sense that a rock made up of a gazillion moving parts “knows” its own state just by being the rock in that state, a false rock-memory of being something independent of knowing or any ability to think, not the real memory or knowledge of the exact state of the rock by a thinking being.

Note again that we’re right back to the order of precedence – experience precedes knowledge because knowledge compresses experience, but one cannot experience one’s own state, one just is that state.

This is a problem. It is a very serious problem. Indeed, it is an insuperable problem in information theory. God cannot simultaneously know It’s own mind right down to the microstate of everything that makes up its own brain – material or immaterial, makes no difference, we’re talking about information here, not
the specific means of information storage – in anything but the sense of rock-
knowledge! Specifically, it cannot know its own mind right down to the microstate
of every single irreducible chunk of “stuff” that it uses to remember things in
any way but the irreducible rock-sense described above, let alone use that stuff
a second time and in a different way entirely to represent the state of something
else (anything else!) and establish the highly degenerate mapping between its
internal memory state, its non-rock knowledge of its internal state, and that
other stuff!

At this point, you are doubtless a bit confused as this is a tricky and subtle
idea to grasp, which is why it has been missed (I think) by philosophers and
information theorists to this point. Let’s reduce it to pennies, or neurons, or bits
– but again let’s choose pennies.

Grab your nine pennies. Shake them and drop them onto the floor (in such a
way that they don’t go rolling off under the furniture). Look down. Now tell me
what they mean! Hopefully you are sensible enough to correctly answer “abso-
lutely nothing” (other than their existential state – they “mean” something like
“hey, look, we’re nine pennies lying on your floor in some pretty much arbitrary
pattern” ![12](https://example.com)

OK, so let’s go one better. Let’s invent “time” and “space” (or at least an
ordinal ranking system of some arbitrary sort – and don’t forget to add the one
used to your dictionary) so we can sort out the pennies in a spatial way that
encodes their temporal ordinal ranking. And don’t forget these inventions –
remember that reality was that existential flop of the pennies when you shook
and dropped them, with nothing to even identify which penny is which after you
drop them!. Here’s a good one: flip the pennies one at a time and arrange them
in a line from left to right in the order you flipped them. Or label them 1-9 with
a marker and flip them however you like but then arrange them from left to right
in one of the 9! \( \approx 360,000 \)-odd ways they can be arranged (but record the one
you use).

If you actually do this – and if you don’t actually do the exercises I suggest,
well, don’t blame me if you don’t get the point entirely – you’ll get some pattern

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12 We could digress into a long and learned discourse on the futility of shaking out the marked
sticks of the I Ching, reading entrails, rolling the bones, reading tea leaves, building a horoscope
on the basis of the positions of the stars and planets, or using a Ouija board to spell out
meaningful messages, but I think it would probably be better to just let this footnote stand in
for the whole pointless digression. If you actually think that any of these things have useful
predictive power of anything but, e.g. – the most likely configurational patterns of tea leaves
in the bottom of a cup, well, there is little point in your reading this book at all, right?
OK, now what does this mean? Again, the answer is basically nothing (but itself). Oh, we can make it stand for something. For example, if we let tails equal 0, heads = 1, and use our previous code, this is 110 = 6 = g, 001 = 1 = b, , 100 = 4 = e, so it means gbe! Wow! A hidden message! Or should we have let tails be 1 and heads 0? Now it is h-g-d. gbe? hgd? Huh? Or maybe it stands for 11001100, a nine bit number standing for $256 + 128 + 8 + 4 = 396$.

396? Well, it’s not 42, but it is – something? But wait, maybe the message is scrambled! After all, the order we laid out the pennies is pretty arbitrary. Of course there are a lot of ways we could reorder the pennies (360,000 of them, in fact), each with many possible hidden messages – depending on how large you want to make that dictionary. Or maybe... wow!

There are a lot of things this can mean! So many, that as noted, it means nothing, at least not without a fair bit of help.

Now try to find a way of representing the state of the pennies using the pennies themselves! No, you don’t get to count the obvious one (and only one that works) as a row of pennies in this precise order and orientation to represent themselves. You have to use the pennies to store the information and indicate how you encoded it onto the nine pennies, including how you encoded the particular order of your arrangement. That is, even if you encoded their state into – their state, you have to encode the fact that this is the specific one of all the possible encodings of a particular arrangement of the pennies into all the possible states of pennies it could stand for that you actually used into the state of the pennies at the same time you encode the state of the pennies using that encoding!

And you can’t do that. Nobody can. It can’t be done. There simply aren’t enough pennies. You can observe that the pennies in that order stand for themselves, but you cannot be given even the simplest imaginable representation of the information in the actual state – 110001100, say – and reconstruct the state of the pennies even if you ignore the order permutations because you don’t know if ‘1’ represents a head or a tail, and it takes at least one more penny to tell you! You can never catch up.

This doesn’t get any better when we add in the fact that we’re treating whole pennies as “bits”, while they are not. They aren’t even pennies. What they are
(as best as we can actually tell using sound reasoning) is a series of fleeting configurations of little teensy bits of energy and other stuff in space-time. All of the time you are looking at these “pennies”, this stuff is whirling this way and that, vibrating, interacting with every other piece of matter in the Universe in weird quantum ways, in such a way that their future state cannot even in principle be predicted or be considered “known” from knowing the state of every single bit of stuff that we call “a penny” at some specific instant of time! You’d have to know the state of everything else within at least 14 billion light years of the penny – if not even more stuff than that – as well!

