

# **First Science**



**First Science:  
The Missing Science,  
The Theory of Everything,  
and the Arrow of Time**



Universal Publishers  
Boca Raton, Florida

*First Science : The Missing Science, The Theory of Everything, and the Arrow of Time*

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Front cover (from left to right):

Sir Francis Bacon, Sir Isaac Newton, and Albert Einstein

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*To Cameron and Sarah*



# Contents

	Contents	vii
	Preface	ix
<b>Part I</b>	<b>The Missing Science</b>	<b>1</b>
ONE	A Brief History	3
TWO	Limitations of Mathematical Physics	9
THREE	Introducing First Science	23
<b>Part II</b>	<b>Foundations of First Science</b>	<b>29</b>
FOUR	Unifying Principle	31
FIVE	The Unknowable	37
SIX	Theory of Everything	47
SEVEN	Arrow of Time	59
<b>Part III</b>	<b>General Implications</b>	<b>73</b>
EIGHT	Symmetries	75
NINE	Constants of Nature	89
TEN	Special Theory of Relativity	97
ELEVEN	General Theory of Relativity	105
TWELVE	Quantum Mechanics	115
THIRTEEN	Quantum Interpretation	123

**FIRST SCIENCE**

FOUTEEN	Standard Model	149
FIFTEEN	Unification of Physics	191
SIXTEEN	Evolution of Complexity	207
EPILOGUE	A Unified Worldview	229
APPENDIX A	Fundamental Constants of Nature	231
APPENDIX B	Secondary Constants of Nature	233
	Further Reading	235
	Notes and References	237
	Bibliography	253
	Index	267

# Preface

First Science is the most general of sciences. It underlies all the sciences. Whilst some may claim that mathematical physics holds this position, this is not so. Here we show that mathematical physics cannot, in principle, explain the Arrow of Time (i.e. that time has a direction). As a result, the sciences built around the Arrow of Time, such as biology, sociology and economics, cannot be reduced to mathematical physics. As such, a complete unified theory of nature, which includes the Arrow of Time, cannot be constructed within the framework of mathematical physics.

Instead, if there is to be a complete unified theory, it must be based on a deeper science that unifies mathematical physics and the more complex sciences. This deeper, missing science is First Science. First Science is an empirical, logical, universal science. It provides the framework for mathematical physics (and physics, in general). It explains the natural world.

In this book, we introduce and name the new field of First Science. We explain what it is and why it is needed. We postulate the foundations of the field. In short, this book is a manifesto for First Science.

Spencer Scoular  
December 2007



**PART**



# **The Missing Science**

ONE	A Brief History	3
TWO	Limitations of Mathematical Physics	9
THREE	Introducing First Science	23



# CHAPTER 1

## A Brief History

### Introduction

There have been a number of deep thinkers who have had the foresight, in one form or another, to envisage or hint at the missing science – a science more general than mathematical physics (and physics, in general). Whereas mathematical physics assumes all of nature can be represented mathematically, the missing science does not. The history of the missing science begins four hundred years ago, at the turn of the seventeenth century, with the advent of modern science.

### Bacon

One of the great contributors to the establishment of modern science was the English philosopher Sir Francis Bacon (1561-1626). In 1605 he recommended that the knowledge common to all science should be incorporated into a fundamental doctrine that was to be “a receptacle for all such profitable observations and axioms as fall not within the compass of any of the special parts of philosophy or sciences, but are more common and of a higher stage.”<sup>1</sup> In his day he called this fundamental doctrine First Philosophy, an appropriate term when science was known as Natural Philosophy. The equivalent modern term is First Science, a term we use throughout this book.<sup>2</sup> Bacon described First Science as the trunk of the tree of knowledge:

But because the distributions and partitions of knowledge are not like several lines that meet in one angle, and so touch but in a point; but are like branches of a tree, that meet in a stem, which hath a dimension and quantity of entireness and continuance, before it come to discontinue and break itself into arms and boughs: therefore it is good, before we enter into the former distribution, to erect and constitute one universal science,

