Why has physics failed to completely explain the universe: a philosophical approach to a final theory

by

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DECLARATION

I declare that:

"Why has physics failed to completely explain the universe: a philosophical approach to a final theory"

is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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John Frederick Thompson
26th January 2023

Abstract: English

WHY HAS PHYSICS FAILED TO COMPLETELY EXPLAIN THE UNIVERSE: A PHILOSOPHICAL APPROACH TO A FINAL THEORY

This thesis investigates why there is still no ‘final’ physical theory of the universe despite the enormous resources involved. Current physical and philosophical methodologies are examined leading to a new strategy. The history of knowledge from mythology to the present day is traced to establish the general nature and psychology of human sapience and group dynamics. This reflects strongly on human common sense, education and entrenchment caused by peer pressure of mathematical and physical ideas. Arguments consider physical and philosophical standpoints of empirical versus rational and mathematical versus non-mathematical deduction. The former is decided by introducing a special foundational philosophy; the latter by arguing the universe has no need of mathematics in any form to exist. Criticizing current ideas is useless unless they can be replaced by a better theory. As a paradigm must be better than that which it replaces, it must stand up to testing against observation. Using the concept of time with a clear definition, possibly the first such definition, shows how a universe must causally develop. The human concept of space, together with a reason for its 3-dimensionality, automatically arises to answer, ‘if a universe is to be created, into what is it placed?’ The conundrum of existence is also explained. The reason for contemporary physics’ failure is its reliance on observation, which is governed by unreliable human perception, in particular its lack of definitions for time, length, mass, electric charge, energy, work, wave function from which its ‘laws’ are deduced. Doubt is raised on physics’ main theories, quantum mechanics and relativistic field theories which deny a fundamental cause for the universe. Mathematics suffers from overconfidence in its efficacy and accuracy. There also exist processes that the foundational theory shows are completely hidden from current physical and astrophysical experiments. The conclusion to be drawn is that mathematical physics cannot produce a final theory whereas non-mathematical reasoning can. Foundational philosophy then becomes the means of attaining a final theory with physics the method of determining philosophy’s accuracy. As no such pointer has been considered in the literature it has to be a testable primary assumption. Lines for further research to produce a complete theory of the universe are given.

Keywords: Theory of Everything, Cosmology, Quantum theory, Causality, Ontology, Epistemology, Mathematical Platonism, Mathematical obscurity, Mensuration, Empiricism, Definition, Group/peer pressure, Entrenchment, Common sense.

Opsomming: Afrikaans

HOEKOM HET FISIKA NIE DIE HEELAL VERKLAAR NIE: AFILOSOFIESE BENADERING TOT 'N FINALE TEORIE

Hierdie tesis ondersoek hoekom daar steeds geen 'finale' fisiese teorie van die heelal is ten spyte van die enorme hulpbronne wat betrokke is. Huidige fisiese en filosofiese metodologieë word ondersoek wat lei tot 'n nuwe strategie. Die geskiedenis van kennis vanaf mitologie tot vandag word nagespeur om die algemene aard en sielkunde van menslike weelde en groepdinamika vas te stel. Dit reflekteer sterk op menslike gesonde verstand, opvoeding en verskansing wat veroorsaak word deur groepsdruk van wiskundige en fisiese idees. Argumente oorweeg fisiese en filosofiese standpunte van empiriese teenoor rasionele en wiskundige versus nie-wiskundige afleiding. Eersgenoemde word besluit deur 'n spesiale grondliggende filosofie in te voer; laasgenoemde deur te redeneer die heelal het geen behoefte aan wiskunde in enige vorm om te bestaan nie. Om huidige idees te kritiseer is nutteloos, tensy dit deur 'n beter teorie vervang kan word. Aangesien 'n paradigma beter moet wees as dit wat dit vervang, moet dit standhou tot toetsing teen waarneming. Die gebruik van die konsep van tyd met 'n duidelike definisie, moontlik die eerste so 'n definisie, wys hoe 'n heelal oorsaaklik moet ontwikkel. Die menslike konsep van ruimte, tesame met 'n rede vir sy 3-dimensionaliteit, ontstaan outomaties om te antwoord 'as 'n heelal geskep moet word, waarin word dit geplaas?' Die raaisel van bestaan word ook verduidelik. Die rede vir kontemporêre fisika se mislukking is sy vertroue op waarneming wat beheer word deur onbetroubare menslike persepsie, veral sy gebrek aan definisies vir tyd, lengte, massa, elektriese lading, energie, werk, golffunksie waaruit sy 'wette' afgelei word. Twyfel word geopper oor fisika se hoofteorieë, kwantummeganika en relativistiese veldteorieë wat 'n fundamentele oorsaak vir die heelal ontken. Wiskunde ly aan oorvertroue in die doeltreffendheid en akkuraatheid daarvan. Daar bestaan ook prosesse wat die grondliggende teorie toon heeltemal verborge is van huidige fisiese en astrofisiese eksperimente. Die gevolgtrekking wat gemaak moet word, is dat wiskundige fisika nie 'n finale teorie kan produseer nie, terwyl nie-wiskundige redenering wel kan. Fundamentele filosofie word dan die middel om 'n finale teorie te bereik met fisika die metode om filosofie se akkuraatheid te bepaal. Lyne vir verdere navorsing om 'n volledige teorie van die heelal te produseer, word gegee.

Isicatshulwa: isiXhosa

KUTHENI I-FIZIKSI ISILELE UKUCACISA INDALO YONKE:INDLELA YOPHANDO-LWAZI NGOBUNJANI NENTSINGISELO YOBUKHO BEZINTO UKUSA KWITHIYORI YOKUGQIBELA

Le thisisi iphanda ukuba kutheni kungekabikho ithiyori yendalo iphela nangona zizininzi izixhobo ezisetyenziswayo. Iindlela zangoku zokwemvelo nezefilosofi ziyavavanywa ukuze kufikelelwe kwisicwangciso-qhinga esitsha.

Imbali yolwazi ukusuka kwizifundo ngeentsomi ukuza kuthi ga ngoku iyalandelwa ukuze kusekwe imeko yendalo ngokubanzi nemeko yobulumko bengqondo bomntu kunye nenkqubo yokuziphatha kunye neenkqubo zengqondo ezenzeka ngaphakathi kweqela. Oku kubonakalisa ngamandla/ngokukuko kwindlela yokucinga komntu, imfundo kunye nokuzinza okubangelwa luxinzelelo loontanga kwiingcamango zemathematika kunye nezendalo.

Iingxoxo zithathela ingqalelo iimbono zendalo nezefilosofi zamava achasene nengqiqo kunye nemethamatika ngokuchasene nokunciphisa ekungeyoyamethametika. Eyokuqala igqiba ngokwazisa ifilosofi eyodwa esisiseko; ze engeyokugqibela igqibe ngokuxoxa ukuba indalo iphela ayifuni imathematika nangaluphi na uhlobo ukuze ibekho.Ukugxeka iingcamango zangoku akuncedi nto ngaphandle kokuba zinokuthatyathelw' indawo yithiyori engcono kunazo.Njengoko iphatheni/ imodeli(paradigm) kufuneka ibengcono kunaleyo inqwenela ukuba ithathe indawo yayo, kufuneka ikumele ukuvavanywa ngokwemigqaliselo ngokokuqwalasela. Inkcazo ecacileyo yengcamango yexesha, ekunokwenzeka yingcaciso yokuqala enjalo, ibonisa indlela indalo ekhula ngayo ngokuzenzekelayo. Ingcamango yomntu yesithuba/ indawo ejikeleze ihlabathi, kunye nesizathu sobukhulu bayo ngokobuthathu, iwuphendula ngokuzenzekelayo umbuzo othi ‘ukuba indalo iphela iza kuyilwa, ibekwe kwintoni?’ Uqashi qashi wobukho ucacisiwe. Isizathu sokungaphumeleli kwefiziksi yanamhlanje ukuchaza indalo kukuxhomekeka kwayo ekuqwalaseleni, okulawulwa yimbono yabantu engathembekanga kwaye, ngokukodwa, ukusilela kwayo kwiinkcazo zexesha, ubude, ubunzima, ubungakanani bombane, amandla, umsebenzi, kunye nomsebenzi wamaza apho 'imithetho' isekelwe/ ithathwa khona. Amathandabuzo abekwa kwiithiyori eziphambili zefiziksi, ubungakanani bobuxhakaxhaka obufunekayo kunye neethiyori eziphikisa ukuba kukho unobangela osisiseko wendalo iphela. IMathematika inengxaki yokuzithemba ngokugqithisileyo kumandla ayo okusebenza nangokuchaneka kwayo. Ithiyori yesiseko ibonisa ukuba iinkqubo ezithile zangoku zifihlwe ngokupheleleyo kwimifuniselo ngokobunzululwazi bezemvelo nokwakheka kweenkwenkwezi.

Isigqibo sesokuba ifiziksi (ubunzululwazi ngezinto zemvelo ezingaphiliyo) yemathematika ayinakwakha /ayinakuyila ithiyori egqibeleleyyo ngelixa ukuqiqa okungengokwemathematika

kunokukwenza oko. Ifilosofi esisiseko ngoko iba yindlela yokuseka ithiyori yokugqibela ze ifiziksi ibe yindlela yokumisela ukuchaneka kwefilosofi. Ekugqibeleni, kucetyiswa imikrwelo/izihloko zophando zokuqhubela phambili uphando ngenjongo yokuvelisa ingcamango/ ithiyori epheleleyo ngendalo iphela .

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CONTENTS

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Glossary

γ_Δ	photon that carries off excess energy, particularly in the visible spectrum
γ_ξ	photon responsible for forced interactions especially for 'electric force'
$\dot{\theta}^+$	The rotation of the relativistic universe
$\dot{\theta}^-$	The fundamental rotation of the natural universe
Φ	The starting point of the universe
$\dot{\varphi}$	Replaces $\dot{\theta}^+$ in the macro-universe description
$\dot{\psi}$	A spin required to keep the two representations of the universe in balance
c	Speed of light
c^*	Rate of creation of space-Time
f	frequency instead of v (nu) to distinguish it from velocity v.
CMB, CMBR	Cosmic microwave background (radiation)
EPR	Einstein, Podolski, Rosen paper on completeness of quantum mechanics
Flip	The change in orientation of a neutron to proton
Free axis	A development direction that leads directly to space-Time lattice points
GR	Einstein's theory of general relativity
LQG	Loop quantum gravity
N	The set of all natural numbers
N′	The set of Time numbers contained in the natural numbers
Natural universe	The universe outside of space-Time – the point universe
P-rotation	A name used to distinguish a fundamental form of rotation which, by being fundamental, cannot be described in more fundamental terms. It leads directly to an exact definition for rotation.
QFT	Quantum field theory
QHM, QHO	Quantum Harmonic motion/oscillation
QM	Quantum mechanics
qul	quantum unit of length; 1 qul = 1.77041×10^{-15} m
qut	quantum unit of time; qut as 4.175785×10^{-24} s
Relativistic universe	The universe consisting of space-Time intervals
SHM, SHO	Simple harmonic motion /oscillation
$\hat{T}$	Time creating operation – rotation operator.
T_A	Age of the universe
Triad	A set of three orthogonal axes
Triple-triad	A group of three triads formed into a rotating space-Time volume (particle)

Trace-point	A point created in the space-Time lattice
w	The maximum possible rotation of, or in, the universe

The following mathematical terminology is used.

$2^{1/2}$ = square root of 2. $2^{-1/2}$ = 1/square root of 2. 10^{24} = 1 followed by 24 zeros = 1 million million million million; 10^{-9} = 1/1000 000 000; 10^{-9} m = 1 nanometre or nm; ms^{-1} = metre per second in SI units, m^2 = square metre etc; dimensional terms T= time, M = mass, L = length, T^{-1} = per time unit.

Speed is given in lower script, velocity, speed with direction, in bold. Time (capital T) is a vector quantity so never considered as a scalar.

Preamble

67 years ago, I was taught “We know that everything is made of protons, neutrons and electrons, but we do not know what those are made of”. That set me on a course of thought: If I was God what single thing could I say that would lead to a universe? After a few suggestions to my physics master, I was told to stop reading advanced books (I had none) and concentrate on my schoolwork. A couple of years later I heard of Einstein and Quantum mechanics and thought that my ideas had already been discovered so buried the matter, although I was still interested in certain problems like, how big could the universe be or become? 35 years later when my daughter was at university, a chance remark led her to suggest I should develop my original ideas further. I did so taking into account relativistic field theory. There, I discovered the Higgs problem noting that his equations had no mass term which had led him to deduce that certain expressions they contained counted for the mass term as a separate particle. However, a different idea occurred to me. Could it be that the imposition of a relativistic expression in field theory was so strong that it removed terms such as mass and electric charge; that is, could relativity be showing that really, instead of four fundamental entities (space, time, mass and charge) only two were actually necessary for a natural, or a theistic, cause to create a universe? Then immediately a further step suggested itself: If this was the case, why stop at two dimensions, space, and time? Could it not be that only one of these (space or time) might provide a basic cause for the universe?

CHAPTER 1
Introduction

1.1 Background

The theory of how the universe functions, and why it exists, has been developing over thousands of years from purely mythological concepts, through general philosophy, gradually fostering more practical ideas, and eventually rigorous physical theories based on observation. Leaving aside mythology, Aristotle's ([350 BCE] 1923) original philosophy aimed at discovering the first causes of existence, and the universal structure, but these were purely deductive philosophy rather than based on experiment. Consequently, the introduction of experiment, or testing of theory, by Bacon (1605) and Galileo (1632) towards the end of the Renaissance period, showed up falsities in the earlier interpretations of the world. The result was a rise of experiment and change from Aristotelian metaphysics to scientific reasoning based on observation, while imposing suspicion on common sense and reducing the role of reasoning (Feyerabend 1993:291; Sankey 2010; Yu & Cole 2014:679). Nevertheless, the structure and existence of the universe has become a subject that is no longer limited to scholars but is now of great interest to the public at large, as suggested by the number of television programs screened.

However, despite the huge resources thrown at it, no complete, or 'final' theory of the structure and processes of the universe has been uncovered. If these are known they should surely lead to a much improved set of living conditions for not only humans but for all of Earth itself. Consequently, it seems essential to delve deeply into the concepts and methods of physics to find, firstly, a pointer on why physics has so far failed in its quest for a theory of everything, and secondly, to obtain pointers on why we may need another completely new approach and exactly what this should be.

This thesis is concerned with those arguments pertaining to, or directed at, establishing a final, or complete, theory of the structure of the universe. That is, a final theory should be a complete description of the fundamental structure and processes giving rise to any universe. Preliminary research determined, after considering contemporary physical ideas, that such a theory must be heavily reliant on philosophical concepts. Consequently, an aim will be to use these arguments to point the way to a theory that relies only on pure philosophical reasoning, by which I mean sapient thought based on the principle 'if A then B must follow'; which suggests an initial single principle for an original starting point.

The background for this chapter is thus divided into three main areas of review: physics, mathematics, and the role of philosophy. For this review physics is taken as specifically the human interpretation of the concepts of 'matter' and 'energy', their form, properties, and interactions with regard to our observed surroundings[1]. Mathematics is taken as "The study of numbers, measurements and space; a science dealing with the measurement, properties and relationship of quantities …"[2,3] Philosophy: " … the study of the principles of all real knowledge, study of the most general causes and principles of the universe: …"[2].

1.1.1 Physical review

The last hundred years has seen advances and exchange of_knowledge in the physics of the universe increase at an almost exponential rate; not only through the ability to construct ever larger and more powerful telescopes (e.g., Hubble and Keck) and research equipment, (e.g., the CERN accelerator) but through the introduction of computers enabling viciously difficult calculations to be carried out in seconds and information transferred equally fast. Indeed, this thesis could not have been created without such technology. Despite the huge resources, including humans, the attainment of an all-encompassing theory seems as far away as ever as more and more problems appear with every observation (Witten 2005:1085).

The basis of physics, the structure of matter and how it forms the universe, passes back to the ancient Greeks and earlier. Even now this basis is not clear. Physics asserts four fundamental entities space, time, mass, and electric charge, none of which are defined. Of these, mass is believed to be somehow responsible for gravitation; and charge for the properties of attraction and repulsion between particles, causing them to bind into specific forms. But the actual constitution, what is, how and why questions of these effects, is still unknown. Quantum mechanics (QM) and quantum field theory (QFT) have arisen as an attempt to explain respectively the concept of matter including mass, and its interactions including electromagnetism. These theories produce some seemingly absurd ideas concerning the reality of existence itself, for which a major concern is the 'rejection of reality' by both theories (Schrödinger 1935:3, Penrose 2004:507, Rees 1987:46, d'Espagnat 1979:158, and argued against by Einstein, Podolsky and Rosen (1935) (**EPR**). Here, one must consider the meaning of reality in terms of human concepts. To some extent this subsumes the human feeling of solidness, concreteness and 'material being' created by the ability to touch. In this sense the question must be asked whether quantum physicists have thought far enough to overcome their idea that the world is made of objects that cannot be considered real (comment attributed to Bohr, [Leggett 2002:419]) and

[1] World Book Dictionary 1989. cf Oxford Reference 2015, Cambridge Advanced English 2020 .
[2] World Book Dictionary 1989.
[3] Some physicists e.g., Tegmark (2007) have considered mathematics to be the foundation of the universe itself.

now adopted as a QM principle. This and allied concepts become 'problems' when physics is confronted by human common sense. As a result, common sense becomes an interface between science, philosophy, and education with a commonly held view that, as above, human common sense is unreliable (Yu and Cole 2014:680, Maxwell 1966:295), it being based at best upon both human perceptions and interpretations of our surroundings. This will necessitate clarification as there may be more than one interpretation to each perception.

To quantum theories should be added Einstein's ([1916]1923) General Relativity (GR). Much of the last ninety years has been spent trying to correlate this to quantum theories. GR, as with most relativistic field theories, is mathematically so complex that only the simplest solutions have so far been obtained, providing ideas for exploration rather than confident conclusions. A possibility of coordinating the two (GR and QM) has recently arrived, loop quantum gravity (LQG), but this, too, has its problems; it requires reforming some sacrosanct physical concepts (e.g., spacetime continuum see Chapter 4). If these problems could be overcome allowing QM and GR to be amalgamated, it would be a major step in producing the so-called 'theory of everything' (TOE) – a combining theory of the four forces thought to rule the universe, the electromagnetic force, gravity, the strong and weak nuclear forces – also called the grand unification theory (Peskin and Schroeder 1995:§22.2).

However, the question must be asked whether such a combination would present a complete, or final, theory which overarches all processes of the universe. Ellis (2012:27), for example, states that physical laws cannot answer ultimate questions on themselves – why they exist or are they complete (see EPR 1935). This is equivalent to stating that no theory can prove itself. It must therefore be capable of being tested outside of itself (Popper 2006) – a somewhat difficult process in QM as QM refutes the concept of any local reality (EPR-Bell 1964). As a result, doubt may arise whether an overarching theory can ever be reached and of what form it may take. An interesting article in Nature (2005) surveying eleven physicists gives three hopeful of success: Weinberg, Smolin, Stachel; six reserving judgement: Ellis, Randall, Fukugita, 't Hooft, Witten, Susskind; and two believing such a theory is far off: Rovelli and Penrose. Baumgarten (2017) argues that such a theory will arise through clarifying existing physical theories. Of those quoted in Nature (2005) only Ellis expresses real doubts concerning this, while Rovelli and Penrose believe that, like EPR something is missing. Ellis later called for a conference on "the wildly speculative nature of modern physics theories" (in Wolchover 2015). None of these scientists appeared to consider that perhaps a totally new approach might be necessary. (String theory, not considered in this treatise, is approximately 50 years old [Greene 2000:136]). But Baumgarten (2017:2) points out that if the final theory arises under current conditions, then it has to be a tautology, it will add nothing new. He also rules out (2017:2) "like Weinberg" (section 1.1.3) that any such theory can be derived by reason alone. It can only come from fully explained physical laws, (2017:4, 11 [contradicted by Feyerabend 1993:291]).

But, as foreseen by Ellis (2012:28), physical content must destroy a final theory's truth value: as he points out, equations are limited to predictions, especially as they are built around limited knowledge of local observation about particular rather than general problems – "conditional statements" (Wigner 1960:7). Eddington (1928:141) puts it that science constructs a world symbolic of "commonplace experience", which can be misleading and thus not necessarily truthful to the underlying structure. So, as with Feyerabend (1993:291), we must consider that physics is "not sacrosanct." It "may have basic faults" and be "in need of global change". Furthermore, Ellis (2012:27) suggests that physicists cannot create experiments that answer the metaphysical questions – the current laws must be explained, particularly in terms of a basic universal law which itself requires an explanation why it should exist. Perhaps the most valid comment is that by Hossenfelder (2020) in "Why the foundations of physics have not progressed for 40 years" – new methods are needed with greater care over financing research.

These thoughts compel questioning of physical methodology. The views of Einstein (1916:221) and Dirac (1940:122) have shaped the direction of such thought and research over the last sixty years. They reflect exactly 'the state of the game' at present. The physicist determines by experimental means the measurements of the universe that give values according to human systems of measuring units. He then determines the assumptions that will allow interpretation of these results, assuming them to be generally representative of every part of the universe. From these he formulates rules, or laws, that combine the experimental results into predictive equations. He performs further experiments to ascertain whether the rules he has imagined are correct. The basis of his research then becomes **measurement**, that is, mathematically structured valuation based on some human system of measuring units. The process will thus be human perception → measurement → interpretation. In this view, observation, and only observation, forms the basis of physical laws which themselves form human scientific knowledge of the universe (Stenger 2015:1-4; Einstein 1933;274).

Both Einstein (1936:324 and Dirac (1940:124) are clear that the laws of nature are to be expressed mathematically. Consequently, the relation of mathematics, not only to physics, but more importantly to the human psyche should be considered, because that must play a role in the methodology adapted.

1.1.2 A brief review of mathematics from a physical perspective

> We prove propositions, theories and lemmas in mathematics, but do we explain in mathematics? (Persson 2011:2).

It is all very well to explore mathematical theory to extremes, but one should keep in mind the question whether these theories fit the universe and explain its fundamentals; or are these explorations more of a mathematical game or challenge to human sapience?

Mathematics is said to be formed on a set of truths or axioms based on the concept of number. Fundamentally numbers are measurement. We all count, learning the symbols 1, 2, 3 … . In essence, these are all built on the form 1 meaning singularity – thus: 1; 1,1; 1,1,1; which humans have defined as one, two, three, three being larger than two or one, and so on. These can be split to 1; (1,1); (1,1),1; so that 3 is an association of 1 and 2 together. Then four would be two lots of 2, and so on. We can also employ the symbols + and ×, and by inference – (subtraction), and then include the reciprocal function to × or multiplication as ÷ or division. From these simple definitions we can build up some axioms such as the transitive theorem: if A implies B and B implies C, then A implies C. Or the commutative theorem: if A and B are two simple numbers then A+B = B+A, or A×B = B×A. These are basically self-evident truths. If all mathematics is derived from these and other such conditions it should be unequivocal and computations derived from them should be true.[4] As mathematics has developed, some of these rules must be carefully amended to cover the developments, for example in matrix theory where if A and B are matrices A×B is not commutable in general. As this have both philosophers and mathematicians assiduously examined all, I shall go no further into this subject (Hilbert [1899] 1950; Russell [1903] 2019; Gödel 1931; Zach 2019).

From these simple axioms, deductive reasoning can be used to prove theorems. In a sense these could be considered as a game of logic taught early on at school using geometry, for example, the theorems of Pythagoras. This is an approach which has led to the assumption becoming ingrained in educated people that all deductively reasoned mathematics is true. As Brown (2008:2,60-62) points out, mathematical (logical) proof equals certainty, such mathematics has yet to find an exception and this on-going accuracy is a reason for our belief. Consequently, once proven a mathematical theorem lasts forever. Furthermore, as mathematics develops, always through logical arguments, new rules are based on unequivocal definitions. In theory, such mathematics should be truthful to itself, and where errors occur it is due to incorrect application or human error. I shall not go into the philosophical concept of 'nominalism' on the existence and abstractness of mathematical objects other than to say that the abstractness of so-called Platonic mathematics, being independent of other structures, should not be muddled with abstraction as in abstract art – drawing out of ideas from concrete observation. Mathematical abstractness should be taken as being not concrete in the sense of not having material

[4] Allowing for Gödel's incompleteness theorem that says given an axiomatic mathematical system it is always possible to find unanswerable questions or even statements that can be both proved and disproved. This is similar to saying no theory can prove itself, or deriving the liar paradox that if a liar says he is lying, is he lying or not?

existence. However, the subject of Platonism is important as it appears to sharpen the belief in favour of mathematical arguments supplying the fundamental concepts of universal structure, in particular those of quantum mechanics and field theory.

Many mathematicians are Platonists (Abbott 2013:2148) meaning that mathematics is akin to Plato's belief in certain divine concepts in the construction of the world. Plato's discovery of abstract objects corresponds to a view that mathematics is an autonomous discipline whose concepts are abstract entities, existing independently of time, space, humans, and the physical world (Brown 2008:61, Linnebo (2009:1), Colyvan 2011:88, Bueno 2013:§1, section 1.3.1 (i)). It would be the same for any universe that might exist as Nunez (1999:48) points out. This is virtually the opposite of the quantum mechanical views that the universe is not independent of humans![5] The platonic view could mean that, as Brown (2008:61) suggests: "Mathematics is *a priori*, not empirical", and (2008:14) he notes that no physical result has ever overturned any mathematical calculation. Linnebo (2009:1), for example believes mathematics is discovered, not invented, which perhaps fits in with Lappas and Spyrou (2003:2) that it is genetically embodied in the human brain. Certainly, humans seem to have a predilection for number and measurement. The thought that numbers were first in the world tracks back at least to the Pythagoreans (Aristotle [350BCE] 1923:bookA§6), although Aristotle himself remarked at the end of book N that "objects of mathematics … are not the first principles".

The use of mathematics over the last century has developed rapidly in its complexity. It invades every part of human life. The usefulness of mathematics to physics, is not in doubt (see e.g. Hughes 1985:40-59; Brown 2004:59; Colyvan 2001:116).[6] Specifically, Einstein (1933:274) stated that mathematics is necessary to construct and express nature's laws with nature being "the simplest that is mathematically conceivable", echoed by Wigner (1960:1-14) who refers to its effectiveness in promoting physical theories as "mysterious": "...the laws of nature must have been formulated in the language of mathematics to be an object for the use of applied mathematics."

Through the work of Einstein and Dirac inter alia (e.g., Maxwell 1865), mathematics has been taking an ever-increasing role in the hunt for an all-encompassing theory of the universe based on the proposition that it may be mathematical in creation (Dirac 1940, Tegmark 2007). At the very least, mathematics is regarded by many physicists and mathematicians as the only way in which any theory

[5] Views discussed by many mathematicians and philosophers. See e.g., Lappas and Spyrou (2003), Nunez, Edwards and Matos (1999), Quine (1951), Putnam (1975) among many more including those already mentioned. For further reading see bibliography.