Even this pessimistic analysis, incidentally, requires that you actually did as I asked and dug up nine actual pennies and flipped them and arranged them. If you are relying on the image of pennies I arranged for you (shame on you, you lazy human you), the “pennies” you are relying on to get the point aren’t even pennies, and never were pennies, and you simply don’t want to know how much stuff and how many layers of information, dictionaries, rules, and just plain machinery was required so that I could have an idea, transform it into simple ideas that communicate the point (which has nothing to do with pennies per se) and arrange a presentation so that you could be fooled into interpreting what is, after all, just a set of neural impulses in your brain into the meaning – whatever that might be – obtained via the light from points on your screen that most certainly are not pennies or numbers or bits or letters – until, of course, they reach your brain and in some abstract way, they are!

Now try storing that in your nine penny memory!

Hopefully this is obvious to any thinking being that knows almost anything at all about how real brains function, or real computers operate – and now is just as obvious to you, even if originally it wasn’t. Experience leads to knowledge, right?

In summary: Bits in a computer are made up of lots of stuff. Neurons are made up of even more stuff. To precisely specify the state of all of that stuff in a memory that holds (say) a billion bits or a billion neurons takes way, way more than a billion bits, or neurons or atoms, molecules, elementary particles or anything else we might even conceive of to represent the information. The actual stuff itself has some definite state, to be sure, but that state isn’t what we ordinarily call “knowledge” of the state. Three pennies cannot encode every feature on Lincoln’s head on even one penny.

No computer – or mind – can perfectly symbolically encode all of the information needed to perfectly symbolically encode its own state symbolically encoding
*its own state* any way other than as the irrelevant existential rock-knowledge tautological sense of *being* in its own state. It requires a dictionary (and functionally, a lot more to even vaguely be considered “knowledge”) and the dictionary has to select a single choice from a domain that is strictly larger than the state space of the system doing the encoding. This inequality persists as one takes limits, and if anything it just gets worse as the system gets larger and more complex, and we haven’t even *added* knowing its own state while it is knowing *anything else* at the same time!

Just because there are bound to be mathematical purists out there who mentally discretize the entire physical Cosmos at some scale and then say “ah, but in a single real number there are an *infinite* number of digits, and hence we could in principle *store the knowledge of the entire Universe in a single number!* or something equally silly – if this is you, please meditate on the *inequality* involved – you cannot encode the real number and a rule for decoding the real number into the same real number, so while the real number can stand for anything you like, and in principle can encode the very, very large rational number that you want to transform the state of the Universe into as well as a rule for mapping that number into back into that state – maybe – you can’t do that *and* know the number itself as anything but a representation of itself that is rock-knowledge, not knowledge. This isn’t solvable by the continuum hypothesis, in other words, because you can *never catch up* to the need to store the information *and* the dictionary where you store the information – if you want to be omniscient in any sense more meaningful than the omniscience of a rock!

Real brains get out of this dilemma quite simply by *not knowing everything.* I don’t know the actual microscopic state of *anything* inside my own head as I’m typing this. I cannot be said to ”know” the state of one single neuron in my brain in any useful *sense*. But *using* all of my neurons[^13] I can generate, think about, type, and reason with all of the symbols used in this book. Think about what I would have to know if I had to know the specific state of every neuron and synapse and biomolecule and atom and electron and quark and photon and... in my brain in order to be able to think about my own brain at the level we would call *knowing everything* about my own brain. I can’t do it. It is impossible. It is impossible for me and it is impossible for God. Not because it is very, very difficult, so if I were smarter I could do it and God is possibly a lot smarter. Because it is provably impossible to represent the microscopic state of *any* information storage and processing system *within* that system in any other way than the microscopic

[^13]: Well, some of them. Those that survived decades of abuse and continue to function in some way I can’t understand or define in any detail, even as they do the work on their own just fine.
state itself as a self-representation. Try to encode it as usable knowledge, and you have an information explosion.

There are several other properties of God in the standard model that are equally easy to formally disprove (as long as one does not permit the slippery arguments that require the redefinition of evil as being good, or pain as being equivalent to pleasure), but many of these require a mix of reason and observation taken together – that is, the application of the Cox axioms and the global optimization of a worldview seen as a set of posterior probabilities that are most consistent with the actual evidence of our senses and rigorous experiments and observations made of the real world. equally easy to disprove or fail to support by either reason or observation. For example, the “human” property of omnibenevolence and omnipotence in a Creator God is contradicted by experience – all of the evil of the world becomes the direct, preordained consequence of the deliberate act of creation of the omnipotent, omniscient deity. This deity bears the responsibility for its acts, and indeed because it is omnipotent and everything that happens was planned and is caused only by it, nobody and nothing else does.

For example, the “human” property of omnibenevolence is contradicted by experience – all of the evil of the world is the will of an omnipotent deity, the problem of theodicy is just as potent an argument against an all-good God today as it has been over the thousands of years since it was first proposed and written down 14.

In the end, the problem of theodicy disproves any assertion of an all-good God today as effectively as it has over the thousands of years since it was first proposed, let alone written down 15.

