9. Science

In This Chapter:

* * *

Science is the belief in the ignorance of experts.
Richard Feynman

One might feel that a chapter about science is out of place in a book about instinctive thinking. Sadly, that is not the case because humans are emotional group-thinkers who seek validation far more desperately than we seek truth. As such, science is not as exact as it should be. It is an arena fraught with bias, failure, accidental discovery, preconceived notions, greed, reputation, ego, money, politics, and fear. Just like everything else in the sphere of human experience. While the scientific method is designed to sidestep our human subjective failings, some humans fail to side-step their own failings when using the scientific method. And they are usually the last to acknowledge it.

When science is done right, it has brought and will continue to bring us incredible advances that improve and save lives, that reduce superstitious irrationality, and that make society better. This is self-evident. What we need to emphasize, however, is that science is not automatically done right by the scientific animal in the mirror. What is automatically expressed is our instinctive programming. It tempts us to want outcomes that validate our existing beliefs, and this will tend to bias the scientific process. In some cases the bias might be so slight as to have a minor or minimal impact on results and conclusions, but in other cases, the bias can be more meaningful or even blinding.

Whoever engages in science must appreciate this in no uncertain terms in order to guard against their science becoming corrupted. In order to retain intellectual integrity, we must first understand the human animal — the lens through which we must all perform our science. It is a lens that we like to believe is perfectly polished, aligned and true, but that is self-serving and wishful thinking. We must be willing to acknowledge the limits of our understanding, and that is something that makes our survival instinct very uncomfortable.

The reader should not get the wrong impression. We do *not* intend to undermine or lessen the power or accomplishments of science, scientists, or the scientific method. We have truly come a long way in our understanding of the universe as a result of this process. Science has clearly answered many questions for us, and it has seen us discover and develop many incredible tools and technologies. This shows that we are capable of doing science right (even if our progress is slower than it needs to be).

There are many areas of science that are well understood and that will probably not be up-ended by new discovery. Examples might include the way a capacitor functions, the way an aircraft wing generates lift, why one water molecule attracts another, or many other well-understood structures or processes. Of course, even in these areas we should still expect that in the future, details and nuances will come to light, perhaps revealing previously unimagined depths of new wisdom hidden in plain sight.

But there are other areas of science that are not nearly as well understood or well-founded, the ones where we cannot yet measure or observe directly or with accuracy. As such, some of our accepted scientific 'facts' will invariably be shown to be false, like Ptolemy's Epicycles (as we will see below).

This chapter will focus on the ways in which our human instinctive thinking influences and sometimes constrains our science, and how we can strive to guard against its corruptive influence. We will also look at how the public, non-scientist views and leverages scientific topics, especially those with validating political or monetary overtones.

In the Appendix at the end of the book, we will look at some interesting new models that may deepen our understanding of the nature of subatomic particles, as well as the large scale structures of the universe. We will also look at one aspect of the highly politicized topic of climate change, and attempt to offer solutions that empower the individual at the local level.

We will try to avoid too much scientific technicality in our discussion, but in some parts a little is included in order to satisfy the reader for whom it will mean something, and without which, too little explanation would be as unhelpful as no explanation at all.

9.0. Setting The Scene

Let us take a moment to understand a little about the scientific process, as well as its sometimes ruthless and infuriating history. Since this process is *still ongoing*, looking back at how it has manifested in the past can give us a compelling window into our current reality, if we are willing and courageous enough to look. While today's science may have become more detailed, complex, and comprehensive than the science of the past, the processes by which humans fear, think, discover, and resist change have *not* changed. If we understand this honestly, we stand a better chance of sidestepping our decidedly human pitfalls and keeping our science uncorrupted by bias, politics, or the arrogant certitude of the scientist. No easy undertaking.

THE SCIENTIFIC PROCESS

An expert is a person who has made all the mistakes that can be made in a very narrow field.

Niels Bohr

Science begins with observation. We notice something about our world — a pattern or an effect — and then we attempt to understand and explain why and how it works. We come up with a theory that tries to describe it, and then we test that theory by doing an experiment. If the theory holds up, we keep it. If it does not, we discard part or all of it and we keep looking for the truth. If we are ever unwilling to discard part or all of a theory that is failing to explain what we observe, we have abdicated scientific thinking in favor of the much more comforting emotional thinking.

Science is about measuring and describing the physical world. It is based on evidence and results. When we do an experiment, we specify the question we are investigating, the equipment and materials we are using, and exactly what procedure we will follow. Anyone can then repeat our experiment and verify our results, and through this process, 'facts' can become established. If an experiment cannot be repeated successfully, its conclusions were either a mistake, a fraud, or a misinterpretation of the experiment's results. Sometimes, even when an experiment can be successfully repeated, the conclusions reached may still be a misinterpretation of the experiment's results because we may be using an incomplete understanding. We may still be incapable of telling the difference, as was true during the time of Ptolemy.

MODELING

There is an issue in science that is frequently overlooked, but whose importance cannot be overstated if we wish to achieve any kind of real understanding. If an experiment cannot be performed because the system it is testing is too complex, too large, too small, or too far away, then we have to rely upon mathematical (or computer) models and extrapolations to try and complete our understanding. Over the last century or so, as we have learned more and delved deeper, we have increasingly needed to model concepts at the frontiers of our knowledge, things that we are not yet equipped to know for certain. It is important to remember that most of these models are approximations and may not be entirely (or at all) accurate. Sometimes they have helped, but sometimes they have also muddied the waters because a mathematical result does not necessarily mean that the result must automatically exist in reality.

As eminent British physicist Sir Roger Penrose puts it in his book *The Road To Reality: A Complete Guide To The Laws Of The Universe*, "mathematical coherence and elegance, in the mathematics of physical theory, despite their undoubted value, are clearly far from sufficient. Physical considerations usually have a much greater importance.[132]" It is still *observation* that must remain the ultimate arbiter of scientific truth. Penrose continues that "in situations where experimental guidance is lacking, mathematical qualities then assume the greater importance." Pure mathematics and computer modeling are a necessary fallback position in those cases where we cannot yet have definitive data or parameters. But they can never replace the confirming role that observation can and must play in science.

To bring this into more specific relief, during the Corona virus pandemic of 2020, the world's top virologists and modelers in the United States did their level best to predict how the outbreak might develop and progress across the country. Initial models suggested mortality numbers that were alarmingly high, in the millions. At the time, Dr Anthony Fauci, director of the National Institute of Allergies and Infectious Diseases (NIAID), specifically adjured viewers during his many appearances on the daily White House briefings that "models are only as good as the assumptions you put into them." As we will revisit below, models do not arise on their own. They are constructed by modelers who often have a specific goal or objective in mind.

Dr Fauci's sentiment was mirrored by his colleague, Dr Deborah Birx, who warned that "we won't know how valid the models are until we move all the way through the epidemic." The reason for this is simple

---

[132] Roger Penrose, *The Road To Reality: A Complete Guide To The Laws Of The Universe*, Vintage Books (2004), p. 1015.

and profound, as Dr Fauci himself expressed: “Data is real; model is hypothesis.” And when models are predictive of the future, we cannot know their validity until after the fact. There are many who forget this, especially when the model is telling it the way they like to hear it. And indeed, once the pandemic worked its way through the population, the death toll did not reach the numbers predicted in the original models. Fortunately.

Models are therefore designed to be used with care and continually updated and improved in light of new, current data. As such, a very important component of the scientific method is having a cold, clear cognizance of where certainty ends and uncertainty begins. This requires great humility, though humans do not all possess this trait in equal measure, scientist or no.

A RUTHLESS UPDATING PROCESS

No amount of experimentation can ever prove me right;
a single experiment can prove me wrong.

Albert Einstein

For as long as Mankind has walked the Earth, we have been trying to make sense of our surroundings. Ancient people perceived the ground beneath their feet to be stationary, expansive, and permanent. It was the sun, moon and stars that were seen to move in the heavens above. With no knowledge of astronomy, they of course assumed the Earth to be the center of the universe… because it was the center of their reality.

Over thousands of years, the many cultures of Earth have gathered many observations. They were gradually able to piece together certain patterns, which allowed them to predict the appearance and motion of the sun, moon, and stars — months, seasons, and years — to significant degrees of accuracy. By way of example, in the Babylonian Talmud, written in about the 5th century A.D., the length of the lunar month is given as 29.530594 days[133]. The current measurement of the

[133] Literally, ’29.5 days plus two thirds of an hour plus 73 *chalakim* (1,080ths of an hour).’ *Rosh Hashanah*, 25a.

(synodic) lunar month is 29.530589 days[134]. The values differ by less than 0.00002%.

Of course, instead of understanding the movements of the heavenly bodies and their relationships, many living in the ancient world ascribed Divine or supernatural traits and significance to them. Comets became omens; heavenly bodies became gods.

In the 3rd century B.C., the Greek philosopher Aristarchus proposed the heliocentric model, that the sun was the center of the known universe and that the Earth actually revolves around the sun. His idea also seemed to find the support of fellow philosopher Archimedes, who quoted Aristarchus' ideas in his writings.

During the 2nd century A.D., the Greek astronomer Ptolemy constructed a model that described the Earth as the center of the universe, with the planets orbiting around it in a series of circular paths called Epicycles. The stars were all believed to be at a fixed distance away, like little lights in a domed ceiling. Ptolemy's model became widely accepted as the definitive scientific dogma for many centuries. This was not because experiment had confirmed it. They were not capable of doing so back then. It was because his system ended up accidentally being a crude approximation of elliptical planetary motion, even though Ptolemy had not intended this. It was also because no one yet had the knowledge or technology to contradict the Epicycles with actual evidence. As a result, the apparent correlation between the theory and reality was thought to mean that the theory was accurate. It was not.

The study of physics also had its roots in ancient Greece. About 2,500 years ago, Aristotle taught that in nature, when things are pushed, they tend to stop on their own. That was his experience of the world, and for 2,000 years we believed it was a fundamental truth of nature. Then, in the 17th century, Galileo showed that Aristotle was wrong. Things only stop because of friction. In the absence of friction, it is more natural for things to keep doing what they are doing (moving or resting) until some force pushes or pulls on them to make them change. We know this is true because a hockey puck slows down much less on smooth ice than it

---

[134] Chapront, Jean; Chapront-Touzé, Michelle; Francou, George (2002). "*A new determination of lunar orbital parameters, precession constant and tidal acceleration from LLR measurements,"* Astronomy & Astrophysics, 387 (2): 700–709. doi:10.1051/0004-6361:20020420

would on rough concrete, and it would not slow down at all if it were flying through a frictionless outer space.

Friction presented a radically altered view of the world, and it was not Galileo's only innovation. He also continued the work of Copernicus and Kepler, positing that the sun was in fact the center of the universe and that the Earth revolves around it. This made the Church in Galileo's Italy very uncomfortable because the Bible implies that the Earth (and Man) is the focus, the spindle around which all of Creation turns. It also set the scientific experts of the day on edge because it challenged the widely held belief in Ptolemy's Epicycles. As a result of his 'revolutionary' ideas, Galileo, one of the greatest and most pivotal scientific minds of all time, suffered a trial by the Inquisition. He was forced to recant his theories and he endured house arrest and other social and political pressures from the Church and the Pope for his 'heresy.'

Of course, *he* was right and the consensus of all the experts was wrong. What we need to realize today — what this book is attempting to underscore — is that human nature has not changed as much as we would like to imagine since the time of Galileo and the Inquisition. They acted then precisely in accordance with their instinctive, group-thinking nature, just as we do today.

Among Galileo's many contributions to astronomy, engineering, physics, optics, and other disciplines, was the modern telescope. This brought astronomy into a new age, along with the undeniable implication that the Earth *does*, in fact, move around the sun. As these truths are learned, previous, incorrect theories are discarded without mercy, as they must be, no matter whose money, power, or reputation is tied to them.

The great English scientist, Sir Isaac Newton, took Galileo's correct ideas about friction and motion and used them as the foundation of his famous *Laws of Motion*. About 250 years later, at the dawn of the 20th century, Albert Einstein pointed out that Newton's Laws of Motion are inaccurate when we are dealing with, for example, extremely high speeds (approaching the speed of light), although they still work very well in Earth's reference frame. Einstein showed that Newton's Laws are really just a simplification of what is actually a relativistic reality. This is reflected in Einstein's Special Theory of Relativity, which made famous his legendary equation $E = mc^2$.

Of course, in our modern age we all know that the sun is not the center of the universe at all, but only of our solar system. It is not even at or near the center of our galaxy. It is one of billions of stars in the Milky Way Galaxy, and it lies almost half way between our galaxy's center and it edges. And the Milky Way Galaxy itself is not the center of anything either, as far as we can tell. It is surrounded by an endlessly-expansive fabric of space filled with a seemingly endless supply of galaxies and star-systems that extend beyond the furthest reaches of our capacity to measure… or even to *imagine*. From a purely observational point of view, there is also nothing to indicate that the expansiveness of space should end anywhere or under any particular condition. There is still so much we do not know.

In addition to Galileo, there have been many other instances in which the consensus of scientific experts of the day was not only wrong, but sometimes, hatefully or dangerously so. Nonetheless, these experts shunned and in some cases tried to destroy or suppress the lives, reputations, and breakthroughs of scientific innovators who would turn out to be right. And it happens in our time too, as it will in the time of our children and grandchildren. That is the nature of scientific development, as long as it must live under the same roof as our human nature.