[6] Locke ([1690] 1999:556) wrote "… the reality of mathematical knowledge. I doubt not but it will be easily granted."

of the universe can be expressed (e.g., Baumgarten 2017:1, Penrose 2005:18 as well as others already mentioned). Its ability to underlie the human construction of rules to predict conclusions – and formulate rules such as Maxwell's electromagnetic equations (cf Krauss 1984) – has had a massive impact on advancing physical theory and has been treated at length from the philosophical view by many philosophers (Kuhn 1970 and Cartwright 1983:5, 11). It has even shaped new physical ideas: Dirac (Field theory 1927), Pauli (Neutrino 1930), Yukawa (mesons 1935), giving it an apparently eternal quality as though it is the basis of everything (Lappas and Spyrou 2003). Indeed, mathematics' rhythmical undertones can be perceived in music, art, and advertising. (Bhat, Wani and Anees 2015, Tubbs 2014, Gamwell 2015).

I should state here these are the views of physicists and mathematicians. I put the views in as forthright way as possible without arguing about their truth or falsity – that will come later. In any case, it is hard to find any sensible contrary statements. The adopted implication, then, is that there is a clear-cut affinity between the laws and structure of the universe with mathematics – taken to the extreme by Tegmark (2007). Hamming (1980:82) in a similar essay writes "Constantly, what we predict from the manipulation of mathematical symbols is realized in the real world."

Tegmark (2007) believes that the universe is purely mathematical. "There exists an external physical reality completely independent of us humans" or any other sapient beings; and "Our external physical reality is a mathematical structure." How this would work is not clear as the mathematical formalism does not exist at this stage; rather it is a collection of theories, but he points out ideas that might eventually produce reduction to a single overarching fundament. His concept is very similar to Aristotle's philosophy (see Chapter 2) of trying to find a first principle by analysing human thought structures from the general to the particular. Tegmark (2007) considers various forms such as scalars, vectors and tensors, or rotations and translations, being functions of a simpler structure – what mathematicians call an irreducible representation – one which can have no greater commonality. Further, he believes it should be possible to reduce measurements (units of scale) to a commonality, that is, to pure number form. To some extent he puts his finger on a problem of observation. Our universe is complicated in that we see the large picture composed of enormous groupings of minute entities forming their own group structures. Consequently, it is extremely difficult to work back to the real underlying fundamental structure. (This will be seen in the following chapters even down to 'hidden from us' factors).

Clearly, physicists believe mathematics works for them and provides answers to properly constructed questions. Here properly constructed means clearly defined input for, as computer analysts say, rubbish in – rubbish out! It is also here that we must be careful because 'applied' mathematics, that is, physical mathematics whether it is for astrophysics, rocketry, industry et cetera, depends on its applicability. So, while mathematics may be seen as true, it depends very much on its interpretation and usage when applied outside of itself. The question might even be asked whether some of the more recondite mathematics might be beyond any requirement of a mathematical description of the universe. Have these advanced concepts arisen because of themselves, meaning that they are muddying the waters of far simpler explanations?

From these few paragraphs it therefore seems clear that mathematics is heavily entrenched in the human psyche and particularly in physics. Humans are logical (on the whole!) and thus prefer logical objectivity. Nevertheless, the question should be asked whether mathematics should be the totality of physical research. Under Platonism it is regarded as being independent of humanity, that is, not shaped by human intuition, whereas human sapience depends on perception of our surroundings. Is this fixation on mathematics, then, in the best interests of human deduction? Does it inhibit thoughts outside the 'box'? Humans should have been asking: (1) to what extent is this apparent usefulness of mathematics self-centred; (2) whether it could possibly be at the root of the universe; and (3), if not (2), what is the root of both mathematics and the universe?

There thus arises the concept of other human views, that is, through philosophical reason or logic. For example, I take the view that mathematical results are founded entirely on hypotheses that are formed by the human mind, and therefore, mathematics should not be taken as an absolute truth of natural causes in relation to the actuality of the universe. As expressed by Kuhn (1970) and others, there may be different explanations that fit the original problems. Testing these hypotheses is an established principle, but again to what extent may other explanations, such as those founded on philosophy, prove acceptable or even better? This, after all, must be based on the structure and processes of the universe because the human mind has grown out of the universe.

It seems to me the fundamental problem with theoretical physics (the mathematical expression of cosmology – taking cosmology as the fundamental structure of the universe including its basic elements) is its empirical nature building on observation, which, in its theories, has led to its empirical nature becoming self-contradictory. On the one side it uses human observations built up over the centuries entrenching them through their use to formulate physical laws. On the other side, mathematically based theories such as quantum mechanics have produced ideas that conflict strongly with human perception. As already mentioned, Bohr is famous for his attributed statement that the universe is made of things that are not real (Leggett 2002:419); while (d'Espagnat 1979:158, Rees 1987:46, and Mermin 1981:397) claim the universe is dependent on humans for its existence.[7] The use of observation must then be considered an important problem with physical explanations because

[7] Actual quotations given in section 2.5.

it may overlook hidden fundamental causes that are beyond current human comprehension. In short, physics, mathematical or otherwise, cannot be relied upon to give an accurate assessment of the fundamental structure of the universe (cf Hossenfelder's (2020) objection above). So it is to philosophy that I now turn, to the philosophy of science and metaphysics. From the aspect of an overall theory of the universe it will prove valuable to consider contemporary views of these subjects – views that have developed with the advance of physics. However, I shall only take those concepts relevant to attaining a final theory.

1.1.3 The role of Philosophy

> For if we do not at least know *what a thing is,* how can we talk or think comprehendingly about it? (Lowe, 2021: 5.)

Contemporary philosophy has its basis in ancient Greek discourse about everything that mattered around or affected human life. The branch that deals with science matters is defined in dictionaries severally as the speculative rather than observational use of reasoning about the fundamental nature of the real world, existence, and limits of knowledge.[8] The difference to science is that science relies on testing of observation by experiment whereas philosophy, sometimes referred to disparagingly as armchair physics, relies on pure thought and discourse over variant views. The part of interest, the fundamentals of nature and existence, has so far been considered as metaphysics, 'the after the physics', as ascribed by Andronicus of Rhodes to the series of Aristotle's works, the books A-N (alpha to nu) [350BCE](1923). As suggested by the title, these followed Aristotle's "Physics", books I-VIII [350BCE](1991), in which he laid the foundation of what was to become the subject of science.

In his metaphysics Aristotle analysed observation by classification of general concepts to specifics, and vice versa, in the hope of finding the reason for their existence which he considered a superior knowledge to merely knowing what those observables were or did. From this classification he hoped to find the most fundamental principles "universals" governing the world around him: "the hardest for men to know; for they are farthest from the senses" (1923:A1). These principles then become the most important knowledge as everything else follows from these. (A point I will argue, particularly with respect to QM, which eschews causality, throughout this thesis raising the subject of a methodology for an investigation process, which follows in section 1.3.1 onwards).

[8] Combinations of philosophy definitions retrieved 19th May 2022 from:
Cambridge English Dictionary, Cambridge University Press https: //dictionary.cambridge.com
OED, Oxford University Press https: //www.oed.com, Merriam-Webster https: //www.merriam-webster.com

However, Callender (2011:2) and van Inwagen & Sullivan (2014§1) find metaphysics no longer has a clear definition following a recent move that metaphysics should be concerned with “developing generalizations” from physical theories and should not be in the business of attempting to formulate physics rules. This is clearly like the philosophers Ladyman and Ross (2007) ‘naturalized metaphysics’ and is I believe, most certainly putting the ‘cart before the horse’, for the latest scientific theories are the most controversial leading to numerous peculiarities as mentioned above. Ladyman and Ross accept and even argue by using the peculiar views (non-reality) of quantum mechanics as a basis for rejection of metaphysical argument. For example, they write: “a first approximation to our [naturalistic] metaphysics is: ‘There are no things. Structure is all there is.’” (2007:130) They argue that this principle has been established by successful QM tests. Maudlin (2007:1) seems to agree:

> The basic idea is simple: metaphysics, insofar as it is concerned with the natural world, can do no better than to reflect on physics. Physical theories provide us with the best handle we have on what there is, and the philosopher's proper task is the interpretation and elucidation of those theories.

French and McKenzie (2012:44) accept the arguments for naturalized (naturalistic) metaphysics but rather see a role for traditional metaphysics in the same context as pure mathematics to physics – mathematics defining to physics what is acceptable. The last view is better, but still not, I feel, the full use of philosophical reasoning. Reasoning is to develop by logical argument, and to question ideas that appear illogical (such as existence depending on ‘unreal’ objects) *and to provide alternatives*.

The Ladyman and Ross arguments are that metaphysicians do not consider ‘hows’ as opposed to science which does; metaphysis only asks ‘what’ by analysing semantic categories (2007:21). Consequently, standard metaphysics has contributed nothing to contemporary knowledge (2007:vii) and if it is to have any use it should be *dependent* on science (an idea also evident in Russell (1913:6)), as science provides the best theories available. However, it seems to me this ignores a fundamental concern of metaphysics: the exploration of existence itself. Such a revelation would surely be of an immense value to attaining an overall theory of the universe. But then Ladyman and Ross believe structure (‘structuralism’) is the only reality. Thus, they assume (2007:310) they have defended realism, adding “For example, when people consider whether God created reality, they have deflated reality so as to allow for there to be something more”. (But is realism just a structure created out of human attempts to find the basis of our universe?)

As a result (2007:259) Ladyman and Ross agree Russell’s rejection of causality on the basis physicists do not seek causes and therefore it would be improper for metaphysicians to say they should. They place causality as an “artefact of an anthropocentric perspective that science supersedes”

(2007:260,267) and add "If this possibility obtains, the metaphysician is justified in studying physics in search of universal glue, but causation cannot itself be that glue." Surely this is the total entrenchment of an extraordinarily blinkered view?

But then the arguments of Ladyman and Ross do seem to leave something to doubt. They (2007:16) point out areas where metaphysical ideas have proved completely false in the past. This is as ridiculous as blaming physics for many of its original views, such as electricity being a liquid, or inflammable objects containing a quantity of fire. Ideas come and go as knowledge advances. Ladyman and Ross should rather consider the possibility of philosophy developing new ideas outside the limits of current thought, whether these be physical or philosophical.

Having given one view of philosophy I will give a brief synopsis of an alternative they attack (2007:15-16).

Lowe (2002) follows Aristotle's view that metaphysics deals with the deepest questions of 'being' or existence, together with the essential nature of knowing about existence, to know about the universal structure. He considers metaphysics should be used as a science with its "epistemic basis [similar to] mathematics and logic" by using "ontological categories" like Aristotle, whose influence can be seen in Lowe's statement (2002:11) that "the real essences of material substances *are* known to those who talk or think comprehendingly about such substances".

Lowe is not alone: Fine (2014:8) states "Metaphysics is concerned, first and foremost, with the nature of reality" and the nature of things – what they are (2014:10); it is distinguished by its generality compared to other philosophies dealing with particulars – like Lewis's supervenience theory. Lewis (1986:25-46 and 1996:549-567) tacitly suggests that humans believe a reality depending on the point of view of the beholder at a given time; to obtain the fundamental truth one reduces the concept to a common goal. But this in fact shows that such a method cannot arrive at the truth because it always depends on human perception. So therefore, we cannot ever arrive at a metaphysically general truth by any human method. We can only speculate at a possible truth or first cause. In any case there may exist several possible foundational principles so that an assumption to the truthful one is the only possible method of genesis.

Aristotle's metaphysics explores, among other things, the notion that philosophy should deal with the concept of truth in relation to theoretical knowledge – the aim of theoretical knowledge being truth (1923: A1). Such an enquiry will depend on a combination of discovering the nature of different objects, finding a possible first cause of everything (1923 A2) and the principles for determining such a cause (B6). It will have to deal with existence (B2 on) and being (books D1-2, H and Z) which must include consideration of abstract (for example love) as well as material things. (The abstract will feature at the most important level in this thesis). Aristotle introduced the concept of classification from universals to particular, like phyla unfolding to species in biological classification. Also included in Book Z is the important concept of definition which I will argue is a major failing of physical theory.

Thus, Aristotle's metaphysics deals primarily with discovering the *nature* of things (abstract or substantial), existence and being, and finally the fundamental cause of everything, and principles behind the cause. I shall take the opposite view that the cause is the originator of the universe which leads to the principles and nature of its existence; that is, discovering the cause will lead to why anything should be in existence.

In my view, a valuable contribution on the question of metaphysics, and that of philosophy in general, is that of Stenlund (2003) that the question of its rationale is always "perpetually present" to discussion. Physics is based upon sometimes disconnected observations or experiments; therefore, it is dangerous that philosophy of science should be based upon it when philosophy in its ancient frame was to determine the basis of our world. According to Campbell and Jeffreys (1938:133) philosophers are more interested in theories than physical laws, which is as it should be, because the laws are surely the result of something fundamental that perhaps observation, and thus empiricism cannot uncover? The fundamentals should then give the laws. Philosophy is supposed to find the problems in physics (de Haro 2013:8) – not support it 'willy-nilly'.

As Callender (2011:2) says the connection between physics and philosophy has been argued without conclusion over the last hundred years. Therefore, I shall need, not only to consider the philosophy of physics and metaphysics in relation to physics, but also to consider how they should be used in this respect (section 1.3). But before doing so it is necessary to consider arguments on the use of philosophy in contemporary attempts to discover the fundamental processes of the universe. As Aristotle (1923: A§1 and 2) claimed, and I shall argue, theories should follow from a set of first causes, not the other way round. This cause would be responsible for what humans see as laws.

1.1.4 Philosophy versus physics

The arguments raised above appear to have devolved into a struggle between philosophers and physicists perhaps polarizing the two sides, maybe even subliminally leading to the 'naturalistic' concept that metaphysics should follow from physics rather than plying an alternative road to an overall theory.

The distinction between 'philosophy of physics' and 'metaphysics' is not always considered by physicists, the two sometimes being conjoined and then rejected in the physical consideration of natural laws; for example, Weinberg (1993:Ch 7) writes "the teachings of philosophers...[won't] provide today's scientists with any useful guidance". Stenger (2015:1-4) records[9] most physicists believe philosophy is only of interest to philosophers; that "observation is the only reliable source of knowledge about the natural world". A 'logical positivist' view originally suggesting that *only* physics can provide factual knowledge about the universe but now somewhat relaxed in the view that, although observation is the centre of physics, philosophical input is used by physicists in its interpretation. Nevertheless, an extreme stance was taken by Hawking and Mlodinow (2010:13) who declared that "philosophy is dead" because it has not kept up with advances in science, not that this is true: in the philosophical literature there are numerous references to contemporary physics in the form of cosmology, quantum mechanics and field theory[10]. However, a question rises over the meaning of Hawking and Mlodinow's bald statement, as indeed of Weinberg and others of the same ilk: Do they accept or refute that the principle of metaphysics was, and still is, the discovery of the fundamental reality of the foundation of the universe? Their statement seems somewhat arrogant in assuming that all the peculiarities of contemporary science are absolute, and philosophy has not been able to particularize these deductions. Or do they mean that philosophical questions concerning the truthfulness of modern science are null and void? They may here have a point: human perception may differ from one person to the next so that many views can be entertained, none of which can ever be regarded as absolute although everyone may appear to agree with apparent observation. There may be more than one explanation for a given set of data (Kuhn 1970:76). The same problem would apply equally to all physical theory.

Against this, de Haro (2013:5) has pointed out that not all of theory is purely scientific; it must consider that theory, even when based on experiment, is an interpretation of the human mind and therefore open to philosophical review. As with Ellis (2012:27-29), Zinkernagel (2011:215,217), or Feyerabend (1993:317), de Haro sees the possibility of philosophical enquiry giving new insights into knowledge. An examination of many of the theories will show that physicists (see e.g., Mermin 1981, EPR 1935, Ellis 2012) adopt philosophical arguments, particularly on aspects of reality. Weinberg in his much cited '*Against Philosophy*' (1993: Chapter 7) states that physicists use their own philosophy with no need of external sources – often expressed in unintelligible language. He complains that philosophy is a "*great danger*" because it may cause physicists to question established theories. This is perhaps a strong argument in favour of philosophical questions (see Ellis 2012:27). After all, physicists, possibly more than in any other discipline, are entrenched in 'accepted' theories (Bird

[9] Stenger in article on discussions by physicists. Krauss, Baggini, Tyson, i.a.
[10] See e.g., philosophical articles by Esfeld (2018), Fraser (2018), Myrvold (2014), Dorato and Laudisa (2014), Frigg (2014), Weinstein and Rickles (2015), Vaid (2014), and Ney (2016).

2000:37,45; Duck and Sudarshan 1998:5; Fischbein [1980]1982; Sherin 2006, Ogborn 2011, Feyerabend 1993:164,207) a subject reviewed briefly in section 2.5.3. These 'accepted theories' are often without fundamental definitions and assume absoluteness without any form of proof. They cannot even begin to answer questions such as why anything exists, or what mass or electric charge are, or even more fundamentally, what time or space are. As a University of Florida course (2007) says "Some of the simplest questions we ask about things are also the most fundamental and the most difficult to answer. … When [they] go deep enough, they are philosophical in character"; a point that will need to be considered in constructing the arguments formulating a theory of everything, or final theory. By ignoring the philosophical side physicists may be ignoring valuable pointers to unexpected solutions. If we do not know the nature of something, how can we formulate laws about it? A view from Stenlund (2003) is relevant here that when physicists engage in philosophical discussions, they are between physicists using their own mathematical-physical arguments and methodology. External views can provide insights that do not arise through physical observations or mathematical constructions.

Returning to Hawking and Mlodinow, they unintentionally raised, or rather missed, a very important point: physical theories are based on human perception which may vary from individual to individual. If they are not to be tested at an extra-theoretical level how can anyone 'know for certain' they are correct. Merely calling them mathematical neglects the problem raised earlier that this depends on both human observation of the universe and interpretation of these observations. The resulting mathematics will only follow the data it is given. There should be an underlying foundation that can be determined as truthful. Here, Immanuel Kant's problem raises its head: reality must be the primary (*a priori*) or foundation of existence, but the establishment of such reality can only be made by human thought/perception (Kant [1783]1902: Part3)[11]. However, there is a partial way round this difficulty, the concept of a self-evident premise. Again, one must veer away from the often-used concept 'self-evident truth', due to its self-evidence being purely in human perception/interpretation. Nevertheless, self-evidence seems the closest we can ever come to truth, provided such a 'truth' contains the possibility of a contradiction should it be false. Common reason then suggests a universal foundation should reflect the most basic notions of human perceptions: those of space and time – agreeing with Aristotle's fundamental causes.

In any case, the nature of reality is not necessarily the first foundation because it depends on the existence, or being, of something in the first place. So, an overarching rule, something that determines foundational reality leading to human observation, must follow from existence. But this creates a

[11] Cf. Wilshire and Walsh (2018) who reflect on the concept of knowledge allied to the concept of truth, also cf Carter (2003:159).

vicious circle because, again, humans can only conceive of existence by existing themselves. Thus, we must be led to the principle that a first cause – or foundation for a theory of the universe – must, by its end, establish two things: (1) the reason for existence, and before that (2) the other fundamental problem, into what is anything that might come into existence to be placed? Thus, the concept of metaphysics in the study of reality and Aristotle's first causes cannot be separated from a comprehensive, or final, theory of the universe. It must, in fact, provide an overarching rule which itself will determine the physical laws. Therefore, I am using the concept of a first cause to be a concrete step rather than the instigator of the step. The 'why' of existence becomes the creator of the first cause, not the first cause itself. 'Why does anything exist' becomes the ultimate question as this would motivate the first cause or foundational principle. Hopefully then, an analysis of the first cause, engendered through tracking its development into creating a universe, might lead to suggesting the initial 'why does anything exist'.

Furthermore, the complaints that metaphysics does not consider the latest views of physics should consider two points. (1) Physics' main theories are founded upon extreme hypotheses, – for example, de Broglie's (1925) idea that matter is composed of waves; or Schrödinger's equation (1926) which he created as a pure guess, and which has not yet been derived by physicists from first principles (Renn 2013). Many QM ideas appear illogical and so cannot be accepted without question. It should not then be surprising that traditional metaphysics – which is concerned with 'being' – does not take onboard such views. (2) More importantly: physics does not have to be the only method of deriving the essential knowledge of the fundamental structure and existence of the universe. Physics cannot prove its own ideas and, in any case, has not provided such an outcome. Other methods could be efficacious and should therefore be pursued. Perhaps this is a philosophical point but nevertheless the possible usefulness of 'think tanks' and external (meaning outside of physics) thought experiments should not be scorned. As Feyerabend (1993:57) says, all ideas add to knowledge. Current empirical thoughts have failed so human sapience has to pass into the transcendental.

The trouble is that views like those of French, Ladyman and Ross add to the entrenchment of the absoluteness of mathematics and physics as the only determinants of understanding the universe. The more obtuse their (mathematics and physics) views the more it seems to add to their apparent profundity and to the deference of non-professionals. Instead of broadening the area of enquiry, they restrict it. While they may suggest mathematics can produce ideas "beyond the capacities of individual minds" (Ladyman and Ross 2007:300), they forget that mathematics is the product of human beings and is restricted from transcendental thought by its axiomatic nature.

Summing up: (1) these projected primary arguments must lead to (2) a reasonable concept which must then be (3) testable.

To end with a contrary view, even Einstein, perhaps the epitome of philosopher-scientists, believed reason alone could never explain the basic structures of the universe (Einstein 1933:274). But this, to me, is a challenge, and I believe a falsehood, that must be engaged.[12]

1.2 Fundamental problem and objectives

The fundamental problem must have two sides:

(1) It would seem, from section 1, that despite the amount of experimental and theoretical research carried out over the last hundred years, and not neglecting three thousand years of ideas, humans are still not close to understanding the basis of the universe (Hawking 2002; Hossenfelder 2020). This must raise the questions: (i) is physics on the correct track and if so, or even if not, (ii) why do the problems seem to grow more recondite rather than less?[13] Are the ideas put forward to smooth over these problems merely that, or are they real advances in knowledge? If we are not on the correct track, then, is there another way of looking at the universe?

(2) If so, the solution to this problem must give a foundational cause that answers the current fundamental problem of determining the structure and functioning of the universe. The full fundamental problem is answered if (a) we can find a first cause and check that it leads to *a* universe and (b) test it against human observed measurements to see if it agrees with our universe (cf Popper [2006)]. The latter requires a great deal more work than can be given in this thesis. Thus, this thesis is to examine the current methodology with a view to finding its short comings so that a way forward, a new methodology, can be determined. This is best answered with a secondary, but perhaps more important function, of finding a basis which can be developed into a complete theory.

There are then two main research questions to be answered. The first is a deeper questioning of current methods. But this is a facile process unless it can initiate a new methodology to overcome the first fundamental problem. The second will be to ascertain a fundamental basis from which a universe can emerge, that is, to explain basic concepts of time and the space we see, including its dimensionality and form, assuming particularly, that it had no *a priori* existence. Neither space nor time is explained in current theory. It should be considered that extracting a definition for these two most important fundaments may lead to a complete understanding of the basic structure from which a full final theory can be built.

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[12] See also Hume (1777:§25) although Einstein ([1939]1960:2) had accepted Kant's revision.

[13] For example, Quantum mechanics arose to explain the existence of matter but led to the loss of reality, multiverses and decoherence, all highly debatable problems.

1.3 Methodology

> We are, in practising metaphysics, … free to make sense of things in a way that is radically new (Moore, 2012:15).

It has been a major concern, not only of philosophers and scientists, but of all humans at some time in their life – why are we here, why does the universe exist, how large is it, where did it all come from? This must lead to a question on the direction of human studies. It seems to me that the philosophical arguments and physical theories so far developed must, by their failure to explain these questions, be highly suspect, especially when they lead to peculiarities that defy human common sense such as the universe being constructed from entities that are 'not real' (section 1.1.1). (It may be that quantum physicists have taken to heart – but dismissed – the philosophical arguments concerning the problematics of reality and causality, but these dismissals cannot hold if everything is based on a first cause). If this criticism is even possibly correct, it means the standard methods must be amended or replaced by a new methodology. It is towards this new methodology that this section is addressed. As Stenlund (2003) suggests, philosophy is at its best, "alive", when it questions its own methodology.

Why anything should exist, I contend, should somehow be founded in a first cause. Not necessarily in answering the 'Why' but in the construction of our universe. It is, after all, a single question. For example, if one assumed there was an individual cause for mass, and an individual cause for space, and another for time they would have to interact to give the (one) universe in which we live, irrespective of whether one might divide the result into spiritual and temporal levels. In any case, one could ask what caused or generated the three causes or different levels. So, we will always come back to a possible first, or single, cause.

Why anything should exist, is a question that appears to transcend human experience: Physics is wrapped in its own methodology which does not require such an answer, although there are physicists who regard this as a legitimate question, but not perhaps for science. For example, Ellis (2012:27) raises it specifically as a metaphysical problem. In fact, its solution touches on both general philosophical and metaphysical problems because it depends entirely upon human thought processes. Stenger (2015:5), for example, points out that although physics may 'understand' the universe it would be more accurate to say its models describe only what we observe. Since a fundamental existence has not yet arisen in human explanations, other than in theistic terms, it will need the entire thesis to lead up to it in temporal theory.

I have already pointed out that, in any case physics has become theoretically dependent first and foremost on observation and experimentation. Observation is purely in accord with our perception and beliefs (Reiss and Sprenger 2020:§2.3). Individual perception depends on one's life experiences and internal thoughts. By producing apparent laws, the physicist can associate the result as giving greater truth to experimental observations. This still relies on interpretation. So, its laws are still perceptions, for which I contend in section 2.5.2 even experiment based on human perception can provide demonstrably false answers. In other words, objectivity is always related to subjectivity. Scientific theory should always be, and mostly is, subject to corroboration. But while observations may provide 'answers' to questions, underlying both answer and question there may be a false impression/assumption. For example, the concept of mass has no definition, so answers based on mass may not actually reflect the true situation.[14]

Apart from mass, physics is also based upon space, time, and electric charge, none of which are defined under the excuse that, with mass, they are too fundamental to be defined in terms of anything more fundamental. But this view is, surely, exactly the view to be avoided; it is pure assumption. It may even be that physicists have been unable to define mass and electric charge because they *are* created from something more fundamental, or perhaps worse they are only figments of human imagination and not real entities anyway – something else is responsible for what we believe to be mass and charge. Thus, ruling out the concept of a fundamental cause, as demanded by quantum mechanical principles, must be highly suspect. *It is contradictory to the very principles of physics derived since Galileo.*

Such a contradiction implies the concept of a fundamental principle must be considered as a construction point for the universe. Then the question raised by Fine on the nature of reality, in section 1.1.3, must be recentred on the construction of a final theory because the two become inextricably linked. That is, in as far as humans can be certain of anything: (1) we can only assume of the fundamental causes of the universe. Such an assumption must therefore be checked to see whether (2) it can be developed into an overall theory which explains a universe and finally (3) whether this overall theory, and thus the foundation itself, agrees with all the measurements made of the universe. In this respect it should also agree with any further measurements made in the future. If it does not then it will have to be revised or replaced, much as is done with current theories. The main difference would be that current theories are unable to explain the measurements made of the universe (Hawking 2002); they only allow physicists to predict outcomes based on theoretical equations constructed around observations (instrumentalism). A final theory should answer why anything exists, which will

[14] See Bogen 2017 "Theory and Observation in Science" in Stanford Encyclopedia of Philosophy for greater depth of discussion.

depend in the first place upon the foundational cause adopted; and this hopefully will reflect upon the nature of reality. Objections may be raised that metaphysics, in its sense of dealing with reality, its foundational, or *a priori* concerns, may be considered to halt at reasoned deductions (Kant [1787] 1998:Bxx-xxiii). However, points (2) and (3) show that the full realization of philosophical reasoning extends to, even, the testing of an overall theory against observation before it can be given the tentative title of 'final theory' – tentative because it can, as said before, never be perfectly proved. Even this imperfection counts towards the necessity of philosophical intervention.