A second problem with the standard model of God is that the “action” properties of God are never verified empirically in careful experiments. For example,

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14 It is almost certainly prehistoric and was around long before it was written down. My five year old son discovered it for himself without being taught or told, asking me in the car one day “Daddy, if God is good why do people suffer?” Smart kid! I didn’t have an answer for him then, and don’t have an answer for him now. Nobody does.

15 It is almost certainly prehistoric and around long before it was written down. My five year old son discovered it for himself without being taught or told, asking me in the car one day “Daddy, if God is good why do people suffer?” Smart kid!

If a God worthy of the name exists, I didn’t have an answer for him then, and don’t have an answer for him now. Nobody does. On the other hand, if reality is what it is without any intelligent causal agency one can identify as a Standard Model God, one can easily understand why things happen in nature in such a way as to be as almost completely indifferent to any associated suffering in sentient biological entities as we observe them to be.
a number of double blind experiments have been conducted that attempt to
demonstrate a positive benefit to prayer. All have failed, some of them getting
(as one would expect in a data dredge of a null result) a *negative* result (the very
sick people being prayed for recovering at *less* than the rate of the control group,
although not significantly so)\textsuperscript{16}.

The most powerful argument against a God who is relevant to the real world,
however, can be more or less directly and algebraically in terms of Bayes’ theorem,
the central precept of what I argue above is *the* best rigorous basis for knowledge
of the real world. This argument is sufficiently important (and simple!) that it
is worth a short subsection all its own.

\textsuperscript{16}Wikipedia: \url{http://www.wikipedia.org/wiki/Studies_on_intercessory_prayer}. As you can
imagine, it is remarkably difficult to set up a double blind, placebo controlled study of the
efficacy of prayer. My favorite study is the one where they studied whether prayer *now* could
affect outcomes *in the past!* Hey, if everybody just prays *hard enough, right now* maybe we can
make World War II *not have happened.* Madness.
Chapter 15

Bayesian Proof of the Implausibility of God

The law that entropy always increases holds, I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell’s equations then so much the worse for Maxwell’s equations. If it is found to be contradicted by observation – well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation.

– Sir Arthur Stanley Eddington, The Nature of the Physical World (1915), chapter 4

Is it more probable that nature should go out of her course, or that a man should tell a lie? We have never seen, in our time, nature go out of her course; but we have good reason to believe that millions of lies have been told in the same time; it is, therefore, at least millions to one, that the reporter of a miracle tells a lie.

– Thomas Paine, in The Age of Reason

We have seen in the previous chapter that the axiomatic definition of a Standard Model God is not consistent. Because the possibility of completely disjoint subsets of reality exists, then no being can ever be certain that the reality of their personal experience is exhaustive, and no omniscient being can be certain. God, if God exists, cannot prove that Its knowledge of reality is complete.
and consistent any more than you or I can, and Godel’s theorem proves that if the simple example I’ve given several times of a disjoint LoTR Cosmos is insufficient for you to see that it must be so without it. Information theory also contradicts omniscience of a dualist Standard Model God, although it leaves open the possibility of a monist Pandeisty who is the Universe and hence is its own self-representation from the information-theoretic point of view, but who cannot meaningfully know itself at the microscopic level any more than you can precisely represent the state of every electron and quark in your body in a symbolic encoding involving on the neurons in your brain that are made up of and operate via transformations between specific states of a strict subset of those electrons and quarks.

However, we would like to at least try to be consistent in our reasoning process, and one thing that has been repeatedly asserted in this book is that one cannot really make logical arguments of this sort about the real world. It isn’t that the real world is immune to logic; it is instead that there is a terrible infinity in the set of all possibly true notions about the real world and that pure T/F logic is a poor tool to use to attempt to establish the best thing to believe. Best belief, as we have seen, should be based on evidence and common sense, or in more mathematical language, on probability theory and Bayes’ theorem, where we refuse to make definitely true or definitely false assertions even as (especially as!) priors, or axioms, of an argument, and let evidence speak by reconstructing posterior probabilities for our priors as evidence accumulates in such a way that they can, over time, be (almost) completely disproven or (almost) completely proven without ever reaching the level of being known to be perfectly true or perfectly false.

What does Bayesian probability theory have to say about the probability that a Standard Model God exists? To find out, let’s express beliefs about a Standard Model God in a probabilistic format:

\[ P(G) \in (0, 1) \]

stands for the probability that G(od) exists. We express it in this way to make it clear that it is not certain that God exists, nor is it certain that It doesn’t. No matter how strongly you believe, you must admit a chance that you are wrong. No matter how strongly you do not believe, again you could be mistaken. As described above, a critical aspect of Bayesian reasoning is that one cannot assign a prior probability of a statement as equal to 1 or 0 exactly and leave it “correctable” by evidence in a posterior probability computation. It then becomes truly an axiom as in ineluctable truth that will warp your entire concept of reality in a way
that no evidence can overcome.

\[ P(L) \in (0, 1) \] stands for the probability that the Laws of Nature are, in fact, laws that cannot be broken. Note that this is not the assertion, per se, that the Laws of Nature that we teach in physics classes and do experimental and theoretical research on in University departments and laboratories and use as the foundation of our everyday engineering, chemical, and biological enterprises and research are precisely correct in all details – it is not about whether or not we have the precisely correct Unified Field Theory or Theory of Everything – it is about whether or not the major components of those laws are (probably) correct or incorrect.