Some examples include (but are certainly not limited to):

- The 19th century Italian scientist, Amadeo Avogadro[135], proposed that equal volumes of different gases contain an equal number of molecules (when at the same temperature and pressure). This is known as Avogadro's Law. His work was rejected by the experts of his day, and only accepted four years after his death.
- Even more tragic is the case of late-19th century Austrian physicist, Ludwig Boltzmann, who correctly developed equations that explain the properties of atoms and how they determine the physical nature of matter. His ideas were rejected because they disproved the popular existing theory. After years of fighting for his atom theory to be accepted, Boltzmann committed suicide. Three years later, Ernest Rutherford and his team discovered the nucleus of the atom, proving Boltzmann's theory correct. His tombstone bears his famous and important formula describing entropy: $S = k \log V$.

[135]He is perhaps most famous for Avogadro's number, the number of particles (6.02×10^{23}) in a "mole."

- Louis Pasteur believed that disease was spread by organisms called germs. He had been moved to make this discovery after suffering the unimaginable loss of three of his five children to infectious diseases. When he first proposed his germ theory in the 1850's it was met with vehement resistance from the medical community because it threatened to unseat the popular theory of spontaneous generation[136]. Pasteur was eventually able to prove by experiment that "There is no known circumstance in which it can be confirmed that microscopic beings came into the world without germs, without parents similar to themselves[137]."
- Dr. Ignaz Semmelweis was a Viennese obstetrician at around the same time. The common practice was that doctors did not wash their hands between examining diseased corpses and delivering babies. As a result, many women died of disease post-delivery. Semmelweis proved that washing hands before delivering a baby saved the lives of many mothers, though he could not explain why. He tried to have the practice implemented at hospitals other than his own. Not only was the practice resisted, but he was eventually lured into an insane asylum where he was straight-jacketed and beaten so badly that he died shortly thereafter of his injuries[138]. His hospital then reverted back to the former practice of not washing hands, and the post-delivery mortality rate of mothers returned to its previous levels.
- When Albert Einstein published the Gravitational Field Equations for his General Theory of Relativity, the work was ridiculed by the scientific community, despite the acceptance of his Special Theory of Relativity not long before. A notice was even published in which a hundred different scientists explained why he was wrong. Einstein famously remarked that, since a hundred scientists had responded, "now I know I am right. You only need one person to prove me

---

136 Spontaneous generation was the theory that living organisms can spring from non-living matter, like fleas from dust or maggots 'appearing' in dead flesh.

137 René Dubos, *Louis Pasteur: Free Lance of Science*, Da Capo Press, Inc. 1950, 1960. p 187.

138 Since he was a Jew, some suspect that anti-Semitism may have played a role in the resistance to his ideas and to his eventual fate.

wrong." Einstein was not wrong (or as he might say, he has not yet been shown to be wrong).

- Alfred Wegener proposed the theory of continental drift in a series of papers between 1912 and 1929. His work was replete with persuasive fossil evidence, yet his ideas were rejected by the scientific establishment of his day with criticism and ridicule. They were only accepted in the 1960's, more than thirty years after his death.

Now, these historical examples might tempt us to believe that these spells of unscientific thinking only afflicted people back in history because they knew so little back then, and since we know so much more today, it should not happen as much anymore. But do not be fooled. Bear two things in mind. Firstly, this is wishful thinking — the self-deceptive denial of reality into which our emotional thinking is so easily and so willingly drawn. Human nature has not changed, and neither has our deep-seated need to feel like we are right, nor the arrogance with which we regard what we know. Secondly, as we will illustrate in the Appendix, the marginalizing of new (and therefore threatening) ideas (with which no scientific fault can be found) is still occurring today in our scientific and academic communities. This should come as no surprise.

Recall that the examples we mentioned above were not cases of the public rejecting the innovations of scientists. They were examples of scientists rejecting the innovations of scientists. This reality will continue to color our experience until we evolve beyond the imperatives of fear, insecurity, selfishness, and group-think.

WHERE ARE WE NOW?

I am not a world-renowned scientific expert, although science is and has always been an area of passionate interest for me. As such, I will rely upon the voices and work of scientists with credentials far more impressive than my own in order to present my perspective throughout the rest of this chapter.

Roger Penrose, quoted above, shared the Wolf Prize in physics with Stephen Hawking in 1988, and he is an Emeritus Professor of Mathematics at Oxford University. In his 'magnum opus,' *The Road To Reality: A Complete Guide To The Laws Of The Universe*, he not only provides a comprehensive history and mathematical context for physics, he is also able to clarify where we stand in terms of our current level of knowledge, as well as how we might progress into the near future. (To be clear, I do not mean to imply that he would necessarily agree with everything that will be presented in this chapter and the Appendix, although, as we will see, some of his very words seems to anticipate it.)

In addition to summarizing the various models and theories in modern physics, Penrose explains the following:

"Things have moved a great deal from those beginnings of an understanding of particle physics, as it stood in the first third of the 20th century. As we embark on the 21st century, a much more complete picture is to hand, known as the standard model of particle physics. This model appears to accommodate almost all of observed behavior concerning the vast array of particles that are now known[139].

"We have already seen, in the contrast between the approaches… how different mathematical developments, each guided by its own set of aesthetic mathematical and physical criteria, can develop in mutually contradictory directions. Some have argued that perhaps we should seek ways in which all these approaches can be brought together in some kind of synthesis, perhaps by distilling what is appropriate from the body of all of them taken together. On the other hand, it could reasonably be argued that the contradictions between the different approaches are too great, and that at most one of them can survive, all the rest having to be discarded. I suspect, myself, that the truth lies somewhere between these extremes, and that something of importance may yet be found even in many of the theories whose major tenets will eventually have to be abandoned.

"I believe, indeed, that a new perspective is certainly needed, and that this change in viewpoint will have to address the profound issues raised by the measurement paradox of quantum mechanics and the related non-locality that is inherent in EPR effects and in the issue of 'quanglement'.

"How are these to come about? May we expect a 'new Einstein' working in a solitary way, and coming upon such revolutionary views

[139] Roger Penrose, *The Road To Reality: A Complete Guide To The Laws Of The Universe*, Vintage Books (2004), p. 628.

from largely internal deliberations? Or will we find ourselves driven again by immensely puzzling experimental findings?[140]"

Perhaps some of the current work being done will provide such a "new perspective." As it turns out, the work we will reference below (and in the Appendix) emerges from one scientist working "in a solitary way" and another working with the best experimental data-gathering equipment available on Earth.

But first, let us clarify *how* our instinctive thinking resists the purity and objectivity of the scientific process.

9.1. Instinct In Science

Scientific Instinct & Bias

A dogmatic assumption inhibits inquiry.

Terence McKenna

Innately insecure humans — a description that applies to every one of us to some degree — need to be validated. Unfortunately, science is the very discipline that is concerned with validating things. To boot, we humans are experts at finding and using any juicy rationalization or justification we can contrive to make us feel right. That is a dangerous mix because if there are any unresolved or open questions, our minds will willingly lead us to make the connections we *want* to make, when such connections may or may not be warranted. While we know that *correlation does not necessarily equal causation*, in the absence of a known cause, we *will* equate them because it invites us to feel right, and therefore safe.

To an instinctive thinker, if an observation could *possibly* represent evidence in support of something we believe, we will choose to see it as evidence *in fact*. Once we make the connections we want to make, we will almost certainly claim them to be scientifically sound. And if no one *can* yet know its truth, as in the case of Ptolemy's Epicycles, or if the experts are mistaken — and history shows us how frequently that is the case — who is in fact present to argue for the truth?

---

[140] Ibid, p. 1025-1026.

That is why people thought Ptolemy's Epicycles were correct for so many centuries, ridiculing all who thought otherwise.

By definition, science is about seeking to know the unknown; it is about entertaining open questions without condition or constraint. Any agenda, preconceived notion, or ideologically-inspired boundary condition that we impose upon our science will lead to inaccurate, selective, or corrupted science. This is self-evident.

Our scientific instinct also dictates that whenever transitions of major discovery occur, they will usually be resisted because they tend to be inconvenient for the scientific establishment, for anyone who has a stake in the outgoing theory or the system based upon it.

The human scientist is not immune to emotion, and is therefore susceptible to human weakness, illogic, and self-serving group-think — just like the rest of us. If someone or something may undermine our closely-held truths, we all feel an instinctive threat to our security. Our judgement can become so clouded that even those of us who know how to use science properly can end up manipulating it as a tool for personal validation or financial gain. Whether consciously or subconsciously.

There are many who make a living from science and as such, their financial motives, which represent their sense of security, can cloud their scientific objectivity. If your research grant money depends upon the truth of your theory, you will not readily or freely admit to its failings or you might lose the ability to put food on your table. There are also those with accolades or standing in the academic community whose egos are connected to the continued truth of their ideas, and they will therefore not be as objective toward counter-evidence or competing theories as they should be, as scientists. The respect and deference others afford them is too comforting to their survival instinct and they are not willing to risk losing it. And there are also those whose preconceived ideas and values influence or cloud their scientific thinking, as their minds try to work toward a desired, needed, or more satisfying conclusion.

Our blindness to our own scientific bias is directly proportional to our instinctive insecurity, raised to the power of our certainty of correctness. Receiving a degree (or even professorial tenure) does not in any way diminish the chemical forces at work within our body or brain. Our amygdala still calls the emotional shots from a level deeper than logic.

As humans, our bias and justification can subvert the scientific process in ways so subtle that some scientists can remain blind to it because they think that, as scientists, they are automatically above such unscientific bias. They are therefore unwilling to look for it, or to recognize or acknowledge it within themselves. As a result, keeping science unadulterated by human failings is a very real challenge… even for some of our greatest scientific luminaries.

Despite how unscientific it sounds, this is human nature and it is unavoidable… until we evolve. The best we can do is to focus on understanding our propensity for these failings, and to try and put in place in our scientific methods reminders — warnings — to be on the lookout for these psychological pitfalls.

In case you feel this paints too unflattering a picture, I invite you to consider that Einstein himself fell prey to this bias. When he released his famous General Theory of Relativity, the mathematics did not quite add up to the static (unchanging) universe in which he believed, so he added in a factor to make it work out 'right.' Einstein himself said many times that the use of this Cosmological Constant (Λ), the infamous "fudge factor," was the greatest blunder of his life. To be fair, Einstein's ideas and opinions evolved throughout his life. At one point in his life, he would almost certainly have disagreed with his own opinion at another point in his life, on more than one issue. Can you or I, then, claim to be less susceptible to these pitfalls (or to the fallibility of certainty at the cutting edge) than Albert Einstein?

So while *science* might be unbiased and objective, even our greatest scientists are vulnerable to self-serving thinking, which should induce in the rest of us a healthy dose of humility when using the word 'science.' You may feel that, on the whole, the consensus of scientific expert opinion should be insulated from such subjective failings. That may be true for certain testable, proven, and established truths… but that *has never been* — and is still not yet — the case at the frontiers of science, where fallible theory and over-simplified model are often as close as we can get to an answer. When we conflate the two — the known and the speculative — it shows that we cannot tell them apart. This is an unenviable position in which a scientist should find themselves.

Our instinctive thinking means that, when we have a choice, we are each predisposed to seek out and believe the scientific opinions and research papers that support the ideas or values in which we *already* believe. We are equally predisposed toward *dis*believing, ignoring, or denying the validity of any scientific opinion that differs with our comforting worldview. The more insecure we are, the more we will cling to the science we like, believe in, or that is validating to us. Whenever issues of safety or survival become aroused in our subconscious decision-making process, that is the point where our science is at risk of being manipulated by our wily, self-serving, animal in the mirror. And we may not even notice it, consciously, because that scientific animal in our mirror is hacked in, wielding our own sophisticated brain from the inside.

When the time arrived to award the Nobel Prize in physics in 1903 for the groundbreaking work that Marie Curie had pioneered, she was not even considered for the prize. Despite discovering radioactivity, at least two new elements, and opening the door to subatomic physics, it did not occur to the men on the nominating committee to nominate her because she was a woman. Marie Curie's husband was nominated, even though he had only assisted her with her research. What made this worse was that one of the men on the committee had been her teacher, mentor, and had even presented her research in public. Bias clouded his judgment to what should have been blatantly obvious, until Pierre Curie wrote to the committee, clarifying that he had simply assisted in the work that was conceived and carried out by his wife. Marie Curie was then included in the award. She would later receive a second Nobel Prize on her own.

Despite how tenaciously we might cling to the illusion of our capacity for objectivity, it is more easily subverted or compromised than we like to admit. Despite how desperately we might cling to a favored theory, ultimately, no area of science is safe from the ruthless updating process of new discovery and shifting paradigms. There is another shift coming. There will *always* be another one coming because there is so much yet to discover… and (undoubtedly) so much more to correct about what we *think* we know. An interesting exercise is to wonder which theories or accepted wisdoms will next be shown to be wrong or obsolete? What will turn out to be the *phlogiston*[141] of our lifetime?

WHO ARE THE EXPERTS?

Just like we subconsciously (and naively) believe that the actor wearing the white coat in the medication commercial is actually a doctor and that we should listen to him, we fall prey to that same unconscious bias when we hear the words "scientists say."

Since it is so easy for just about anyone to use the opinion of 'a scientist' as validation, we must also ask what qualifies someone to be considered a scientist? A bachelor's degree, a master's degree, or a doctorate? Is someone only a scientist if they work in research or if they earn a living at it? Or if they make a new discovery? Are they only a scientist in *their* field? Should a botanist or a nephrologist be given equal deference as 'a scientist' when consulting on the minutiae of subatomic physics or satellite orbital mechanics? What if they know very little about these topics but are still superb scientific thinkers?