Expanding briefly on section 1.1.3, Florida State University defines metaphysics as: "the study of the nature of reality, of what exists in the world, what it is like, and how it is ordered." and that is how I shall take it with the addition of 'reasoned speculation' rather than observation. The question then becomes the concept of reason and particularly its relation to common sense. By reason I mean the principle 'if A then B' where common sense considers the conflict between reason and absurdity, for example the concept that the world is made of things that are made of things that are not real – surely reality implies existence and vice versa making a so-called self-evident truth?

In these circumstances physics must always bear a relationship derived from metaphysics – not the other way round. Physics is concerned with a large, and increasing set of laws (as new theories, both physical and mathematical such as group theory, develop over the ages) which, as argued above, are purely interpretations derived by humans through observation of their surroundings; I specifically use the word 'interpretations' because still many intransigent problems exist both in the microspace (atomic and subatomic) and macrospace (cosmology), some of the most important of which have already been raised. These laws may then become subject to refinement under a metaphysical foundation principle that answers the two main questions of existence given above. Others concern, for example, the 'what is', how and why of the dimensionality of our space, force, particle existence, time, even motion, or energy conservation. In particular: Can these all be reduced to a single fundamental? If so, there can be no fully satisfactory final physical theory without the intercession of a philosophy geared to foundational principles.

I therefore contend that the open ends in physics derive in the main from human cognizance being unable to (I) divine a proper foundational principle; (II) to create definitions for the fundamental entities of physical enquiry (space, time mass, charge, energy, matter waves); or (III) to satisfy human ideas of reality by creating apparent absurdities which defy human common sense; or (IV) to explain the two fundamental philosophical questions 'If a universe comes into existence into what is it placed?' and 'Why does anything exist in the first place?'

This background may seem to suggest that although a foundational starting point will be metaphysical, its offshoots will contain both physical and metaphysical concepts working in harmony, that is, both specific and general conditions (Fine 2014:18). Lewis (1986:25-46 and 1996:549-567) tacitly suggests that humans believe a reality depending on the point of view of the beholder at a given time; to obtain the fundamental truth one reduces the concept to a common goal, but this in fact shows that such a method cannot arrive at the truth because it always depends on human perception. Therefore, as suggested earlier, we cannot achieve an unequivocal metaphysical truth by any observational or mathematical means. We can only speculate on a possible first cause as there may be several possibilities. Consequently, although Aristotle originally mentioned the concept of a first cause, in the case of this thesis it should be derived independently of any existing physical or philosophical precedents.

I have emphasized that the so-called physical laws, equations and measurements all follow human interpretation of their observations which, in turn, assume that the laws always hold equally everywhere after the first few quadrillionths of a second. (It is recognized they may not hold before this miniscule interval in time. As the methods of philosophy of science and metaphysics have produced nothing towards a final theory, the same problem applies to both as philosophy of science and metaphysics are based upon human interpretation of their surrounds). The common factor is observation. It therefore seems that observation with its probable misinterpretations should be removed as much as possible from the methodology chosen. This can never be totally achieved because we are of this universe so must be shaped by its structure. That is, our minds must be shaped as much as our bodies and actions. This shaping is not just of our current era but of many thousands of years of human development from the first sapient concepts of primitive minds. So, we must consider this development as a first base.

These concerns suggest that physics, particularly considering its empirical nature mentioned in section 1.1.2, and philosophy of physics, in their present form, will be unable to supply a complete answer to the fundamentals of our universe and therefore a foundational philosophy will require a *new branch of philosophical reason* devoid, as far as possible, of human perception.

A ray of light in this direction appears in Aristotle's idea that there must be a first cause; he suggested a set of causes, but I contend that any set should be reducible to a single fundamental cause. Analysing by 'contras' or by reducing ideas to universals has failed miserably to suggest what it may be. Here I should emphasize that quantum theories do not accept causality (see Chapter 2) – which in my opinion, as I shall show, has been more detrimental to finding a final theory than any of the peculiarities they produce. So there seem few antecedents on which to form a proposition. The only alternative seems to take a 'flying guess' at a possible premise.

1.3.1 Methodology questions

Consequent upon the conjecture, the methodology will have to allow the development of a comprehensive theory which can be tested to check it completely fits human experimental physical observations. This means the method decided on will have to answer:

i. Is the universe mathematical or non-mathematical in construction?
ii. What constitutes a final theory?
iii. To what extent is non-mathematical reasoning physical or philosophical?
iv. Can any one discipline provide all the answers?
v. How should a final theory relate to existing ideas?
vi. What is meant by universe?

Conversely, these must have an unequivocal bearing on the method of argument adopted.

i. Is the universe mathematical or non-mathematical in construction?
First ask: if there were no living and intelligent beings in the universe would the universe still exist? If mathematics is only in the intelligent mind, then the answer must still be ‘yes’ because the universe came before living things. Second ask: if our imagination is founded by our biological structure, which in turn is founded on the physical structure of the universe, can we be certain there does not exist a possible structure that would fit human derived mathematics but does generate some non-mathematical rationale through which humans relate to the universe? Consequently, we cannot state that our mathematics dictates the fundamental structure of our universe; but we can state the reverse: that the fundamental structure determines how our concepts relate to it. Moreover, Abbott (2013:2149) suggests mathematics is “a mental abstraction” which is like physical views expressed in the Copenhagen interpretation of modern quantum theory that the “ultimate and final measuring apparatus is the observer's consciousness” (Lazerou 2009:§3). It is also possible that the difficulties with human theories arise through using mathematics to describe a universe that may not be mathematical in origin. Gödel’s (1931) incompleteness theorem could be argued to support this view. That is, he formally demonstrated that given an axiomatic mathematical system it is always possible to find unanswerable questions or even statements that can be both proved and disproved. This is like saying no theory can prove itself, or deriving the liar paradox that if a liar says he is lying, is he lying or not (cf Penrose 2005:377).

Further, it has been assumed since Galileo that only experiment and observation can provide knowledge of the physical universe (Einstein 1933:274). A mathematical universe would be deducible purely by mathematical reasoning: not so far forthcoming with, instead, an ever-increasing mathematical complexity. I shall, therefore, make the basic metaphysical assumption that the universe is not mathematical in origin; in fact, it will not even require a number system to exist, though presumably its foundation must be such that it leads sapient beings to create number and measurement systems to answer their needs, whatever those may be. Current philosophy and physics would then have to be adapted to a foundation that may be entirely different from the needs of the human sapient being. In the meantime, this will require non-mathematical reasoning based on the assumption the universe is not mathematical in origin. Should such reasoning provide a comprehensive theory that answers current major problems then it seems likely that indeed mathematics is purely a production of the human mind and not an *a priori* system independent of the human mind, time, and space.

ii. What constitutes a final theory?[15]

A final theory should provide a complete testable description of the structure of the universe, its basic elements should lead to what humans call matter, the general interactions between these fundamental elements, and the causal relationships between them – also known as fundamental properties. It should follow from a single foundation principle and a single overarching rule that everything in the universe must obey. As such, it should provide the fundamental *nature* of existence, or 'being'. By 'testable' is meant the ability of humans to compare these derived properties to any experiment they may conduct – the concept of 'any' being that experiments thought of by humans must follow from human conceptions and thus from the universe bringing about their existence. Although not included in this thesis, the fundamentals of the theory must be those leading to a full description of other disciplines such as chemistry, geology, biology, and even pure mathematics. That is mathematics should arise from the fundamental theory, not the other way round.

Philosophically, it should cover the concepts of knowledge, being, reality and especially causality.

It, too, must give precise definitions of any naturally existing fundamental physics' terms, that is, those terms with a common existence in both standard physics and derivations from the foundational cause.

Baumgarten provides a background to the essential elements. It can leave no unanswered questions (2017:2). It should derive the spacetime dimensions. In particular, he mentions that a final theory cannot assume basic concepts such as mass, charge, energy, or velocity. Obviously: because these must be dependent upon the foundation principle, a *first* cause (2017:3). But most interestingly

[15] 'Final theory' is a term already in use. I sometimes use 'complete theory' to stress the necessity of a final theory to be complete. Neither should be muddled with another term in current use 'Theory of Everything' or 'TOE', which refers more to a combination of forces derived in quantum field theory (QFT).

he projects that space must emerge from the theory (2017:11). However, having given a few inclusions he denies (2017:15) that it can tell us the two most important points: why there is something instead of nothing, and worse, what matter really is. The second must in fact be among the first things that arise from the foundation principle, or first cause. In fact, this first cause should also determine in what the universe should exist. To say that it exists within itself is meaningless, unless one can say it has existed forever and even then, one must ask how big this existence is since observation has shown beyond doubt that it is expanding (see Chapter 5). The existence of anything is more difficult but not impossible once the entire structure has been unravelled.

To these Baumgarten could have added a point to be made in section 1.3.2 that these expectations should arise naturally without any preconceived, or pre-expected human knowledge – the *a priori* assumptions of relativity, electrodynamics, and the Dirac equation (2017:2). This would immediately rule out Baumgarten's assertion that the laws of physics should be upheld by a final theory, because that *presupposes* they are correct. He believes in the causality of all laws and interactions (2017:2), although QM itself does not (Suarez 2007, Bell 1964:199, Mermin 1981:406-407); a fundamental problem that must unequivocally be cleared up. The methodology adopted should explain the peculiar mass relations of the fundamental particles (2017:2). To his conditions I add that it should be a simple structure (Occam's razor[16], Einstein 1933:274) and that all its relations/actions should be automatic without preconceived causes[17], but all interactions must be causal. So, the methodology must empower reflections on these contradictory issues.

Finally, Baumgarten (2017:3) believes that "if all substantial concepts of physics have to emerge within the final theory, then a [final theory] is formally equivalent to mathematics". This highlights an important point for future reference that any physical theory should have comparable descriptions in both non-mathematical reasoning and mathematics; any problems that arise must be explained by that theory alone, not by using a different theory. (For example, the famous twins problem of special relativity arises in that theory and should be solved by that theory, not another (General Relativity). If not possible, then attention should be paid to the construction of that theory. In the case of the theory to be constructed here by non-mathematical reasoning, Baumgarten's assertion demands that it be tested mathematically.

[16] Occam's razor (see e.g., World Book Dictionary 1989) suggests that the simpler an explanation the better the chance it is correct. Einstein (1933:274) says the simplest that is mathematically conceivable which implies the necessity for a non-mathematical theory, as projected in this thesis, to be mathematically testable.
[17] By this I mean QM's belief that interactions are 'two way' interactions. For example, Hawking and Mlodinow (2010: 103) "*According to quantum physics, you cannot 'just' observe something.* You have to cause it to be observed for example by shining "*a light on it*", leading to Rees's (1987:46) equally odd statement that the "*The universe could only come into existence if someone observed it*." The false nature of these two ideas is covered in chapter 4.

iii. Is non-mathematical reason physical or philosophical?

Once a foundation, or first cause has been introduced the deductions become more specific thus losing the generality attributed to metaphysical reasoning by Fine (2014:9,18). The question is whether these deductions are philosophical or physical. Ellis (2012:27) sums the above concepts by stating science cannot answer "ultimate why questions such as 'why do the laws of physics exist?' These issues lie outside the scope of the scientific method, which deals with how mechanisms operate." So, if we want to find some method of determining whether theories are final theories, we must go outside of physics, that is, to philosophy. Here I take non-mathematical reasoning 'to develop by logical argument, and to question ideas that appear illogical (such as existence depending on 'unreal' objects) and to investigate or provide alternatives where necessary'. This will incorporate specific reasoning which, if Fine's account of metaphysics is to be accepted (2014:9:18), will be a reasoned adjunct of metaphysics. At its most general the answer may have both philosophical and physical content but there is a difference between these two aspects. First, physics is built around observation of our surroundings, which as discussed involves our interpretation empirically built up and entrenched over the ages. As Aristotle would say, it is for the men of experience but not for the men of knowledge or wisdom. Physics must follow on from a foundational cause though it may not know this cause. Second, it is not founded upon proper definitions of its fundamental entities which in any case are not related by any thought processes to a first cause. Third, physics is declared by its main proponents to be mathematical and empirical. So, if philosophy of science deals with the acceptability of physics and its methodology, while metaphysics deals with the essence of existence, or being, the two come together: that is, much as French and McKenzie (2012:44) commented, 'mathematics tells physics what it can say', metaphysics will dictate what philosophy of science can say. That is, deductions directly from a first, or foundational cause, barring any external human preconceptions, will fall under the aegis of philosophy.

iv. Can any one discipline provide all the answers?

In view of its relationship to Aristotle I shall consider metaphysics similarly to (1) Fine: Its primary function is to provide a foundational truth from which further truths can be deduced, similar to Aristotle's hunt for a first cause; and philosophy of physics in terms of discussing physics methods (see section 1.1.1); and (2) (Kant [1783] 1902:§40): "Metaphysics has to do not only with concepts of nature, which always find their application in experience, but also with pure rational concepts, which never can be given in any possible experience". Then if, as Aristotle intended, metaphysics is beyond physics, and physics is based alone on (uncertain) human observation, metaphysics itself passes beyond observation. It must discover, and negate, any mistaken perceptions in current theories – for which it is ideally situated through introducing an alternative methodology to support human ideas (cf next paragraph); no theory can prove itself, and furthermore, even using mathematical principles, a mistaken concept can be made to fit previously established concepts.[18] This is especially true if these have become entrenched.[19] Feyerabend (1993:80-82) mentions that theories build upon preceding ideas thus reinforcing them; this should require a new look at scientific methodology. In any case, I contend that physics should be based on a fundamental principle, that is, a first cause. It makes no sense to me how any complete theory of the universe could not incorporate a fundamental cause of universal existence. This, surely, is where the laws, if they do exist, must originate? Even the question of each separate law must be thrown into doubt without such a cause. The fact that a particular law in our experience may not have been broken does not mean it may not have been broken before human observation, or may be broken in the future, or somewhere beyond our current range of observations. Therefore, to be a law it must have a founding cause. Then every so-called law must have a founding cause. And if there exists a single foundation principle, the founding cause of all laws must be bound up within this single foundation principle.

de Haro (2013:12) asserts that science and philosophy have diverged over the last 200 years into concepts of the natural world and the human mind (quantum mechanics), the difference in their methodologies being sometimes quoted as ‘science relates to how-questions and philosophy to why-questions’. The requirements of a fundamental cause must take this into account.

The average human would probably accept that what does not materially exist is not real and what does materially exist is real – existence implies reality and vice versa. But ‘material’ itself is unclear. For example, is an action such as rotation (on a material object) real? An object may rotate and be invisible but knowable through a force field. A unicorn is only imagined and unreal (unless it exists on another planet). A fundamental cause should then automatically include the principle of material existence as a reality whether it is visible.

The final theory must then be restricted to, yet all included in, foundationally based reason, that is a **foundational philosophy**. The efficacy of this treatment then becomes whether its results match human experience and, indeed, common sense where common sense is equated to reason. This can and will touch on metaphysical principles in the form suggested by earlier sections.

v. How should a final theory relate to existing ideas?

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[18] Cf Zinkernagel (2011:217) “*No matter how elaborate the mathematical* formalism *of a physical theory is, it should be distinguished from the* interpretation *of that theory*.”

[19] Weinberg implies in ‘Against Philosophy (1993:173-174) there is nothing further to be said about “*space and time on the basis of pure thought.*” – a very short-sighted view as Chapter 2 onwards will prove.

The existence of a fundamental cause would imply that everything in the universe must arise as a result of this cause either directly or indirectly. It should therefore be possible, and desirable as a check, to derive an entire theory without reference to existing ideas by deductions from the fundamental cause, or in the case of a projected hypothesis, a foundational principle. In view of the failure of current methods to provide such a principle the expectation must then be that the principle itself may lead to deductions that will differ significantly from, and even contradict past ideas and methods. However, should such a final theory be established it must be capable of expressing current observations and particularly successes of current theories and physical law-like deductions (Kuhn 1977:321-22).

vi. What is meant by universe?

Different people may have different ideas of the meaning of the universe. Furthermore, there is no definitive agreement between physicists or philosophers. For example, there are different cosmological theories such as the FLRW (Friedmann-Lemaître-Robertson-Walker), homogeneous and, isotropic with three possible curvatures, positive (spherical), none (Euclidean), or negative (saddle); ΛCDM (Λ cold dark model) similar but including developments such as dark energy and inflation; block universes, with a question over the existence of time as an element (Ellis 2014). Discussion of these is only of incidental importance in Chapter 5. However, the concept of gravity (for which there are different concepts – general relativity, loop quantum gravity, MOND [Modified Newtonian Dynamics]), the possible end of the universe, multiverses, and the concept of space being a continuum as until recently believed, or discrete as hypothesized by Bahr and Dittrich (2010) are of importance (Chapters 4-5) as is the end of the universe. Dictionaries[20] suggest universe means all of reality, or hypothetical physical reality while QM questions (dismisses) reality (Chapters 4 and 5).

I shall consider two very different universes. The one universe (with small initial letter) I take as the existence of everything, including the physical theories about its contents and construction, the space it exists in, the concepts of time, energy, force et cetera, as interpreted by human perception. That is, one that has *no other foundation than unqualified belief in human perception*. As this does not reach the target of a final theory, I will derive a different possibility. This Universe (with capital U) will be constructed by non-mathematical deductive reasoning around a fundamental, or foundational, principle or cause. Thus it will only contain processes and structures that can be deduced from that principle. *All current and previous physical concepts, or human preconceptions* other than the foundational principle, *are thus discarded, ignored or rejected*, unless the foundational principle leads to a structure that humans currently believe exists, for example, an electron; in such a case a comparison will then be made and the physical idea accepted only from that stage onwards perhaps

[20] cf. World Book Dictionary 1989, Cambridge Advanced English Dictionary 2020.

with modification (cf Kant 1998:134§B28 in section 2.1). This thesis will consider only the fundamental cause, and overarching rule, the basis of the universe, the nature of time and space, existence, and most importantly the question of ‘into what is the universe placed’ and some important macro-universe problems. Because these concepts are to be constructed philosophically it must also deal with the fundamentals of philosophy and its place in human sapience. The development of the fundamental rule into an all-encompassing theory of the universe will be completed in another work planned by this author.

The philosophical considerations here, then, are not only to examine the processes and structure of a universe but to go one step further and ask why these should exist in the first place. This should eventually explain why anything exists.

1.3.2 Methodology – strategy

It seems to me, then, that the consideration of a foundational theory requires a four-part strategy:

First: determining the terms of reference of the proposed foundational philosophy;
Second: determining a plausible first cause;
Third: showing that this will automatically lead to a structure for a Universe, or so-called ‘final theory’;
Fourth: testing this theory to ensure it agrees with the observations of the universe we live in (not included in thesis but a necessary outcome of such a methodology).

1: It must be recognized that the outcome of this treatise is dependent on human sagacity. Consequently, the parameters of the changes from contemporary philosophy to the proposed foundational philosophy must be determined in relation to historical human philosophy considering the views already given.

2. There is no obvious natural choice for a first cause, so it is necessary to make some assumptions to narrow the range of possibilities of hypotheses to take us out of ‘the box’. The first assumption is, of course, that there is a first cause or principle on which the universe is built. The second assumption would then be that this first cause can be represented by a ‘self-evident truth’ as a basic premise. This would then require a definition of any fundamental term in that premise. While this definition will depend on human perception, once it has been attained as a basis, step by step deductions can be made towards an overall reasoned theory of the Universe. But these deductions must avoid *any a priori perception of our surroundings or any assumptions not contained in that definition*, (see Kant [1781] 1998:134§A14). This includes measurement because measurement depends on human

resources. For example, humans believe in atoms. But it is not acceptable to preconceive this concept and deliberately work out how they can be derived from the first principle. The first principle can only give what can be logically derived from it. However, there is a problem with the 'no *a priori*' concept in that both time and space are obvious factors of our existence so that it is impossible to somehow derive these without conceding their existence (see section 1.3.3). But thereafter everything else should follow automatically.

3. Only this premise should be used to forge a theory avoiding any preconceived ideas. This will require determining those factors of current theories that have hampered physics in attaining a complete understanding of the universe.

4. Testing whether the complete theory and its foundational premise are valid. Physics is not based on a fundamental cause nor on properly constituted definitions. Therefore it cannot answer the two fundamental questions of universal existence. The value in pointing this out is only achieved if it can be shown that such deliberations lead to the construction of a valid theory of the universe, and preferably one that answers all the problems physics has raised. But even this is not sufficient. It has to be shown that such a (foundationally based) theory agrees with all the observations so far made of the universe. That is, it has to agree with Popper's testable philosophy and Kuhn's (1977:321-22) criteria for new theories:

It must be:
1. accurate, that is agree with experiment and observation
2. consistent both internally and with existing workable theories[21]
3. broadly based, that is, extend beyond the initial scope
4. simple – Occam's razor
5. fruitful, that is, disclose new phenomena
6. and where disagreements with current theories occur, it must give a much improved argument that explains why the previous theories arose.

Thus, a final theory cannot be achieved without strong philosophical questioning of physical theories or the fundamental elements (such as space, mass, charge, energy, matter waves). Its entire structure must flow from a foundational premise which by its foundational nature will determine the course to be taken. Consequently the attainment of what is, why, and how, will be ascribed to philosophy providing the fundamental Universal structure. The role of applying these results to the benefit of the Earth and its living creatures, 'structuralism', belongs to physics, chemistry, biology,

[21] This will require an examination of existing theories as the operative word is 'workable' in the sense of leading to a complete final theory. For example, contemporary theories based on QM, or the 'big bang' have not been able to establish a final theory thus casting doubt on whether they represent the actuality of the universe. It may even be that they contradict themselves.

and allied disciplines. In this case of role reversal, it is *up to the philosopher* to carry his ideas to conclusion. Physics no longer provides the impetus with metaphysics questioning the validity of the methodology. The philosopher provides the impetus and physics the validity test.[22]

1.3.3 Some intractable problems of expression

The limits of my language mean the limits of my world (Wittgenstein 1922:74)

There is, however, a major problem concerning descriptive language, one which would not be expected to occur in human cognizance. For example, it is not hinted at in Quine's (2007) extensive treatment of language. The reason it does not occur is because human language, including philosophical and scientific thought, has been empirically moulded over thousands of years around human observations of surroundings and the need to communicate. Science fiction is even built around human assumptions of existence, that is, of space, time, mass, electric charge, force, energy. The thought that any of these, or established laws, might not exist is not considered. To write anything sensible one can only use language already in use, with maybe a few definitions for innovative ideas; but even these must be expressed in understandable language (Feyerabend 1993:38, 276). As a result, it is difficult to express innovative fundamental ideas of a universal construction that do not fit current ideas. For example, we have become completely used to measurement, noticing distances and even the concept of time from the moment we first open our eyes. However, suppose the universe does not need measurement to exist. How do we express this concept without using the word measurement or any other word, or words having the same connotation? The same goes for numbers. How do we suggest the universe can start from a single point without the concept of singleness or unity? We can only use these words in trying to attain a fundamental 'numberless' 'start' (again both concepts of measurement) to the universe. These must then taint the expectation of this thesis in attempting to derive the structure of the universe from a 'single' first principle while trying to avoid human preconceptions. A similar problem occurs in section 2.3.2: what descriptive word exists to describe the formation of a smallest possible interval, for which there is no such thing according to Lucas (2018:31)? Or the concept of space and volume[23] or time? If only one cause, or foundational entity, is to be responsible for the existence of the whole universe we cannot choose both space and time. If it is either, then the other cannot be a first cause. But how does one refer to 'no time' without using something based on time, for example atemporal? If such a word was invented, how could one explain its meaning without the use of some concept of time? The same applies to space. Therefore, one must use human language with words defined as in dictionaries.

[22] Cf. Chapter 4 footnote 32, re Popper test.

[23] I consider space and volume to be different. Space has many connotations. In particular it may refer to 'flatland' a two-dimensional world, or multi-dimensional space. Volume is specifically three dimensional.

Then there is a second equally intransigent problem, even more difficult for the reader: the one of preconception. Humans, as pointed out throughout this chapter, are sapient creatures with built in ideas of their surroundings. Some of these have been in existence, as above since our birth. We can see distance, so we assume the concept of space and volume. Then we find we can move our limbs and reach out to touch things. Our mother moves in and out of our sight. Eventually, as we grow older, we may consider the universe. How large is it? Does it extend to infinity to avoid having to be contained in anything? And here already we have made certain assumptions. It has a volume, it has the connotations of measurement, of infinity, containment, or lack of it. There are many more 'facts' we have learnt at school. But what if there is no space or volume? What if the 'facts' we have been taught are false ideas? What if we have relied on these facts to produce new concepts that in our experience work? We assume such success demonstrates acceptability of the earlier 'facts'. But there may be another reason which works just as well but is way out of our thought processes. To find out we must question and maybe even dump our firmly entrenched ideas.

For example, consider mass. Experience tells us that some objects are more difficult to move than others. Some may be out of our ability to shift without machines. Yet scientists cannot explain its 'what is' concept. Physics has supplied it with no definition. The Higgs mechanism, once thought to have been the answer, has not been proved correct[24]. According to theory, mass is responsible for gravity, adding strength to our belief it exists. But suppose it is merely a figment of human imagination to explain what humans cannot otherwise understand. Suppose there is another much simpler concept that accounts for the difficulty in moving an object, one that emerges from a first principle or foundation. Can we abandon our preconceptions from what we have learnt, both through our experience and at school? If we are to find that first principle, we must discard such concepts as possible falsehoods. The same follows for electric charge: it has a mathematical (gauge theory) explanation but that presupposes that the universe is mathematical in basis. It is one of physics' four supposed basic forces giving the so-called TOE, the other three being, gravity, strong and weak forces, and all four only having a mathematical 'what is' (see e.g., Peskin and Scroeder 1995); humans do not have a complete 'what is', how and why for any of these in common everyday language.

This concept runs further. For example, Newton suggested "the force law" $F = ma$: mass times acceleration. But there is no definition, nor understanding of the nature of mass, nor the exact meaning of velocity and acceleration. That is, why do these concepts exist in the first place? How is

[24] The Particle That Wasn't - The New York Times. https://www.nytimes.com › science › cern-large-hadron-collider-particle

force transferred or received? What in force, mass, and acceleration allow their linkage and the changes Newton's equation purports to support? Consequently standard definitions cannot be accepted in describing or validating this development. They must first be derived from the first principle, thus leading to the necessity of an overall test. If there are, as I suggested earlier, 'hidden from us' concepts then even mathematics may be incapable of explaining the universe.

The difficulty of these points lies not only in our perceptions but in fixing the reasoning that follows, particularly in providing unequivocal definitions. It is not always possible to place everything in perfect order to proceed from one explanation to another without the need of language which involves a concept that still has to be deduced (cf Kant [1787] 1998:axvi). For example, if we think of time and try to describe it without reference to anything else it cannot be done because it involves the concept of an interval which to many people implies time – although an interval may be something outside of time. For example, it can be a space between things, or even a colour difference between say red and green. Therefore, which should be defined first – the concept of an interval which to most people implies time, or the concept of time which implies the introduction of an interval?

This is particularly true in the introductory parts of a section or chapter. If one is to describe the point or outcome of that section in the introduction, it preconceives the outcome thus disallowing the ordered reasoning of possible outcomes without the knowledge of where they may lead. Furthermore, it may be necessary to give examples compatible to human experiences/ideas to explain particularly difficult, preconception defying concepts. This is especially the case in answering the first order question already given: 'If a universe is to exist into what is it placed?'