## FIRST SCIENCE

by the name of *philosophia prima* [First Science]... as the main and common way, before we come where the ways part and divide themselves...<sup>3</sup>

He believed the introduction of First Science would lead to a deeper understanding of nature:

Another error...is that after the distribution of particular arts and sciences, men have abandoned universality, or *philosophia prima* [First Science]; which cannot but cease and stop all progression. For no perfect discovery can be made upon a flat or a level: neither is it possible to discover the more remote and deeper parts of any science, if you stand but upon the level of the same science, and ascend not to a higher science.<sup>4</sup>

Bacon's vision anticipated a unity of science and knowledge corresponding to the unity of nature. That is, we perceive nature to be an integrated whole. But if nature is an integrated whole, then our knowledge should also be an integrated whole. Therefore, there should be a science that integrates all the other sciences.

## Newton

Sir Isaac Newton (1643-1727) is one of the founders of mathematical physics. Interestingly, he did not dogmatically believe that all of science was encompassed within mathematical physics. Irish mathematician John Sullivan (1886-1937) explains:

It is not possible to say that Newton held these opinions dogmatically, since he himself said that science, in the mathematical form it had assumed, was an adventure, which might have to be replaced by a truer method. But for practical working purposes he certainly made these assumptions, and his immense success caused these assumptions to be unquestioningly accepted by the whole scientific world.<sup>5</sup>

Contrary to popular beliefs, Newton was interested in understanding all of Nature – not just its mechanistic, mathematical component. His goal was knowledge of God, through the universal understanding of nature.<sup>6</sup> In many of his earlier years, he sought to understand the self-organization of nature by searching (via alchemy) for a universal, animating, vegetative principle.<sup>7</sup> In the second of his two great works, *Opticks*, first published in 1704, he commented on the unknown *active* principles organizing Nature:

...if it were not for these Principles, the Earth, Planets, Comets, Sun, and all things in them, would grow cold and freeze, and become inactive Masses; and all Putrefaction, Generation, Vegetation and Life would cease...<sup>8</sup>

He continues:

These Principles I consider...as general Laws of Nature, by which the Things themselves are form'd; their Truth appearing to us by Phænomena, though their Causes be not yet discover'd.<sup>9</sup>

After Newton, the mechanistic, mathematical conception of nature overshadowed its self-organizing element. However, unlike many of his followers, Newton recognized that there might one day be a science reaching beyond the realm of mathematical physics.

## Husserl

In 1911, German philosopher Edmund Husserl (1859-1938) published an essay called “Philosophy as Rigorous Science,”<sup>10</sup> in which he discussed the historical importance of establishing philosophy as a rigorous science:

From its earliest beginnings philosophy has claimed to be rigorous science. What is more, it has claimed to be the science that satisfies the loftiest theoretical needs and renders possible from an ethico-religious point of view a life regulated by pure rational norms. This claim has been pressed with sometimes more, sometimes less energy, but it has never been completely abandoned, not even during those times when interest in and capacity for pure theory were in danger of atrophying, or when religious forces restricted freedom of theoretical investigation.<sup>11</sup>

He observed, however, that historical philosophy has not achieved this goal. As a result, historical philosophy is unscientific and has no absolute knowledge to teach. Husserl believed that historical philosophy is pre-scientific in the same way that alchemy and astrology were pre-scientific. He argued that historical philosophy precedes an as yet undiscovered “philosophy as rigorous science” (or First Science).