There are so many fields of scientific study, with so many levels of expertise within each, that few individuals are competent enough to be called an expert in more than one sub-specialty, let alone in an entire subject area. Let alone in more than one discipline. In addition, in the real universe there are no contour lines dividing between biology and chemistry, or between optics and cosmology. This makes it even more challenging to understand reality accurately, especially if one remains confined to any one discipline. Without interdisciplinary study and the benefit of collaboration, any expertise will necessarily be limited.

Even though we have the propensity in popular culture to view anyone who enjoys the epithet "scientist" as an expert whose opinion is beyond reproach, that is not always the case in practice. If it were, seeking a 'second opinion' when consulting a medical specialist would not be so common. In many scientific fields, few but the very true

[141] In the 17th/18th centuries, it was believed that burning and rusting was the result of a substance called phlogiston leaving or combining with an element. The work of Lavoisier and others proved that phlogiston did not exist, that burning and rusting resulted from reactions with oxygen in the air.

experts are able to tell fact from misconception — truth from manipulation. And sometimes, as we saw, not even *they* can.

INTENTIONAL MANIPULATION OF RESULTS

Let us take this one step further. There are a surprising number of cases in which researchers have deliberately misused science in order to gain the outcome or results they desired. While there are too many examples to include here, a few notable ones include:

- British physician Andrew Wakefield was found guilty of falsifying his research results in order to draw a connection between the MMR vaccine and childhood autism. He was banned from practicing medicine in the UK, and his original 1998 journal article was retracted. The *BMJ* (formerly the *British Medical Journal*) commented on Wakefield's results as "based not on bad science but on a deliberate fraud.[142]" It has been suggested that he had a financial incentive, that he was trying to develop his own vaccine to compete with the MMR vaccine.
- The Australian Bureau of Meteorology has been exposed on more than one occasion for manipulating data in order to reinforce a trend showing global warming. They are accused of ignoring the coldest temperatures recorded by their instruments and not including or not quoting these values accurately in the national database. Reporter Jennifer Marohasy writes on July 18, 2017: "Two weeks ago, in response to my queries the Australian Bureau of Meteorology acknowledged that it had put in place limits on the lowest temperature that an individual weather station could record.[143]"
- The *BMJ* reported in January 2012[144] that "one in seven U.K. based scientists or doctors has witnessed colleagues intentionally altering or fabricating data during their research or for the purposes of publication, found a survey of more than 2,700 researchers

---

[142] Godlee, F., "The Fraud Behind The MMR Scare," *British Medical Journal,* 2011;342:d22

[143] https://morningmail.org/bom-figures-removed/

[144] https://www.bmj.com/content/344/bmj.e377

conducted by the *BMJ*." The *BMJ* later reported that "fraud, not error, is why two thirds of biomedical papers are withdrawn.[145]"

- For a longer list of incidents of scientific misconduct, a simple online search will provide many examples.

MONEY & BIAS IN PEER-REVIEW

There are many researchers who hope to have their work published in a peer-reviewed academic journal. It gives them and their work exposure, recognition, and shares it out with the rest of the academic community. The publishers of these journals therefore act as gate-keepers of sorts, as one would expect, since not every paper submitted will be up to scientific snuff or worthy of publication. Their job is therefore important, though it also gives them a large degree of control over the work and ideas of others.

The first area of concern is the way money has subverted the scientific process in the world of peer review.

It has become typical that a scientist submitting an article to a journal has to pay a submission fee in the *thousands of dollars*. We can all understand the concept of bringing in revenue in order to cover costs, and even in order to make a modest profit, but the journal publication business has gone way beyond this. In his 2017 article "Reject Nature[146]," Carlos Sierra points out the following regarding two journals published by *Nature*. "In 2016, *Nature Communications* published 3,686 papers, and *Scientific Reports* 21,057, according to their websites. Article processing charges (APC), depending on where you live, may cost you between $4,000 (UK) to $6,000 (Japan) US dollars (USD) using exchange rates for mid June 2017. Similarly, APC for *Scientific Reports* are between $1,400 (UK) and $1,650 (China)." As a result, the *Nature-Springer* company generated more than $50 million dollars in revenue, only from APC charges, in 2016 alone. Sierra points out that this amounts to five times the operating budget for the Max Planck Institute. One might rightly wonder whether this status quo is serving scientific progress or the pocketbooks of the publishers' private investors. In the

---

[145] https://www.bmj.com/content/345/bmj.e6658

[146] http://www.bgc-jena.mpg.de/~csierra/blog/2017/03/21/rejectNature/

next section of this chapter, we will discuss possible ways to address this abuse.

The second area of concern is the extent to which bias has entered and stifled the peer review process.

If a paper being submitted does not agree with the scientific views of the gate-keepers, they will usually not publish it.

In the Appendix, we will look at two specific modern cases of this type of consensus bias in science. We will look at the work of three scientists with serious and respectable scientific credentials, who have had some of their work resisted by the peer-reviewing establishment in precisely this way, even though the science they submitted was acknowledged to be rigorous and without error.

The most effective weapon against this type of bias is humility. One would imagine, with as many unanswered and unanswerable questions that remain at the cutting edge of so many fields, that all serious scientists would demonstrate humility in their quest for clues, ideas, and even out-of-the-box thinking in order to conquer those next, elusive, sometimes mysterious layers of discovery. But such humility seems hard to come by.

Scientific humility is enhanced when researchers work in an inter-disciplinary way. It is often those unconstrained by the accepted wisdom in a field that are able to see creative solutions or new avenues of inquiry. Unfortunately, the insecurity of some experts — which can manifest as a sense of superiority — can cause them to avoid or resist this type of process, this foraying into uncharted territory, perhaps because it opens their ego up to revealing the limits of its expertise.

POPULAR SCIENCE

It is important to point out that the lay person too has only a basic knowledge of a handful of scientific concepts, and little grounding to any degree of technical depth beyond the surface. We tend to believe that the experts in every field know precisely what they are doing because this makes us feel safe. The layman's view of science is also influenced by the simplified, generalized science or science fiction that they see in movies, the science they hear about in popular culture, on the news, or in the little they remember from high school. It is ironic, then, that so many of us who are not scientific experts can nonetheless have passionate — sometimes vehement — opinions on scientific topics, especially when they have political implications or when they are tied to religious dogma.

Since science can be such an effective claim of legitimacy, it can be used as a powerful political weapon. And therefore, it often is. When we find a scientific opinion or idea that supports our views, we will then brandish that science with the confidence as if we had discovered its truth ourselves — whether or not we actually understand its detail or its constraints of relevance. Our defense: 'well, the scientists know, and they said so, so it must be so.' We are then free to parrot the science we have heard in defense of our position, assured of our rightness. In this context, scientific ideas and research become incredibly easy to smudge and manipulate, especially in service of the most powerful of group-thinks, and especially when large sums of money are in play.

Whenever we need the science to back up our political or religious beliefs, it is more likely than not that the science is being manipulated to suit the rhetorical outcome. Whenever someone vocally insists that a scientific debate is settled, while legitimate scientific questions still remain to be answered, they are attempting to use manipulation to end a debate they find too uncomfortable, too undermining, or too emotionally unsettling to have. These are the people who need science to agree with *them* in order to feel safe. And their intellectual gravitas is diminished as a result.

POPULAR MISCONCEPTIONS

> *Here and now, the space and time in which we are living is conditioned by the far away and long ago particles that constitute the universe in which we are embedded.*
>
> John G. Williamson

In order to gain a deeper appreciation of just how it can be that even very smart and well-educated scientists can have fundamental misunderstandings pervade their learning, we should look a little more deeply into some specifics. The next three pages will be somewhat technical, and may be of more interest to those who have a deeper grounding in science. For those who do not, feel free to skip ahead to section 9.2.

There are certain concepts that many believe are well understood, but they are in fact misunderstood. These misunderstandings can, for example, be born of using mathematics to model a physical concept in nature. We might impose mathematical constraints where nature does not have them, or we might not impose them where nature does.

In addition, people tend to make simple abstractions of phenomena that do not fully reflect the science. The analogies we use can provide a simplistic view of too many aspects of a more complex reality. We are then tempted to take the analogy as being a complete representation of the concept, rather than simply as an analogy, because it gives us the illusion of complete understanding. Problems begin to develop when these analogies become fashionable thinking in science, because that fashion of wrong-thinking (or not thinking) becomes quite difficult to shift.

A few examples are included below, a consequence of several conversations with quantum mechanic and solid-state physicist Dr. John G. Williamson.

1. The electron is *not* a point particle.

Many believe the electron is a point particle with no meaningful size and no substructure. In quantum electrodynamics the electron is treated as a point charge, and indeed, standard model particle physicists measure the electron's scale in high energy scattering experiments to be smaller than 10^{-18} meters. But this is because it *acts* that way under those high energy conditions. Experimental experts therefore differentiate between the electron being a point particle versus it having point-like scattering. These are not the same thing. Aside from these experts, many people take this to mean that the electron is truly a point particle. It is not.

The electron has spin — angular momentum. An elementary calculation shows that it cannot have the spin it has if it were as small as 10^{-18} m, even if it were spinning at the speed of light.

Dr. Williamson explains that, at less than $2x10^{-15}$ m, the mass of the electron has already been accounted for by its charge alone.

Integrating down any further would result in an electron with infinite energy, which is obviously not the case.

The electron's Compton wavelength is of the order of 10^{-12} m, which is a million times bigger than 10^{-18} m. In a hydrogen atom, the single electron envelops the atom and is effectively the size of the whole atom itself — about 10^{-10} m (or 1Å). But the electron is even bigger than that in the solid state, where it has been measured at tens of nanometers in size, which is about 100 times larger than a hydrogen atom[147]. The size of the electron thus depends upon its circumstances[148].

2. Maxwell's *other* equations.

Maxwell's famous four equations representing electromagnetism are only *part* of — an abstraction of — his original full set of relations[149].

Maxwell's work contained a number of equations. Some say the main equations number six, some say eight, and Prof. Peter Rowlands contends that 15 equations encompass the essentials. Maxwell's equations did some remarkable and essential things, which were removed when the equations were simplified (or abstracted) down by Gibbs (and Heaviside) to the four that are famous today. Ironically, even Maxwell agreed at the time that simplifying the more complex quaternion algebra down to vector algebra would make the work easier for students to understand. It is important to note that ignoring quaternion algebra was *in fashion* at the time in scientific circles, which would certainly have played a role in Gibbs' decision. In addition, all of this occurred *before* the discovery of the electron (by J.J. Thomson in 1897).

So what is missing from our four Maxwell's Equations?

Aside from elements like the continuity equation, the Lorentz Force, or the relation between vector potential and current, the removal of the quaternions was perhaps the most significant. The complex algebra

---

[147] Williamson, J.G., Timmering, C.E., "Quantum point contact as a local probe of the electrostatic potential contours," Physical Review B, vol 42, no 12 (1990). https://bit.ly/quantumpointpaper

[148] https://bit.ly/electronsize

[149] See James Clerk Maxwell, *A Treatise On Electricity And Magnetism* (Dover, 1954)

now used to describe a complex wave is commutative. Nature, like the quaternion algebra, is non-commutative. By taking out the quaternion part, you are removing the language that allows for the proper description of the natural process. By way of example, field signs in products are changed when you translate a quaternion algebra into a vector algebra.

Sadly, as a consequence of this, quaternion algebra has not been sufficiently well taught in academia for more than a century. This has allowed a superficial understanding, forced by inferior mathematics, to be perpetuated, even at the post-doctoral level.

3. Relativity and Quantum Mechanics

Schroedinger's wave equations are non-relativistic, however, his quantum mechanics rests on the assumption, from the work of De Broglie, that $\lambda = h/p$. De Broglie derived this relation from a proper consideration of a fully relativistic oscillator.

While this does not make Schroedinger's quantum mechanics relativistic, it does mean that he has imposed a relativistic relation onto it from the outset. This is a constraint, where Relativity forces quantum mechanics to do what it imposes, that $\lambda = h/p$. Schroedinger then developed a non-relativistic theory from that basis.

This is not to imply that Schroedinger's work is less remarkable and beautiful, but simply to indicate that this underlying debt to Relativity is not widely acknowledged.

4. Photons have mass.

Many people believe that photons have no mass. This is not accurate. A photon has energy and momentum, which means that it must contain mass. What is true is that a photon has no *rest mass*, but then a photon does not exist at rest[150]. It only exists, traveling at the speed of light, between its point of emission and its point of absorption.

---

[150] Van der Mark, M.B., "Quantum particle, light clock, or heavy beat box?" J. Phys.: Conf. Ser. 1251 012049 (2019) https://bit.ly/lightisheavy

9.2. Evolved Science

In the context of this challenging and potentially confusing reality, how do we approach science and scientific inquiry without falling into the very human trap of subjective and self-reinforcing thinking? This is made all the more troublesome by the fact that the most scientifically-minded among us will resist believing that we can or will fall into this trap. Would that it were so.

Consensus Is Unscientific

In questions of science, the authority of a thousand people carries less weight than the humble reasoning of a single individual.

Galileo Galilei

While giving a lecture at Caltech, as part of their 2003 Michelin Lecture series, author Michael Crichton said the following:

"The work of science has nothing whatever to do with consensus. Consensus is the business of politics. Science, on the contrary, requires only one investigator who happens to be right, which means that he or she has results that are verifiable by reference to the real world.