Thus, I must take an abstract foundational definition and turn it into a foundational cause of something concrete and recordable. Something which humans understand by perception of their surroundings. Then that must be the sole springboard to show that it leads to a Universe, without using preconceived physical ideas. *These points must always be in the reader's mind as the thesis unfolds.*

Finally, a note on the wording of this thesis. It is written for readers of all disciplines as well as people with no academic training. Thus I avoid jargon in favour of plain wording as much as possible. Weinberg's comment is particularly apt (1993:133): philosophy is written in "a jargon so impenetrable" that he feels it is aimed to impress those who "confound obscurity with profundity", a possible shortfall of metaphysics mentioned centuries earlier by Kant in1783 in his introduction to his prolegomena.

1.4 Significance

The above thoughts only have a value if they lead to significant advances in the philosophy of science and then if the philosophy of science leads to significant advances in science itself. Its greatest significance would be if it produces the first completely workable causal theory of the universe in the history of human thought, giving a full explanation of the origins, structure, and processes of the universe.

This would be the ultimate target, but it runs far beyond the scope of this thesis. If this thesis shows the way to a causal theory by producing a new method for humans to approach the subject, that would be a significant start to the quest. However, such a concept would be only a small part of the whole project. If it provides a fundamental structure answering the principle questions of (1) into what can a universe (of any form) be put and grow, (2) how do time and space form this structure, and (3) why do they exist in the first place, it will be hopefully the most significant advance in the history of science since these are all unanswered problems that have entertained human scholars for thousands of years. The successful attainment of these three questions would automatically lead to a comprehensive theory of the universe.

1.5 Summary of central themes

(1) Human perceptions are inherently fallible.
(2) Therefore, current methodology, hypotheses, definitions, and laws belonging to physics, metaphysics and philosophy of physics must be regarded as suspect until further investigated.
(3) Hypotheses, definitions, and laws must be founded upon a fundamental premise, or first cause – which, in view of human fallibility can only be attained by a guess followed by testing against observation – not the other way round.
(4) A totally new methodology is then required based upon the metaphysical notion of a first cause.
(5) This may entail arguments completely strange and totally contradictory to current attitudes, especially deeply entrenched attitudes.
(6) Physics is concerned with what an entity does; metaphysics with what causes it, that is, with its quiddity.
(7) This requires a new branch of philosophical reason – ‘foundational philosophy’.

1.6 Structural outline

Chapter 2 gives a brief overview of the basis of human intelligence with a view to 1) considering the main factors in the evolution of human thought and 2) to obtain some idea why it has been unable to provide an overall theory of the universe. Some of this evolutionary evidence is lost in antiquity so the synopsis can only start from certain factors such as carved bones and manuscripts. Mythology shows a definite group structure or pack mentality in the human species. The three sections (2.3, 2.4, 2.5) that follow look at the disciplines and methods of philosophy, mathematics, and physics as these must all have a bearing on the results of human contemporary hypotheses. The final three sections then consider how these contemporary views relate to education, common sense, and entrenchment of theory in line with group dynamics.

Chapter 3. The chapter opens by considering the methodology required for successful conclusion of this thesis after taking into account the factors outlined in Chapters 1 and 2. This requires a closer look at aspects of Greek (Aristotle's) philosophy in which he mentions causal principles. The view is adopted that mathematical arguments, having so far failed, should be replaced by metaphysical arguments but metaphysics and philosophy of science are by themselves unable to completely fill the requirements. Consequently, a new foundational philosophy is suggested with its basis being to find a suitable first cause for universal existence. This is taken to be Time, which in section 3.3 is analyzed in order to obtain a first ever definition of what it is rather than what it does. The final section examines the concept of reality with some reference to definitions.

Chapter 4 then proceeds from the definition of Time taking into account a first point for the existence of a universe – into what could it be placed? Sections 4.3 and 4.4 then analyse the definition of Time in connection with the analysis of Chapter 3, arriving in section 4.5 at Time intervals which induce the concept of a relativistic space – one which depends upon a fundamental form of rotation. Sections 4.5 to 4.7 then demonstrate how this can produce a three-dimensional relativistic space-Time volume without the need of a fundamental space into which it is placed. This is then related to Einstein's theories of relativity showing how space-Time provides the factors which led to his discovery. However, this still leads to the human perceptive problem of how we can view space even though the universe itself occupies no volume. This is outlined in section 4.9. As the general principles go beyond any concepts of existence yet imagined, section 4.10 summarizes the whole chapter. Section 4.11 projects the result to an overarching rule for the construction and processes of the Universe.

Chapter 5 transfers the rules for a fundamental causal space-Time to produce a macro-universe, that is, one with stars and galaxies. It should be noted here that due to space reasons the formation of particles and the operations and definitions of force, motion, energy et cetera had to be omitted (see chapter 6). Section 5.2 details the contemporary theory. Section 5.3 takes up the philosophical issues from this theory, following which sections 5.4 and 5.5 explain how the factors of Chapter 4 lead to a Universe which undergoes contraction and expansion epochs. The outcome then explains the solution to the dual problems of why anything exists in the first place and a more complete explanation of how and why we perceive a space around us.

Chapter 6 concludes by emphasizing the views given in the main text that, to understand the universe, it is first necessary to understand and define space and time. Furthermore, no theory can be taken seriously if it rests on undefined fundamental concepts. For example, the standard theory has no definition for space, time, mass, electric charge, force, energy, fields, or matter-waves among others, nor does it explain the mechanisms of, for example, force and motion, nor does it derive its equations from first principles. In section 6.4 possibilities for further research are considered which includes the material omitted from this thesis on length grounds.

CHAPTER 2

The shape of human reason

2.1 Introduction

This thesis is to investigate the failure of physics to find a theory of everything and to ask whether it is even on the correct course to do so. To obtain a full understanding of the nature of the universe, its structure, and processes, we first should understand the position of the human psyche pertaining to science and its place in the nature of things, where I use ‘things’ in the ancient philosophical sense of everything in our surroundings. Our mind-set should not be considered in isolation, but as part of the total make-up of our evolution on planet Earth. Human thought has been subject to many changes in this time, all of which may have influenced our present sapience and thus should be at least briefly considered as possible contributors to our current methods of enquiry. As the genetic background of humans is reasonably stable, we might expect a similar train of development, though perhaps accelerated significantly, in modern times.

Questions on why we are here, how the universe began, how big it really is, or how it works are questions which perhaps everyone has asked themselves at some stage in their lives. They seem to be an inborn feature of humanity. Historians have shown that these questions precede even the most ancient of myths. For example, fertility in all its forms, from the spring growth to the bearing of human children was among the central mysteries of living (Behjati-Ardakani 2016). Many religions, running equal with mythology, were formed to deal with questions of life and death, and therefore beginnings and endings, and droughts, disease, and other catastrophes. Naturally the fundamental beginning of everything, the Earth, the Sun and Moon, the heavens and associated stars followed. But as human language and philosophy developed around these central ideas of ancient existence, the questions became deeper. Humans began to map the transition of stars in the heavens and the peculiar motion of the planets. They wondered what everything was made of. They invented theories and even discussed the logic of theoretical discourse.

2.2 The Beginnings and Group mentality

Nobody will ever know when the first footprints were laid in the quest for an ultimate theory. In fact, the first steps will have been laid long before the idea came to the human mind; possibly before it was even able to reason, possibly before the Australopithecine ape-men. As they roamed the grasslands hunting for food, they must surely have come across large carcasses that could only be carried by the bigger and stronger members of their group while other fare such as berries, leaves or roots were easily handled by small children. Such a concept would have been a step in learning and even cognitive thinking. How many animals will kill prey that is too large for them and then must waste energy standing guard against scavengers? Even scavengers could outnumber the most powerful.

If the group could cut up their meal and carry it back to their lair they would not have to hunt so often. The idea of sharing work according to their abilities would have been an advance in the animal world. In the dawn of comprehension some being must have moved one step further to consider that size was not so much what counted. Some objects could be large, but a small child could carry them over large distances, while others were small but only a full-grown man could pick them up. And then he might only walk a short distance before his arms became tired. He might have added a new grunt to his language to indicate the idea 'heavy' and followed this later by the idea 'weight' as a comparison between objects. Like the universe, nothing is stationary in time, everything evolves including human ideas.

The search for an ultimate theory should then start with the development of human sapience over the ages, for it is only from the human mind that such a theory can evolve. Even if one were to consider the theistic concept that such an explanation can only come from God one must accept that it has to be in a form humans can understand, and thus evincible within the human brain. Either way, the human mind and language has an enormous role to play as it is both triggered by our personal perceptions of the world as well as by other peoples' ideas, in particular those induced through education. Thus I start with what little is known of primitive religion and mythology. Here I am not so much interested in the stories themselves but the genetic background (survival of the fittest) and certain psychological factors that led to human creation of these stories.

The earliest known written mythology, from Sumeria, dates to around 2500BCE. However, mythology must assuredly have been alive much earlier than this date as rock art from the Indonesian Island of Sulawesi has been dated to about 44 000 BCE (Aubert et al, 2019). The art of the Lascaux caves about 17 000 BCE is well known and more recently from the Maltravieso caves in Spain dating to about 64 000 years ago, both assumed to be Neanderthal. Rock art animals are believed to have been used symbolically to bring good luck in hunting. Myths can be of many forms: they can refer to historical events such as earthquakes, floods, volcanoes, disease; history of the tribe or great tribesmen generating them; lessons of morality and behaviour; or the creation of the world, in most cases in association with water as the primary life-giving force. Even the plainest of water left outside and protected from visible intruders could suddenly be found full of tiny living creatures; bare earth would suddenly sprout plant-shoots when watered.

The Sumerians believed there existed an initial primeval water, Nammu, who gave birth to Ki and Anu, Ki being the earth and Anu (An) the chief god and ruler of the sky and rain (Ions 1974:10), and his subordinate chief of the earth and wind god Enlil. The wind brought rain and fertile land, but it also brought destructive dust-storms and locusts. As far as can be ascertained Anu and Ki had children: Enki (god of wisdom), Enlil who married Ninhursag and various others who all interbred to produce a pantheon. This is not dissimilar to Egyptian mythology of approximately the same age, around 3000BCE in the first dynasty, as pieced together from archaeology. Again, there was a primordial water, an ocean called Num that filled the entire universe. From these waters came the Ogdoat, or eight first gods which included Amun and Amunet, and Nun and Nunet (Brier 1999). These gods represented chaos from which Amun created himself on a hill that arose from the water (in relation to the observation plain water could inexplicably produce living creatures). He then created the other gods who married or had other relationships to produce a vast array of gods and goddesses.

Chinese mythology is somewhat different. It was based more on venerating ancient rulers (Ions 1974:178), the first of these being Fu-hsi (Fuxi), about 2850BCE, who unified the tribes from the chaos of petty wars. Creation theory was of less importance, and not well recorded, being passed down only by word of mouth. As its first references appear to be from around 1200BCE, it was possibly a later addition to satisfy evolution in human curiosity. It believes the earth grew from a cosmic egg, P'an-ku (Pangu), which split into a light part, the sky, balanced by the heavy part, earth – the concept of yin and yang or balance between all things. Fu-hsi then became interpreted as the father of humans and it was his divine duty to keep harmony against chaos.

Passing to the Americas, mythology is much more recent, but this is expected because it seems certain that humans did not populate them until about 8000BCE. Due to the lack of writing materials, the earliest records are only from about 500BCE in the form of wood and stone carvings or textiles and seem to be more of a history than mythology. The inhabitants appeared to accept the existence of the earth and cosmos as a fact rather than questioning its creation. Consequently, their myths centred on the geological structures, animals, and plants they found around them, or the winds and weather (Boas, F. (1914).

In any case an overview of the Americas is difficult because the continent is broken up into many regions and tribes. Where divine intervention exists, it is often of the form of three deities: the power above, the earth-mother, the trickster. A super deity, such as Viracocha, does appear in some areas but where such a deity deals with the heavens it seems to have been more of the form of finding reasons for the sun, the moon, and star configurations to exist. Some regions also worshiped the sun. Death was not certain as in many areas the spirits of the dead passed into their surrounds. In North America the myths, or folklore, were passed on by appointed story tellers which helped to bond each village with its own identity (Ions 1974:220). Longfellow's (1855) Song of Hiawatha reflects exactly the sort of stories that might be told and exhibits a summary of everything suggested here. He also stated the stories come from the animals and plants themselves.

Thus, there are some similarities and some differences throughout the earth's early thinkers. But they all reflect a view of the human mind at its earliest known workings, and they had a far greater value than just being plain stories. Myths formed a religion that shaped people into social groups necessary for effective existence against external forces, much as wild dogs and hyenas form packs under a leader. This pack mentality is fundamentally a genetic trait established through survival of the fittest. The ability to speak allowed the pack-leader to establish rules, often in particular reinforcing his and his offspring's position (Masse et al 2007:24). It produced over time a fundamental culture, sometimes explaining not so much how, but why events occurred, particularly those associated with death and destruction. But it also produced ways of avoiding such catastrophes, at the same time providing rules by which to live that could be transmitted from generation to generation (as in the Song of Hiawatha). It provided a sense of security and acceptance in the group not only for the present but in a hoped-for future. This was a significant role for the leaders helped by people of experience, often elders. Knowledge of 'why?' should lead to principles of avoidance. As the psychologist Gabriel (2021) says, beliefs lead to feelings of security 'guided by emotion'. But leaders could not avoid death. But they could induce the view they belonged to a group of immortal leaders living in the stars, or they were in the first place born in human form from the gods. Gods provided the continuity against final disaster. Such ideas would stabilize the reign of a leader with trust in their decisions. The strongest societies were those with strong beliefs.

The concept of gods would prove useful to give continuity to an unstable world with its beginnings and particularly endings. For example, the sun with its life-giving warmth rises and sets day after day. What if it failed to rise? If controlled by an immortal god, it is guarded from final disaster. But then, are the gods related to human actions? Humans carry out acts of aggression, revenge and appeasement so why should the gods be different (Masse 2007:19)? It would, in any case, be in the tribe-leader's interest to instil this view. Consequently, the gods must be kept both happy and appeased for supposed transgressions. Human sacrifice seems to have been rare except in South America where it was carried to its extreme by the Aztecs – the rain god Tlaloc at one time requiring sacrifice of a thousand children. Sacrifice of enemies served a double purpose, they (Aztecs) thanked their god, Huitzilopoctli, the Aztec war god, for victory, and at the same time sent their captives to an honourable sojourn in the afterlife. While human sacrifice also occurred in other South American groups, the Maya and Inca, it is not certain whether it occurred elsewhere on earth, though the possibility is certainly referred to in the Bible (Abraham Genesis 22). Roselyn Campbell (2019:

52, 56, 72) suggests there may be instances in China (5000 -2000BCE) and again during the Shang dynasty (1600-1050BCE); in Mesopotamia (2600-2450BCE) and Egypt (1070-712BCE), the last two being the possible slayings of servants on the death of their royal masters to wait on them in the afterlife. Personal sacrifice was another matter. Individuals learnt that honour in the afterlife came to those prepared to give up their lives for survival of the whole; reinforced strongly by Jesus in Christian religion and Abraham's preparedness to sacrifice his son in the Hebrew faith (Genesis 22:11-12). Thus pressure was imposed for individuals to think of the good of the whole by keeping to the prevailing mythology; where I interpret mythology as being social norms engrained in the many by the many.

A leading god was a necessary concept to reinforce the leadership principle in humans. The need for a leader is a basic human need for security of mind as can be seen in times of stress and war when a leader, however unacceptable he may have been in halcyon times gains popular support so long as he leads. A chief or king of gods then reinforces the concept of a living chief of a clan especially if he is considered to be divine and will take his place among the gods; or as became the norm, to be the gods' representative on earth – the divine right of kings which came to a close in the United Kingdom with the end of the Stuarts.

The lesson is that, although a tyrant can enforce his rules, the overall group view is one of belief. If humans were completely free there would be perhaps as many ideas as people, tugging in different directions with little achievement. As with animal packs, group action, co-operation, is an effective way to meet adversity and to maintain survival of not only the group but oneself. "Belief is our guiding star. Believing in something is an act of commitment guided by the emotions and solidified by habit and repetition" Gabriel (2021). As James (1897) argues: with difficult arguments our emotions decide. Belief is then not a guide to truth, only to co-operation, an innate form of peer-pressure.

With a lack of formal education, those able to write and calculate had a higher standing in the group. Consequently, it was in their interests to maintain the ruler system with the working lower class merely following the educated leader's directions. This led to stability and in this sense happiness as every person knew their place and worked for the good of the whole. Thus the social group was largely cohesive. With the hunter-gatherer groups there was little need of formal education as children naturally learn from the actions of their parents. Modern young children enjoy bedtime stories and fairy tales which one can imagine would have instilled in primitive groups their current folklore. But as populations grow, they need to harmonize so that the group mythologies become closer to a binding religion, especially in the rise of cluster living such as larger villages and towns. This could only be in favour of the leaders to install group rules of living and settlement of disputes.

Children learn at an early age, sometimes through fighting and bullying, that cooperation usually works better than antagonism. If not, they end up in various degrees of punishment. Thus, group mores are established as a natural process with little formal education but, as the towns turn to city states and rival other cities to build empires, individual group beliefs have to merge with others.

Here we see a difference with Egypt in that the Mesopotamians and Chinese had become mainly city states forming empires (Overy 2004:68) rather than unified nations. However, Egypt emerged around 3100BCE with the upper and lower kingdoms combined under the one ruler demanding a larger administrative base than those of the Mesopotamian area. A slightly different structure was then required with the area being divided into regions under supervisors appointed by the Pharaoh. It needed a widening class structure: the ruler, advisors, upper echelons, scholars, artists, middle business classes, and workers. The pharaoh's business was to defend the region and to ensure that chaos was prevented through a system of balances (ma'at, similar to the Chinese disposition of yin and yang). Nevertheless, the mythology of Egypt from the philosophical-psychological point of view was probably little different from that already described: reinforcing the feeling of belonging and safety in a group.

There is, therefore, little to be added to the thoughts of maintaining the group system until the Greek ideas of democracy took shape around 500BCE, which allowed a new understanding of the world and society to arise. It is the written works that have survived. They reinforced the burgeoning Christian religion forged out of rebellion against foreign empires. Democracy presented the freedom to investigate new methods of survival in a social world.

The question arises why the ancient Greeks broke away from the ancient traditions to produce one of difference of opinion and debate. It seems to be accepted that it originated with the Greek philosopher Thales (c. 620-545); but very little other than references made by Aristotle is known about him. He is attributed as being the first to consider the composition of natural objects with the idea that water was a major element of everything, to which his pupil, Anaximander, added another element: air. However, Thales is said to have studied in Egypt, so it maybe that he either followed, or was influenced by Egyptian thinkers (Letseka 2014), and it was the written works of the major philosophers from Greece that gives the impression of a change in thought being theirs.

On the other hand, it may be that the Greek city states started to rise at a time when the Persian and Assyrian empires were at their peak. As a result, the Greeks had to be strong warriors to exist independently, with a consequent reaction against Mesopotamian ideology. The two main city states were Sparta and Athens both of which considered education of their citizens to be of major importance to their survival. The former was possibly the first state to introduce state education (around 700 to 600BCE), for both girls and boys; but there was to be a notable difference in Athenian education. The Spartan system was against change or independent thought, and primarily to build up fighting character in patriotism and service of the community (Petraki 2010:71). The best students became the leaders (Petraki 2010:72). Due to the military training literacy was ignored. Nevertheless, Sparta was the first state to use education in support of its social system (Petraki 2010:73) which produced an exceptionally strong and well-motivated army well able to defeat assaults from the Persian and Assyrian empires. Athens, seeing the value of Spartan schools followed (50 to 100 years later) but with a much wider system based more on the concept of attaining wisdom than the ability to fight.

Both Athens and Sparta were fundamentally two-part states consisting of (free) citizens and non-citizens. However, Athens had established a council of citizens to vote on prominent issues. The main departure from previous ideologies was then the freedom of thought and consequent philosophical debates on both ethical and scientific subjects (though science at that stage was far removed from the principles that started with Bacon and Galileo). Nevertheless, this freedom of thought was mainly inspired to attain a majority decision for the good of the group – the concept of democratic rule. Education was then an important part of citizenship for the art of government. Wisdom, the development of current ideas, unlike Sparta, became a fundamental aim.

> The task of philosophy was to educate the citizens in practicing their ethical en [sic] political skills. The Greek citizen gained awareness of his individual ethical being through his awareness of the limits of the universe, guarded by gods, destiny and social structures (Müller 2016:14).

The male citizens were trained in the arts of rhetoric, reading, writing, mathematics, philosophy, music, and gymnastics (sport), the extent of their learning depending on the wealth of their families. The non-citizens were mostly slaves or peasants; girl citizens were only educated in domesticity.

Up to the age of 16 education was private depending on the wealth of the parents, though within certain government rules. Afterwards the young men attended state gymnasiums tending to athletic abilities with attached schools for development of rhetoric skills run by fulltime philosophers, among them Plato and Aristotle, thus breeding a search for truth to replace past myths.

Both the Athenian and Spartan education contrast to the other nearby regions. Sumerian education mainly produced scribes obtained from wealthy families. Royalty instructed their own children. Egypt was mainly parental with fathers passing on their knowledge to sons, and mothers teaching domesticity to girls, although rich girls were also formally taught to dance and sing (Zinn 2013:1-2). Most adults were illiterate, only the elite males had some education – in the subject of *ma'at* by priests. Severe discipline to maintain cultural uniformity was maintained in both Egypt and Mesopotamia (Brier 1999:33). All of these together with Sparta, despite its schooling which was to maintain the concept of strict discipline with no thought of variation, thus maintained the old mythology. On the other hand, all of them, including Athens were aimed at sustaining the identity and lifestyle of the individual group.[1]

This, of course, does not say how earlier groups performed but I shall mention in section 2.4 that mathematics, as an ability to record or even calculate, could have been in existence as long as 45 000 years ago. There should be little reason to doubt, then, that similar forms of story and beliefs to the above would have existed at least that long ago. Consequently, the reliance on group culture and companionship with a similar reliance on leaders and contemporary knowledge is a major part of the human psyche. It possibly has a far deeper effect on our perceptions than observation of our surrounds. In particular, the comparison of different areas suggests it is an inborn trait that has grown in strength over the ages as the human population has grown. This increase has led to innovative ideas, as with the Grecian advances, paradigm changes as Kuhn (1970) would say, which then are followed in the sense I have described above – though perhaps with some reluctance (delay) to change as would be expected.

Keeping the above background in mind, I shall now move on to examine fields of interest to contemporary eyes. This must, of course, start from the ancient Greeks because that is where physics started: physics being the underlying theory for all science, be it chemistry, biology, or industrial design/architecture/psychology. The next section will thus consider the main groups starting first with philosophy, then mathematics and finally physics.

2.3 Philosophy

Contemporary philosophy covers many subjects including ethics, theology, politics as well as the nature of things. As stated in Chapter 1 the basis of Western philosophy started with the ancient Greeks following through to Aristotle (350BCE) who could be said to have laid the concept of science, though it remained to Galileo (1632) to separate it into a discipline by itself.[2] The difference between philosophy and science, as it has become in the contemporary world around us, is that

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[1] China started state education about 500 years earlier, but philosophy started with Confucius (551-479BCE) a little after Thales. I have been unable to find any firm interaction with early Greek philosophy, so China is not included here.

[2] Bernal (2001) has disputed that the basis of western philosophy arises from the Greeks, but this seems to me irrelevant to my thesis, as his thesis is based on the question of where the Greeks (Hellenes) originated (Afro-Indian). The fact is that Thales changed the course of philosophy as developed in western world irrespective of the origins of his antecedents.

science relies on creating and testing its theories by experiment whereas philosophy relies on pure thought.

Aristotle wrote two series of books on the subject, starting his investigation of natural science by considering exactly what I am looking at here: the concept of thought and how to use it to find the underlying truth of our existence – not that he succeeded in finding the truth, but he did launch a method of investigation. This took two forms, starting from apparently known facts.

The part of interest, the fundamentals of nature and existence, falls into metaphysics, 'the after the physics', as ascribed by Andronicus of Rhodes to the series of Aristotle's works, the books A-N (alpha to nu) [350BCE](1923). As suggested by the title, these followed Aristotle's "Physics", books I-VIII [350BCE](1991), in which he laid the foundation of what was to become the subject of science. The limits of knowledge, epistemology, falls more under the title 'philosophy of science' which also considers the physical methodology of experiments and derivation of laws together with their interpretation and application.

Metaphysics was primarily based on observation and Aristotle's interpretation thereof using the principle of reducing generalities, whether these were material or abstract, to specifics (particulars) – a classification process similar to the biological system of phyla, orders, classes, et cetera. The more important subject, in his view, was the philosophical extension of the second set of books (1923:A-N) in an attempt to determine the overall concept of existence: what he called first causes, or 'first philosophy', the ancient equivalent to the modern 'why does anything exist in the first place?' As Aristotle makes clear in the opening of book 1923:A, his so-called 'metaphysics' should be distinguished from his 'physics' as knowledge should be distinguished from experience. The latter is of little value without knowledge – "For men of experience know that the thing is so, but do not know why, while the others know the 'why' and the cause". And he goes on to say "the most universal, are … the hardest for men to know; for they are farthest from the senses" (1923:A1). He links these to first principles as being the "most exact of the sciences" (1923:A2)[3] and relegates those dealing with what we would call physics to a lower place, that is, below metaphysics. This is as it should be because physics cannot prove itself from its own laws. The first principles then become the most important knowledge as everything else follows from these.

An excellent example of what Aristotle means, that will form an important part of this journey of philosophical exploration, is that of time. If one looks through the literature, which I will come to

[3] Van Inwagen &Sullivan [2014:1] point out that Aristotle uses first science, first philosophy and wisdom interchangeably.

later, there is no definition for time. Here, we must distinguish between two especially important fundamental concepts as questions: ‘what is it?’ and ‘what does it do? For example, time is usually measured on a clock though, of course, it can also be measured in terms of days or revolutions of the earth around the sun (years) or between full moons as often done by ancient humans. The question of what time is, is often answered by ‘something that is measured on a clock’. That measurement is only a property of time. It tells us that some mechanism causes a change in the hands on a clock, that is, it gives us a property of time – the ‘does’ part – though it is the spring or battery that runs the clock that causes the motion in the hands. But why should this spring or battery manifest these intervals of time? The clue to the problem lies in the answer: the ‘*something*’ that is measured. What *is* that something? Even if we go to high precision caesium clocks run by atomic vibrations as an electron constantly changes from one state to another, we must ask why there is an interval between the vibrations? That is, why should there be an interval in the first place? What is so special about this thing we call time that is somehow responsible? Philosophers consider this as the essence or *qua* of time. So, returning to Aristotle’s difference between experience and knowledge, what time does – causes intervals – is easy to say, but the ‘why or is?’ is far harder. I will provide what I claim to be the first ever definition in Chapter 3.

Unfortunately, it is extremely hard to define metaphysics as it has expanded somewhat beyond Aristotle’s original work, so much so that even philosophers cannot agree on its range. It may be easier to describe it from what physics does not consider (section 2.5). Its most fundamental form must obviously be the form of arguments raised by Aristotle ([350BCE] 1991 184a17-21).