To be a bit more specific, I’ll limit this assertion to the claims that (in particular) the First and Second Laws of Thermodynamics are correct – essentially the conservation of mass-energy (First Law) and directed time evolution of sufficiently complicated systems from less likely (lower entropy) macrostates to more likely (higher entropy) macrostates – and in general terms that the theories of gravitation and of electromagnetism, in particular, are at least excellent empirical approximations to unbreakable law when they correctly expressed that might have a more general form, eventually.

\[ P(G, L) = 0 \] stands for “God is supernatural and can violate the Laws of Nature at will.” Yes, this is an exception to the common sense rule that we not make egregious claims of perfect knowledge of almost anything about or in the real world, but it follows from the Standard Model of God! If God is omnipotent, omniscient, omnipresent, and so forth, then of course God can violate the Laws of Nature at will. That is, we can never expect to observe a Cosmos in which the Laws of Nature are inviolable and evidence of a supernatural deity that violates those laws. The two ideas are mutually contradictory, and hence mutually exclusive!

\[ P(L|G) \] and \[ P(G|L) \] are the conditional probability of the inviolability of the Laws of Nature being true given the certain existence of a Law of Nature Violating God (first form) and the probability that a Nature Violating God exists, given that it is true that the Laws of Nature are Inviolable.

We are now set up to write down Bayes’ Theorem:

\[ P(L, G) = 0 = P(G|L)P(L) = P(L|G)P(G) \]

From which we can write down two “syllogisms” in probability theory as opposed to formal logic. In a moment you will see why the problem is formulated in this way.

First, hopefully it is obvious that if we are not certain that the laws of nature are false, that is, if indeed $P(L) > 0$, then $P(G|L) = 0$. That is, there is no good reason to conclude that a Law-violating God exists as long as we think that there is a good chance that the Laws of Nature are, in fact, probably true and never violated.

The opposite is also true. If one thinks that there is a good chance that a Law-violating God exists, then there is no good reason to think that the Laws of Physics will be observed to be inviolable.

The reason for formulating the problem in this way is that now we can formally apply observational evidence to the question. There has never been a credible, reproducible, report of a violation of the Laws of Nature. Whenever we test the First Law of Thermodynamics (conservation of mass-energy) in any of its many forms, we have never observed mass-energy to be created or destroyed. Sometimes energy turns into mass. Sometimes mass turns into energy. Sometimes they both turn into each other. But always they balance within the fundamental limits of the physical theories that seem (by their success!) to govern them and experimental error, when experiments are carefully done. Similarly, we have never observed a credible violation of the Second Law of Thermodynamics and

This is why the U. S. Patent office no longer accepts patent applications for Perpetual Motion Machines of the First Kind (ones that violate the First Law) unless accompanied by a working prototype. Precisely the same argument can be made substituting in $M$ for $G$ where $P(M)$ stands for the chance that an energy-conservation-violating perpetual motion machine can be built and hence observed in nature.

Similarly, the laws of nature as best we understand them might be wrong (by being incomplete, for example) but never appear to be violated in careful experiments that perform quantitative measurements under circumstances where there is some claim that God is intervening, has intervened, or might intervene. People do not come back from being really, truly dead, especially not after being dead for 24 hours or more. Irreversible changes in cell biology occur within minutes of death (or rather, are the process of death) as cells starve for oxygen and rupture and bacteria start to run rampant, unchecked, no longer opposed by the body’s living defenses. One cannot move a mountain through faith, or at
least no one has ever reliably observed such a thing being done.[1]

It is sometimes asserted that God has to hide its existence from humans in order to permit the existence of Free Will. However, there is no plausible reason that a Universal standard model God would hide its existence from mankind now but make itself known, reportedly, with tremendous regularity back in the Bronze Age. Were Bronze Age humans not equally entitled to their Free Will? Any attempt to construct a Standard Model God that hides its own existence while (in most models) judging humanity harshly and violently posthumously on the basis of the “sin” of mere disbelief results in a petty, jealous, silly, anthropomorphically human God that fails even the most elementary tests for “benevolence”, all the more so given that these same Bronze Age gods (are alleged to) invariably punish non-believers horrifically for the mere “sin” of refusing to believe in the impossible, or the highly improbable, without any real evidence or proof. God in most religions resembles nothing so much as an unrestrained human tyrant – wishful thinking on the part of the believer, an extrapolation of the human lords and masters that they were subordinate to every day. It is no accident that in many early cultures, the prevailing ruler was considered to be (a) God and was often worshipped and obeyed as if they were.

Finally, variants of the Standard Model of God that include things such as “perfect justice”, with heaven and/or hell held out as ways of balancing supposed morally good or bad acts on the part of normal humans during their normal and real lifetime on Earth are especially inconsistent with everyday experience as they are perfectly unjust unless the “God” involved is completely passive or completely active. A completely active God would prevent injustice from ever occurring because otherwise all moral responsibility for injustice would devolve upon It. This is contradicted by observation. A completely passive God, one that does absolutely nothing but allow the Universe to evolve in time without any reward or punishment for any action – in a sense infinitely unjust – is paradoxically perfectly fair and just, ignoring the good and the evil alike. This latter sort of God again isn’t consistent with sentient, benevolent, Standard Model God, but pandeity models without “normal” sentience (and hence benevolence) are, perhaps, acceptable.