"The greatest scientists in history are great precisely because they broke with the consensus. There is no such thing as consensus science. If it's consensus, it isn't science. If it's science, it isn't consensus. Period.

"Nobody says the consensus of scientists agrees that $E=mc^2$. Nobody says the consensus is that the sun is 93 million miles away. It would never occur to anyone to speak that way[151]."

Crichton believes that if you are invoking consensus, it is precisely because your science is *not* on solid ground. This is the same point Albert Einstein was making in his response to the one hundred scientists who tried to refute his Gravitational Field Equations, as we mentioned above.

---

151 http://www.s8int.com/crichton.html

If you are a seeker of truth rather than conformity, you will learn that expert consensus in the scientific community does not equate to truth. It never has, and it probably never will. If you doubt this, try listening in on a conversation between quantum mechanics experts about the structure and nature of a photon of light.

If you are a seeker of truth, you must be comfortable living in a world of unanswered questions, unknown underlying principles, and 'this is the best sense we can get at this point.' And you must be comfortable disagreeing with the masses, because you invariably will.

SCIENTIFIC WISDOM

> *Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.*
>
> Marie Curie

In order to approach science in a more evolved way, let us work to manage our scientific thinking in the same way that we try to elevate all of our thinking and behavior.

The first step is to cultivate our scientific emotional intelligence. In order to do science right, we must first clearly see our propensity for doing it wrong. We must recognize our tendency to *want* to be selective with conditions and data in order to coax out a desired outcome. We must recognize our tendency to design our models using the variables, weighting, and curve-fitting that will give us an outcome in the right vicinity. We must also recognize that our ego wants recognition for our brilliance.

If we are a scientific publisher or gatekeeper, we must recognize our propensity to want to uphold the ideas we accept, and to stifle those which might seem new, different, or inconvenient. If we do not see these things, we will delude ourselves into thinking that all of our science is good and true, when in fact it is only self-serving. We will delude ourselves into thinking that we have a complete understanding of something when we do not. Cultivating this scientific emotional intelligence has been the purpose of the first section of this chapter.

Once we understand how our emotions might try to cloud our scientific judgment, the second step — cultivating our scientific emotional wisdom — is to anticipate and then to try and correct for our instinctive thinking. If we do not believe ourselves capable of scientific bias, we will not see it when it occurs, and our science will be affected without us realizing it.

AN 'ADD' TO THE SCIENTIFIC METHOD

By way of offering one suggestion, it may behoove the researcher to add another section into their report or paper. Now that we are gaining a deeper, 21st century insight into our mental thought processes, perhaps the time has arrived to add a component to the scientific method, a component uniquely designed to compensate for the instinctive thinking of the human scientist.

A *Statement Of Bias* could follow the hypothesis or introduction of a paper or experimental report, one which specifically clarifies:

- Whether the intent is to confirm, disprove, or investigate without preconceived notion.
- Whether an outcome or observation is anticipated or hoped for.
- Possible places where bias toward an outcome might have influenced the design, materials, procedure, conditions, or calculations in the study.

If these questions cannot be answered in an honest and transparent way, the investigation risks being corrupted by bias that may or may not be recognized by either investigator or consumer.

Every scientist must remember to fight the instinctive urge to celebrate our *current* knowledge, rely on its correctness, and ride its coattails all the way to a sense of security. We must be ready to ride the forces of change and discovery instead, in whichever direction they lead, stepping gingerly over any theories that turn out to be flawed. We must be willing to follow the scientific method, even to risk financial insecurity in service of the truth, and that requires courage. If we are not willing to risk these things, then we are not being true to science but, instead, working to uphold our comforting dogma of choice.

We must further have the courage to divorce the truth of science from political considerations. This is not easy to do if we entertain any political sensitivities, and if we try, it will tend to elicit an angry response from others who are hoping to leverage the power of science to reinforce their political agenda.

If we are able to use our scientific wisdom and exercise veto power over the thinking of our scientific animal in the mirror, then our science will be fine. We need no wisdom other than the scientific method in order to do science. Our task is to keep the integrity of that science above corruption — easier said than done. If we can, the beautiful and unequalled scientific method will guide us the rest of the way on its own.

PUBLIC PEER REVIEW

Another suggestion, designed to sidestep our scientific bias, might be to improve the way in which peer review is conducted.

I am privileged to be a part of an organization that is actively changing the way that peer review is done in the scientific community. The Quicycle Society[152] believes that the peer review process should be transparent, public, and that those doing the reviewing should be able to demonstrate their understanding of the material they are reviewing, as well as their competence to critique it.

Too often, peers have been able to reject papers with little to no transparency, and rarely with the assurance that its technicalities were thoroughly understood. Some papers are even returned with diametrically opposite responses from different peer reviewers. This reality has not empowered scientific progress but has held it back.

In the Quicycle model of peer review, peers open their process to the scientific scrutiny of the community. Presentations are discussed, questioned, and ideas are developed in video conversations that are made available for viewing online. This approach is expected to find support within the broader scientific community, though it will undoubtedly face resistance from those established players whose authority (and large income) is threatened by such openness, accountability, and democracy.

This is a different type of peer review, in which individuals require the courage to conduct the process in public, which can seem daunting.

[152] http://www.quicycle.com

SCIENCE VERSUS RELIGION

Science is a differential equation. Religion is a boundary condition.

Alan Turing

Religion is always right, that is its weakness. Science is always wrong, that is its strength.

Garnet Ord

As we mentioned in chapter one, neither science nor religion can be used as a weapon against (or a proof of) the other since they operate in different paradigms. Science is about measuring and quantifying the physical world, something that cannot be done with a non-physical reality. Religion is about faith and our inner, 'spiritual' experience. It deals with concepts that science can neither confirm nor refute.

Some will still try to use the one to support or to deny the other. That is the predictable truth of our self-serving nature, which needs the validation of our correctness in order to soothe our instinctive vulnerability. But the attempt will always be doomed to failure.

On the other hand, when we understand each in its correct place, limited to its appropriate purview, we are capable of doing both with integrity. Since science and religion are not in necessary conflict, one can at the same time pursue excellence and rigor in science while engaging in an abstract, internal, subjective process based in philosophy or transcendence. The two need not be mutually exclusive, as long as we clearly see the animal in our mirror for what it is, and for what it so eagerly *wants* in *both* contexts.

9.3. DELVING FURTHER...

CLIMATE & SUSTAINABILITY

> *Anyone who has read the 2014 report of the Intergovernmental Panel on Climate Change [IPCC] knows that, while the modest warming of the Earth since 1880 is indisputable, as is the human influence on that warming, much else that passes as accepted fact is really a matter of probabilities. That's especially true of the sophisticated but fallible models and simulations by which scientists attempt to peer into the climate future. To say this isn't to deny science. It's to acknowledge it honestly.*
>
> Bret Stephens[153]

> *We do not inherit the earth from our ancestors, we borrow it from our children.*
>
> Native American Proverb

All thinking, spiritual, and caring humans who consider the issues of climate, pollution, and sustainability tend to arrived at the same self-evident conclusions. We are the only species capable of being conscious custodians of the planet; we are the only one with an adequate combination of reason, communication, and technology. The responsibility as custodians therefore falls to us. And even more than that, this planet is our home, our source of resources, our air and water purifier — it is our spaceship and protector as we traverse this inhospitable, super-heated, almost-vacuum of space. Were it not for Earth's atmosphere and magnetic fields, the sun's intense radiation would kill every last living organism on this planet and boil off every last drop of water into space, rendering this a lifeless rock.

The fact that there has been warming of Earth's atmosphere over the past decades is indisputable. The fact that it has occurred as a result of fossil fuel combustion is also incontrovertible. This is based on evidence, not projections, and we will therefore focus our scientific conversation in this direction.

---

[153] Stephens, Bret, "Climate of Complete Certainty," *New York Times*, April 28, 2017.

We will *not*, however, discuss the question of whether the global warming trend will (or can) lead to a catastrophic, civilization-ending planetary heating in the future, the kind that currently scares an entire generation of young people… perhaps unnecessarily. That question is beyond the scope of this book because it is fraught with both political questions surrounding money and policy, and scientific questions surrounding mathematical modeling choices and the exact quantification of *all* complex interactions between every local, non-local, and buffering mechanism on the planet. This question involves the type of science that attempts to project into the future and make definitive predictions based upon our current understanding. The problem is that our knowledge is still incomplete in these areas. We cannot yet accurately model the many complex and seemingly-chaotic natural systems that cause weather and climate, which renders this predictive process uncertain. This is the intent behind the very (scientifically) defensible statement made by columnist Bret Stephens, quoted above, over which he was excoriated for his lack of political correctness.

And while it is important to debate these issues and to clarify the nature of this predictive science, we will not have that debate here or the vehemence that some bring to it may derail the central message of this book. Instead of getting bogged down in that quagmire, we will rather focus on something far more practical and useful. We will focus on what we, as individuals, can do in a meaningful way about the issue of global warming, as we currently find it.

MAKING A CLIMATE DIFFERENCE

For the individual, making a difference may seem hopeless in the face of such an enormous and seemingly insurmountable planet-sized issue. This is made worse by the fact that trillion dollar industries and power-brokers are fighting this battle from opposing sides.

Dr. John Williamson explains, however, that there are two practical things that each of us can do to help:

1. Cooling the planet
2. Re-greening the planet

1. COOLING THE PLANET

The term *albedo* refers to the amount of radiation that a surface reflects. A mirror reflects everything so it has an albedo = 1. A black surface absorbs radiation so it has an albedo = 0.

Humans change the albedo of the Earth's surface when we re-engineer it. Since Roman times, we have known that putting black tiles on the roof of a building results in a warmer interior. Similarly, the tarmacs, concrete, and glass of a cityscape have very different reflective properties than a rural area with grass, trees, soil, and rock. We tend to ignore this aspect of global warming, even though our use of black materials can have a meaningful effect. Consider how many miles of road are there in the United States alone, let alone the rest of the world. These black surfaces will have the most meaningful heat-absorbing impact in sunny places.

One way to cool the planet is to convert dark, absorptive surfaces to light, reflective ones. White, reflective surfaces can in fact have a larger impact on lowering planetary temperatures than can a reduction in the burning of fossil fuels. Dr. Williamson performs a simple calculation to show that we can cool the planet:

- by 10^{-13} degrees (Kelvin) for every square meter of white surface that replaces a black surface.
- by 10^{-12} degrees (1 pico-degree) per white car parked on a black tarmac in a sunny place like California. (This will be less effective in a cloudy place like Scotland.)
- by 10^{-14} degrees (10 femto-degrees) per white shirt worn outdoors in a sunny place.
- by 10^{-14} degrees per meter of (10 cm-wide) white line painted on a black tarmac.

So park your white car on an existing dark surface and you are actually helping the planet. Wear white outside on a sunny day and you are doing your part for global cooling. If we take these concepts on as societal values, we can make a meaningful impact and help our planet.

I am sure that you realize the obvious danger associated with this approach. Too much cooling can also cause problems. If we engineer too much of an albedo increase, we run the risk of over-compensating and ushering in a period of cooler global temperatures. This can itself cause major climate and agricultural problems, not to mention risking the hastening of a period of glaciation, so one must indeed be balanced and careful in how one approaches this type of engineering or global movement. It must be paired with rigorous science devoid of political interference, which is a tall order indeed!

We are entering an age where we become capable of terraforming our planet and manipulating her weather through the use of technology. Just as in the genetic and nuclear ages, we must be exceedingly careful that we not make things worse through scientific arrogance, or worse, a scientific ignorance that we are not willing to recognize or acknowledge.

2. RE-GREENING THE PLANET

What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and to one another.

Mahatma Gandhi

Another under-acknowledged cause of planetary warming and dehydration is the cutting down of the world's forests. Global warming activists seem to delight in all manner of tactics and rhetoric against any fossil fuel related interest, but not as much against other offenders. Meanwhile, rampant deforestation continues, in third-world countries like Madagascar, in the third-world backwaters of pseudo first-world corrupt democracies like Brazil, as well as in the woodlands of first-world (corrupt) democracies like Canada.

The clear-cutting of vast areas of forested landscape prevents the uptake and holding of *both* water and carbon dioxide from the atmosphere, it promotes the dehydration of a biome, and it hastens animal extinctions. Notably, water vapor is an even more effective greenhouse gas than carbon dioxide (CO_2), making the loss of trees a direct factor in global warming.

Significantly, cutting down trees also releases the large amounts of carbon dioxide stored within them back out into the atmosphere. The lack of trees also decreases the consumption of carbon *from* the atmosphere since atmospheric CO_2 is, quite literally, the planet's primary plant food. The lack of trees results in higher concentrations of CO_2 in the atmosphere in ways that will appear indistinguishable from (and can be too easily blamed on) the fossil fuel industry (alone). And still, deforestation continues under the cover of this ignorant diversion of attention.

The clear-cutting of vast areas of forested landscape should be considered a criminal act against humanity, if not also against biodiversity and the health of the planet. All who take the issues of climate and sustainability seriously ought to put their money where their mouth is and prioritize the prevention of deforestation. Any international Accord, whether emerging from Paris, Kyoto, Montreal, or anywhere else, that does not address deforestation in a meaningful and global way is abdicating its responsibility and squandering a vital opportunity.

These are challenging issues that ask challenging questions of us. Do subsistence farmers in one country or corporate loggers in another have the right to deforest a biome upon which the entire global ecosystem depends? The legal answer might be 'yes,' but the obvious answer is certainly 'no.' One need only look at the existing global scars to be moved. How can one not be when satellite images show a once completely-forested Madagascar now reduced to less than 10% of its former green. And when their island nation is completely deforested, its topsoil eroded away for lack of cover, where will their economy be then? To where will their once-rich animal life have escaped?