> … we do not think that we know a thing until we are acquainted with its primary causes or first principles, and have carried our analysis as far as its elements. Plainly, therefore, in the science of nature too our first task will be to try to determine what relates to its principles. … The natural way of doing this is to start from the things which are more knowable and clear to us and proceed towards those which are clearer and more knowable by nature

This means categorizing observations of objects “from universals to particulars”, that is, from something that is generally true of many things to something true of only one thing – similar to the contemporary biological sequence of grand phyla down to orders, families, genera, and species.

His second consideration was in the use of contraries to facilitate arguments to attain the reductions. Thus ‘is’ and ‘is not’ are contraries but this may depend on the context. For example, time may refer to spring or winter but not all springs represent the same time in terms of this year, next year, ten years ago. Or two things may be in motion together so that they are not moving one from the other, but they are both in motion relative to other things. This form of discourse is still applied in philosophy courses today as an introduction to reasoning.

By these methods Aristotle was perhaps the first to aim at discovering the *cause* of existence, and the universal structure, even if only using purely deductive philosophy rather than experiment. It is at least the first known literature attempting some form of logical exposition. As a result, his ideas ruled Western religious thought for nearly two thousand years. Some of these ideas are a little peculiar to human views today, but nevertheless they represent an honest hunt for knowledge. Some, possibly starting with Empedocles (c. 450BCE), believed everything was made of four elements, Earth, Air, Fire, and Water. Perhaps not surprising as these must have been among the most primitive ideas discussed by the earliest thinkers as they sat around their fires at nightfall, be they ape-men or hominids. Not all philosophers shared this view. Leucippus (c. 430BCE) and Democritus were the first to propose the idea of an atomic structure, but this fell away under the views of Aristotle (1923 :138 225a24-255b31) plumping for earth, air, fire, and water, with air and fire by being light in weight having a natural tendency to move upwards while earth and water would tend downwards.

Nevertheless, the cause, or first principles, then became the most important quest for knowledge as they should answer the basic concept of ‘why?’ – that is, assuming that the universe has a root cause, as the ancient mythmakers must have intuitively believed. Everything else would then follow from this cause. Together with Plato’s views these could be transferred directly to Christianity, the causes of which I need not go into other than saying it arose at a time when part of the Roman Empire wished to throw off its yoke. When leadership falls out with the needs of the group, the group will look for another course.

This Greek philosophy was what Kuhn (1970) refers to as a paradigm change, that is, a complete redirection of human thought. Its, neo-mythology, philosophy, held for nearly 2000 years before the next change.

Bacon wrote in1620:

> It is not true that the human senses are the measure of things; for all perceptions—of the senses as well as of the mind—reflect the perceiver rather than the world. The human intellect is like a distorting mirror, which receives light-rays irregularly and so mixes its own nature with the nature of things, which it distorts.

These distortions are due to the individual’s upbringing, tuition, reading, particularly of authors the individual admires, and his environment. (Of course, these will have all changed from the first rays of mythology, in particular with language, especially true now with difficulties over precise meanings of words in an ever-increasing science driven complexity). What Bacon ([1620] 2017) said is as true now as in 1620. He referred to rules and laws, a (falsely) believed order and regularity in the world; supposed proofs of facts from single events. He called all these mirages "idols … that beset one's mind": Idols of the tribe – errors in human perception; idols of the cave due to an individual's upbringing and social contacts; idols of the marketplace – difficulties with impreciseness of language; idols of the theatre – entrenchment of human derived dogma. These are very much views I had in mind from an early age when thinking of the universal structure before I heard of Francis Bacon.

Locke (1690):28§2) was later to add what is somewhat a condemnation of the dogma that had held sway for those 2000 years: "But because a man is not permitted without censure to follow his own thoughts in the search of truth, when they lead him ever so little out of the common road, I shall set down the reasons that made me doubt of the truth of that opinion". They, taken together with those of Bacon are fundamentally the start of the branch of philosophy that has become known as the 'philosophy of science'. Here I include metaphysics for the sake of discussion although the two are usually considered separate by philosophers.

To grasp the relevant current philosophical principles, we need to look at some of the writings of more recent philosophers. They lead to several important considerations in attaining an overall theory of the universe. For example, Lowe (2002) is an 'essentialist' believing that metaphysics deals with the essence or nature of things – what it is to be. As a result, he contends metaphysics should be used as a science (2002:1) in its own right, by analysing classification as a rational exercise. A point he raised is the thought that an object must have essence in order to exist: "essence precedes existence", although he added it does not necessarily imply the actual existence of a specific entity, Bacchus, for example – his essence is clear even though he is only a myth.

Here there is an element of uncertainty on the concept of essence in the sense of determining an absolutely precise reality of anything – what Locke (1690) attempted to define as 'the very being of any thing, whereby it is, what it is'. Aristotle ([350BCE] 1991 Book1§1-3), for example, puts his finger tacitly on a problem in his opening of arguments in physics, using whiteness as an example. He argues that whiteness depends on the view of the beholder and should not be attributed to the concept 'is' as if it is a property of nature. In this case whiteness could not be an essence of a given thing if the thing could also be blue or yellow. From here one can see that it is possible to go round and round in circles by developing the subject of the whiteness of an object depending on the context of its use. This is somewhat equivalent to the Duhem-Quine thesis raised more recently (Duhem [1914], Quine [1955])[4] known as underdeterminacy which should, in the contention used in this thesis be, in fact,

[4] See Stanford, K. 2021. "Underdetermination of Scientific Theory", in: E.N. Zalta (ed). *The Stanford Encyclopedia of Philosophy* (Winter 2021 Edition) in Bibliography.

indeterminacy. This thesis questions whether scientific experiments are complete because they must include assumptions about the background to the test. A good example of such a problem arose in experiments by Michelson and Morley (1887) in determining whether an experiment involving the passage of a wave of light in an interferometer could be affected by passing traffic on a road outside their laboratory thus possibly invalidating their results. (They took extraordinary precautions to avoid the possibility). The Duhem-Quine argument then implies that we cannot know with certainty that any belief we establish by observation is true to nature. As far as Aristotle is concerned, however, the whiteness of the object is real to the beholders – a crucial point in the human view of the ‘reality’ of observation in our minds. With more recent knowledge it could be described in terms of wavelengths: but again, context plays a role – do all animals see it as whiteness in view of the fact that not all animals have the same perception of colour as humans (Gerl and Morris 2008)?

Such arguments *are* important to full understanding of nature. Consequently, I shall develop this vein a little longer.

For example, returning to Lowe: essence goes further than knowing an exact structure such as water consisting of two hydrogen atoms combined with one oxygen. That certainly is incomplete from most peoples’ knowledge of water. In fact, it may be that there is no perfect description that can say everything that many minds might suggest. One could carry on detailing every attribute of water and possibly attributes of those attributes. Again, for example, we know that everything is made of atoms, but what are those made of. Heisenberg (1927) and Schrödinger (1926) would say they are made of vast numbers of waves, but then I would ask, define these waves. They could tell me some things the waves could do but not exactly what they are (see sections 2.4 and 2.5).

The problem of this philosophical form of uncertainty was first raised by Hume (1739) and then Kant (1781-87). It is well worth looking briefly at their arguments because they bring us to the fundamental dilemma (of knowing the universal structure); an argument that perhaps is the most fundamental problem in both philosophy and science; one that is essential to the direction of this thesis in understanding the basic structure of the universe, and thus, perhaps directing a finger at the reason for our failure to yet understand the universe.

Hume ([1739] 2017:13-14 Book1,iv) pointed out that all our thoughts are formed by our perceptions. *A priori* assumptions, of the form raised by Aristotle – as Hume called them ‘hypotheses and systems’ – should be removed from philosophic thought: “All the laws of nature and operations of bodies can be known only by experience”… “our *a priori* reasonings will never reveal [the laws of nature]". That is, we only have our perceptions from our surroundings which may be completely different from what lies underneath. Now we believe in atoms and molecules, which we cannot see, and which quantum mechanics declares are made of matter-waves with only a probability of producing our views of the world we see – admittedly with a remarkably high probability (see section 2.5 physics for a description). But it is a common view that our science is founded upon concepts that have no absolute definition. Therefore, they must be open to suspicion (as will follow in the section on physics). (Einstein refused to accept the proposals of quantum mechanics and tried to find some better mathematical construction even on his deathbed).[5]

Almost immediately Kant ([1783] 1902:endnote) put forward a partial answer that our knowledge in fact consists of two forms: that being empirical, meaning what we observe, and that which we can deduce from those observations to give a "synthetic" view of why they should arise; cause and effect. Our perceptions would then become a mixture of the two. Hume ([1739] 2017), used (to explain his reasoning) the concept of two billiard balls: if one were projected to strike the other with some force, what would be the result? He suggested we could not know *a priori*. However, Kant's ([1783] 1902) synthetic knowledge built from mathematics would suggest that at least the second ball would be induced to move. Thus we would have some idea of a preconceived result.

However, as De Pierris and Freidman (2018) point out, there are obvious, strongly debated problems over whether Kant's attempt to "remove Hume's doubt" is as clear as Kant assumed. They point out that Kant believed that metaphysics as a science depends on his "synthetic judgments" and that this has proved a major problem for the concept of metaphysics.

The point is that the synthetic reasoning does not necessarily explain everything. For example, using Hume's billiard balls, why does the striking of a second ball by a first ball cause the struck ball to move? We may, using contemporary physics, assume that the first ball contains momentum, whatever that might in essence be, which is passed to the second. But it does not confirm that momentum is an absolutely defined concept giving no other possible explanation of the expected result belonging to our intuition – that the second ball will respond in a given way. We therefore still cannot escape the problem, by Kant's reasoning, or any other reasoning, that we have no *a priori* knowledge of the outcome. We only have an intuitive explanation based on our perceptive experiences. Snooker players believe, as they have never observed the opposite, that if they successfully cue their ball in a particular way, the hit ball may move off quickly, or slowly, and their striking ball may stop dead at the point of impact, or move on a short distance, or even reverse its direction of motion depending on how they direct that particular strike. They can give supposed rules

[5] E.g,. see APSNews https://www.aps.org/publications/apsnews/200512/history.cfm.

for this action, but why or how the force applied to the particles making up the cue and balls works is unknown to contemporary physics. Only the indirect cause of the player taking the decision to put a particular spin on the struck ball is known. Even that may be in doubt; for example, a spectator cannot be sure, even if the player asserts it, that the outcome of the strike is exactly as the player wished. Hume, despite Kant's assertion, therefore has some validity in his view.

From these last few paragraphs, it is not clear where philosophy, philosophy of physics, or metaphysics stops and physics begins. Consequently we cannot be clear at this stage about the role mathematics and physics are playing or should play in the scheme of everything. Are they real players or human invented bystanders unable to determine an overall theory? I opened this chapter with Aristotle's metaphysics and his argument that it should be distinguished from physics as if metaphysics were the more profound treatment of the world around us – which would place physics as a mere bystander. Before we can consider any conclusion of the relative importance of either, it is necessary to consider the philosophical background to mathematics and then physics. The role metaphysics is to play will then become clearer as will my determination of its function in the human mindset.

2.4 Mathematics

Mathematics has been exposed to a great deal of philosophical debate. It is therefore important to see what affect it has, and has had, on our mindset. It is all very well to explore mathematical theory to extremes, but one should keep in mind the question whether these theories fit the universe and explain its fundamentals, or are these explorations more of a mathematical game or challenge to human sapience. Much has been written in text and popular books on these theories so that I need only explain in the briefest terms the scholastic elements. Therefore, I shall concentrate on the philosophical aspects and its effect on mathematics' place in the structure of things including the direction of human thought and its subsequent role in physics.

It is not clear when mathematics was first formed as a discipline, but documents and tablets have shown that both the ancient Egyptians and Mesopotamians had knowledge of geometry around 3000BCE. Two papyri from 1890BCE and 1650BCE, thought to be teaching documents, are known with problems in the use of fractions and algebra. Multiplication tables were also in use. The Egyptian number system was based on tens with symbols up to a million. The Mesopotamian (Babylonian) system was based on 60, with the 24 hours to a day, 60 minutes to an hour and 60 seconds to a minute, though why 60 was a chosen base is unknown (Imhausen undated). They also employed multiplication and division tables. However, the concept of number was probably invented earlier than 20 000 BCE, which is the estimated age of the Ishango bone carrying a large number of notches in three columns suggesting possible calculations formed on a base 12 number system. There is, also a recently discovered older notched bone, possibly a tally stick, from the Lebombo cave dating to between 35 and 45 000 years ago but it has not yet been decided whether these marks represent numbers or decorations (Pletser 2012). Nevertheless, it shows that the concept of quantity and possibly mathematics was understood long before the Egyptians or Babylonians. Comments are sometimes raised on the way numbers seem to conveniently add and subtract but as said in section 1.1.2 it is nothing more than the definition of sounds or symbols based on 1; 1,1; 1,1,1; … which humans have defined as one, two, three, with for example, three being split to 1; (1,1); (1,1),1; = 2+1 which degenerates into 1,1,1 which can be separated into 1,(1,1) = 1+2 which by inference can be deduced to the commutative axiom.

It seems obvious how we came to these definitions. They would have become essential from the earliest days of animal sapience. Nine people in a group might have needed nine rabbits for food – one finger less than the number of fingers on the hand of the leader of a hunting party. (Or three knuckles less than the knuckles on a single hand if base twelve is used). From there it is a short stage to making marks on a stick or bone, adding or subtracting to detail how many arrow heads were traded, and so on. Fractions would have developed equally easily through cutting food into parts to serve to the family. Simple thought would have led to the basic axioms without the need for formal deduction, though this would have come later – which is just as well because, as mathematics has developed, some of these rules have to be carefully amended to cover the developments: for example, in matrix theory where if A and B are matrices, A×B is not commutable in general.

Ancient Greek geometry is well known through modern school lessons. Euclidean geometry relates to the human perceptions of an apparent three-dimensional rectilinear space which can be represented by three orthogonal axes used to form a coordinate system. A plane is intuitively described as a two-dimensional space in which any two intersecting or touching straight lines lie. However, an extra straight line does not necessarily lie in this plane unless it connects the original two lines or an extension of them. It is furthermore possible for a line to exist perpendicular to the plane. But in fact, none of these concepts should be taken as anything but intuition because it assumes the universe is actually three-dimensional. We must first settle the, yet unanswered, question in contemporary physics: why does the universe appear to us as three dimensional? It is similar to some questions that will arise later the nature of a line: what is a line? Is it a collection of points, or a collection of short lines? In either case is the number of these parts forming a line infinite? For example, if the line is thought of as made of a number of short lines, then can each of these short lines be divided into shorter lines and so on an infinite number of times? If not why, and how, do you prove it?

The ancient Greeks also rested on the concept that if two lines crossed in such a way that any two of the angles formed on one side of those two lines were equal then all the angles would be right angled. It seems to us as true because we have been taught it is true and it looks true, and it works for engineering and architecture. But it assumes the continuity of a straight line and the absolute nature of a three-dimensional space. If we live, as is possible, in a huge, curved space then an element of scale would become important as can easily be seen with curved longitude and latitude maps of the earth. On a small scale circular map, the crossing latitude and longitude lines are clearly not right angled although as the scale increases the lines come closer to being right angled. A square on a plane is a quadrilateral with equal sides and four angles being right angles, therefore adding up to 360°. But consider a quadrilateral with four equal sides and four equal angles drawn on a sphere. It is possible for this quadrilateral's angles to all be equal and of magnitude, say 120° thus adding up to 480° (SLU 2016)[6]. (And a quadrilateral on a saddle would add up to less than 360°). Returning to the question of a line: a curve can be described as a series of connected infinitely short straight lines, say between atoms, but should the distance between the atoms be described as straight or curved? So, we cannot be certain that Euclid's theorems are true under all circumstances, especially as we do not know under what circumstances our world exists. So I can legitimately argue that a square is only right angled if it is on a plane in flat space. But, in view of Einstein's general relativity and curved space-time we do not know whether we live in a Euclidean space with flat planes. So, we humans, despite the availability of generalized coordinate systems, cannot be certain that our mathematics could in fact reflect the universe because we cannot be certain of a metric at the smallest scales. These thoughts may not seem important for engineering design, but it is important for rules about the micro-universe. Mathematics only functions within its rules and I shall point out throughout this thesis that these rules lie only within the bounds of human perception and may not be sufficiently flexible, or wide enough to deal with the universe as a whole.

The building of theorems in an assumed three-dimensional space is comparatively easy but in a curved space it is notoriously difficult. Astrophysics is mostly built on curved space requiring advanced university level Riemannian mathematics for which only simple solutions to its possible equations have been established. The average person only experiences simple Euclidean (rectilinear or 'flat' space) geometry and accompanying trigonometry. The latter is built upon the concept of similar triangles of varied sizes allowing ratios of triangle sides to be related to angles between them (for straight lines – not curves, for which spherical trigonometry is required). I am now going to give a simplistic explanation of trigonometry, the reason for which will become clear.

[6] SLU Saint Louis University.

Trigonometric functions can be represented by waves. As an analogy think of the second hand on a clock: it starts at zero hours, it passes through a right angle at 15 seconds past the hour, then to two right angles at 30 seconds past the hour which is equivalent to a straight line from the starting point at zero to 30 seconds. Then it moves again on the left side of the clock face, as you look at it, through another right angle and finally ends up where it started. If we define a right angle as 90 degrees, then it passes through ninety to 180 degrees completing the right side of the clock. This can be represented graphically (by marking the position of the tip of the second hand as it passes round the clock face, see Figure 1a) using two axes to draw a wave representing the angle on the horizontal axis against the time it takes to get to a specific angle along the vertical axis. This is the same as observing the position of the tip of the second hand and plotting that on the graph. At zero time the angle is zero, at 15 seconds past it reaches the maximum width horizontally equivalent to 90°, then to 180° where it meets the vertical line again which also represents no angle or zero. After that we can continue the process differentiating the fact the angle formed is now on the left side by drawing the wave on the left-hand side of the vertical axis until it returns to zero after 60 seconds. Then we can repeat it again and again as the time runs from one minute to two minutes and so on. The line we have drawn on the graph looks like a wave in that it is a set of semi-circles as in Figure 1a. But the angle of the clock hand can also be represented using Figure 2a which gives the angle subtended at O as a ratio of the radius to the distance above the horizontal line.

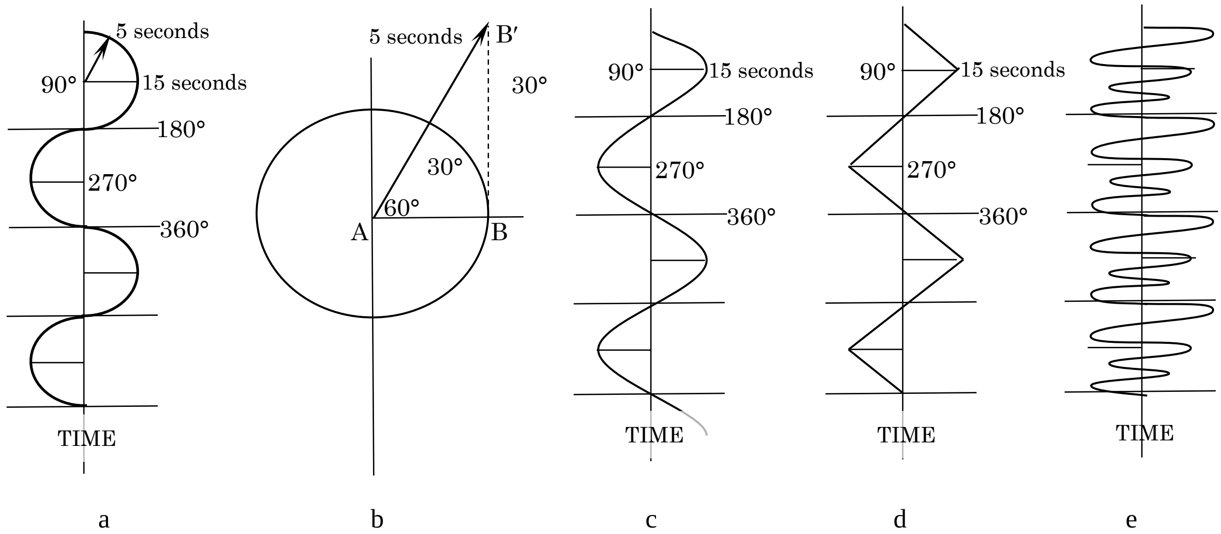

Figure 2.1. Wave-forms

This ratio is independent of the size of the radius as the distance above the horizontal intuitively varies in accordance with the change in the radius. (It can be *demonstrated* geometrically using similar triangles but, as queried before, a *proof* depends on the nature of a line and the idea of straightness. This may seem pedantic but is in fact of fundamental importance).[7] Consequently the ratio allows us to calculate the lengths of all sides of a given triangle if the length of one side is known. Thus, looking at Figure 2.1b, if the triangle represents the side of the hill and we know that the distance between the two points A and B marked on the diagram is 200 paces 'as the crow flies', we can almost intuitively tell that, if B represented a house on a steep hill at an angle of 60°, the distance we would have to walk would be 400 paces. That is, the ratio of AB′ to AB is 2:1. Reversing the ratio gives what mathematicians define as the cosine function value for 60°, or sine value for 30°. This would correspond to the value given in Figure 2.1c for the clock hand having moved through 30° in 5 seconds. The collection of all the ratios as, in Figure 2.1b the angle at O changes, is the sine function which forms a progressive wave as the angle changes through many right angles, as in Figure 2.1c.

As I said, this may seem a rather simplistic explanation of a high, or even junior, school mathematics lesson but it is not to explain trigonometry as such, it is to point out that the relationship between the sine function, or any other basic trigonometric function, fits in with our basic intuition. It is the intuition that is the important concept. We are used to such perceptions which become imagery in our minds when faced with problems. Thus, the concept of a wave and its repetition is not obscure from us. So we take it in our stride without further consideration. But what *do* we mean by wave? And here I am thinking towards the quantum mechanical concept which I hope will clarify the problem of intuition versus definition in physics (see section 2.5).

The simple conception of the semi-circular wave of Figure 2.1a, is just as much a wave as the sine wave. Another shape is a sea-wave, especially as it approaches a shore and gets close to breaking. It is a trochoidal wave which only approaches a sine wave in shape when the two are very shallow. Furthermore, if the clock-wave as described above is drawn by relating its increase in angle of 6° every second up to 90° and then down to 180° as in Figure 2.1d the result is a zig-zag wave. Square waves can also be drawn. Consequently it is necessary to consider the elementary question why sine waves are used when applying Schrödinger's wave theory of matter. Sine (and cosine) waves are easy to deduce and easy to apply for several reasons. They can be easily added and multiplied together to produce variable waves as in Figure 2.1e. By adding a number of waves together (Fourier analysis) any form of repeated wave can be reduced to simple trigonometric functions. If mathematics is taken beyond the simple rational number system to complex number systems to include numbers following from the square root of –1, sine and cosine waves can be expressed in terms of the easy-to-use natural logarithm. They are also easily assimilated by axiomatic mathematics as envisioned by, for example Hilbert ([1899] 1950), who attempted to place mathematics on a completely consistent basis. (This

[7] See e.g., SLU 2016 above.

was shown impossible by both Russell ([1903] 2019) and Gödel (1931) who demonstrated that mathematics was susceptible to the so-called liar's paradox: it is always possible to find unanswerable questions or even statements that can be both proved and disproved. This is similar to saying no theory can prove itself, or deriving the liar paradox that if a liar says he is lying, is he lying or not?).

Hilbert's quest was not a new thought as it was based upon his belief that for mathematics to be fundamentally true it had to exist independently of the human brain and possibly the universe itself. More than two thousand years earlier Plato also had believed in certain divine concepts in the construction of the world. Arithmetic, for example, compelled "the mind to reason about abstract number," which he regarded as useful training in logical argument. Numbers, to him, represented pure truth as did geometry, knowledge of which "is eternal." "… geometry will draw the mind towards truth, and create the spirit of philosophy." Linnebo (2009:§1.2) expressed it as "Platonism entails that reality extends far beyond the physical world and includes objects which aren't part of the causal and spatiotemporal order studied by the physical sciences". Dedekind (1888) who is responsible for the real number system currently in use, had a slightly different concept:

> … I consider the number-concept entirely independent of the notions or intuitions of space and time, that I consider it an immediate result from the laws of thought. … numbers are free creations of the human mind…

In modern terms the view has become, again in the words of Linnebo (2009:§1): "Mathematical objects are independent of intelligent agents and their language, thought, and practices." In Kant's language mathematics is *a priori*. In which case, as Dedekind suggested it should pass beyond the human concept of three dimensions.

Hilbert's project-based mathematics on a set of axioms that could be applied to any number of dimensions thus taking it out of the human perception of a mere three dimensions or Euclidean space. These axioms, such as the transitive axiom, are, in fact, fundamentally intuitive, meaning they exist without the need for thought: "before all thought" as Zach (2019) says. Then, to keep Hilbert's proposal human independent, the operations of mathematics such as addition or division or calculus would also have to be *a priori*. This implies that all its operations should exist without necessarily having a *specific* use – a concept known as 'Formalism' in which mathematical formulae can be manipulated without the need of those formulae to have a meaning. That is, an intelligent being can use these operations for his benefit: for example trigonometry can be used to calculate the angle at which a ladder can be rested against a wall without its base slipping, or trigonometry can be used to calculate the trajectory of a spacecraft, the wind-pressure at a specific point on an aircraft wing, the shape of a hanging chain or the sound of a violin – a disparate list of uses all using the same mathematical concept. Similarly, a simple equation could be used to calculate how many oranges can be bought for five dollars, or, using exactly the same algebraic symbols, it could be used to determine how deep a diver goes in five seconds, or the weight of five cars. As Zach (2019:§1.3) says, Hilbert's mathematics "becomes an inventory of provable formulas", or in Wittgenstein's words (1922:3.317) "it is only a description of symbols and asserts nothing about what is symbolized." Linnebo (2009:1) argues that "mathematical truths are … discovered, not invented" – which opens an even bigger can of worms: what do we mean by truths? But I will leave that one until Chapter 3.

From Hilbert's simple axioms, deductive reasoning can be used to prove theorems. In a sense these could be considered as a game of logic taught early on at school using geometry, for example Pythagoras. It is, perhaps, worth suggesting here that it is an example of how deeply rooted mathematics is in our schools. As Lappas and Spyrou (2003:2) claim, geometrical proofs are a basis of our culture. I was introduced to them at the age of nine or ten years old. It may be that, as Plato considered, it is a good training for logical thought rather than for its value in everyday mathematics, but it still places a suggestion in the scholar's brain as to the truth value of mathematics in general. As Brown (2008) points out, mathematical (i.e., logical) proof equals certainty, but such mathematics has yet to find an exception and this on-going accuracy is a reason for our belief. Consequently, once proven a mathematical theorem lasts forever. Furthermore, as mathematics develops, always through logical arguments, new rules are imposed with supposedly unequivocal definitions.