## Deborin

Soviet philosopher Abram Deborin (1881-1963) proclaimed in 1930 the need for an alliance between philosophy and empirical science: one that (i) avoids the traditional non-factual metaphysical approach and (ii) eliminates the inadequate conception of empirical science without philosophy. To fill the gap, he suggested a general science of dialectics.<sup>12</sup>

## FIRST SCIENCE

### Maritain

French philosopher Jacques Maritain (1882-1973) noted in 1951 that whilst the Ancient Greeks made the mistake of absorbing science into the philosophy of nature, contemporary science made the mistake of neglecting the philosophy of nature by absorbing it into natural science. This resulted in physical-mathematical knowledge being mistaken for *the* philosophy of nature (which naturally lead to a mechanistic worldview<sup>13</sup>) and, thereafter, the philosophy of nature being excluded altogether.<sup>14</sup> He argued that the philosophy of nature needed to be reinstated: the philosophy of nature was different from science on the one hand and metaphysics<sup>15</sup> on the other. It provides the link between the world of each particular science and the world of metaphysical wisdom. Further, he noted, the philosophy of nature is at the heart of the hierarchical and dynamic organization of knowledge on which intellectual unity depends.<sup>16</sup> That is, the philosophy of nature, in fact First Science, explains how each particular science fits together with each other and with metaphysics.

### Einstein

In the early 1950's, Albert Einstein (1879-1955) worried about the Arrow of Time. According to philosopher Rudolph Carnap (1891-1970), Einstein believed there was something fundamental about the Arrow of Time that was just outside the realm of mathematical physics.<sup>17</sup> Going one step further, this provides a hint that the Arrow of Time might be explained by a science beyond the reach of mathematical physics.

### Feynman

Nobel laureate physicist Richard Feynman (1918-1988) recognized a possible world beyond mathematical physics. In 1964, at the end of a series of lectures, he noted:

The next great era of awakening of human intellect may well produce a method of understanding the *qualitative* content of equations.<sup>18</sup>

An explanation of the qualitative content of equations hints at a science beyond the reach of (quantitative) mathematical physics.

## Gödel

The logician Kurt Gödel (1906-1978) was a private advocate of First Science. In 1974, he wrote:

Philosophy as an exact theory [First Science] should do to metaphysics as much as Newton did to physics...[I]t is perfectly possible that the development of such a...theory will take place within the next hundred years or even shorter.<sup>19</sup>

Mathematical philosopher Hao Wang (1921-1995), who discussed First Science with Kurt Gödel, notes:

If ...[Kurt Gödel's] project is feasible, then it would seem to be a sort of science that is even more exciting than fruitful work in fundamental science, although it is presumably also more difficult.<sup>20</sup>

Given Gödel was the greatest logician of the twentieth century; his views in favor of First Science require careful consideration.

## Summary

Although at the outset of modern science Sir Francis Bacon outlined a manifesto for First Science, the success of mathematical physics led to modern science being initially seen as purely a mathematical discipline. Modern science has expanded its definitions to include the complex sciences, such as biology, sociology and economics, which, since they include the Arrow of Time, are not purely mathematical disciplines. However, modern science has not recognized that there is a missing science, First Science, which is a general discipline that unifies physics and all the sciences.



# CHAPTER 2

## Limitations of Mathematical Physics

### Introduction

To appreciate the need for First Science, we first need to understand why mathematical physics is unable to capture the Arrow of Time. This requires us to understand the inherent limitations of the philosophical assumptions underlying mathematical physics.

### Historical Background

Mathematical physics took off with the work of Sir Isaac Newton. He combined the mathematical approach of Johannes Kepler (1571-1630) and Galileo Galilei (1564-1642) with the empirical approach of Sir Francis Bacon, William Gilbert (1540-1603), William Harvey (1578-1657) and Robert Boyle (1627-1691) to create the Newtonian method of mathematical synthesis. The method consisted of three steps:

- Observe (usually by experiment) a simple group of phenomena and determine their quantitative relations;
- Deduce the mathematical consequences of these relations;
- Inductively assume these mathematical consequences apply to all like phenomena.

This method proved highly successful for Newton. He used the method to mathematically unify disparate phenomena. For example, Newton's (mathematical) law of gravitation showed that gravity was a universal force: it not only

## FIRST SCIENCE

acted terrestrially on earth, but also celestially. With his law of gravitation and laws of motion, he was able to predict how the planets and stars moved.