Granted, in a civilized world, if the global community demands a benefit or sacrifice of a local community, it can justly be expected to compensate them in some way. While I am not necessarily in favor of increased taxation, nor certainly of any kind of global taxation, I would consider justified some type of international monetary compensation that would allow subsisting people to survive without deforesting the lungs of the world. Of course, in a first world, civilized democracy like Canada, no such support should be necessary. Nor should their name even have come up in this context!

Worrying about climate change without fighting deforestation is counter-productive, like fighting Malaria by killing the things that eat mosquitoes.

Deforestation must stop, and its devastating scars must be reversed and remediated. Why have we not yet proposed, nay demanded, as a global community, that all tropical and boreal rainforests be designated protected environments? Perhaps because the effort and the international cooperation it would entail are demanding and challenging to effect? Is the need for it not self-evident?

There are countries that are on the right track in terms of forestation. While much of Scotland was originally forested, many of their native forests had become consumed across the centuries. In recent years, however, a concerted effort by the Scottish government has seen meaningful efforts undertaken toward reforesting their landscape. Israel, as another example, had more trees at the end of the 20th century than at its start, since they implemented an aggressive forestation campaign from the founding of the modern state in 1948. Their advances in drip-irrigation and other agricultural practices have also seen the significant reclamation of arid land into farmland over that period.

As we enter the third decade of the 21st century, more and more devices and technologies are springing up that extract water directly from the atmosphere through condensation. There is truly an inexhaustible supply of water in the air, replenished by ocean evaporation as fast as we might extract it. All we need to do, in order to turn this distilled water into drinkable water, is to add in an appropriate balance of ions and minerals, since drinking pure, distilled water can actually be harmful to one's health. But in addition to drinking water, such technologies can provide us with ample water for growing plants and trees and re-greening our planet.

We can further empower these efforts by conserving water, locally, nationally, and internationally. We can also actively work to reclaim more and more desert landscape. In our modern age, we possess the technology to re-green the Sahara Desert, for example, if we choose to. It would only require the will of the North African countries involved, for they would invariably be whole-heartedly supported in such efforts by many in the community of nations.

And we should plant. We should not only plant more trees, but we should grow vegetables and fruit on whatever land we have available. Those of us in cities can plant on rooftops, on balconies, in pots on a window sill, as well as in wall gardens — planters that can be mounted on vertical surfaces.

And if and when we enable technologies that provide us with more efficient (or even freely available) energy, we can use that energy to condense more water from the atmosphere, empowering even further the re-greening of our planet.

As a natural consequence of drawing water from the air, the concentration of atmospheric water vapor might diminish slightly in that vicinity. As the most powerful of all the greenhouse gases, a decrease in water vapor concentration in the air would result in less atmospheric heat absorption, and therefore some measure of planetary cooling. This effect may not be too large, however, because evaporation from the ocean or the humidity in the region will buffer this gradient back toward equilibrium.

DEATH BY POLLUTION?

> *You might not die from ingesting plastic in your food, but your children will!*
>
> Anthony T. Hincks

Before we discuss sustainability, let us take a moment to consider one of the most serious threats to our well-being and continued survival on this planet: pollution.

Man has a long history of polluting. For generations we dumped our waste, our trash, our chemicals, and our exhaust fumes into our rivers and atmosphere because they were then simply carried away. Of course, *away* for us is *here* for others. Even the ocean, which had always seemed so endlessly expansive and forgiving, has begun to show signs of strain. Certain species have depleted stocks as a result of over-fishing. Marine ecosystems have been damaged by aggressive and unsustainable fishing practices. Endless dumping of plastic waste around the globe leads to travesties like the so-called Pacific Garbage Patch, and also the increasingly common accounts of marine animals of all shapes and sizes dying as a result of plastic ingestion. Some are poisoned by consuming bits of plastic or micro-plastic they mistake for food. Others die by suffocation or strangulation by plastic fibers from discarded fishing nets, garbage, or packaging materials[154]. There is scarcely a single fish one can pull from the ocean any longer that will not have bits of plastic in its stomach.

---

[154] See http://bit.ly/TEDTrash.

The smallest and most important organisms in the ocean are plankton because they form the foundation of the food chain. They are eaten by small creatures, who are then eaten by larger ones, who are then eaten by even larger ones. And so on, all the way up the food chain. When industrial chemicals are dumped, or in the case of burning coal, when heavy metals like mercury enter the ocean from the atmosphere, they are absorbed by plankton. When the plankton are eaten, the creatures who eat them pick up and retain that mercury. This is because when mercury enters the body of an organism, it attaches to the tissues and does not leave, not even with the organism's waste. So as the larger creatures eat the smaller ones, they are picking up all of that accumulated mercury. When the next larger creature eats, it builds up even higher levels of mercury than its food because it has been eating food containing this level of mercury *at every meal*. The concentration of mercury in a fish is therefore greater the further up the food chain we go and the larger the fish. This is called biomagnification. As a result, from the point of view of mercury exposure, smaller fish like sardines are safer to eat, and larger fish like tuna or swordfish should be eaten sparingly.

There are many other examples from around the world of toxic pollution with devastating environmental effects. A mere few examples include: BP's Deepwater Horizon oil platform disaster in the Gulf of Mexico in 2010; BHP/Vale/Samarco's toxic dam failure and heavy metal sludge tsunami down the Rio Doce (river) valley in 2015[155]; Cesium-137 contamination of Pacific fish stocks as a result of the Fukushima disaster in 2011; repeated contamination of ground water systems by highly carcinogenic fracking fluid[156], and many others.

Just as notably, humans rely upon soil, water, and a diverse array of animals, insects, and plants in order for the planet to produce enough food to feed us all and in order for the environment to be able to recycle and purify all the nutrients involved. These elements all interact in a complex symphony of influences and feedback mechanisms that will collapse if too many pillars of the system are badly disturbed or degraded. We are already beginning to see collapses in certain

---

155 https://www.youtube.com/watch?v=x-xSd_Qkk1o

156 Vogel L., "Fracking tied to cancer-causing chemicals," *CMAJ*. 2017;189(2):E94–E95. doi:10.1503/cmaj.109-5358

populations of bees, insects, and birds as a result of poisoning from agricultural pesticide use[157]. If this problem is not resolved soon, our attempts to protect food-growing for the masses will result in an inability to naturally pollenate our crops. That would be an unmitigated disaster for global food production.

If we do not get a handle on our polluting and destructive habits as a global community, the consequences may demand a higher price from us than we can bare. As such, we had better develop a keen sense of prudence and foresight if we hope to survive into the future. We had better focus in a serious way on sustainability, on living in harmony with the natural world, and in not polluting or damaging Earth's capacity to sustain us. We must become smarter in our resource consumption and in our planning and policy, and this work must be carried out in a coordinated and international manner. The number of places that continue to pollute unabashedly must be diminished, and international and economic pressure should be brought to bear where appropriate in order to help accelerate this work.

SUSTAINABILITY

Human construction, industry, and agriculture are encroaching ever-faster upon the remaining, dwindling natural and wild resources of our planet. Rainforests are being cleared for low-quality farmland that is only useful for a short period of time, after which more rainforest is simply cleared in order to do it all over again. There are many documentaries that underscore the speed with which we are destroying the vital habitats of so many different creatures[158]. Species are currently going extinct about 1,000 times faster than the natural rate as a result of

---

[157] Lopez-Antia, A. et. al., "Brood size is reduced by half in birds feeding on flutriafol-treated seeds below the recommended application rate," *Environmental Pollution*, Volume 243, Part A, December 2018, Pages 418-426.
See also: Pamminger, T., et. al., "A mechanistic framework to explain the immunosuppressive effects of neurotoxic pesticides on bees," *Functional Ecology*, 17 April 2018, https://doi.org/10.1111/1365-2435.13119

[158] See documentary series like "Our Planet" on Netflix, and many others.

our activities[159]. If the complex web of biodiversity on this planet fails to survive, humans will struggle to, and will then eventually also fail to survive. There is little ambiguity about that.

Certain farming practices are also resulting in the loss of valuable topsoil, just as our resource needs are increasing. Topsoil is sometimes called a renewable resource because nature can produce it, but it can take 500 to 1,000 years to produce about an inch of it.

Fresh water resources are becoming depleted or increasingly polluted. If we do not develop new water technologies, as we mentioned before, finding enough fresh water for drinking and for agriculture will become a significant challenge. Currently, the largest fresh water aquifer in the United States, the Ogallala, is being depleted by agricultural use about 40 times faster than nature can replenish it.

We are also using other material resources in an inefficient and wasteful manner. In industry, unnecessary packaging should be minimized, and creative new ways must be found to minimize and then eliminate the use of plastic in the manufacture of both products and packaging.

There are already cities in the world that have been specifically designed or that are being run in ways that center around sustainability. These cities focus, for example, on providing green belts, parks, and recreation areas, as well as alternative transportation infrastructure that is less polluting, or that includes bike paths or electric trams. The lessons learned from these pioneering cities must be communicated, analyzed, improved-upon, and then emulated around the world.

In the future, energy will be available to us in a cheaper and more abundant way as a result of improving technology. The environment, however, will continue to be degraded by the harvesting of resources, and as a result of the waste from processing those resources for an ever-expanding and demanding human population. As such, our sustainability efforts must place a healthy focus on consuming only what we really need.

---

[159] De Vos, J.M., et. al., "Estimating the normal background rate of species extinction," *Conservation Biology*, 26 August 2014, https://doi.org/10.1111/cobi.12380

In the documentary "*Minimalism: A Documentary About The Important Things*[160]," the point is underscored that our focus on material possessions, and the sheer number of possessions that many of us in the capitalistic West own, is completely out of proportion when compared to the rest of humanity, both in historical terms, as well as in current socio-economic and geopolitical terms. Humans have never needed this many clothes, changed this often for purely style and fashion reasons. At the same time, many in the world go hungry and many a habitat (or life) is destroyed in the manufacture of all of this *stuff*. This message cuts to the heart of sustainability. There are too many (and will soon be ever more) of us to continue consuming, discarding, and polluting at the rate we are.

Something has to give, and if we do not protect the environment from pollution and toxicity, *it* will give. We cannot afford that. We therefore have no choice but to jealously protect our oceans, land, atmosphere, and drinking- and ground-water systems. Our lives and health depend upon it.

But in addition to preventing damage, and in addition to optimizing our resource use, we should each be contributing to the production of resources. Sustainability means living sustainably in terms of our energy consumption, our resource consumption, our waste production, and producing whatever resources we can on our own. We should grow whatever food we can grow on an individual basis. As we mentioned above, this can be done with or without land, and in both rural and urban settings. We should be efficient in recycling our usable waste, for example by composting our organic food waste at home in order to fertilize the food we are growing, and also to limit the waste we require the city to collect and dispose of on our behalf.

POPULATION

The rate at which our population is increasing will continue to place strain upon our resources and our environment. But rising population density also has behavioral consequences because it elevates competition and fear, and this adds further challenges to our sustainability efforts.

---

[160] https://www.netflix.com/title/80114460

Population over-crowding, even without significant resource shortages, will reliably lead to increased stress. This is true of rats in a laboratory or human beings in a city or country[161]. As global population density increases, conflict between individuals and groups will naturally tend to increase… unless we become emotionally wiser as a species.

While I do not suggest we impose limits on those having children, as some countries have done in the past, we must begin to hold ourselves accountable in some way. We would do well to encourage this accountability within those cultures who still value large family sizes — a simple and practical survival strategy left over from agrarian times, but that will no longer serve the modern age.

We must also realize that if we do not take control of our population growth, nature has ways of doing it for us… not through a conscious act of will, but through a series of causes and effects. Consequences. A global pandemic, for example, is always made worse when population density is higher because there are more viral incubators walking around and interacting, and also more people with susceptible genetic makeups. This will cause a larger spread and higher mortality, in effect, controlling the size of the population.

Would it not be in our best interests to design our future rather than leaving it to nature to design for us? Nature tends to be cruel in her unequivocal, naked practicality. Human beings can also be cruel when they revert to their respective group-thinks of choice. We are therefore not suggesting any type of forcible population control. That will too easily lead to evil. We are suggesting instead that we engage with our future in a conscious and intentional way. We should choose our family sizes based upon a global vision of our shares humanity, and based upon the common bond we share to our one and only home of limited size.

[161] Cassel, John. (2017). “Physical Illness in Response to Stress,” 10.4324/9781315129808-10. See also Newman, A.E.M., et. al., “Using ecology to inform physiology studies: implications of high population density in the laboratory,” *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, Vol. 308, No. 6, https://doi.org/10.1152/ajpregu.00328.2014

A SCIENTIFIC LOOK AT OUR FUTURE

The scientific theory I like best is that the rings of Saturn are composed entirely of lost airline luggage.
Mark Russell

Let us take a moment to consider what science might suggest about the future of our human population. Will we prove to be smarter than bacteria, or will our animal nature win out in the end, to our collective doom?

If we watch a bacterial population grow in a laboratory petri dish, we see a simple principle at work, depicted in the diagram below. After an initial slow growth phase, the bacteria begin to multiply exponentially — as long as there is plenty of nutrition available. When nutrition becomes limited because of the increasing population, growth slows and plateaus as competition for resources intensifies. As resources become more scarce, and as waste begins to build up, the population starts to die due to environmental toxicity and a lack of food.