In theory, such mathematics should be truthful to itself, and where mistakes occur it is due to incorrect application or human error. It would thus be wrong to move from here without mentioning the Frege-Hilbert controversy over the correctness of Hilbert's axiomatic approach, which turns around Hilbert's interpretation of 'axiom.' This has been largely dismissed in Hilbert's favour by philosophers of physics such as Resnick (1974) and Blanchett (2019). However, I see a potential problem. To my mind they take the contemporary physical view that definitions are not necessary to explain the universe. They seem to support the view that only the laws that physics says, govern the universe. If these are known (in the sense they always provide testable answers) then that is sufficient. Thus, referring to Hilbert's geometrical axioms he does not *exactly* define the concepts of, for example: line, point, parallelism, *inter alia*. Consequently, it is not possible to state his axioms are absolutely true to reality, a particularly important point when dealing with the reality of the universe, see section 3.5. However, within the terms of geometrical rules (axioms) they produce a workable system and can thus be adopted for contextual use but not for the finer points of determining the fundaments of the universe where absolute accuracy must be aimed at. I shall refer to this later in section 3.5 on reality concerning the subjects of rotation and infinitesimals. As a result of this general position, despite Gödel's and Russell's objections, Hilbert's theory in the form of Hilbert spaces has become a primary basis of pure mathematics. From there it has become a major mathematical background to quantum mechanics. However, I shall leave quantum mechanics until later. This section is more to explain why mathematics is held in such high repute.

In the meantime, I shall introduce one of the most interesting arguments on mathematics raised by Wigner: the 'Indispensability Argument' presented in his famous essay (1960:1-14) "The Unreasonable Effectiveness of Mathematics in the Natural Sciences" which he refers to as mysterious. This discussion should perhaps more appropriately arise in the section on physics, but it fits in here as well. His essay is the result of humans having used perceptions (observations) of our surrounds to suggest physical laws governing the universe. These laws can be, and have been, expressed mathematically although they sometimes need amendments as new observations do not quite fit them. So we change our theories or even add new dimensions in an attempt to make them more comprehensive. But this is a natural process due to uncertainty and fallibility in new and surprising observations. For example, the succession of satellites exploring our view of deep space outside the Earth's atmosphere leads to observations previously obliterated from our view by that atmosphere; Wigner uses the example of the physicist Max Born recalling knowledge he had of matrix mathematics and using it to advantageous effect in quantum theory. Another is the case of Neils Bohr suggesting a special wave formation for electrons in orbit about a nucleus and realizing his suggestions provided a mathematically based agreement with light spectra given off by changes in those orbits. Apart from these there are the cases of Pauli (1930) predicting the existence of the neutrino, and Yukawa (1935) predicting mesons, through the need to balance mathematical equations on which they were working. These are all factors pointing to the use of mathematics as a basis for the universe. Wigner's (1960:1-14) point is that mathematics has been surprisingly effective in predicting and explaining human observation, a point agreed by other authors.

Lappas and Spyrou (2009) take a rather different view to the autonomy of mathematics, instead believing that it is embodied in the human mind and in social groups, aided by schooling. By embodiment they mean unconscious actions of the mind, so that in terms of mathematics it would be the unconscious, for example, measurement of distances every time we see something, or the number of people in a room. In other words, mathematics is a natural concept of the mind which can be extended by teaching; this is a different function to the active function of using it, say to calculate which tin of tomatoes is best value for money (it is the instinctive reaction to some people, but others merely buy by brand without noticing the shelf-price). But, of course, for mathematics to be recognizable even if 'divine' as Plato ([370BCE][8] :204-207) says, we have to use it, or, rather, recognize its usability. In this respect measurement is an inbuilt quality, even in most animals when they consider a safe distance from approaching danger compared to the distance to a hiding place.

[8] Translation undated.

For humans with language, and other animals bordering on definitive meanings to sounds, such as prairie dogs, mathematics runs hand in hand with survival. Low warning, predator/eagle[9] a long way off, high screech, it's too close! So, measurement is ingrained and clearly a survival tool though not available to all living objects. But does the apparent lack of measuring ability of some living objects suggest it is not necessary to existence? For example, we say that atoms have size and thus spatial dimensions; and they move, which requires a concept of time – as in change of position over time which is a form of measurement.

On the social scale animals are aware of overcrowding, though perhaps not in number, or in numbers per unit measurement. Humans tend to have a personal space around them. Size and shape react in our brains forming pleasure, indifference, or dislike. We cannot even necessarily put this down to experience that, for example, some other person's features may recall some unpleasant earlier experience from a similarly constructed person. Even when young we can look at a member of the opposite sex and know they are good-looking while someone else may disagree. So, shape and size are individual experiences depending on our own brains. And brains are primarily dictated by our genes. Different neural connections may set up as we age but these are results of our experiences; the fundamental genes do not alter as an animal ages. Therefore, I am led to believe that mathematics is a result of our need to measure, and that mathematics has arisen as a result of our evolutionary development from instinctively measuring the distance to an animal needed for food, or of knowing how much is needed to feed the family.

Measurement and mathematics are then fundamentally tied together in use. In this respect mathematics is tied to space, time, and motion, and our recognition of these factors. The question is whether it can be free of space and time? Could there be any use of mathematics without space or time? Could we even say that mathematics creates space and time – if indeed it is 'divine'? Or might it be the other way round? I can argue that if mathematics is tied to measurement, then it must require space and time, that is, it cannot be *a priori* to space and time. But without space and time the universe as we know it could not exist. In any case without a universe there would be nothing to measure. Then at best, mathematics could have been born with the universe, but not preceding it. In any case, mathematics is based on numbers and thus measurement in that numbers are principally a form of comparison, which implies these must exist for mathematics to exist. This in turn implies that if the universe appeared from nothing, numbers and thus mathematics could not be *a priori* to the universe – there would be nothing to be numbered.

[9] Slightly different set of sounds – 'it's a jackal'; so, everyone knows whether to look high or low.

Of course, it could be argued that numbers occur because of the rules of mathematics. That is, the rules themselves provide for the numbers as the universe comes into existence – the divine factor of Plato and the mystery of Wigner. Or it may be that the view that the universe began from nothing is incorrect. These are, however, arguments that may be used to defend contemporary ideas. So they must be born in mind, but not allowed to interfere with the current investigation whether there is another way of assessing the construction of the universe not based on mathematical principles. We are bound very much by the abstract nature of mathematics, which is avoided by the role of a fundamental or **foundational** philosophy.[10] Thus space and time should take a new significance as they are fundamental to measurement and thus possibly to the existence of mathematics, be it divine (Platonic) or not. This may have a key role in determining why physics has so far failed in its quest for an all-encompassing theory. We shall have to see what transpires from these investigations into the fundamental existence of our universe.

From the comments made by Brown (2008:2), Hardy (2029:4), Russell (1902:73) it seems clear that mathematics is considered a precise discipline. This is certainly true in the sense that calculations according to simple arithmetical rules are true. But approximations such as power series expansions cannot be considered precise; they may be close to true but through additional calculations approximations can diverge from accuracy (cf Guth (1981:348). However, this is usually taken care of in estimated error factors. But where mathematics can fail is where it is applied to extraneous theoretical rules, or more 'inventive' ideas, formulated by physicists (among others) to explain their observations. It becomes a 'black box' where if rubbish goes in rubbish comes out. Here I argue it requires translation into common language, because, as I will argue later, common sense can be accurate in discerning falsities (see EPR supplement).

In 'The Structure of Scientific Revolutions' (1970) Kuhn deals with the philosophy of change to scientific theories. In it he suggests that mathematics *may* play an aesthetic role (1970:155-158). In particular he points out that mathematics is a much neater expression of laws and explanations than a general description. However, I should add that it does still depend on the interpretation of what it

[10] This is an extension of Foundationalism which fits Descartes's argument ([1641]1911) that for an argument to be completely justifiable it needs to be founded upon a fundamental principle. In this case the fundamental principle must provide a basic rule for everything in the universe and be testable against established experimental evidence – equivalent to Popper's (2006) falsifiability principle. Thus, my foundational theory must also agree with the regression principle that to be foundational the argument must be in some way unequivocal. Unfortunately, this goes well beyond the scope of establishing an arguably possible fundamental principle that has possibilities of being philosophically developed to provide a complete theory of the structure and processes of the universe we live in. As identified in section 1.3 we can only hypothesize this principle. Therefore, my use, 'foundational philosophy' is in the sense of philosophy based upon a single fundamental cause rather than foundationalism itself which covers Descartes's argument.

actually means. Applied mathematics, the mathematics of physics, has two parts both of which are necessary for a successful explanation. The first is the derivation and use of relevant formulae utilizing mathematical symbols. As mentioned before, these are often very general in structure, sometimes up to the limit of having no number meanings at all – mere symbols as expressed above. The other is the interpretation of these into cognitive language. By that I mean into language which any reasonably educated human can understand. As Persson (2011:2) wrote in discussing the point of philosophy: "We prove propositions, theories and lemmas in mathematics, but do we explain in mathematics?"

Here it is important to consider the Wittgenstein-Quine problem arising from different people having different interpretations of individual words and sentences. This requires clear descriptions of meanings but as will be seen later this, especially in totally new ideas, depends on existing language. Any new, invented, words can only be described in terms of existing words. This will be seen to be particularly true with intuitive concepts such as space and time, both of which so far have defied any attempts to define them. Some definitions are looped, a classic being potential energy as the 'amount of work done on a body' and work being defined as 'the increase in the energy of that body'[11]. What information is contained in that? Kuhn (1970) argues that paradigm changes are small, and not completely explicit, so that it needs at least one or more scientists to back them by demonstrating they have something to back that is better than the previous. Mathematical changes are often clearer, and, as Brown (2008:2,60-62) believes in accord with many people, no clear proof of a mathematical formulation has ever been demonstrated incorrect. Consequently Kuhn (1970:81) believes they are likely to gain acceptance more quickly than those not expressed in mathematics.[12] By example he mentions one of the most difficult theories to understand but speedily accepted: "Even today Einstein's general theory attracts men principally on aesthetic grounds, an appeal that few people outside of mathematics have been able to feel." (Kuhn 1970:158)

Another view backing mathematics was given by Hardy (1929:4).

> It seems to me that no philosophy can possibly be sympathetic to the mathematician which does not admit, in one manner or another, the immutable and unconditional validity of mathematical truth. Mathematical theorems are true or false; their truth or falsity is absolute and independent of our knowledge of them. In *some* sense, mathematical truth is part of objective reality.

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[11] Somewhat simplistically put. More advanced statements include 'against a force' which makes it sound more reasonable.

[12] Examples of what I claim to be false mathematical assumptions arise throughout section 4.8 but in particular in 4.8.1; 4.8.3; 4.8.6; 4.8.7.

From these few paragraphs it therefore seems clear that mathematics is heavily entrenched in the human psyche, and particularly in physics. As suggested in Chapter 1 humans prefer logical objectivity; the question should be asked whether mathematics is the be all and end all of research. Under Platonism it is regarded as being independent of humanity (Brown 2008:61, Linnebo (2009:1), Colyvan 2011:88, Bueno 2013:§1, section 1.3.1 (i)), that is, not shaped by human intuition, whereas human sapience depends on perception of our surroundings. Those who practice it believe in its honesty and breadth of expression. Aristotle says: "The chief forms of beauty are order and symmetry and definiteness, which the mathematical sciences demonstrate in a special degree." [350BCE] (1923 M§4). Russell (1902:73) agrees; "Mathematics, rightly viewed, possesses not only truth, but supreme beauty ..."

This is another aspect to mathematics, its structure or intellectual beauty. It is clear cut. Its features are created by logical deduction. In that respect, it could be said to be the epitome of scientific competency. On the theme of social groups, it is not so different from the ancient Greek philosophy schools.

These paragraphs are intended to demonstrate the way in which mathematics with its Platonic features has influenced our thoughts. Summing up, humans should ask whether this fixation on mathematics as an absolute necessity to answer universal problems is in the best interests of human deduction. Does it hold back thoughts outside the 'box'? As suggested, our minds should continually consider the questions of mathematical egoism as well as whether it is truly the root of the universe. It should be remembered that mathematics is mindless. It is quite possibly only the result of human thought. .It certainly, in our universe, depends on humans to put in information to produce calculations. Humans may play games with it and use it for developing the mind at school. If, as I suggest, the universe requires no mathematics to exist then there must be more to the universe than a set of calculations based on measurement, especially where those calculations involve mind-twisting ideas such as Feynman's calculus or Riemannian geometry.

There thus arises the concept of other human views, that is, through philosophical reason or logic. Philosophical reason, after all, must be based on the structure and processes of the universe because the human mind has grown out of the universe. From the aspect of an overall theory of the universe it will prove valuable to consider contemporary views of these subjects – views that have developed with the advance of physics. However, I shall only take those concepts relevant to attaining a final theory.

Finally, one would have thought that if mathematics were inbuilt in our brains, everyone would enjoy it rather than just a few. Perhaps its growing abstract nature stemming from the use of advanced mathematical processes, almost as if mathematicians are treating it as mind games, is daunting. It enters a realm far removed from mere common usefulness to everyday life. Thus mathematics might be viewed by some as impersonal (Dowker, Sarker and Looi 2016) or without personal value (Gafoor and Kurukkan 2015). This view is perhaps advanced through the use of algebra which can be seen as particularly abstract compared to the 'reality' of numbers. Many people may also fail to realize how much they add, multiply and divide in every-day life, instead associating mathematics with often boring school tuition – by rote in learning tables et cetera. There is also the possibility that many people consider understanding of advanced mathematics as requiring brilliance of mind (Chestnut et al 2018). This may be true for the most advanced mathematics required for QM and QFT and would imply that the universe is too difficult to understand without this mathematical brilliance. The mythology of the tribal groups has changed to a new set with mathematics as the leader.

The final part of this initial investigation belongs to physics. So it is to that that I shall now turn.

2.5 Physics

Having explored the seductive fixation on mathematics it becomes necessary to consider its relationship with physics, and also to obtain pointers on whether another approach to obtaining an overall theory of the universe is necessary. If so, what should this approach be?

This raises a similar question to the problems arising in mathematics. What is physics? What does it do? What are physical questions and what belong to philosophy? Physics would claim that those questions that can be answered by observation and experiment are acceptable physical areas of research, but there are some "deep metaphysical questions" that cannot be answered by observation or experiment, such as why there are physical laws (Ellis 2012:27), or why does anything exist in the first place. These seem to me to be the most important questions for a fundamental physical theory irrespective of how deep they may be. Surely the answers to these questions are necessary to understanding the universe? While physics aims towards a so-called theory of everything, this at present refers only towards a mathematical theory bringing the four main forces (electro-magnetic, weak, strong, and gravitational) under one uniform theory (Peskin and Schroeder 1995:781). Ellis (2012:27) suggests that physics deals with "how do mechanisms operate." I shall show that this is certainly not true: it deals with establishing outcomes from known inputs, which is producing laws by which the universe works so that calculations can be run, but these laws do not necessarily, in fact few of them do, detail *why* they work. Force is one such problem; for example, Feynman's calculus allows calculations to be made using the assumption of a virtual particle that operates outside of time, but with absolutely no attempt at describing *how* it may operate (Peskin and Schroeder1995:13-21).

Cartwright (1983 introduction) divides physical laws into two types: phenomenological and theoretical of which the first are those derived from observation, and the second “unobservable” which are fundamental and can be inferred. Hume ([1739] 2017:Book1,iv: 13-14) and Kant ([1783]1903:§40) are of the opinion this is impossible. I argue that inference can only rely on perception which itself is responsible for proposing the phenomenological laws and therefore must be avoided. A phenomenological law cannot be used as a basis for a law supposed to explain its existence – no law can prove itself. With this in mind I survey the general concept of contemporary physics.

Bacon’s essay (1620) was mentioned in section 2.3. Twelve years later Galileo (1632) introduced the modern concept of science based on careful observation and measurement, at the same time imposing suspicion on common sense and particularly the role of philosophical reasoning (Feyerabend 1993:291, Sankey 2010, Yu & Cole 2014:679). His concept of experimental testing of ideas have shown up many false beliefs, for example that heavier objects drop faster than light ones, or that heat contains an element of fire, ‘phlogiston,’ which objects carry in differing amounts. The first was tested by Galileo by measuring the time taken by balls of different weights rolling down a leaning trough – the time taken was unaffected by differences in their weight. They all took the same time. The second was shown to be false by Antoine Lavoisier (1777) proving that burning objects required oxygen.

A better known, and as a result more explicit, example of the empirical process of building theories is that of electromagnetic theory. Although the ancient Greeks had been aware that certain products such as amber, when rubbed on fur, could produce shocks or even sparks, the earliest, what might be called scientific investigations started with Gilbert (1540-1603) discovering a range of products capable of producing the same effect. This was before Galileo, but nevertheless laid the ground for further thought. Du Fay (1733-1734) imagined that these peculiar observations were caused by two forms of fluid which he called vitreous and resinous. Benjamin Franklin (1751) also adopted the idea of a fluid, but he explained it with only one form based on his experiments on electric discharges (such as lightning) or Leyden jars used for storing ‘electricity’. Objects could either have sufficient, too little, or too much of the fluid. A surge of experiments then resulted in Coulomb’s (1785) publication that electricity consisted of positive and negative charges and his corresponding law that like charges attracted and unlike repelled. Since then, developments in other fields have led to the modern views of negatively charged electrons and positive protons, among other charged and neutral particles – a clear example of how scientific theories arise and change over time as they are tested. Nevertheless, current physics has still not deciphered what the actual difference between positive and negative charges is, nor the real mechanism causing this apparent attraction and repulsion. What does attraction and repulsion actually mean in inanimate objects? The concept of electric charge does not explain the mechanics of this action. It seems to be little better in this respect than those of the ancient Greeks, for example, Aristotle in his philosophical approach (though titled physics) attempted an explanation of attraction and repulsion between his four elements, earth, air, fire, and water (Aristotle [350 BCE] 1991). As Kuhn (1970) demonstrated, theories start with ideas which are suspect until thoroughly investigated.

Turning to cosmology, the study of the structure and processes of the universe; it depends on four fundamental entities: space, time, mass, and electric charge, all of which are undefined in physics. Of these, mass is believed to be somehow responsible for gravitation; and charge for the properties of attraction and repulsion between particles, causing them to bind into specific forms. But the actual constitution, what is, how and why questions of these effects, is still unknown. Surely, we should be expecting that, as these are considered to be the most fundamental quantities of the universe and its processes, they should be the first to be unequivocally expressed. It may be acceptable to physicists to follow mathematical rules but is it not more important to understand what is behind them? “[D]o we explain in mathematics?” (Persson 2011:2). Consequently, a major consideration for this thesis is to translate physical and mathematical theories into simple common language. This is of paramount importance if, as conjectured, the universe is not mathematical in formation and moreover has no need of any mathematics in order to exist. As mentioned elsewhere no theory can prove itself; it requires a different discipline to check its efficacy.

The latest theory towards a comprehensive account of the universe is jointly quantum mechanics (QM) and quantum field theory (QFT). Quantum mechanics originated from four major proposals made over the period 1905 to 1925. The first was the concept proposed by Einstein (1905a) and Planck (1900) that energy is transferred in bundles. In 1911 experiments by Rutherford (1911) suggested a nuclear-electron structure of the atom, which Bohr (1913) concluded would collapse rapidly. Consequently, he introduced the concept of non-energy-radiating electron orbitals on the assumption that electrons could only radiate energy in the quanta, or energy bundles, proposed by Planck and Einstein. Finally, in 1923/4 de Broglie (1925) proposed that all so-called matter might be composed of waves, in conformation with Bohr’s orbital-energy concept – which had been validated by spectroscopic analysis of light emitted from hydrogen atoms. Formal QM followed from these proposals when in 1925 Heisenberg produced the first conceptual statement of QM now known as the Heisenberg picture. Later in the year Schrödinger gave a second picture in which he proposed a fundamental wave-energy equation based on a mathematical ‘wave function’ which has become the central theme of QM.

This wave function is a purely mathematical function which is said to contain all the information about the wave representing a particle. The particle wave is then said to be built from a number of superimposed waves travelling at different velocities so that they form a ‘packet’ by constructively interfering with themselves at one location, and destructively interfering with themselves at other places. Being composed of many superimposed waves, a packet is extended over a fixed distance.

Since these waves are all continuous (Born [1925] 2021) they will build up areas of constructive and destructive waves, in other words a ‘wave-train’. But, if the waves are able to combine then as they are continuous, they will automatically produce areas of constructive interference followed by areas of destructive interference in which case they will produce repetitions of the packet, that is a wave train of packet. Mathematically it is possible to add on more combinations of waves in such a way that the packets become further and further apart; the principle being that if the packet contains a large number of waves with very small differences in their wavelengths the probability of repetitions becomes ‘insignificant’.

This leads to a double-edged problem of time. The one edge is the overall continuity while the other is the question of discreteness of units of time. 1) Born (2021) requires that the wave function be continuous over all of time (and space); a condition tacitly reinforced, for example, by Capellmann (2021): “For given initial conditions at some point in time, the solution of the differential equations seemingly determine the behavior at any time in the past or future”. This is not surprising because *t* (time) is an undefined variable in the fundamental quantum equations. Therefore, it has to provide a probability for any time. It is in fact established that there is a problem with time (i.e., Kauffman and Smolin 1997, Moreva et al. 2013, Bryan and Medved 2018, section 3.3.2). 2). A continuum is still a basic concept of physical equations mainly due to the use of calculus with its use of infinitesimals. Einstein ([1921] 1960) recognized that the concept of point (a fundamental problem in continuum theory as I shall discuss in Chapter 4) is not defined but declared it was “not relevant to mathematics” and therein lies a major problem still relevant today. In particular it is a problem of quantum gravity, the combination of Einstein’s general relativity with quantum mechanics. A recent concept is Loop Quantum Gravity (LQG). QM depends on discrete energy quantities so it seems logical that QG, particularly the version known as LQG, should have a discrete quantity attached to it. Early steps in QG using Regge Calculus (Regge and Williams 2000) developed through the concept of simplexes (simplices) which the time-independent Hamiltonian (Synge and Griffith 1959:411) suggests should be a quantum volume. The simplest of these would then be a 4-simplex, a simple tetrahedron. This gives a discrete background volume, originally thought to be incompatible with LQG but now no longer considered the case (Chiou 2014:4). These problems must surely lie with the lack of definition of space and time. It is a problem that must be addressed in any fundamental cause of the universe, should such a cause exist. The concepts of quantum mechanics below must therefore be seen in the light of these two problems.

Returning to QM principles, as Einstein, Podolsky and Rosen (1935) pointed out, more than one outcome is possible to an attempted measurement of superimposed waves. Consequently, its measurable value, which is equivalent to it becoming a recorded entity, depends on an interaction – hence, for example, Hawking's statement (2011:103) that to see objects we need to interact with them. That is, if the wave-packet is to appear as a particle it does so by interacting with something, for example another particle. In other words, if a physicist carries out an experiment involving the packet, he has to cause an interaction with it. Thus, before the interaction, one can only say there is a probability of an outcome to the experiment, or an outcome to what we will observe.

However, this interaction will change the wave-packet itself so that only one experiment at a time can be performed, and any subsequent experiments will thus be on a newly composed, and thus different, packet with different probabilities of their outcomes. Interference with the packet is then required to observe it, and that will be in a form determined by the interference, or input, so that the packet does not have a predefined outcome for any observation of it. As Bohr [Leggett 2002:419] would say, it has no underlying realism. The realism we believe in is determined by the interaction. This is known as Heisenberg's uncertainty principle (1927).

We can now go a step further because all we have are probabilities of possible outcomes and those can only be expressed mathematically. For example, tossing a coin to see whether it comes down heads or tails has two possibilities. So, while it is in the air it has only a probability of one or the other – a half in both cases and a half is a mathematical number. Thus, under the wave-particle precept, only mathematics has any reality.

In the general case of the wave function just given, the function is in terms of distance and time, so the only outcome is the probability value of finding the particle at a given position. But for an individual packet, the packet can be mathematically manipulated to produce the probability of finding other measurable quantities such as momentum or energy (a mathematical 'operator' can 'pull out' an 'observable'). Expanding on these views suggests a quantum mechanical system as one in which all its particles are linked (entangled) by mathematical formalism to each other (Horodecki 2007:9, Moreva 2013), (see Bell's theorem in supplement) through their possession of various quantum features such as position, momentum, orientation, angular momentum or (Pauli) spin.

With this expanded view an interaction between two systems causes disentanglement of a particle from one system to another creating a new system. In the case of a human devised experiment this would allow the interaction/experiment to pull out a specific value based on position and time of the measurement, but this would be for only one of the quantum features (q-numbers) because, as above, its measurement would alter the original system. A measurement of its corresponding component (e.g., position, energy, or momentum) would then be determined from the new system and could thus be predicted only with uncertain validity. Consequently, due to both the uncertainty principle and the position and timing of the measurement in an ever-active entangled system, there is, as with a single wave, only a probability of obtaining an expected value of a measurable quantum observable; that is, only probability values that agree with quantum numbers can be obtained in experiments (Heisenberg 1930, Schrödinger 1935§3:6).

If the interaction destroys the underlying possibilities, that is, causes a particular possibility to now be the only possibility, the wave function is said to 'collapse' (Leggett 2002 :421). If we see a particular possibility but the underlying possibilities remain undisturbed, we get the 'many worlds hypothesis' (Leggett 2002:421-2); all possible outcomes of the experiment are covered by the wave function and interaction pulls out one. Another view suggests that the outcome is no more than the statistical expectation, 'decoherence' (Legget 2002:422, Zurek 2003:1). That is, quantum interference, which allows superposition, becomes destroyed so that the QM system passes into a classical system. It is sometimes said there is a Heisenberg cut (Karakostas 2012:10-11) projecting a quantum object to a measurable (classical) condition. This does not mean the value of the observable can be thought of as pre-fixed (caused). It depends on the context of the experiment. These concepts are the subject of considerable discussion by physicists at present.

Many people who use the theory may not have encountered its most fundamental aspects as its mathematics has developed into simple rotes/algorithms for use in fields as wide apart as chemistry, biology, or economics. The above conditions, known as the Copenhagen convention, have introduced some seemingly absurd ideas concerning the reality of existence itself. Bohr, one of the main founders of quantum theory with de Broglie, Schrödinger, Heisenberg, Pauli, and others, asserted, as a result of mathematical work, that the world is made of things that are not real (cf Leggett 2002: 419). Other statements are:

> The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment (d'Espagnat, 1979:158).
>
> In the beginning there were only probabilities. The universe could only come into existence if someone observed it. It does not matter that the observers turned up several billion years later. The universe exists because we are aware of it (Rees, 1987:46).

> We now know the moon is demonstrably not there when nobody looks (Mermin, 1981:397).[13]

These all follow from the concept of the necessity of an interaction to determine the measurement states of an object, that is, to turn its probabilistic values into an observed value as stated above.

Although these concepts appear to make sense when considered from the principles of quantum mechanics they obviously run against our human instincts. They are clearly peculiar. Not surprisingly they are subject to much debate.[14] At present this part of the thesis is more interested in the fundamentals than debating apparent absurdities. I shall just state here that it seems to defeat Darwin's belief in evolution through survival of the fittest. Humans have the ability to observe because the Sun must have existed outside of any life on earth; it is well established (Lincoln and Joyce 2019, Powner, Gerland and Sutherland 2009) that the bases of life required sunlight as well as heat. Evolution of life very rapidly utilized the difference between light and dark to aid in their survival (Williams 2016) which eventually led to what humans recognize as eyes in primitive animals and eventually us. It is, thus, necessary to examine quantum mechanics further. That means examining its definitions (time and space I will leave to Chapter 3).

Quantum theory is based on the concept of a wave which is easy enough to define when wave refers to a water or sound wave operating through molecular action. Humans may also intuitively imagine radio waves travelling over large distances on Earth and bouncing off 'charged' particles in the ionosphere. But a matter-wave is assumed to be a collection of superimposed sine/cosine waves. How should this be articulated in terms of being transferred over long inter-galactic distances? Sound and water waves can attenuate, radio waves supposedly hold their strength/amplitude as should matter waves formed in the first few seconds after the 'Big Bang.'