Theoretical physicist James Clerk Maxwell (1831-1879) undertook the next great mathematical synthesis in the late 19<sup>th</sup> century. Sir Michael Faraday (1791-1867) had experimentally shown that electricity and magnetism were related forces. Maxwell had sought to represent Faraday's fields mathematically. This he achieved in Maxwell's equations, whose solutions are electromagnetic waves. From the equations he was able to show that the speed that the electromagnetic waves travel through space is equal to the ratio of the electric and magnetic field strengths at any point in space. Using Ampère's law, he showed that this speed was equal to the square root of the ratio of the electric and magnetic force constants. Surprisingly, when he substituted the values of these constants into the formula, he found the speed of the electromagnetic waves is approximately 300,000 km/second, or the speed of light.<sup>1</sup> From this result, Maxwell was able to deduce *mathematically* that electromagnetism, light, x-rays, radio waves, microwaves and other radiation are interconnected.<sup>2</sup>

Albert Einstein led the next great mathematical syntheses. Based on the Galilean principle of relativity and the constant speed of light, he *mathematically* deduced interconnections between space and time, and between energy and mass. Furthermore, in his general theory of relativity, he introduced the equivalence principle to *mathematically* deduce interconnections between gravity and the geometry of spacetime.

The next revolution was quantum mechanics, which relied on *mathematics* for its formalism. By combining quantum mechanics with the special theory of relativity, particle data was synthesized leading to many mathematical predictions that have been confirmed experimentally. For example, Nobel laureate Paul Dirac (1902-1984) *mathematically* predicted the anti-electron (or positron) in 1930 – which was then discovered by Nobel laureate Carl Anderson (1905-1991) in 1932. Many other particles have been predicted and confirmed including, more recently, a number of the quarks and the vector bosons  $W^{\pm}$  and  $Z^0$ . The power of mathematics to synthesize and unify disparate phenomena has led to it being the leading tool for unification.

## Mathematical Philosophy of Nature

Not only has mathematics proved an important tool for unification, it has led to a belief in a mathematical philosophy of nature (also called the Galileo-Newton philosophy). Such a philosophy believes that, of all the elements of total experience, only those that can be represented mathematically are

real. The philosophy began with Johannes Kepler and Galileo Galilei who both believed that nature was inherently mathematical. Kepler believed that those qualities of phenomena that could not be represented mathematically were less real whilst Galileo believed such qualities were subjective; they existed only in the mind.

Traditionally, mathematics was a tool to model the physical understanding between entities. However, with the major mathematical syntheses arose a new phenomenon: there were no physical entities underlying the mathematics; the mathematics was the deepest knowledge we had. For example, Sir Isaac Newton introduced Newton's law of gravitation, but did not provide a physical mechanism to explain how gravity works. Similarly, it was assumed in the late 19<sup>th</sup> century that there was a medium, called the *aether*, through which Maxwell's electromagnetic waves moved. However, Albert Einstein showed that the aether was "superfluous." Instead, the mathematical equations described the electromagnetic waves without physically explaining the mechanism by which they moved. Albert Einstein showed that space and time, and energy and mass were mathematically related, without physically explaining the mechanism by which they were related. Equally, he showed in his general theory of relativity that gravity is the result of stress, mass-energy and momentum bending spacetime, but he did not physically explain the mechanism by which this occurs. Similarly, he showed that the movement of mass-energy is affected by the shape of spacetime, but did not physically explain the mechanism by which this occurs either. That is, the theory of general relativity gives our deepest explanation of gravity, but does not provide the physical understanding of what is going on "under the hood." Similar issues arise with quantum mechanics, which is a mathematical formalism that does not have behind it an explanation of the physical mechanism. As Irish mathematician John Sullivan wrote in 1933:

It is only now, in retrospect, that we can see how very significant a step this was. An entity had been admitted into physics [Maxwell's equations] of which we knew nothing but its mathematical structure. Since then other entities have been admitted on the same terms, and it is found that they play precisely the same role in the formation of scientific theories as do the old entities. It has become evident that, so far as the science of physics is concerned, we do not require to know the nature of the entities we discuss, but only their mathematical structure. And, in truth, that is all we do know. It is now realized that this is all the scientific knowledge we have even of the familiar Newtonian entities. Our persuasion that we knew them in some exceptionally intimate manner is an illusion. So far as the science of physics is concerned, the old entities and the new are on the same footing – the only aspects of them with which we are concerned are their mathematical aspects.<sup>3</sup>