The human population of Earth has been in the exponential growth phase for several centuries. If our population growth continues, unfettered, we will soon enter the stationary phase, in which the population stops growing due to resource shortages and toxicity. That means disease, starvation, and death!

Currently, the world's population grows by over 200,000 people *every day*[162], on average. So in addition to those *already* dying everyday, almost a quarter of a million *more* people will have to die every day from turmoil, malnutrition, and disease in order to keep the population of the planet stationary — let alone decreasing. That is not a pleasant prospect. Furthermore, at that point, we are in imminent danger of entering the death phase of the graph if the trends of resource shortages and environmental toxicity are not addressed in a substantial way.

162 https://www.worldometers.info/world-population/

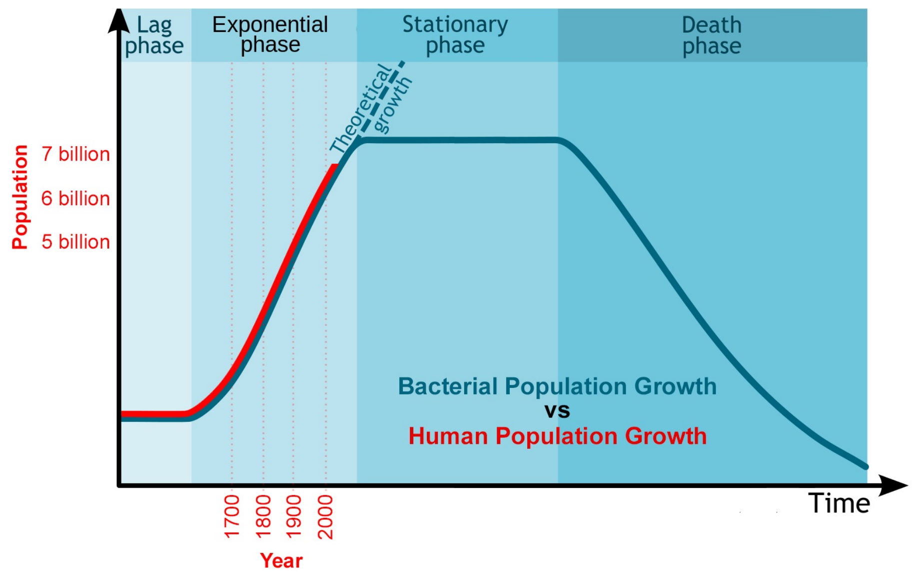

Figure 18: Human versus bacterial population growth curves[163].

If we continue polluting our planet and especially our oceans, a build up of environmental toxicity will impede the planet's ability to provide agricultural, marine, or animal produce. Resources will become increasingly scarce as the planet becomes increasingly degraded. This makes it essential that we learn to get along and work together. We will need to coordinate global resources and efforts in such a way that makes us a more efficient and less wasteful species.

As a result, in order to thwart many possible unpleasant futures on our beautiful blue-green world, we must learn to both cooperate and plan for a successful future. We will not get there by continuing to simply *react*, as a species, from a place of fear and vulnerability. We will also not get there by allowing the guidelines to be set by those with financial incentives or motives. We must engage our ideals and our intelligence. The dire consequences, if we do not, are perhaps one of the best arguments for speeding up our evolution and civilization, and reining in the forces of the animal in the mirror. Our very survival as a race may be at stake… or at least, the conditions in which we will have to *endure* that survival.

We are obviously capable of being smarter than bacteria, but with our instinct running the show, the question is whether or not we *will*

[163] Based on the image "Bacterial growth en" by M. Komorniczak. This file has been released into the Creative Commons 3.0.

be. Given the graph of human population growth and the current state of global dysfunction, this should be a sobering thought for serious people.

So let us work passionately and vehemently to save our world from strife and our environment from pollution, especially by plastic and industrial chemicals. Let us live modestly, peacefully, and sustainably within our ecological means. That will give us all the best possible chance of survival on this all-important, fragile spaceship called Earth.

* * *

If you are interested in delving more deeply into this subject, please see the Appendix at the end of the book. Topics covered:

- The Standard Models of Physics & Cosmology
- The WvdM Photon-Electron Model
- Robinson's Universe
- Genetic Engineering

A.4: SCIENCE: THE STANDARD MODELS

THE STANDARD MODELS OF PHYSICS & COSMOLOGY

Modern science is based on the principle 'give us one free miracle and we'll explain the rest,' and the one free miracle is the appearance of all the matter and energy in the universe and all the laws that govern it, from nothing, in a single instant.

Terence McKenna

A full treatment of this topic is beyond the scope of this book, but hopefully this small teaser will serve to whet the reader's appetite for more.

The standard model of particle physics describes how three of the four primary forces of nature work. These are the two forces of electromagnetism, and the 'strong' and 'weak' forces at work within the atom. The model also describes a variety of subatomic particles. While it has succeeded in making certain predictions, there are certain observed phenomena that remain inconsistent with it[219]. As Roger Penrose puts it, "Things have moved a great deal from those beginnings of an understanding of particle physics, as it stood in the first third of the 20th century. As we embark on the 21st century, a much more complete picture is to hand, known as the standard model of particle physics. This model appears to accommodate almost all of observed behavior concerning the vast array of particles that are now known[220]." Penrose continues by describing some of these particles. "There are new kinds of entity known as quarks, gluons, and W and Z bosons; there are vast hordes of particles whose existence is so fleeting that they are never

[219] For example, baryon asymmetry — the difference between the amount of observed matter versus anti-matter in the universe.

[220] Roger Penrose, *The Road To Reality: A Complete Guide To The Laws Of The Universe*, Vintage Books (2004), p. 628.

directly observed, tending to be referred to merely as 'resonances'. The formalism of modern theory also demands transient entities called 'virtual' particles, and also quantities known as 'ghosts' that are even further removed from direct observability." Penrose then concedes "In any case, the standard model is clearly not the 'ultimate answer,' with regard to particle physics, because it contains many unexplained features and 'ragged edges,' despite its undoubted success. It involves about 17 unexplained parameters that simply need to be taken from observation[221]." As such, the standard model of particle physics has explained much, but it has not yet brought us all the way home. Even the recently-famous Higgs Boson is a subject that is not without controversy and skepticism[222].

We need to understand more in order to answer the unanswered questions. *Physics is not over yet.*

On the large scale end of our observations, the standard model of cosmology centers around the theory that the universe had a beginning — a boundary condition — the Big Bang, which occurred almost 14 billion years ago. It is claimed that, before the Big Bang, all the matter and energy that would ever exist was concentrated into a small point, and there was nothing that existed outside of that point either. All that would become both matter and space-time was confined within it, as strange as this is to try to imagine. According to the standard model, the only force acting at large planetary and galactic scales is gravity.

The idea of the Big Bang was proposed by George Gamow, based on Georges Lemaître's 1927 idea of an expanding universe. The universe was believed to be expanding because the light from distant stars is red-shifted. Light becomes redder in color when its waves are stretched, and one way they can become stretched is if the source of the waves is moving away from us. This is called the Doppler Effect, and it is why the pitch of an ambulance siren becomes lower as it moves away from us. In light waves, the equivalent of the pitch getting lower is the light shifting in color toward the red end of the rainbow of colors in the light spectrum. The wavelength of the light is literally becoming longer.

---

221 Ibid, p. 651.

222 For a robust and substantive dialogue on this subject, see quicycle.com video QC090 (https://bit.ly/HiggsQandA), which follows presentation QC089.

If the red-shifted light implies that the universe is expanding, then if we run the expansion in reverse, extrapolating backward in time, the universe might have originated at a single point in the distant past. Proponents of the Big Bang Theory therefore *begin* with this starting condition, and extrapolate this conception of the early universe *forward* in time in order to try to explain exactly *how* this initial explosion of energy led to our present universe, as well as what features we should expect to see as a result of such a theory.

Thus, in order to remain true to this interpretation of what red-shifted light represents, scientists the world over embraced the Big Bang Theory, but their acceptance of it was surprising. This tiny point with no size, from which the Big Bang supposedly emerged, is known as a singularity in physics. (A black hole is a singularity.) It takes an infinite amount of energy to remove even one atom from a singularity, but the scientific community accepts that *all* the energy of the universe escaped from this particular singularity. This is the 'one miracle' to which Terence McKenna is referring in the quote above.

Next, according to the Big Bang Theory, as the super-hot energy of this infant exploding universe expanded, it cooled. Some of it coalesced to form subatomic particles and then atoms, which now comprise all of the visible matter in the universe. Some of this primordial energy, though, is believed to have simply kept on cooling. Thus, when in the mid 1960s Penzias and Wilson discovered a background noise of microwaves that seemed to emanate equally from every direction in space, it was hailed as evidence in support of the Big Bang Theory. This radiation has the energy equivalent of a temperature of 2.7 Kelvin[223], and it is known as the cosmic microwave background radiation, or CMBR.

If it were possible to explain the red-shift of starlight by means of a mechanism other than the Doppler Effect, however, it would pose a challenge to the foundation upon which the Big Bang Theory balances. Similarly, if the 2.7K CMBR could be explained by a cause other than a Big Bang, it would further challenge the standard model of cosmology.

While the study of astronomy and cosmology have indeed seen magnificent advances in our understanding of the universe, there are still phenomena we observe for which the standard model of cosmology cannot account. Two examples are:

---

[223] About –270.5˚C.

- There are large ‘superclusters’ of galaxies we have detected that are so large that they would have needed at least 100 billion years to form[224]. (One example is the Pisces–Cetus Galaxy Supercluster Complex.) The universe could therefore not be a mere 14 billion years old.
- In the Standard Model, the only force that determines the shape of a galaxy is gravity. The problem is that the outer stars in a galaxy orbit around the center at roughly the same speeds, instead of at different speeds based on their distance from the center. The outer stars also orbit the average galaxy much faster than they should if only gravity were at work. A galaxy seems to have too little mass to explain its rotation. Standard model physicists therefore employ the concept of dark matter to account for the so-called “missing mass.” Now, while there is evidence of something massive and transparent in intergalactic space that lenses light, if this is the dark matter that is ‘correcting’ galactic rotation, cosmologists would have to explain how such material, unevenly distributed *between* galaxies, would influence the shape of star rotation within each galaxy in a consistent and symmetrical fashion.

Interestingly, recent observations of galactic centers have revealed something else unexpected: *counter-rotating* discs of gas. “In NGC 1068, we find direct evidence that the molecular torus consists of counter-rotating and misaligned disks on parsec scales[225].” This means the gas closest to the galactic center is rotating in the same direction as the galaxy, but a disc of gas outside of it is rotating in the opposite direction. This seems incompatible with what is theorized about the action of (or the existence of) a black hole at the center of every galaxy, as one of the lead researchers expressed. “We did not expect to see this, because gas falling into a black hole would normally spin around it in only one direction. Something must have disturbed the flow, because it is impossible for a part of the disk to start rotating backward all on its

[224] Lerner, Eric J., *The Big Bang Never Happened* (Vintage Books 1992), p. 21.

[225]Impellizzeri, C.M.V., et al., "Counter-rotation and High-velocity Outflow in the Parsec-scale Molecular Torus of NGC 1068,” The Astrophysical Journal Letters, Volume 884, Number 2 (2019)

own[226]." Since they subscribe to the standard model of cosmology, they speculate that the cause of the counter-rotation must be "from more recently introduced molecular gas falling out of the host galaxy or from a captured dwarf satellite galaxy[227]."

It is noteworthy that, as a result of the Cassini mission, NASA was able to produce a time-lapse video, viewing Saturn's north pole from above, and a very similar counter-rotation is observed. On the smaller planetary scale, it is visible in far more striking and observable detail[228].

On the other hand, counter-rotation is consistent with the plasma physics concept of a Birkeland current[229], which some physicists indeed use to describe galaxy and stellar rotation. In a space plasma, both ions and electrons are free to move, and when charges (currents) flow in the same direction, the current strands attract each other and then spiral around each other. This may give rise to helical pathways or form filamentary or z-pinch structures, as can be seen in most lightning or arc discharges. Such filamentary structures can also be observed in space at the solar flare, the nebula, and even at the super-galactic scales.

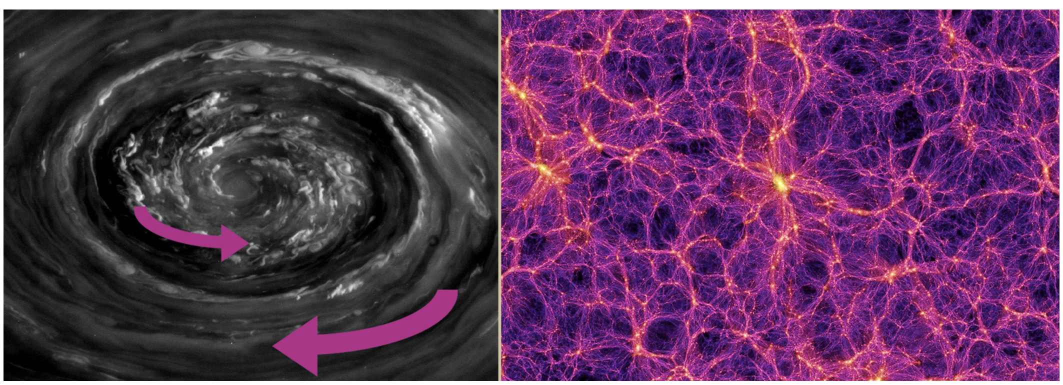

Figure 12: Counter-Rotation around Saturn's north pole[230] (L) and the very large-scale structure filamentary 'Galactic Web'[231] (R).