Mathematical descriptions in quantum theory, while they may be precise, arise from human perceptions, perhaps of the form of those suggested in Figure 2.1 based on drawings of waves, or imagery such as the compression and rarefaction of sound (see Engel and Reid (2006: 294). A common method for teaching purposes is to project a vibration trace onto a moving strip of paper which produces a sine wave tracing. The faster the paper travels or slower the rate of vibration, the longer the wavelength, or vice versa. In this respect the definition of a wave is clear. On the other hand, in its most naïve form a wave can be described as a disturbance (Bueche 1977: 320), but what

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[13] This refers to an objection made by Einstein to Abraham Pais "Do you really believe the moon is not there if nobody looks at it?" [A. Pais, (1979: :907])

[14] See e.g., Chakravartty 2017, Vaidman 2014, Zeilinger 1999a, Mermin 1985) mostly in support of QM with Feyerabend (1993:71) pointing out that if Parmenides (500BCE) was correct in believing that 'being' is ethereal then physicists have a basis for their arguments for 'objective' experiments.

this means in terms of an otherwise empty volume seems to need more thought. Why and how should this be related to a wave traced on a piece of paper? Is the disturbance '*something*' which causes a vibration in particles at the atomic scale, or perhaps a pulsating volume with a bounded expansion and a contraction to zero? What causes, or carries this 'disturbance,' or 'something', to move through space? Merzbacher (1961:5) suggests a "Wave means a periodically repeated pattern in space with no particular emphasis on any one crest or valley…" to which one can add 'that transfers some abstract concept such as energy or momentum.' Apart from our drawing of a sine wave why should we even imagine a matter wave has crests or troughs? I can imagine a crest or trough in a water wave with the molecules moving up and down. It is thus purely a convenience to express something physicists cannot otherwise explain into a mathematical formulation which can be used for calculation purposes. Physicists can hypothesize on this transfer but, in line with theorists such as Newton (1693) and Einstein (EPR 1939), surely there must be some non-mathematical reasoning, or *cause* (Cartwright 1983: 10) contained in the definition that tells precisely how and why it takes place? If a wave is so fundamental that there is nothing more fundamental to describe it, then it can be no more than a mathematical construct and as Marcus (2008:4) says: why should mathematics make us believe "in the existence of abstract objects"?

The mathematical formulation for these waves, whatever they may be, is the wave function, ψ, describing an entity's position in space and time (Engel and Reid 2006:294, Merzbacher 1961:9-10). Dorato and Laudisa (2014:1) raise the ambiguity over ψ, as from an instrumentalist viewpoint it is a purely mathematical "instrument" for calculating probabilities, while realists regard it as a field. For example, in Merzbacher's (1961:10) or Peres' (2002:4) opinion the wave function is as physical an entity as the electric or magnetic field; it represents the probability of a particle existing at given points. (Monton 2006:779) writes: "the wave function doesn't exist on its own, but it corresponds to a property possessed by the system of all the particles in [a given system]." Penrose (2005:508) is more open: "if …one thing in the quantum formalism is 'actually' real … it has to be the wave function, or state vector." However, due to a wave having a continuous format, this position, surely, can only be represented by a probability distribution (amplitude) around a central value – multiple particles operating as a system involve superposition of wave functions. Nevertheless, although the wave function contains the uncertainty relation it is not in itself uncertain (by quantum formalism): for example, by simple mathematical rules (Fourier analysis [Penrose 2005:153]) it can be used to provide physicists with either the momentum or position of a particle at a given instant depending on the form of experiment set up.

In section 2.4 the question of choice of waves was placed firmly on the easy mathematical formulation and use of sine and cosine waves. That is, it is purely the belief in the validity of mathematics that created the choice of such waves. Due to their regular nature, they can be made (in mathematics) to either constructively or destructively interfere with (amplify or nullify) each other. The resulting wave packet is then a supposition (which works for quantum theory but may not be true to nature) and I contend the fact they seem to fit experiments could be due to either physicists manipulating the formulation of the equations to fit experiments, or devising experiments to check the equations much as an artist draws and edits his lines to represent his subject. Consequently, I find the equations cannot be regarded as definitive, in which case basing an entire physics upon them may very easily lead in the wrong direction as opposed to the actual workings of the universe. This possibility is aided by believing that waves can carry numerous probabilities (Hawking and Mlodinow 2011:96-103) so that there is no definitive fundamental cause built into their structure – one that will produce an automatic outcome. This should not be taken to mean that the outcome of an experiment does not rely on the experimental method/experiment; it just means that a single input may carry a collection of possible outcomes from which the experiment extracts one. A causal universe would mean that, on the contrary, a single input would carry a specific cause for a specific outcome. But this should not be considered to give an *a priori* outcome on the sub-atomic scale according to human experiments.

For example, suppose an electron *has a definitive position* around a nucleus at any given time. It is easily shown, as follows, that it is utterly impossible to determine this position. According to standard theory an electron has an electromagnetic field and the only way the position of the electron can be known is by recording this field through another electron in the recording device receiving a photon, virtual or otherwise, belonging to this field. At best, the receiving electron could only determine the direction of the photon motion at the time of receipt, but not the distance it had travelled or the time of its release. Furthermore, the position of the receiving electron, if it had an equally specific position at a specific time, cannot be known because its orbit is continually influenced by the electromagnetic field of its controlling nucleus. All that is recorded is a photon released by the receiving electron as it jumps orbit, from which the knowledge of an interaction having taken place is recorded. (Without the jump no recording can be determined). This jump can be timed but with no knowledge of the exact position of the electron when it jumped orbit. It makes no difference if one had a hundred receivers all recording by triangulation of the electron's field because the recorders only record a time which depends on the position of the recording electron, not the distance the field photon has travelled, nor a direction even if the jumping electron might have received a directional photon. Thus, as stated, the position of an electron is undeterminable. This brings up another problem with perception. Because of this undeterminability it would seem impossible to work out from experimentation an unequivocal theory of the universe. Therefore, the only method is by assuming a possible cause and then testing the cause to see whether it gives reasonable answers. If specific assumptions turn out to be peculiar or fail to explain everything, then they must be cast aside.

In the previous paragraph I mentioned both an electric field and the idea of photons carrying force, as suggested by Einstein, and virtual photons used by Feynman in his calculus of field theory. Exactly what these are and how they function has not been described. There is not a clear picture of how a field operates nor exactly what it means in physical terms, only an intuitive idea that it somehow carries force. Physicists do not even have a definition for force. Newton ([1687])[15] says it causes a change in motion of a body (avoiding the trap of the word 'something' that causes a change, but that is only because the 'something' is implied rather than written). Nevertheless, he did understand the problem when he introduced his idea of gravity. He was well aware there had to be some form of active transmission of a cause to give 'action at a distance' (see for example his letter to Bentley [1693]). Even now it is still not clear in standard physics. The fact Einstein can express gravitation as a distortion from one field structure to a curved field merely emphasizes curvature but not why it should cause a movement towards the centre of curvature on a body at a distance from its field-source. Here one has to also be certain what is meant by a force-field. It can be expressed mathematically, which as a generality avoids questions of continuity, but here I am strictly considering the philosophical aspect, not what it can *do* but what it *is*. The general description in physics (of a force-field) seems to be a space where every point is affected by a force.[16] But nowhere have I found a definition that considers the field itself. If it consists of lines of force, what are these – what makes them? Hobson (2012:6) claims the modern view is that fields are "conditions or states of space," which says absolutely nothing about their essence nor how they can support transmission of force. Fayngold (2021:2) describes it as "a spatial spread of a certain *directly measurable observable*," for example an electric field. It would appear that it is accepted that a field is a continuum, or at least a continuous set of connected 'grainy' points (Regge and Williams 2000, Chiou 2000, Bahr and Dittrich 2010). But again, what is a continuum without knowledge of a field or space for it to have existence? Again, I have to ask: how can a theory be accepted if it cannot answer fundamental questions? This state of a continuum, or its falsity, or knowledge of the nature of a field, might be vital points in understanding the universe.

Thus, without any clear definitions (considering the lack of definitions for space, time, mass, charge, and thus QM observables such as momentum or energy) and various different opinions, quantum theory should be viewed with suspicion. In particular, I am mindful of Karakostas (2012:14) suggesting that an overall "*Archimedean view*" seems completely unacceptable to QM. This, presumably, includes the concept of Aristotle's first principles, which I have already and still do hold fundamental to understanding the universe.

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15 See e.g., Synge and Griffith 1959:27 but also Cohen and Smith (2004:63, 65, 72-75).

16 +See e.g., Encyclopedia Britannica, World Book Dictionary, Bueche (1977:72), Synge and Griffiths (1959:63) for physical definition in terms of coordinates and (1959: 455) in terms of Hamiltonians.

I then have to wonder how valid a theory is if it is not based on defined concepts. How can it have managed to survive without questions being asked, especially in philosophy, and especially when it leads to such peculiarities as mentioned above? I have mentioned that physicists and mathematicians tend to the view that the predictive power of mathematics proves its correctness, but in fact it only proves that it has been revised so that it fits observation (Brown 2008, Hardy 1929). As above, it is purely a 'black box' based on human input without any descriptive power to fuel ideas of its own. Observation does not imply its accuracy to the fundamental processes of the universe, especially if it does not allow the concept of a principal cause for a universe to exist. Admittedly the subject of reality (see section 3.5 including subjectivity) and other aspects, such as wave collapse, multiverses, complementarity, have been heavily discussed between physicists,[17] but more in the sense of rationalizing them rather than investigating the basis of the theory itself. The answer may lie in the processes of education and group dynamics as raised in the next three subsections.

In this sense, the question has to be asked whether quantum physicists have thought far enough to overcome their idea that the world is made of objects that cannot be considered real. This and allied concepts become 'problems' when physics is confronted by human common sense. Therefore, we should also consider this aspect. Common sense should be an interface between science, philosophy, and education, not an unreliable competitor (Yu and Cole 2014:680, Maxwell 1966:295), it being based upon human perceptions of our surroundings. This necessitates clarification as there may be more than one interpretation to each perception. To acerbate the problem, I start with education.

2.5.1 Education

The most important aspect governing physics today is education. This does not necessarily even include at school or through textbooks. We are used to seeing the successes of contemporary life, electrical equipment, computers, television, smartphones, aircraft, spacecraft and all the photos of deep space they acquire. Children playing sci-fi games on their smartphones are already subliminally visualizing possible new avenues for reality: ones different from our surrounds which means, should they enter physics, they may be more easily open to ideas that conflict with former traditional beliefs – the mythology of the age.

At school they learn mathematics as a fundamental basis of living followed by physics, if so inclined, and in many cases the history of changes to physical thought. Textbooks and schools point science in a given direction from which it is difficult to adjust the mind. A fundament of this education often runs through proofs requiring exam reproductions. As Sankey (2010:2) writes: "a

[17] See e.g. Stoeger, Ellis and Kirchner 2008, Melkikh 2013, Schrödinger 1952, Vaidman 2014.

significant issue emerges with respect to the relation between science and our commonsense view of the world." He expands the theme (2010:13) "Throughout the history of science, scientific advance has been made by the elimination of commonsense beliefs in favour of scientific theories which show common sense to be mistaken." Yu & Cole (2014:679) state:

> Some misconceptions in science are so resistant that many past and present instructional remedies have been ineffective in conveying the correct ideas. … Thus, science teachers must devote tremendous efforts to undo common-sense-based misconceptions held by students in order to redirect them to the right concepts.

Others express similar sentiments (e.g., Ogborn 2011, Fischbein 1982, Savinainen 2005, Bao 2002).

I fear that standard science has become so entrenched[18] that there is a serious danger that attempts to overcome common sense may both stifle novelty and worse actually stifle truth. (I do not here include sci-fi games on tablets where they open the mind to new thoughts, although one must take into account this opening of the mind can work to rejecting common sense views in favour of educational views). Educators should be absolutely sure of their position; the comments of Fischbein, and Yu and Cole, must be taken as possibly, and incorrectly, raising the status of academic stricture to entrench what may be false science rather than guiding students towards a reasoned appraisal.[19] (Give me a child at an impressionable age and she is mine forever – Prime of Miss Jean Brodie)[20].

So, the young physicist proceeds to postgraduate research armed with *current* beliefs and as Kuhn (1970:19) points out takes off from accepted theories and uses them to develop new ground "upon the subtlest and most esoteric aspects of the natural phenomena that concern his group".

2.5.2 Common sense.

Common sense should have a much greater role to play in scientific theory even though it is considered unreliable. As Ogborn (2011:1) says:

> Science is reality re-imagined. It populates the Universe with an ontological zoo of entities, some mundane and at one with commonsense, some exotic and beyond but not disjoint from common experience; but some almost

[18] See section 1.2.7 Bird (2000:37,45), Duck &Sudarshan (1998:5) Fischbein (1982), Sherin (2006), Weinberg (1993:ch7), Savinainen (2005:176) and Bao et al. (2002:1), (Kuhn 1970:5) "*Normal science, for example, often suppresses fundamental novelties*" and Kuhn (1970:77) scientists never "*renounce the paradigm that has led them into crisis*."

[19] This view will be developed in line with work still in progress.

[20] Film by CBS Fox, Producer Robert Fryer.

> beyond belief, and some which seem to be purely theoretical fancies. What distinguishes this zoo from certain others is that its denizens are taken to be real. That is, once imagined, they are taken seriously as actual constituents of the physical world, existing and able to act or be acted on in their own proper ways without regard to what we may wish or expect.

Here, I consider more the concepts of theory relative to observation and particularly common sense (see Sankey 2010). I would like to say innate common sense but, it seems to me, to a significant extent this is being supplanted by an individual's scholastic development (rationalism) and the ideas he/she has been exposed to (c.f. Sankey 2010:4). These in turn determine, especially in the case of philosophic thought, the lines of deduction and openness to different ideas. Common sense seems to be regarded as suspect in the philosophy of science (see e.g., Yu and Cole 2014:680), and especially in physics, perhaps not surprisingly as it is more often than not subjective, that is based more on sentiment than constructively thought out. Yet, when we find concepts arising that seem to defy everything, we believe sensible, should we not treat them with suspicion? Einstein certainly did until his death even though the results of experiments on entanglement allowed physicists to claim he was wrong (Bhaumik 2015:1,3). In EPR he pointed out that Heisenberg's uncertainty principle leads to a loss of local reality and its indeterminacy to a lack of causality.

Children are viewed as relying on common sense but Yu and Cole (2014:680), to give them some due, also suggest that this sense is "conveniently and unfairly" seen as antagonistic to certain scientific concepts. Common sense and science have become regarded as completely different: one is "comfortable ignorance" that things could be different, and the other "ongoing self-examination of the evidence and subsequent corrections." I am not sure which way round this is intended! To my mind common sense leads, or certainly should lead, to reason, especially when science (physics) challenges it. Quantum theory certainly seems to be entrenched with the only 'corrections' directed at *reinforcing* its peculiarities. This even applies to the Michelson-Morley interferometer experiment (see section 4.8.2) where the interferometer is adjusted so that the wavelengths of the light travelling up one arm coincides (on reflection) with the wavelength travelling up the other; the reason is because one does not know whether it is the thousandth wavelength (say) on each or maybe the one thousandth on one and 987th on the other that coincide. Our clocks run at a rate such that the speed of light measures the same in whichever direction it is measured.

By common sense I mean the ability to reason from an intuitive knowledge of one's surroundings which of course will produce different reactions from different people depending on what they have been used to. As with knowledge, I see three types: inborn, or genetic common sense, that acquired by life experience, and that acquired by education, reasoning being part of both the last two. As Sankey

(2010:14) points out the first is that attained through the survival of the fittest. It is the last that I feel should be raised here.

Throughout history first ideas have been mostly sparked by observation. These have developed with further study to obviate what had previously been thought as sensible (see Kuhn 1970). Sankey (2010:16) suggests "appearances do not change. Nor does common sense experience. What changes is what we think happens. Our understanding of what takes place is altered." True: our views of common-sense change with acquired knowledge, as opposed to genetic sense acquired by the human species through survival of the fittest. The changes I see are also three-fold, those acquired through experience as we age – as children learning from deeds adults would refer to as "stupid;" those acquired from learning the knowledge derived from forebears; and those through imagination and reasoning or questioning. Thus, we have an idea even from birth, in common with some other species, of number (Feigenson, Libertus and Halberda 2013:74). We then learn the integers, the basic operations, number systems and so on; then Newton's laws, dynamics equations; some go on to relativity changing our whole concept of measurement, or even quantum mechanics and beliefs in reality – concepts which for most people border on incredulity and disbelief. So, what was common sense for one, and changed over growing older, is nonsense for another. It is not that anything in the universal structure has altered, it is our interpretation that has altered, or rather the interpretation of some humans that has altered. This reflects in our search for reality and truth. And common sense has played a far greater role in this respect than current views seem to allow. Without this review of ideas, particularly led by common sense, would we still believe the Earth was the centre of universal rotation and flat, or that heavier objects fall faster, or that so-called electric charge or heat are liquid in nature? As Ogborn (2011:2) notes: "The upshot of a few centuries of development of scientific knowledge is that the imagination turns out to be a great deal more important in understanding reality than might have been supposed."

But this can be viewed from the opposite position. As Sankey (2010:2) writes: "a significant issue emerges with respect to the relation between science and our commonsense view of the world." He expands the theme (2010:13): "Throughout the history of science, scientific advance has been made by the elimination of commonsense beliefs in favour of scientific theories which show common sense to be mistaken." – a concern in the previous sections of this chapter. Here, there arises a significant metaphysical problem which until now has been moving in favour of the scientists as experiments conducted seem to support the views of relativity and quantum mechanics. I have tacitly suggested that *both* philosophical and physical arguments for a given concept should be constructible and must match each other. This is mainly to be realized through the physical aspects being expressed through mathematics which should be interpreted into common language so that it can be compared to non-mathematical philosophical logic. The difficulty is that when a collection of physicists combine, they tend to reinforce the common view as with Bohr, Heisenberg, Born, Sommerfeld, Pauli, et cetera in opposition to Einstein on quantum mechanics. As suggested before, experiments can be conducted in ways that 'prove' the accepted lines. I claim this is particularly true in the case of Bell's theorem examined in the supplement.

Thus, the old views become ever more entrenched. Scholastic time is fully utilized in contemporary methods of preparing students for examination based on 'established knowledge.' As a past teacher of mine at high school said: do not accept anything without thoroughly examining it in your own mind and deciding for yourself it is true. No-one has that time. Entrenched views in a group mindset are difficult to shift. This is even more difficult due to peer pressure under rigorous academic conditions. As Kuhn (1970:4) says, entrenched views "come to exert a deep hold on the scientific mind." As a result, misconception of the original theory may go unchecked for decades, as I argue in section 4.8 is the case in special relativity, which is of particular significance to this thesis. An allied problem is the extensive use of scientific and philosophical jargon (Weinberg 1993). In the former case, in physics, the jargon is the use of advanced mathematics, which makes it difficult to understand in everyday language, which after all is the fundamental language of the mind learnt from birth. The full meanings of many concepts are thus initially recondite for the young postgraduate student. Mathematics becomes the language of their knowledge, removed from that of common sense.

As Persson 2011 inferred, mathematics does not necessarily convey an understanding outside of its own language. Consequently, without translation to everyday language peculiarities may not be immediately obvious.

2.5.3 Entrenchment

In questioning the reason for lack of progress towards a final theory of physics we have to look at the basis of entrenchment. In the opening chapter I referred to group dynamics and the general idea of pack instinct for survival, which is still alive today though with somewhat different needs. According to Baumeister and Leary (1995:498,502), groups meet "psychological and social needs". They also mention the 'belonging hypothesis' that members are equally reluctant to leave groups as they are happy to join. Academic groups tend to reinforce beliefs in their research and maintain self-esteem. They help to build teamwork which helps to clarify individual tasks, but they maintain peer pressure "ostracism is painful: It threatens psychological needs" (Williams and Nida 2011:71). One of the major processes of the group is group discussion as it tends to polarize the group through submerging alternative views.

Then there is resistance to change, a well-known phenomenon. Kuhn (1970 :5) writes “science, for example, often suppresses fundamental novelties because they are necessarily subversive of its basic commitments.” Group prejudice augurs that changes are more likely to emerge from outside the group, and major changes are more likely from a single informed individual with a more unconventional education or mindset. It is possible such an individual is likely to read the literature more widely than the group in order to project as well as solidify there is a general body of belief reinforced by contributions from many subgroups (specific groups). As Kuhn (1970:77-78) suggests from his his different views. With contemporary communications a specific group is not even alone; overall, research into past paradigm changes, the tendency is to stick to an established theory and make *ad hoc* changes. These can sometimes be just as extraordinary as the underlying theory, for example the many worlds theory in the interpretation that, say, a single electron with its multiple wave peaks can be interrupted at different points in its progression to give different outcomes with different observers. (This was a view to problems of wave collapse when an electron interacts with another object). Cartwright (1983:7.3) points out a further case. The wave function is supposed to give a probability which entails squaring the function and integrating thus giving an infinity (UV divergency). As the maximum probability is always unity, Dirac (1930) introduced the concept of the delta function isolating the wave to an infinitely small section of space for computation purposes.

There is therefore, in mathematical physics an element of subliminal preservation enhanced through years of effort creating an almost supernatural feeling, but it must be remembered perceptions are only human and as has been seen in the past can produce Aristotle’s earth, air, fire and water, as well as Heisenberg’s uncertainty theorem. QM proofs are purely experiments run and interpreted in terms of current views which, as seen through Kuhn’s thoughts, are liable to paradigm changes. Consequently, what is believed proved today may be found untenable another day.

Surely a number of heavily debated ideas (see Chapter 1 footnote 20) belonging to a specific theory suggest that there may be an underlying problem requiring a paradigm change, or even abandonment of that theory? (I agree here with Kuhn that the latter must involve the substitution of a workable alternative). Since physical theories are covered by applied mathematics, there is also the tendency to believe the fact that the mathematical formulations provide the ability to calculate accurate outcomes to measurement problems proves the theory’s correctness. As Dirac (1926:§1) said in his introduction of QFT “it is possible to build a theory without knowing anything about the dynamical variables except the algebraic laws that they are subject to” (which gives grounds to those physicists who believe that mathematics may run the universe). But here there is yet another problem. As discussed, mathematical formulations are established to do just that. They are linked and adjusted to agree with the theory. The difficulty here then depends on the problem exposed by Wittgenstein ([1922]2021) and Quine (1951). There has to be an unequivocal understanding of the terms as different people can interpret language in different ways, especially if, as observed at the beginning, none of the basic concepts of physics have been defined. Under these circumstances the interpretation into mathematics can always be amended (the ad hoc amendments mentioned earlier), or experiments can be interpreted to agree with what the physicist wishes to see and believe. The subject will be brought up again under the thought of a fundamental cause – denied existing by quantum mechanics.

2.6 Brief summary of Chapter 2

It can thus be said there are clear changes in the direction and form of human thought. Some of these take time to shift such as belief in a pantheon and mythical heroes establishing human mores. Using Kuhn's concept of paradigm changes there seem to be two types of changes: minor – those which keep the main theme intact, such as in the development of electromagnetic theory which thought in terms of a liquid basis, and then set on a field force based on two different charges; and major changes where an entire method of thought itself changes. For example, it is firmly established (entrenched) that mathematics is essential to understanding the universe and any overall theory will be set in mathematics while philosophical reasoning cannot achieve such a theory. Safety relies in accepting that dogma. I argue that mathematics has absolutely nothing whatsoever to do with the construction of the universe; and I will argue the only possible route to finding that construction is through non-mathematical reasoning based on a fundamental cause. That would represent a total change in methodology if it can be tested to provide an explanation for all the human observations of this universe.

Consequently, taking into account all the comments in this chapter, I shall turn to the possibility of a new philosophical approach to the subject of the fundaments of the universe. The underlying theme so far has been the suspect nature of our perceptions, especially their shaping by group mentality, the over reliance on mathematics and its truthfulness, the lack of definitions, and entrenchment of physical views by various means. In particular, the theme has questioned the idea that mathematics is fundamental to the universe. The implication arose that mathematics could not have preceded the formation of the universe which in turn implies it is, in fact, a product of the human mind as a science and as pure measurement in the living minds of animals. It arises from the evolutionary protective and/or hunting mechanism. This must place doubt on the methods so far employed and it should obviously form a basis for a philosophical intervention raised in Chapter 3.

Much of this thesis will then rest on examining the most fundamental aspects of human reasoning concerning the basic structure of the universe. It should be expected that this may impinge upon some of physics' most entrenched ideas, particularly if such an investigation signals the need for a fundamental cause of the form denied by quantum mechanics. It should then further be expected that this thesis: (1) will produce a completely new method of looking at the universal structure; and (2) will challenge some of the most accepted physical ideas.

CHAPTER 3

A Thought-Experiment in Time

3.1 Introduction

Chapter 2 roughly tracked the formation of human knowledge and its effect on our visions of the universe today through its formation of physics. In particular it suggested we have to look more closely at the most basic level of our current methods. These methods introduced some peculiar views in quantum mechanical physics which strongly militate against many peoples' common sense. As a result, it seemed sensible to consider a new approach to the whole subject of a final theory, not only the scientific side but the basic fundamentals that give rise to our perceptions. In a way this is not so different to the ideas of the early quantum theorists but there is, in fact, a big difference. Their ideas were a combination of mathematics and physics, so to a great extent were only a small paradigm change from one form of mathematics to another. It is thus a continuation of the typical human sapient processes. What Chapter 2 suggests is that a major paradigm shift away from our perceptions and preconceptions of the universe is required. This is a philosophical, not a mathematical change. It borders on a change in the psychology of the human species.

However, it was also determined that such a change can only be valid if it leads to a testable replacement to current physical theories. This must, of course, be achieved through developing the new line of thought, that is, the principle of a fundamental cause of the universe. This must be adjunct to the suggestion (section 2.4) that the universe probably is not mathematical in structure in any sense and that mathematics is a human idea based on the human requirements of measurement in order to survive.

Chapter 1 suggested that a major significance in questioning the methods of physics in its attempts to provide a complete theory of the universe would be the establishment of a new methodology. Incidental to such a project, the greatest significance, and thus test for the new methodology, would be obtained if it led to a complete theory of the universe emerging from the deliberations. Thus, a major aim of this work becomes proving that an underlying structure for a Universe, what might also be called its 'being', or 'fundamental nature' can be obtained through pure reason alone, by which I mean not mathematical as mathematics is considered as reasoning, if synthetic (cf Kant [1781] 1998 and (1783) 1902). In this respect, it should be expected that such a project is more intensive than a purely mathematical-physical approach because the latter, in human constructed physics anyway, has so far ignored definitions of its most fundamental entities – this arising from reliance on mathematical principles. Chapter 2 suggests that current ideas, by relying on human perception of our surroundings, are highly suspect, being of the form of a modern mythology entrenched by group norms. Chapter 2 also implies that the most important factor is a fundamental cause, denied a possibility by mathematical physics, while the questions ‘why does anything exist?’ and ‘why the so-called physical laws?’ are regarded (by physics) as inessential and ‘only’ of philosophical interest. I argue that no theory can be complete without establishing a reason – that is, a fundamental cause – for the structure and processes of the universe. Chapter 2 established this cannot be obtained by physics as currently constructed and therefore must rely on philosophical intervention. However, questions were raised over the ability of contemporary philosophy to undertake this action. It is all very well to attack established principles, but the real justification must be in replacing the attacked with new and better ones.