We conclude, on the basis of pure reason (Gödel’s theorem or information theory) that no Standard Model God with the property of Omnisience can exist. We conclude, on the basis of the direct observation and knowledge of human

[1] Accounts to the contrary in religious scriptures – and there are such in the scriptures or apocrypha of all the major world religions, all equally unbelievable – are almost certainly myths, stories told by a lying frog.
suffering (including our own, which we can scarcely doubt), that no Standard Model God that includes the properties of Omnibenevolence and Omnipotence can exist. When we look for actual direct evidence of a God that interacts directly with the world, using the careful application of the same empirical methods and common sense tests we apply to any other notion that wants to be promoted to a “probably true” belief, we find none.

In the end, the only non-standard model of God that is not excluded by reason and experience is the Universe itself, which is indeed by definition ubiquitous, omniscient and omnipotent, infinitely unjust (uncaring, even) and hence is somehow just as it neither praises nor blames, rewards nor punishes all beings equally. Whatever happens happens, and indeed the Universe itself is ultimately “responsible” for everything that happens as the Universe itself. It is neither Omnibenevolent nor Omnimalevolent. It even has the required non-contingent existential property. Pandeism is therefore worth exploring in more detail as a possibly-not-inconsistent model of God, even as the Standard Model God is, one hopes consigned to an eternity on the ash-heap of discarded, impossible mythologies.
Chapter 16

Pandeism and Panendeism

Let’s start with a couple of useful definitions:

**Pandeism** is the belief that the Universe itself is God. This is not in any sense a rare belief – it is arguable that one entire branch of Hinduism is not *really* a polytheism but is in fact a monist monotheistic pandeism, the Universe as Brahma (or even more abstractly, the principle of *Brahman*) who initially just was the Universal all in perfect knowledge only of Itself, but who out of boredom or a creative desire or both at the same time split itself from one into Many, creating our visible spacetime continuum as well as the gods (lower case ‘g’) and humans and rocks and stars out of Itself. Pandeism is belief in an informationally *closed* Universe – one that is still Brahma in a state of perfect knowledge even as its many parts have at best *imperfect* (relative entropy laden) knowledge of everything else.

**Panendeism** is Pandeism’s “open”, dimensionally unbounded cousin. It is still technically Pandeism, God is everything that exists, but now everything that exists is infinitely infinite. The spacetime continuum we live in and *assume* is “the Universe” really isn’t, the Universe is larger. To a Panendeist, God is *more* than the visible spacetime continuum, although we have already carefully defined the Universe to be everything that exists for the direct purpose of eliminating any sort of argument that a God that simultaneously exists and is “larger” than the set of *everything* that exists is possible. The big difference is that a *kind* of entropy is possible for a panendeity, although ultimately it isn’t particularly different from pandeism unless you also explicitly assert a particular kind of openness to the *real* Universe with its *infinite* set of spacetime continua (as any finite set would
be right back at ordinary Pandeism).

- Pandeism is a possible model of God, one that deftly avoids the problems with Gödel by not being “aware” in any sense that permits high order self-referential semantic complete knowledge. Knowledge isn’t impossible – we are part of the Universe and know of some part of the Universe in the sense this book establishes, as an imperfect, fuzzy, noisy, low-resolution but self-correcting map/model – but our knowledge as only part of the Universe is never complete and consistent, it is partial, entropy-based, transient.

This makes the Universe something worthy of a sort of “worship” – if Pandeism is a true hypothesis, then our evolution and the our search for the best possible knowledge of the Universe is the Universe (God) coming to know itself.

- Panendeism is another possible model of God, one that exploits infinite incompleteness in an infinite open system to allow any finite partitioning to experience time and entropic flow, a calculus of being. This model is a Hilbert Hotel deity that always can produce a new cigar from an infinite supply of rooms, and can always be discovering itself. Indeed, the simplest such model is one where one partitions into past and future, if one can show that an infinite set of futures branch off consistently from any given present with its past. It isn’t clear that this is the case, but quantum theory at least admits the weak possibility, depending on whether e.g. a many-worlds interpretation is literal truth.
Chapter 17

A Critique of Scriptural Theism

Is it more probable that nature should go out of her course, or that a man should tell a lie? We have never seen, in our time, nature go out of her course; but we have good reason to believe that millions of lies have been told in the same time; it is, therefore, at least millions to one, that the reporter of a miracle tells a lie.

*The Age of Reason*, by Thomas Paine, American Patriot

Do you think I wouldn’t obey my own rules?

Aslan, in *The Magician’s Book*, by C. S. Lewis

In the previous three chapters we developed what reason and the firm resolution to believe the most what we can doubt the least trying very hard to doubt has to tell us about God. To summarize it, if we assemble axioms into an actual model of God that assign to the concept of God those attributes most commonly associated with God (omniscience, omnipotence and so on) we run into logical and mathematical difficulties almost immediately. Indeed, we ran afoul of Gödel’s theorem at the very beginning – God seems to be a logical system capable of expressing arithmetic that is both consistent and complete and can prove its own consistency, *all things that Gödel has mathematically proven to be impossible!* We also discovered difficulties based on information theory in a dualist model that partitions the Universe into both the visible Cosmos (and whatever else might exist outside of the visible part) plus God as a separate entity. It seems remarkably difficult to construct any sort of consistent picture of God as a
thinking entity, outside of spacetime (but with a time axis of Its own?), coupled
to and pervading spacetime events, that is not ultimately a static description
and hence incapable of action.