226 https://public.nrao.edu/news/going-against-the-flow-around-a-supermassive-black-hole/

227 Impellizzeri, C.M.V., et al., 2019.

228 Watch this video: https://bit.ly/saturncounterrotation

229 See http://www.ptep-online.com/2015/PP-41-13.PDF

230 Source: NASA.gov

231 Volker Springel/Max Planck Institute For Astrophysics/SPL

Standard model physicists deride the concept of the Birkeland current because the standard model excludes the possibility that electrical effects can manifest on a cosmic scale. They are therefore only willing to consider the force of gravity as a candidate, despite the lack of a gravitational mechanism to explain how such unintuitive rotation might occur.

Does the counter-rotation around galactic centers in fact offer counter-evidence to the theory that there must be a black hole at the center of every galaxy? Some will, no doubt, contend so. Others will, no doubt, vehemently disagree.

Penrose notes that "The spacetime singularities lying at cores of black holes are among the known (or presumed) objects in the universe about which the most profound mysteries remain – and which our present-day theories are powerless to describe... It is quite likely that the 21st century will reveal even more wonderful insights than those that we have been blessed with in the 20th. But for this to happen, we shall need powerful new ideas, which will take us in directions significantly different from those currently being pursued. Perhaps what we mainly need is some subtle change in perspective – something that we all have missed…[232]"

Penrose further opines "I believe that particular caution is to be recommended in matters of cosmology, as opposed to most of the sciences, especially in relation to the origin of the universe. People often have strong emotional responses to questions of the origin of the universe – and sometimes these are either implicitly or explicitly related to religious preferences[233]."

A purely scientific observer of the universe, who comes at the study without a preconceived set of starting conditions, will look to see how the universe behaves *now*. They will then extrapolate that same behavior backward in time, neither concerned with nor requiring a specific beginning condition. Without reason to expect otherwise, we will assume that the laws of the universe remain consistent, and that they

---

[232] Roger Penrose, *The Road To Reality: A Complete Guide To The Laws Of The Universe*, Vintage Books (2004), p. 1045

[233] Penrose, ibid., p. 753.

did not suddenly spring into existence, in violation of everything else we know about the nature of reality.

DR. JOHN G. WILLIAMSON

Dr. John G. Williamson is a world expert on subatomic and high-energy physics. In addition to teaching at the University of Glasgow for many years, Williamson spent seven years working at CERN — the large supercollider facility in Switzerland — where he was involved in confronting theory with experiment. He also spent several years working at Philips in the Netherlands, performing pioneering design and engineering work on single-electron devices.

It was through his published research that I discovered his work, and he was gracious enough to respond to my correspondence and engage with me in dialogue. Dr. Williamson has been published in peer-reviewed scientific journals more than 125 times, and his papers have been cited by other researchers in excess of 12,000 times[234]. But as soon as his new research began bumping up against the accepted wisdom of the standard model of physics, those papers began to be rejected by the peer reviewers. He relates that he has actually been told point-blank by journal publishers that, while there is no fault to be found with his work, since it does not accord with the standard model, they will not publish it. This is a remarkable and disturbing admission coming from the publisher of a scientific journal, and directed toward a leading expert in his field. A supposed gatekeeper and person of science is rejecting work because it differs with the scientific consensus on ideas that lie at the very edge of subatomic physics knowledge — a place where clarity does not yet exist.

It is important to note that the areas of science where consensus should be *least* important are those where we have the least clarity. These are the disciplines probing both the very smallest and the very largest structures known to the scientific imagination, or the systems too complex for us to yet model accurately. By definition, consensus is meaningless in such an environment, while humility, rigor, and interdisciplinary inquiry should be the order of the day. This is self-evident… even if not in evidence.

---

[234] His h-index = 45. This is an impressive number. (Roger Penrose has an h-index = 44.)

THE WVDM PHOTON-ELECTRON MODEL

Dr. Williamson's recent (published) and potentially some of his most important work, along with his research partner, the late Dr. Martin van der Mark of Philips in the Netherlands, centers around describing the sub-structure of the electron, something that has for decades proven elusive.

In a nutshell, we know that matter and energy can interchange between one another, as described in Einstein's equation $E = mc^2$. They are two different expressions of the same thing. According to the Williamson-van der Mark model, pure radiant energy (in the form of a photon) transforms into a particle when the photon becomes confined into a self-perpetuating, circular, double-loop[235] rotation. Similarly, a particle converts back into a photon — its pure (radiant) energy equivalent — when the double-loop rotation becomes unconfined from its tight circular loop and propagates in a straight line once again. This is depicted in the diagram below.

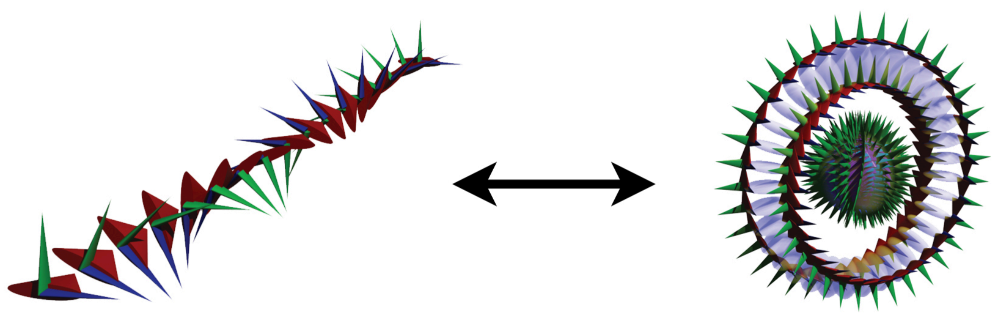

Figure 13: The Williamson-Van der Mark Model of the Photon-Electron[236]

The fins in the diagram represent the electric and magnetic fields, and they create a dipole magnetic and a monopole electric distribution for the electron snapshot on the right.

It is important to understand that this image of the electron is set in momentum space, not in normal 3-dimensional space, and it contains

[235] The loop involves two rotations per wavelength in order that the fields return to perfect phase alignment.

[236] Williamson, J.G., "The nature of the photon and the electron," Proc. SPIE 9570, The Nature of Light: What are Photons? VI, 957015 (10 September 2015)

two elements that actually represent the same thing. In order to interpret it correctly, we must understand it relativistically. While the electric and magnetic field energy is circulating with angular momentum, tracing a toroidal path, it is circulating around *itself*, and doing so at the speed of light. Imagine that, at the speed of light, the radius of rotation actually shrinks so that, if we project the image of the torus into normal 3-D space, it appears as the sphere shown in the center of the torus. The glass discs that make up the body of the torus are all slices of the same sphere in the center, as strange as this may be to try to imagine.

This work is rigorous, based on first principles, and yields a particle with half-integral spin and a charge of the order of 10^{-19} Coulombs, both of which agree with observation and experiment. The Williamson-van der Mark model is significant because it elucidates the substructure of the electron for the first time, and also provides a doorway to a more fundamental understanding of the relationship between particles, the energy density that constitutes them, and the very nature of and reason for quantization.

ABSOLUTE RELATIVITY THEORY

Some of their more recent work involves the development of a coherent 4-D algebra involving multiple coupled differential equations that govern the current, fields, angular momentum, and masses of all particles[237]. It is an extension of relativistic quantum mechanics — a sub-quantum mechanics, if you will — that delves into the substructure of the subatomic particles. While other theories take the proton and certainly the electron as axiomatic, this theory elucidates how the properties of these particles emerges as a *consequence* of their structure. Dr. Williamson calls this Absolute Relativity Theory, and as part of the mathematics, he and Dr. Van der Mark have calculated the General Inverse for every case of the Clifford-Dirac algebra that encapsulates

[237] The Mathematics of Absolute Relativity Theory (MART) can be summarized by the equation $\mathscr{D}_\mu \mathbf{\Xi}_\mathscr{G} = 0$, where $\mathscr{D}_\mu$ is a Dirac-Clifford four-vector derivative, and $\mathbf{\Xi}_\mathscr{G}$ is the root-energy in sixteen space-time forms including a Lorentz-invariant scalar 'point' mass-energy.

their work. This is not only noteworthy, but the process of inversion may in fact provide an answer to the mystery of quantum collapse[238]!

Another by-product of the Williamson-van der Mark model is the emergence of a fifth primary force of nature, the "superstrong force." This is the force responsible for holding the electron together. It is a force far stronger than that which holds the proton together. We know this because, in high energy scattering experiments, when protons (or muons) are struck by electrons, which have two thousand times *less* mass than they do, *they* are smashed to bits while the electrons remain unscathed.

The Williamson-van der Mark model is exciting new work with important implications, yet they have found when they try to publish some of it, since it is not a part of the standard model, these papers have been rejected (as of this writing)[239].

Now, while we may all agree that spurious, incoherent, or flawed papers should rightly be rejected from publication, the editors in this case were not able to find fault with the work of these highly-published experts. I suspect (nay, challenge) that neither would any of my readers be able to find such fault. As such, it is the decidedly instinctive nature of such thinking, especially within the scientific establishment, that deserves mention in a book like this.

DR. VIVIAN ROBINSON

Australian physicist and engineer Dr. Vivian Robinson is the inventor of the Robinson Detector, a backscattered electron detector that made significant improvements to scanning electron microscope technology. Dr. Robinson explains that his scientific study commenced, as a young man, with world experts in a particular field rejecting ideas that he knew would work. Instead of following a career in academia, this experience propelled him to develop his ideas into commercial products. He has since spent over 25 years making a living manufacturing, marketing, and selling these products to a receptive clientele. He has also conducted much of his research independently.

---

[238] View Dr. Williamson's presentation on "Quantum Coherence & Quantum Collapse" at quicycle.com, video QC068: https://bit.ly/quantumcollapse

[239] This material can nevertheless be viewed on www.Quicycle.com.

It was through my dialogue with Dr. Williamson that I was introduced, by him, to the work of Dr. Robinson. And then also to Dr. Robinson himself, who was equally gracious in conversing with me and sharing some of his research and insights.

Dr. Robinson has had similar problems having some of his research accepted for publication. He has also been told directly, unabashedly, by peer-reviewers that they would not consider his work for publication because it does not accord with the standard model. He was even told on one occasion that the mathematics in one of his submitted papers was not complicated enough, despite the reviewer's inability to find fault with the substance or mathematics in the paper.

Dr. Robinson's work not only exposes some of the shortcomings of the Big Bang Theory, but he provides compelling alternatives that accord with first principles and align with observation. As we quoted Penrose above, "It is quite likely that the 21st century will reveal even more wonderful insights than those that we have been blessed with in the 20th. But for this to happen, we shall need powerful new ideas, which will take us in directions significantly different from those currently being pursued." One wonders whether the ideas of Williamson, Van der Mark, and Robinson might fall into this category.

ROBINSON'S UNIVERSE

The details of Dr Robinson's model, encapsulated in his book *How To Build A Universe*[240], are beyond the scope of this book. He begins by describing the very properties of space-time that support light, and progresses to discuss the microscopic and macroscopic structures of the universe, Relativity, and red-shift. Those who are scientifically inclined are encouraged to read it[241]. Some of the elements of his model include:

- In addition to photons, there are only four stable particles in existence: electrons, protons, neutrons, and neutrinos (along with

[240] As of this writing, *How To Build A Universe* has not yet been published. Dr Robinson was gracious enough to share an advance copy with me, and to allow me to refer to his work here.

[241]See https://universephysics.com/ for more information. See quicycle.com for video presentations by Dr. Robinson of his model.

their anti-particle equivalents). All other short-lived subatomic particles decay into various combinations of these four particles plus one or more photons[242].

- Only three dimensions of space and one dimension of time are required by this model in order to understand the science of the universe.
- Photons and particles transform into one another in a way very similar to that described in the Williamson-van der Mark model.
- Protons and neutrons are higher-resonance forms of confined, rotating photons. In this model, charge is distributed in two dimensions, as shown below. Red represent positive charge and blue represents negative charge. Height and shade in the diagrams represent charge intensity. This model shows how and why protons and neutrons bind to each other. Opposite charges attract each other, and since the edge of the neutron has a negative charge, it can bond to the edge of a positive proton by overlap.

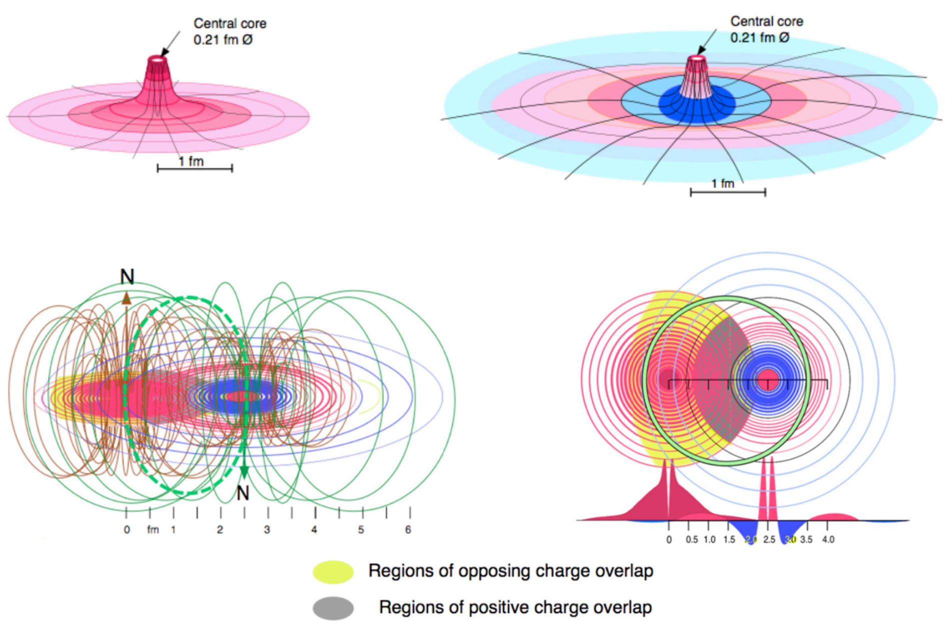

Figure 14: The Charge Distributions of Proton (L) and Neutron (R) in the Robinson Model (top), and Charge Overlap & Field Alignment in Proton-Neutron Bonding (bottom)

---

[242] Penrose's reference above to these "vast hordes of particles whose existence is so fleeting that they are never directly observed" as 'resonances' aligns well with this conception.