## FIRST SCIENCE

He continued:

With this realization it is no long step to Eddington's position that a knowledge of mathematical structure is the only knowledge that the science of physics can give us. Of all the philosophical speculations [that] have been hung on the new physics, this seems to be the most illuminating and the best-founded. It seems to be true that 'exact' science is a knowledge of what Eddington calls 'pointer-readings' – the readings on an instrument of some kind. We assume, of course, that these readings refer to various qualities of the external world, but all we actually know about these qualities, for the purposes of exact science, is the way they affect our measuring instruments.<sup>4</sup>

Now, if our deepest current understanding of nature is purely mathematical, then it is a small step to conclude that nature is purely mathematical. That is, it is a small step to believe in a mathematical philosophy of nature. This small step was taken in the middle of last century. For example, quantum physicist David Bohm (1917-1992) said:

But this notion that the mathematical formalism expresses the essence of our knowledge about nature did not really become commonly accepted until relatively recent times. For example, when I was a student [in the late 1930s], most physicists felt that a physical or intuitive concept was the essential point and that the mathematical formalism had to be understood in relation to this.<sup>5</sup>

When asked why the mathematical philosophy of nature came to dominate physics, David Bohm replied:

It was really because the quantum theory, and to a lesser extent relativity, were never understood adequately in terms of physical concepts that physics gradually slipped into the practice of talking mostly about the equations. Of course, this was because equations were the one part of the theory that everyone felt they could really understand. But this inevitably developed into the notion that the equations themselves are the essential content of physics.<sup>6</sup>

Albert Einstein did not favor the mathematical philosophy of nature. According to his friend Maurice Solovine (1875-1958):

Einstein...spoke out against the abuses of mathematics in the hands of physicists. "Physics," he would say, "is basically a concrete, intuitive science. Mathematics is only a means to express the laws that govern phenomena."<sup>7</sup>

Once we make this small step, then we come full circle: if we believe in a mathematical philosophy of nature, then the way to unification and ultimate understanding is purely through mathematical synthesis. However, before

making this small step, it is wise to recognize the inherent limitations of the assumptions underlying a mathematical philosophy of nature.

## Limitations of a Mathematical Philosophy of Nature

The adoption of a mathematical philosophy of nature has produced great success for mathematical physics. However, a mathematical philosophy of nature suffers from four primary limitations:

1. It makes quantity the basis of the universe;
2. It cannot explain all phenomena;
3. It analyses the world in parts, not as a whole; and
4. It uses mathematical time, not real time.

Let us consider these limitations in turn.

### Limitation 1: Makes quantity the basis of the universe

A mathematical philosophy of nature (i.e. the Galileo-Newton philosophy) makes quantity the basis of the universe. But, as philosopher Wildon Carr (1857-1931) wrote:

The existence of quality implies quantity; but quality is the condition of the existence of quantity, and not vice versa.<sup>8</sup>

Newton scholar Alexander Koyré (1892-1964) explained the difficulty:

Yet there is something for which Newton – or better to say not Newton alone, but modern science in general – can still be made responsible: it is the splitting of our world in two...[I]t did this by substituting for our world of quality and sense perception, the world in which we live, and love, and die, another world – the world of quantity, of reified geometry, a world in which, though there is a place for everything, there is no place for man. Thus the world of science – the real world – became estranged and utterly divorced from the world of life, which science has been unable to explain – not even to explain away by calling it “subjective.” True, these worlds are every day – and even more and more – connected by the *praxis*. Yet for *theory* they are divided by an abyss. Two worlds: this means two truths. Or no truth at all. This is the tragedy of modern mind [that] “solved the riddle of the universe,” but only to replace it by another riddle: the riddle of itself.<sup>9</sup>

If we understand the quantitative world then we only understand a small subset of the larger qualitative world.<sup>10</sup> To assume, therefore, that mathematics gives us a complete unified understanding of the world misses the deeper non-mathematical elements of nature.