In the end, only two models of God that satisfy the basic “infinity” (omni-) axioms seemed viable – pandeism, the hypothesis that God is the Universe, and panendeism, the hypothesis that God is the Universe which is open in a way that permits God to be all-knowing and yet not all-knowing (and hence free to change and discover and learn and act). The latter hasn’t really been proven to be a consistent hypothesis because it isn’t at all clear that even a Hilbert Grand Hotel Universe possesses a free limit, but we can at least imagine that it might, pending the invention of mathematical and theoretical metaphysics as an actual discipline neither more nor less practically useful than lots of other research in pure mathematics that occurs today that might address the question.

In this chapter we are going to be concerned with something else entirely. This book is hardly being written in a vacuum – the world is chock full of religions, most of which are based on some body of theistic scripture – holy writings that claim to reveal the nature of God to humanity, convey God’s moral instructions to humanity, establish complex social, economic and political structures wherein humans can perform actions collectively referred to as “worship” of God as well as petition God for various forms of intervention in the natural course of events to make things work out in favor of the petitioners, seek to attract new recruits to the worldview/belief system associated with the religion, provide a social system for transmitting the worldview between generations and reinforcing the worldview within the current generation, and act collectively as a political network to attempt to coerce others who might have different moral or social or political or economic or religious beliefs to act according to the beliefs of this one or experience various religious sanctions. Over 80% of the current population claims membership in one organized religion or another.\(^1\)

The reason for this is very simple. As this chapter will summarize, reason itself provides more than ample reason for rejecting all of the world’s scriptural theisms as being, for want of a better term, lying frogs.

- Prime axiom of scriptural theism “This scriptural theism is (perfect) truth”.
  This is the lying frog and Gödel rolled into one. If it claims to be true as an axiom it is almost certainly false.

\(^1\)Wikipedia: [http://www.wikipedia.org/wiki/http://www.adherents.com/Religions_By_Adherents.html](http://www.wikipedia.org/wiki/http://www.adherents.com/Religions_By_Adherents.html). 86% as of the time of this writing. This is probably an all time low, historically, reflecting the high rate that organized religions are being abandoned.
• Otherwise, one has to apply the calculus of doubt to the question, “Is this scriptural theism true?”

• Trivial to show that at least parts of it are very easy to doubt; indeed, they directly contradict things we believe very strongly and for very good reasons.

• It is then time to throw the frog through the door. Is there reliable empirical evidence for the truth of the claims of scriptural theisms? Specifically for their claims about God, of course.

• The answer is no. In fact, most of those claims are logically inconsistent in addition to being unsupported by evidence. For example, in addition to the reason-based constraints (which describe a deity incompatible with the Abrahamic faiths from the beginning)...

• The problem of theodicy is a big problem for all world religions. There Ain’t No Justice (however just!) is the rule we observe in nature.

• We also lack anything like solid evidence that God breaks the observationally confirmed laws of nature. In fact, we never observe these laws to be broken in a way that can reasonably be attributed to action of God. Historical reports that once upon a time this happened are subject to the criticism of Paine (and Jaynes, and C.S. Lewis, inadvertently) that men and beasts lie, but the stars never do. (That is, when a religious mythology reports as fact things that science contradicts, it is far better to believe those things a myth, legend, or lie than it is believe them true, because we cannot doubt that myths, legends, and lies abound in scriptural mythologies – even religious people manage to doubt very well the theistic scripture of all of the other religions – but we find it very difficult indeed to doubt what we learn of physics and the history of the visible Universe by looking at the evidence and using reason to infer natural law and natural history.

The conclusion is that we can all easily doubt the truth of scriptural theism. In fact, mere common sense tells us that it is almost certainly false. Because world religions have many negative consequences – social, ethical political consequences of great import – they should be abandoned wholesale by anyone wishing to do their best in the specific sense of believing the most what they can doubt the least and using this most reliable knowledge (so far) to guide their moral, social, and political choices instead of a religious mythology written by superstitious and exploitative individuals, usually over a thousand years ago when humans were enormously ignorant about the Universe and reason itself.
For individuals that find abandoning the idea of God difficult – or wish to consider the Universe itself (as God) to be evidence of God – I remain sympathetic, and only suggest that they *divorce* this religious feeling from scriptural theisms in general and refuse to give up any measure of their political power or ethical judgement to those that falsely claim to speak for this sort of God. If God exists, and is capable of thought and action, It needs no defense and is perfectly capable of appearing on the Daily Show at any moment that It deems suitable for unambiguously revealing Itself to humanity. It is silly to think that this sort of thing happened in the early Bronze age or 2000 years ago (but only to select individuals, of course) but never happens now, and the claim that it did is without exception used to extort your money, your political power, and your social power and give it up to a group of ordinary humans who in the end have no more real understanding of the nature of being than you do (and often, have far less).

So enough. Time to move on.

Humans have enough difficulty being “free willed” in a Universe where all action appears to be dictated microscopically by physical law, whether or not the law is deterministic or random.

If it is deterministic then your will is not free as long as the particles that make up “you” are obeying laws of nature with a unique solution. If the laws of nature admit probabilistic (non-unique) solutions, you *still* aren’t free, your actions are then determined by the rolls of metaphorical microscopic dice. However, human actions can *feel* like they are free-willed because the past is imperfectly remembered and the future imperfectly extrapolated so we can *choose* from various possible futures that can come about contingent upon our desires and our actions.