- Neutrons and protons bond to each other in a side-by-side (equatorial) arrangement to form two-dimensional layers of varying sizes (and shapes). The layers form hexagonal and diamond-shaped structures, most comprised of units of overlapping alpha particles — the 4-dot shape below (having 2 blue neutrons and 2 red protons).

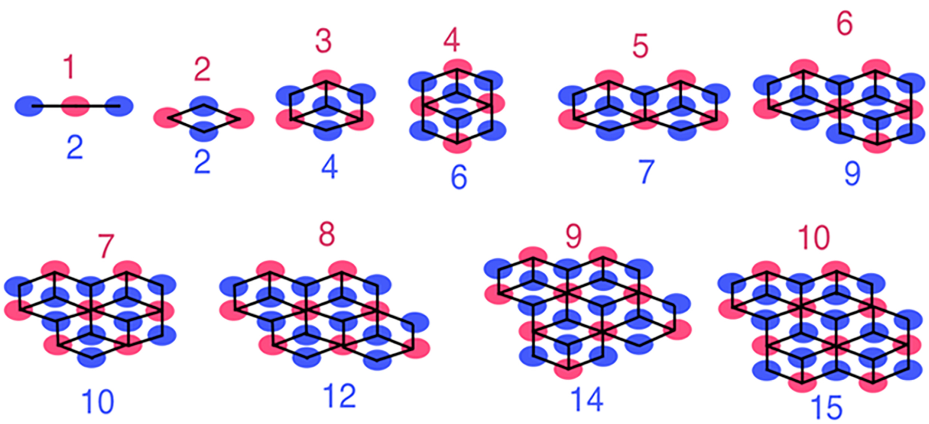

Figure 15: Examples of Some Possible Nucleon Layers in the Robinson Model. (Top row, second from the left, represents an alpha particle.)

- Like nucleons, for example two protons, are unable to bond with each other in these (equatorial) layers because the like charges at their edges repel each other (see below left).
- The model further clarifies how these nucleon layers arrange themselves in three dimensions within a nucleus. Layers can stack vertically (axially), bound together by their magnetic fields in the axial direction (below right). It also explains why certain arrangements form stable and others form unstable isotopes.

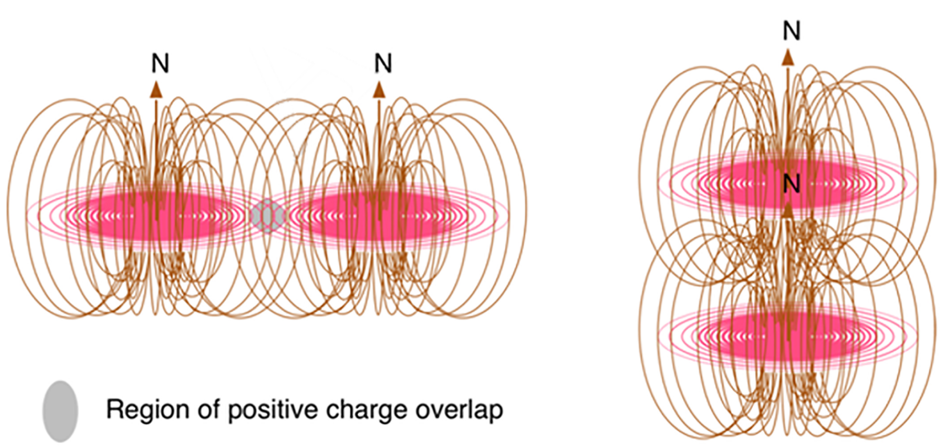

Figure 16: Robinson Model of Axial Nucleon Layer Binding

- This model obviates the need for quarks or gluons, which have never been directly observed or isolated, and clarifies *for the first time* why and how neutrons and protons bond in a nucleus.
- The Robinson model also predicted that the nucleus of the carbon atom should be triangular in shape (shown below). This triangular shape seems to have been subsequently borne out by experimental observation[243].

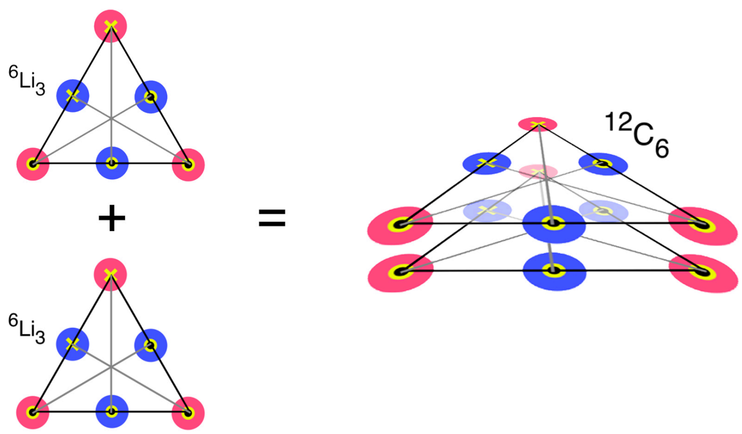

Figure 17: Robinson Model of Nucleon Layer Binding and the Carbon-12 Nucleus

- Robinson's book also explains, along with the relevant equations and diagrams, that photons are red-shifted due to gravitation and the distortion of space-time, as borne out by Einstein's Gravitational Field Equations in General Relativity. Contrary to the belief of some, while photons do not possess rest-mass because they do not exist at rest, they do in fact possess mass. The red-shift of photons has been interpreted by many to be a Doppler Effect. If it is not a Doppler Effect, one of the major pillars of the Big Bang Theory is undermined.
- Finally, how does the Robinson model account for the shape of galaxies and the speed of their star rotations? As we know, both gravity and electromagnetism are inverse square laws that weaken proportionally with distance. Electromagnetism, however, is stronger than gravity by about *thirty six* orders of magnitude — that is, by

---

[243] D. J. Marín-Lámbarri, R. Bijker, M. Freer, M. Gai, Tz. Kokalova, D. J. Parker, and C. Wheldon, "Evidence for Triangular 𝒟3h Symmetry in ^{12}C," *Phys. Rev. Lett*. 113, 012502 (2014)

> 10^{36} times. If a charge imbalance were to exist between the galactic core and the stars in the outer regions, an imbalance of a mere one charged particle out of every 10^{18} particles of matter could result in enough additional inverse-square attraction to account for the so-called 'missing mass.' The movement of stars within galaxies would then no longer be problematic. According to Robinson, cosmic rays can accomplish this type of charge imbalance since galactic magnetic fields deflect electrons more easily to their periphery, whereas the more massive cosmic ray (positive) ions can penetrate more easily toward the galactic core. This would cause the core to develop a positive charge in contrast to the peripheral stars' negative charge. As such, galaxy shape would be the result of both gravity *and* electromagnetic forces. Consequently, there is also no need for every galaxy to have a black hole at its center in order to contribute enough extra mass to the rotation effort.

The reason I have been impressed enough with Dr. Robinson's work that I would include this section in my book is that his theory is the first I have come across that actually explains nuclear physics in a way that makes both logical and intuitive sense. It explains the structure of the subatomic particles as photon resonances, and also explains precisely how protons and neutrons combine to form a nucleus.

Combined with the Williamson-Van der Mark electron model, this work brings to mind Penrose's comment quoted above: "Perhaps what we mainly need is some subtle change in perspective – something that we all have missed." This work is elegant, based on first principles, and yet not so esoteric that a college science graduate would not be able to follow the math and understand the basic building blocks of the universe. It is based on observation and accords with experimental results. I believe many who work in or around science understand that these things — elegance, simplicity, and being consistent with observation and experiment — are the hallmarks of good science. Esoteric and highly abstract mathematical models, not to mention extrapolation based upon approximation, provide too many dark corners in which unproven conjecture and misplaced priorities can lurk, unchallenged and unchallengable. As Dr. Robinson explains, an exact solution to an approximation is still an approximation.

Dr. Robinson's book, *How To Build A Universe,* lays out his model in sequence, from smallest to largest structures in the universe, and also shows how Special Relativity emerges as a consequence of photon structure. Clearly, those who are invested in the standard model may have a difficult time accepting his work because it calls into question some of the tenets in which they currently believe. But his work is scientifically compelling enough that it deserves, at the very least, to be heard.

In addition, given that his work is so far-reaching, covering so many scale factors of the universe, it is entirely feasible that some of the ideas contained in his work may be found to be either incomplete or somewhat inaccurate. This should not be construed as a disqualification of the other elements of his model, some of which have evidence in the academic literature to support them, and one of which resulted in a prediction (the triangular shape of the carbon-12 nucleus) that seems since to have been verified by experimental observation.

AND WHAT ABOUT THE CMBR?

As far as the cosmic microwave background radiation is concerned, one of the reasons it was assumed to be left-over Big Bang energy is because it appears to be emanating from every direction in space, and in a roughly uniform density. In his book *The Big Bang Never Happened*, Eric Lerner explains that the background radiation need not be the left-over heat from a Big Bang at all. Not only is there an alternative explanation, but observational evidence actually seems to preclude it from being a Big Bang energy-echo.

One alternative explanation is that, since interstellar and intergalactic space is not entirely empty, particles and ions can absorb and re-emit radiation. "Other scientists, including myself and Dr Anthony Peratt of Los Alamos National Laboratory, have hypothesized that the background is the glow from a radio fog produced in the present-day universe. Irregularities in this fog would produce fluctuations of just about the size observed[244]." Just like the tiny droplets of water in a fog scatter light in random directions in such a way that the light appears to be spread out more evenly, coming from every direction, so too, intergalactic radiation is scattered, making it appear roughly uniform.

According to observational evidence, "The cosmic background must, in fact, be generated locally, near to our galaxy, by an intergalactic medium that both absorbs and emits radiation[245]." Since the radio brightness of galaxies appears to fade rapidly with distance, it appears to confirm that radio waves are being absorbed and emitted by an intergalactic medium. If the microwave background radiation were a remnant of the Big Bang, such intergalactic absorption would greatly affect this radiation since it would be originating ten billion light years away. It should therefore appear far less uniform to us than it does.

In addition, before the microwave background radiation was discovered to be at a temperature of 2.7 Kelvin, the major proponents of the Big Bang Theory, Dr. Jim (P.J.E.) Peebles and George Gamow, had calculated that it should be approximately 20 to 30 Kelvin. Lerner points out that since this calculation involves the fourth power of temperature[246], the radiation was found to be present in an amount several thousand times less than their theory had predicted.

WHERE DOES THIS LEAVE US?

Now, many readers may feel that they are not in a position to judge the validity of the scientific positions mentioned in this section. That is not the aim of this conversation, and nor need it be. Firstly, the point is to illuminate the difficulty with which *anyone*, expert or no, can claim expertise, knowledge, or especially consensus in any area of science in which our knowledge is still in its relative infancy or bumping up against the boundaries of our understanding.

---

244 Lerner, Eric J., *The Big Bang Never Happened* (Vintage Books 1992), p. xxi. NASA's COBE Satellite measured small fluctuations in the uniformity of the background radiation. The Standard Model attributes these to conditions present right after the Big Bang.

245 Ibid, p. 276.

246 Ibid, p. 151. This is the Stefan–Boltzmann law, $j^* = \sigma T^4$.

Secondly, the point is to bring to light how often and the ease with which both experts and non-experts can ignore or seek to subvert legitimate science with which they do not agree, or whose truth, if proven, would be inconvenient to their status quo. As of this writing in 2020, the European Union is planning to spend €21 billion to build a new 100 km long supercollider to probe deeper into subatomic particles and at much higher energies. If the Williamson-van der Mark and Robinson models are correct, there is no need for this enormous sum of money to be spent in this way. This would prove most inconvenient for a lot of people, and they are scarcely likely to be objective on the question.

IN SUMMARY

Legitimate science, especially when performed with rigor and without obvious error, should be accorded a hearing in order to defend its truth through community challenge and validation. Without this, science ceases to be science.

It is not our claim that all aspects of the work of Drs Williamson, Van der Mark, and Robinson are true and correct in their present form. What is very much our intention is to underscore that openness to serious scientific dialogue and investigation enables science and progress. Shutting down dialogue stifles thought and scientific progress. Penrose echoes this sentiment and acknowledges the sad truth of our bias when he writes:

"It is right and proper that minority activities should not suffer merely by virtue of the fact that they are in the minority. Mathematical coherence and agreement with observation are far more important. But can we ignore the whims of fashion all together? Certainly we cannot[247]."

[247] Roger Penrose, *The Road To Reality: A Complete Guide To The Laws Of The Universe*, Vintage Books (2004), p. 1018.