## FIRST SCIENCE

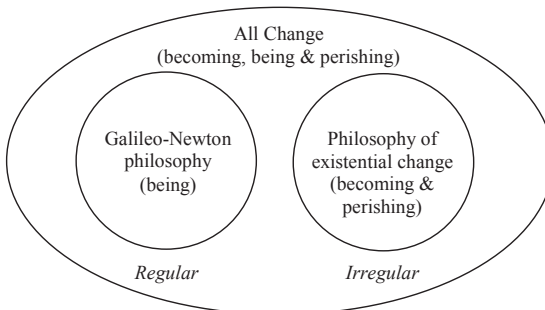
### Limitation 2: Cannot explain all phenomena

Kepler and Galileo quite deliberately chose only to consider those phenomena that can be understood mathematically. This, however, leaves many phenomena that cannot be explained.

The Galileo-Newton philosophy is designed to discover regularities in nature. Any happenings in nature that are not regularities are not explained. Along these lines, in 1877, logician and economist William Jevons (1835-1882) noted that the mathematical sciences are incomplete, since they only represent an infinitely small part of nature (i.e. there is infinitely more potential diversity in nature than regularity).<sup>11</sup> Similarly, in 1907, Nobel laureate Henri Bergson noted that modern science, although studying an original whole, always analyses the parts that show repeatability: “Anything that is irreducible and irreversible in the successive moments of a history eludes science.”<sup>12</sup> To understand why this is the case, consider the three types of change in nature identified by Greek philosopher Aristotle (384-322 BC):

- Non-being to being, called becoming (for example, birth);
- Being to being, called being (for example, changes between *existing* objects or within an *existing* system);
- Being to non-being, called perishing (for example, death).

Since the Galileo-Newton philosophy focuses on regularities, it is blind to two of the three types of change in nature. In particular, whilst being may be represented mathematically, both becoming and perishing are irregular and, therefore, not mathematical. As a result, only being may be fully explained by the Galileo-Newton philosophy. The Galileo-Newton philosophy underlies the mathematical theories of general relativity and quantum mechanics whereas the residual philosophy, here called the *philosophy of existential change*, is associated with the non-mathematical theories of biological evolution and social change.



The two philosophies, which *together* represent the whole, have contrasting descriptors:

<i>Galileo-Newton philosophy</i>	<i>Philosophy of existential change</i>
Mathematical	Non-mathematical
Simple	Complex
Reversible	Irreversible
Regular	Irregular
Reducible	Irreducible
Homogeneous	Inhomogeneous
Symmetric	Asymmetric
Isotropic	Anisotropic
Atemporal	Temporal
Ahistorical	Historical
Acausal	Causal
Acontingent	Contingent

In addition, the two philosophies have other unique descriptors:

<i>Galileo-Newton philosophy</i>	<i>Philosophy of existential change</i>
Predictable	Evolving
Mechanistic	Emergent
Reproducible	Information generating
Lawful	Self-organizing/hierarchical
Invariant	Language/symbols
Constant	Structure/fluctuations

Existential change (i.e. becoming and perishing) is associated with changes of form. It is what makes our world different to the reversible, mechanistic Galileo-Newton world: existential change, for example, underlies life, consciousness, social organization and the arts. Interestingly, the two philosophies are analogous with the quite different cultures of natural science and the humanities, as famously expressed in 1959 by Lord Snow (1905-1980).<sup>13</sup>

British philosopher Herbert Spencer (1820-1903) identified the problem with the Galileo-Newton philosophy:

An entire history of anything must include its appearance out of the imperceptible and its disappearance into the imperceptible. Any account of an object [that] begins with it in a concrete form, or leaves off with it in a concrete form, is incomplete; since there remains an era of its existence undescribed and unexplained.<sup>14</sup>