God, on the other hand, is *omniscient*, so that no action of God can *change* its present knowledge of the future to be different from its past knowledge. Freedom and choice require multiple alternatives and appear quite incompatible with omniscience.
Part V

Ethics
Part VI

A Global Worldview
This is out of a GR diatribe, but worth preserving to redo into the intro to this part of the book. It will require that it begins with a bit more of a connection between axioms as “self-evident truth” and “myth” as the basis for much of human decision making, the trade-off between complete critical rational appraisal of every proposition and the need for SPEED, where most judgements have to be made RIGHT NOW or you get eaten, or somebody dies needlessly, or you lose in the complex game of survival and reproduction where there is no trophy for coming in second.

I still want to finish the book with just such a mythology – a complete metaphysical science and ethics sufficient to act as a basis for a global worldview in a global society. This may well lead to the sequel for this book: *Utopia: How to Get There from Here*.

I recall a thread some time ago about writing an atheist bible or a secular humanist bible or some such, a proposition that was promptly shot down because a bible contains myths. However, ethics (however rational) is going to be based on ”myths” in the precise sense that its basic premises will be not only unprovable, but in a deep sense they will be false.

Take a statement such as “human life has worth” and pretend that we’ve worked long and hard on a dictionary such that the terms “human”, “life” and ”worth” have some not-too-amorphous meaning, so that this means approximately what it says up front in English but can’t be automagically generalized to imply that sentient alien robots from Arcturus cost $180,000 if you are purchasing them to use as household slaves (where ”human” means ”sentient like a human” instead of ”being an approximately normal human being”, where ”life” means ”the state of biological existence between birth and death”, not ”animate and self-willed”, where ”worth” means ”general value to human society” not ”cost”, and you can already see one major difficulty with writing down theistic ethical pronouncements in any human language...:-).  

This axiom is simple enough, and as a sound bite it is very appealing. It seems as though it is very nearly a basic axiom for any useful human ethos – even if the life in question is sufficiently damaged or filled with pain that the living human in question wishes to end it, the feeling of regret that we all might share in association with the ending is a recognition that the life itself had, as an ideal, worth.

And yet it is so very obviously false. The notion of worth itself is a complex illusion, or better yet, an illusion born of complexity. There is no worth in nature, and the notion itself only emerges in the context of sentient beings that create...
an ordinal system of values that pertain to their biological imperatives (first, at some point in evolution) and later to things that go far beyond biological imperatives to where neural representations of certain patterns derived from our sensory experience of sound are assigned higher “worth” than others, transiently in time, in a highly culturally variable way.²

I would assert that we are in the middle of a major myth-war, an upheaval of human social and ethical myths of epic proportions, a vast convulsion that has been taking place on an ever-accelerating basis for centuries now and that nobody, not even I, can predict its outcome. It is a part of the general worldview revolution that began with the Enlightenment, but unlike the scientific part of the Enlightenment, it isn’t on anything like sound logical ground. Quite the opposite. It really is a myth war, a paradigm shift in our mythos.

Here are a few common myths: Human life has worth. Humans have “rights” – such as the right to be alive, to be free, to be happy, to be treated on an equal footing with other humans independent of irrelevant differentiators. These rights are more fundamental than any “rights” of human societies to impose restrictions on the behavior of its members.

Yet, within the same general myth-set, human societies do have explicitly stated and prescribed “rights” to impose restrictions (e.g. laws and taxes) on their human members. Even highly abstract e.g. corporate entities – businesses, associations, religions – have certain “rights” within the axiomatic framework of social/legal control.

All of these axioms casually referred to as “rights” and “right behavior” (human and otherwise) have gradually been separated from theistic/religious/social axioms that formed the comparatively rigid and stratified social structure humans lived with for almost all of recorded history and presumably beyond into the pre-historic past. All lies, all myths, often logically inconsistent (that is, full of internal contradictions) that lead to conflicting answers to such important questions as whether or not a female of child-bearing age is within her “rights” to expose locations on her body to the eyes of the general public.³

At the same time, we must have – that is, as necessary, invent, discuss, and agree upon – just such a set of utterly necessary myths if we wish to ever live in a

²That is, “music”. Non-verbal, non-specific, no dictionary, no intrinsic symbology, no survival value worth mentioning. Does it have value? We certainly exchange things that do have value for it, and spend a fair bit of time with tunes running through our heads and no idea how or why they got there.

³...and not just the “good” bits, either. We’re talking the “right” to expose the ankle, the face, skin of any sort. Sheer madness.
mostly-rational free society. Hence the current and ongoing myth war between modern (arguably somewhat more consistent) “humanist” myths and the hodgepodge of leftover myths built into us by evolution, refined into integrated religious and social rules, and inherited via a vast chain of memetic social transmission from our stone age roots, through the bronze and iron ages, right up to the present. The successful myth-sets that survive and fight today were all “selected for” by a brutal evolutionary process of naked violence and outright war that permitted – note well! – not the “best” social/religious systems (even by their own nominal internal standards) to survive to perpetuate themselves, but rather those systems best able to expand at the expense of and by violently destroying other competing systems, taking over their resources human and otherwise.

Passive socioreligious superorganisms, however healthy, cannot compete with superorganisms willing to kill, kill, and kill some more to achieve dominance. At the end of the day, we are the million-year-descendants of the most bloodily efficient of the killer apes, apes that won the evolutionary battle by evolving enough intelligence to be able to organize and modify our social groups to where they were the best at killing off the other social groups. At long last we have arrived at the logical end point of this process – one where the most violent in a long succession of violent societies are in direct and violent conflict, one where the only credible threat to our collective survival (beyond “act of God” level natural events such as supervolcanoes, falling asteroids, or gamma ray bursts) is – us.

At the same time, over the last century, human technology has accelerated socioreligious memetic evolution to the point where even silly memes can “go viral” and become known to a substantial fraction of the global population in a matter of days if not hours. This has opened up an alternative pathway of comparatively nonviolent social evolution. Naturally, this has provoked the most extreme responses of the most extreme socioreligious superorganisms as they suddenly find themselves beset by an enemy they cannot easily fight – open and unblockable access to a truly global information stream, combined with human reason leading humans to actually think about and choose their personal axioms

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4A glance at almost any page of human history is all the evidence one could possibly need for this. On paper (or if you prefer, on the parchment fragments that originally defined it), Christianity ought to be a pacifist, turn-the-other-cheek religion whose members would universally allow themselves to be tortured and slain rather than harm another living soul. Islam as defined in the Qu’ran is rather less pacifist, as are most of the various religions that competed with Christianity from its inception right up to the present. To survive, it sold its soul to Constantine in order to become the state religion of a highly successful – and violent – empire and consequently spread with that empire all over the world with fire and sword.
rather than accept the rigid set of their locally prevalent superorganism.

Our only real long term hope of safety from ourselves is that we come to agree on a workable set of ethical myths, ones sufficiently “fit” – and flexible, capable of being modified without necessarily triggering a violent response – that they wipe out the alternatives without a trace and without compunction in the ongoing mythi-clasm. It truly is the prophecied ”End Times” – we have the means to easily bring about our own end if we don’t find a common ground and a common goal, even though the basis of that ground and goal is a glorious myth!

So as Stephen says, Madge – the myth that humans have rights is a myth, but one that free people can self-consistently choose to adopt as a myth that they will freely live by, and build a society upon.

There appears to be that in the human brain that to a greater or lesser extent requires these grand myths in order to be happy, to fit well into a society with sufficient self-esteem and sense of purpose that our evolutionary imperatives are satisfied. Harris remarks on this in one or two of his books. If you try to raise

\[ \text{It is difficult to come up with a metaphor that can adequately convey this, but I’ll try. Rabes, as we know, is a disease that invades brain tissue and systematically destroys it, ultimately killing the host. Evolutionarily, of course, this is counterproductive – more successful diseases co-evolve to not kill off their hosts. To ensure transmission, rabes a) kills the host comparatively slowly; and b) attacks first the specific parts of the brain that regulate social behavior, increasing the probability that the organism will go out and fight and bite (on average) at least one other organism at least one time before it actually dies to perpetuate the chain of infection. For humans it is especially horrible, because you are self-aware as your brain fairly rapidly deteriorates, as its cells betray the host and literally take over its rapidly diminishing mind to the point where even humans are likely to fight and bite and perpetuate the chain.}

\[ \text{Now consider your favorite (or least favorite) socioreligious group. It is “self-aware” in the sense that its members follow highly rigid rules for behavior and worship. If it is “alive” in the present, it has memes for violent defense of “self” even if they are currently inactive due to a lack of threat. Suddenly, it finds itself losing members as the young people it relies on recruiting to perpetuate self are suddenly presented with a choice and start to choose to believe something else and regulate their ethical and social behavior in other ways. Like rabes, this loss triggers the ascendance of the violent memes as the alternative is complete dissolution of the socioreligious superorganism.}

\[ \text{The current obsession with zombies is a sociocultural reaction to this ongoing process that transcends specific cultures. After all, isn’t this exactly how zombies “propagate”? One day everybody is “healthy”, praying in the general direction of Mecca, taking communion, worshiping Shiva, whatever, maintaining a healthy respect for and obedience to the priesthood and local government however corrupt and violent. The next, all the kids have cell phones and are suddenly reading about human rights and rejecting the government and its local rules for God and, like zombies, if they spend any time with your own children or those children have cell phones, you’ll find yourself losing them as well. And the only way to fight zombies is with a shotgun and a machete, to cut off the head. Hence 21st century war and terrorism.} \]
a complete little rationalist without any myths whatsoever, they will just invent their own (and besides, this is impossible as in a very deep sense even “the law of gravitation” is a myth, albeit a “special” kind of myth, one that has a particular basis of empirical support and consistency). Empirically, some humans are far more susceptible than others and “need” a higher proportion of myth in order to be able to function (indeed, I rather suspect that myths serve as a replacement for actual intelligence in humans who are less gifted with the latter, permitting them to still function constructively in an environment too complex for them to actually comprehend or critically manipulate).

So it may be that even secular humanism, even atheism, eventually will require a clear and persuasive statement of its core myths, a statement not unlike Jefferson’s – loose enough that they can be made to fit a wide range of cases, simple enough that even the stupid can understand them and see how it is advantageous and righteous to apply them to themselves and others, powerful enough that they can stir men to act as violently as our killer-ape nature requires to inconsistently establish them as the dominant myths of our species in place of the usual “We are God’s Chosen People and therefore have the right to torture, enslave, or kill you, even if you are one of us” myth that has dominated human history and mythology from as far back as the eye can see, the historical record tells, and archaeology can excavate.
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