In this course I shall not try to emulate either physics or human perceptions but to forge a completely new set of ideas about the universe, which in a way may be even more foreign to what humans perceive or believe they know than quantum mechanics.

This new chapter will therefore investigate how this can be achieved. In this respect I shall apply the thought that a philosophical first cause must imply that the entire structure of the universe could also be derived philosophically without the need for mathematics, especially if the implication of the last chapter is accepted that mathematics relies on the existence of space and time for its own *raison d’être*. Physics with its empiricism would then become a test of the efficacy of philosophical arguments, a role reversal of the current concepts where philosophy of physics is supposed to check whether physics fits in with our common sense. Should it prove possible to derive such a theory of the universe it would demonstrate that the thoughts concerning mathematics and physics in the previous chapter are justified and further it would explain why mathematical physics has failed in its attempt to provide a workable structure of the universe. Consequently, to establish a cause I must review some of the most basic human perceptions.

Important contributory factors will be obviously the principle of causality; common sense, being more important than physical mathematics believes; the human concept of reality, but it should be remembered that deliberations into the nature of reality are bounded by human perception. In order to determine the best methodology, I shall have to take the concept of metaphysics raised in Chapter 2 further, as it would be the obvious choice for an initial approach. Following that I shall then consider other methods. The rest of section 3.1 then looks at the establishment of a philosophy centred around causal principles in contradiction to QM’s anti-causal beliefs. 3.2 discusses a serious problem of measurability which must come to the forefront of finding a first cause. Section 3.3 then follows on towards finding a fundamental cause. Finally, a fundamental definition is raised in section 3.4 followed by a discussion on reality including the concepts on objectivism and subjectivism.

3.1.1 The fundamental principles of the arguments.

In particular could mathematics be a single fundamental cause? The answer must be no because mathematics requires at least two principles, for example, at least number and addition. Therefore, it would have to have a precedent from which it can be derived, and as suggested in section 2.4 if the universe appeared from nothing, numbers could not be *a priori* to the universe; nor could commensurate measurement be fundamental. But does this overlook the completely abstract Platonic concept of mathematics? In this respect the possibility that a Divinity might exist should be acknowledged. The mere thought is enough for consideration, even if one is an atheist of the strongest belief, because it allows the concept as a pure hypothesis of an *a priori* correlation between mathematics and the creation of the universe. Therefore, the mere thought that mathematics could have been first is enough to make it impossible by reason alone to state it could not have come first.

However, there is another approach to the subject, one which is *a posteriori*. Instead, one can consider whether the universe has to know any specific numbers in order to function, or if it has any need of mathematics in order to exist in the form in which we see it. The answer can be obtained if reason can create a universe without the need of actual number values. This does not necessarily mean ruling out comparison in general. For example, one time interval can be obviously longer than another without any need of numbers to distinguish the fact. Comparison and distance need not, as such, be, measured in any defined metric; that is distinct *a priori* measuring units. Here I mean measuring in the human sense where humans have determined some material form of measurement such as a human foot or distance between knuckles. The universal construction itself could lead to some form of unit which cannot be measured in terms of anything smaller (cf section 3.2). In this case measurement and mathematics follows from the universal construction, the construction causes mathematics, not vice versa.

I shall therefore take the assumption suggested in section 1.3.1 that numbers are the outcome of human predilection and not fundamental to Universal construction. Current physical laws would then be purely human ideas in an attempt to rationalize observation. They could no longer be regarded as definitive, meaning that they might not be causal laws in the overarching causal sense aimed at in this thesis. They must then be open to philosophical examination for at best they could only follow from a fundamental cause.

3.1.2 A philosophy for causality?

Removing mathematical physics entirely from the reasoning of this thesis demands a new line in contemporary human thought. It may have to border on the transcendental, having little immediate correlation with human perception while testing the limits of human conception, for this conception obviously has to go where no thought has yet gone. It will largely be based on the search for that which factually is responsible for everything humans see around them, what might be called “reality” (David 2020, Smith 2018), despite the problems raised by QM. The line now is no longer that of uncertainty, locality, indeterminism, or even measurement, raised by quantum theory but the more mundane thought that what humans see may not be as we imagine it should be below our vision; that is, in the microscale universe. It must consider how this affects our vision of the macro-universe.

Interminable philosophical arguments (Kant [1787] 1998:109§Bxv, Persson 2018:52) could be raised on the question of existence and the root causes of the universe, but it seems to me their use is questionable unless they produce recognizably concrete answers. Kant ([1787] 1998:114§Bxxiv-xxvi) holds that a complete “framework” should narrow reasoning (cf Persson 2018:68) and also that intuition is necessary to obtain understanding of intangible things beyond our immediate experience. This understanding must include the root causes and underlying structure of the universe which Kant calls transcendental philosophy (1998:132§A11): “a philosophy of pure, merely speculative reason” (1998:135§B29); which he reinforces, (1998:134§B28): “… absolutely no concepts must enter into it that contain anything empirical”. As in section 1.3, I obviously concur with this statement, but it is questionable how this should be compartmentalized today. The results that contain the measurements, physical laws and empirical theories are obviously physics but placing the rest, the discussion of root causes and underlying structure, into metaphysics, or philosophy of science is not so clear cut. As pointed out in Chapter 1 there is no firm commitment to a specific definition of the last two. Different authors have different opinions. Fine (2014) regards metaphysics as studying the nature of reality, Ellis (2012), Lowe (2002: vi), Farr and Ivanova (2019:3-4) as investigating deep underlying questions, both of which views tie in with Aristotle’s (1923:A1) belief that, what we call science, is superficial and the real wisdom lies in understanding the why. Kant ([1783]1903:§40) despite his transcendental reference included “pure rational concepts, which never can be given in any possible experience”.[1]

Countering these views, a recent development, ‘naturalistic metaphysics,’ is exemplified by Ladyman and Ross (2007) that metaphysics should be *dependent* on science (an idea also evident in Russell (1913:6), which for reasons above, is completely opposed to my position that demands a first

[1] Kant also denied the possibility of attaining *a priori* causes except with the use of synthetic reasoning ([1783] 1902§5,27) which Hume had also denied, though not taking into account synthetic reasoning ([1739] 2017:Book1,iv p13). But as this thesis shows that it is completely possible to do so I shall not go into these arguments.

cause. They argue that metaphysics cannot determine *a priori* fundamental causes, nor prescribe physical theories, to which the obvious contra-position should be: why not, provided such deductions are measurably testable? On the other hand, Ladyman and Ross (2007:1) do say that metaphysics should unify physics; but, it seems to me, merely 'rubber stamping' physics, as Maudlin (2007:1) also seems to infer (see section 1.1.3), becomes the mere elucidation of physical theory, which is no help in uncovering the fundamentals of the universe (cf section 1.1.4: Stenlund 2003). French and McKenzie (2012) rather see metaphysics as reflecting on the acceptability of physical theories. The last view is better, but still not, I feel, the full use of philosophical reasoning. Reasoning is to develop by logical argument, to question ideas that appear illogical (such as existence depending on 'unreal' objects) and provide alternatives. Hans Reichenbach (1930:1) had a different idea to the aforementioned authors: " Philosophy should produce *results*, not manifestos," which is a principle of foundational philosophy.

Quantum mechanic's lack of reality, as accepted by Ladyman and Ross (2007:4) – the world is not "'made of' anything at all" – is interpreted by quantum mechanics as destroying the hope of a first cause (Hoefer 2004, Goswami et al 2018, Greenberger, Horne & Zeilinger 2005:1, Friederich and Evans 2019), thus constituting a clash between Aristotle's metaphysics and contemporary natural metaphysics. This lack of causality stems originally from Heisenberg's uncertainty principle and then from the realization by Einstein (Einstein, Podolsky and Rosen [EPR] 1935) that the Bohr-Heisenberg concept of QM (the so-called Copenhagen convention) would lead to the condition where *two different outcomes could be realized from a single experiment* performed on physically related (entangled) events; thus creating the idea of the beholder determining the outcome. As Einstein (1935:779) objected, such a possibility would indeed destroy a fundamental caused reality as it would require the input of measurement by an external object to determine *by chance* which of the outcomes should stand/be selected.

Causality was demanded, apart from Aristotle, by Newton in his very firm letter to Bentley (1693) – though Newton's is on a different plane. That is, it is a secondary causality between interacting objects, as opposed to the one considered here: the cause of everything in our universe, including the so-called physical laws and theories, as well as how the cause generates the human perception that creates these theories. It is, as Kant_(1998:133§A13) wrote: "the understanding, which judges about the nature of things." For Newton (1693), his principal worry was the concept of action at a distance seemingly created by gravity. He believed that there had to be a cause even though he could not conceive of its action. As such, discussions on the subject would fall under the philosophy of physics. They would be a method of testing whether physics is on the road towards 'truth' – but they can hardly take this line if they are to 'depend,' according to natural metaphysics, on what they test. This consideration of physical theories suggests a difference between metaphysics as suggested by Fine

(2014) or French and McKenzie (2012), which examines the nature and cause of objects and their existence, versus philosophy of physics discussing the nature, interpretation and relevancy of physical arguments and experiments – although when considering epistemological or ontological aspects of the arguments philosophy is regarded as metaphysical, or even meta-metaphysical. A similar example to Newton's difficulty, from contemporary physics, is the controversy over the concepts of decoherence and 'many worlds' theories in quantum mechanics (see Zinkernagel 2011:218).

However, there is causality and causality. Here I only deal with a fundamental causality, not that caused by living, or viral, action. Causal laws are purely human ideas formed from repeated observation of similar events producing given outcomes – particular interactions. They, therefore, may not reflect the actuality of foundational causes underlying the 'laws' themselves. Much of thinking about causality revolves around these laws and what may be described as cause and effect of 'everyday' events while in the main bypassing the fundamental cause, or nature of the universe, which determines why these apparent laws should exist in the first place. Causality has been a heavily discussed concept over many years. For space reasons I consider only a few views on its fundamentals, bearing particularly in mind the views of quantum mechanics given in Chapter 2.

Russell (1913:1), for example, decided (before QM) that the so-called 'law' of causality, was a falsehood ("its complete extrusion from the philosophical vocabulary [was] desirable"). True in that a law cannot precede its determinant, but not in the same vein as saying a fundamental cause of the universe cannot exist. Dowe (2010 §6.5) notices Russell to suggest that empirical analysis of causality as "an objective feature of the actual world", relies on physics for its "justification". This seems to me to miss the pointed dogma of QM that uncertainty belies causality, (which Aharonov et al., 2017:6484 claim is even more fundamental than Heisenberg's principle) that is, that human observation determines the outcome of events as shown by the quotations above or Hawking and Mlodinow's (2011:103) interaction between ridiculous cause does not make it true. The human species could not have existed without the sun having two objects. As suggested in section 2.5 such views strike me as nonsense because if I receive a ray of light from the sun, I have not caused that ray to be emitted, nor has anything on the Earth. If the Earth did not exist, that ray, it seems to me, would still be emitted. One can always *argue* that the non-existence of the human race would exclude the existence of the sun, or moon as in the famous Einstein-Pais case (Mermin 1985; does the moon only exist when someone looks at it). Arguing a ridiculous cause does not make it true. The human species could not have existed without the sun having existed. It would, of course, be possible to infer that the absence of humans could mean that the sun did not exist but not the human species is responsible for the sun.[2] Returning to more logical thoughts: if physics (QM) denies the existence of causality then the suggestion that a universal cause relies on physics for its justification must be false. In any case, surely the opposite must be true, physics must rely on causality for its (physics') justification. This is the case pursued here. Causality must then at least be covered by some form of reasoning other than physical, for it seems that some form of fundamental causality must exist in order for any form of causality, or even apparent laws to exist. It is this form of causality that I intend to introduce and demonstrate, by test, to be relevant to human understanding of the universe.

Dowe (2010§5) also discusses Russell's (1913:5) concept of world lines as an object proceeds from one state to another, that is, local cause and effect. As it does so, it intersects with other lines in Minkowski space to create an event, not so different from the concept of tropes.

The idea of a trope as a metaphysical concept was considered by Kuhlmann (2000) as a 'once-off particular', equivalent to an individual property subtracted from a universal (2000:122). The problem is the complexity of the number of particulars (see Morganti 2009:197 for a minimalist list based on Simons 1994). It therefore has to be a highly metaphysical argument until such time as the large array of different properties (particulars) can somehow be accommodated into one bundle and can then be separated at an interaction. It is not unlike a cause-and-effect world-line in which universal properties are reduced to particulars as a way of dealing with the fundamental nature of existence. For example, there is an increasing number of different 'species' of hadron particles in standard physics each of which might be considered to add to a trope. But these can be reduced through the colour theory of quarks (Greenberg 1964) to just three particulars (or six if anti-particles are included).[3] Keinänen (2011:12) requires tropes to be simple, meaning they have no subdivisions because if they did these would be tropes in themselves. The trope bundles have position and time (Keinänen 2011:12). The hope would be that analytic metaphysics might provide physics with the fundamental elements to underpin its basic laws and definitions. It at the least is an attempt to say something concrete rather than producing open-ended arguments that perhaps produce more confusion than clarity (Weinberg 1993:133).

[2] The question must arise whether humanity, or indeed any living things have a causal line, it being assumed that pure chance gave rise to life. However, experiments by Gibson, et al. (2010), Lincoln and Joyce (2009), and Powner, Gerland, and Sutherland, (2009) show that this chance would be extremely high.

[3] The main particles of standard physics are protons neutron, and electrons. However, a large number of other highly unstable particles can be manufactured in high energy collisions. These experiments have led to the formulation of group theory founded on combinations of different species of quarks in order to try to find a more basic fundamental particle. According to this hypothesis quarks themselves are combinations of three different quantum numbers known as 'colours', hence the term quantum chromodynamics.

However, neither of these ideas is definitive in meaning other than being concepts for cause and effect. D'Ariano (2018) has suggested that causality and QM indeterminacy have been incorrectly linked as contradictory, which to some extent is true, as it is the concept of entanglement and associated observation that destroys a *fundamental* reality.[4] These all require intercession in a bipartite particle system by receptors of each part of the bipartite system. Consequently, there is an interaction between each part and the receptors which extracts the state observed in the recordings. This is part of quantum mechanics dogma, which says that only one 'observable' can be determined by a single experiment at a time as the state is changed by the experiment and that a subsequent experiment to determine another observable will interact with the new state created by the first experiment, not the original state. Thus, if one takes this concept, there is a very clear cause and effect; one that is in accordance with the concepts of Dowe and others as a timeline or Minkowski world-line. The problem lies in the uncertainty of the original state of the two parts of the bipartite system. This has been destroyed by the test itself and is therefore uncertain. This goes to the root concept of causality (cf EPR in the supplement). If one takes every possible interaction backwards along its world line one has to ask: do all these world lines meet? Is there a fundamental cause and is it in this meeting of world lines that one has to consider causality?

This uncertainty over causality may also stem from another principle. In physical theory there are several fundamental entities (for example, space, time, mass, electric charge) which are regarded as too fundamental to be expressed in more fundamental terms, plus others which are poorly defined or left to intuition (such as force, energy, motion, rotation which themselves rely on the undefined concepts of mass, space, and time). They must therefore be considered as disconnected, as would their world lines, for any connection would itself be fundamental to more than one of them. In this sense QM must therefore say that we cannot ascertain a fundamental cause because this would require an interaction between two or more of the fundamental quantities and we could only observe the outcome, not the original input. Among other things it suggests that the study of universals can never uncover a fundamental cause. There is therefore more to attaining a fundamental cause than considering a few apparently fundamental entities which do not appear to have any unequivocal definitions. Fair (1979:245), for example, suggested that energy or momentum are acceptable fundamental causes through their transfer from point to point or particle to particle. However, the suggestion still lacks the knowledge of what is energy or momentum, what originally causes this energy or momentum, and causes it to be transferred.

[4] For example, if a particle is split into two parts that travel in opposite directions thus forming a bipartite system, the question arises whether they have distinct properties that can be determined, such as spin.

It should now be clear that all these views deal with a secondary causality and not a primary causality that leads to the universe itself – what might be called its reason for existence. As a last thought in this opening phase, Hume ([1739] 2017:45) raises the query whether it is possible to prove causality. Here, although he links beginning to causality his treatise refers, as with contemporary philosophy, to experience in judging cause and effect. Equally the question must arise whether it is possible to disprove causality. In both cases an original cause is beyond our knowledge. It can therefore only be speculated on. However, it would give credence to a positive answer if the speculation should lead to developments that explain our universe from a fundamental conception up to its current status. The thought of this completion must form a leading role in this study. Here I state I do not distinguish between divine or temporal, for one would still have to ask how a possible Divinity acted to bring entities into being.

3.1.3 Metaphysics, philosophy of what?

The acceptance of the QM statements that the world needs sapient minds to exist (in the hope of keeping philosophy of science alive against the attacks of Hawking or Weinberg?), and worse supporting them without argument thus refuting the possibility of a cause for the universe, is an anathema. As de Haro (2013:7), a physicist, states “One of the tasks of philosophy is to scrutinize the concepts and presuppositions of scientific theories, to analyse and lay bare what is hidden and implicit in a particular scientific paradigm.” This investigation should then not only consider the QM indeterminacy-reality issue but also redress any other QM fundamental, or ‘nature of primary existence’ oversights.

Such an issue cannot be physical because physics is based on observation and experiment, which are both suspect, to produce laws and theories which are then equally suspect; and, in any case, contemporary physics apparently denies such a cause can exist (Ladyman and Ross 2007:4, Heisenberg [1935]2011:18). Neither can the reasoning be metaphysical in the sense of factual-counterfactual or Aristotle’s contraries (Aristotle [350BC] 1923:A5) because these rely on human perception, and human perception does not see the fundamental causes of nature – only the results – if fundamental causes do exist. (Human perception may, of course determine the cause of effects such as, for example a smashed window hit by a cricket ball). On the other hand, the nature of things is accepted as metaphysical, but again, as just argued, this relies on human perception whereas causality must border on currently transcendental ideas beyond human comprehension. A complete description of the structure of a universe based on a fundamental cause, or attendant principle, and only on that cause or principle,[5] and which agrees with experimental measurements, should carry an aura of reality. Again, I stress that it cannot represent absolute reality because there may be other possibilities. Reality is discussed in section 3.5.

If this inquiry cannot be physics, nor directly philosophy of physics, and has a question over metaphysics, what else could it be? Considering the problems of reality in contemporary physics, and requisites of a new approach, its generation by exotic reasoning in the mind, suggests the word 'noetic' in the form given in YourDictionary[6]. This definition includes the words "… *specifically, able to be understood only by the intellect*" which fits the thought that a fundamental cause cannot be itself observed – only its aftereffects. Krader[7] (Levitt 2010:xxxvii) saw noetics as bound to metaphysics, but, in view of the wider aspects of this inquiry, I shall consider the use of noetic to be broader in essence than metaphysics. Unfortunately, both the words 'transcendentalism' and 'noetics,' have been given spiritual meanings far outside their use here.[8] I use them only in the sense of thinking completely from the mind, without reference to physical or measurable perception. I cannot say completely 'without human perception' because we appear to live in a temporal and spatial world – although if time and space are true factors of universal reality, why is there no definition for either in human language (see section 3.3.2)? Because maybe their (space and time) description is beyond true human comprehension, and passes into the realm of the transcendental?

There is one further problem concerning the nature of philosophical questions which I feel somewhat strongly about because I think this may be largely behind the failure of human thought to have arrived at an ultimate theory. That is, philosophy has excluded itself from a role in finding the answers to the fundamental questions of the universe irrespective of the position taken by Ladyman and Ross referred to in section 3.1.2. The problem arises as a result of the philosophical view concerning philosophical questions.

Floridi declared these to be questions that do not have an empirical or mathematical answer and are open to disagreement (2013:203). Russell (1912:chXV) gave a similar view by suggesting that as soon as something is certain it becomes part of a science while those with indefinite answers are called philosophy. Acar-Erdol (2020:225) agrees, adding that scientific questions are objective while philosophical answers are subjective and should "generate" a new bout of questions. That is, they should have no final conclusion. There also seems to be a belief that they must consist of what

[5] That is, accepting Kant's view (1998:134§B28) refusing anything empirical,
[6] www.yourdictionary.com/noetic retrieved 4th December 2020.
[7] Krader died before publication which was carried out by his editor Levitt.
[8] For example, Institute of Noetic Sciences deals with parapsychology, ESP, alternative healing and after death experiences. Transcendentalism was adapted as a religious and idealistic 19th century U.S. movement.

Aristotle referred to as 'contras' or contrapositions, for, as Russell (XII (1)) contends a "theory of truth must …admit its opposite". This may be true for a theory of truth but as this thesis will assert, there may always be other answers so we can never ever be certain of truth. Thus such an argument should not be placed across the entire philosophical discipline where it deals with deduction. I shall argue by demonstrating that such ideals can never lead to ascertaining the nature of anything and thus will fail Aristotle's main theme, the discovery of the nature of our world.

On the other hand, Floridi (2013:199) said philosophy without answers is useless and Reichenbach (1930:1) stated the objective of philosophy should be to produce firm outcomes. Without such outcomes we cannot know the nature of anything, for knowing is the end of enquiry, for if there are additional questions then the knowledge is not complete. One perhaps can consider the three 'laws of thought' raised by Russell (1912:ChVII), not that he accepted them as absolute.

(1) *The law of identity*: 'Whatever is, is.'
(2) *The law of contradiction*: 'Nothing can both be and not be.'
(3) *The law of excluded middle*: 'Everything must either be or not be.

If the contra is to be part of philosophy and questions are to be open it is hard to consider them as laws. Laws (2) and (3) are of particular interest as they appear to be self-evident and therefore as a principle presumably act as a fundamental guide to human argument, be it intuitive or learnt through education external to intuition. Since this thesis is in the first place focused on human failure, these 'laws' must be subject to non-acceptability, as otherwise they become unnecessary limits to enquiry. If they should in fact be false, as will be shown to be arguably the case, then in probability they are partly responsible for the lack of an ultimate theory.

As with everything else in this thesis, new ground needs to be broken. It is therefore essential to pass beyond current philosophical principles in order to investigate whether current methods have taken a false track, as seems highly possible in view of the peculiar ideas of contemporary physics that do not seem to fit ordinary common sense. It needs the concept of the proposed special 'foundational' philosophy with the sense that all human perception and thought must surely depend on a fundamental cause of the universe. A cause that, if it could be established, would settle the questions of reality, how and why we see what we see. If then, a foundational cause can be shown to exist, as Kant says (1998: 134§B27), the foundational philosophy "would also have to contain an exhaustive analysis of all of human cognition *a priori*" to be complete. Otherwise, it could not be said to be the only cause. The problem here is there is no pointer on how to formulate a first cause as such a cause has not been uncovered. This philosophy, being transcendental/noetic, will need, then, to pass outside current human views possibly by guesswork (at novel assumptions) and by pure non-mathematical deductive reasoning. But being of the human mind, I can only establish a first cause by taking an intuitive guess based on ideas taken from my mind – here Hume (1777:XII3§79) seems correct, we cannot back-track logically from existing perceptions. However, once this fundament has been presumed it then becomes necessary to avoid any other preconceptions and only to use whatever can be derived from that cause to test its efficacy. This is where there must be a major departure from metaphysics revolving around human perception. It means dismissing all physical ideas, laws, mathematics, unless and until they can be derived directly from the first cause. They must arise naturally without previous thought as to how to introduce them. Should an existing idea be needed as an argument the answer is simple: it is only a human idea, not *a priori*, nor a true process of the universe.

I thus propose a quite different form of reasoning that diverges from standard methods. It incorporates metaphysics in the sense of the fundamental nature of things to be derived by pure non-mathematical reasoning. It cannot be *a priori* because it must determine the *a priori* and in this sense it must be transcendental. But it must also deliver a full structure for the universe by pure reason that is testable against human observation. This cannot be 'philosophy of physics' because the reasoning, as projected, will contain no mathematics or physical laws or ideas as such. Nevertheless, the results will project *into* physics where they agree with physical laws and human observation. This is a necessary outcome of a properly causal argument. On the other hand, when dealing with shortcomings of physical theory, where necessary, philosophy of physics will be needed, particularly as an aid to understanding differences between current human ideas and ideas arising from a fundamental cause. The foundational philosophy will then provide the alternative suggested as part of logical requirements mentioned in the previous section. Furthermore, unlike contemporary philosophy with open ended arguments for and against a concept, a foundational cause cannot be preceded and therefore its associated generating (foundational) philosophy should be definitive, that is, it should give an unequivocal (closed) outcome. This should be possible because it should aim to transcend human reason which by its nature has to be based on perceptions of the universe.

Having decided on a 'foundational' philosophy the next question is how to proceed. Two major directions of enquiry can be immediately identified:

(1) Why does anything exist?
(2) If the universe is to exist into what is it placed; is there a pre-existing volume and if so, how large could this be?

These are in any case fundamental questions of philosophy (Glymour and Serafin 2018:52, Kant [1787] 1998, Aristotle [350] 1923), and as such must be an essential key to understanding the structure and processes of the universe. As raised in section 2.5 these two questions should be the basic requirement for a complete theory of the universe but according to Ellis (2012:27) such “ultimate” questions are out of the range of physics. I suppose if it is true that physics only deals with immediate ‘whys’ – those creating hypothetical laws – and cannot answer deeper ‘whys’ then the fundamental causes of physical ‘whys’ should become, as raised in chapter 1, the subjects of metaphysics. Thus question (2) is dealt with in this chapter as it will have a key role in shaping a foundational structure for a Universe (given a capital U to distinguish it from the current physical description of our universe). Question (1) requires information derived from this foundation to conclude an answer, so is postponed to Chapter 5.

But first, as the current human physical description of our universe depends almost conclusively on measurement, section 3.2 opens with a few important observations on this subject. Section 3.3 raises options for hypothesizing a foundational cause of the universe. The final sections 3.4-3.7 formulate a possible fundamental ‘cause’ and take the first step (sections 3.6-3.7) towards a possible humanistic reality (which in Chapter 4 will be shown to both answer question (2) above as well as giving a construction for space-Time that humans would perceive as three-dimensional).

3.2 Measurement

One of the most interesting problems towards determining a foundation can be found in the discovery made by Einstein (1905) of relativity, although here I introduce only the basis of his theory as a problem of measurement.[9]

Measurement has been the subject of debate from Aristotle through Kant, Helmholtz, Russell, *inter alia* (see Tal 2015). The immediate considerations here run along different lines which will eventually naturally answer some of the views discussed by philosophers. A general discussion of the concept of measurement goes beyond the scope of this thesis but reference to philosophical views will be given where appropriate, particularly in the case of reality and existence in Chapter 4.

Measurement has also been raised many times in relation to mathematics. It is a form of comparison (Tal 2017§3), one which is usually imagined in terms of a system of units. But this is an instinctive human view determined for human convenience in the choice of units, as well as by relation to human surroundings (see e.g., Tal 2017). As human units are purely arbitrary to suit human perception, they cannot feature in a first cause itself, though this cause may produce a structure that humans *can* measure. Such a view automatically questions traditional concepts. Principle among these

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[9] As there are some highly contentious issues arising from the way it is now taught at universities, Einstein’s theory is covered in section 4.8.

is the idea of a frame of reference, which by definition requires a coordinate, and thus measuring system. But in this thesis, I am assuming my prospective Universe (and the universe) is not mathematical in construction and does not need mathematics to explain it. This frame of reference, from the foundational point of view, must then be free of mathematical construction.[10]

Unfortunately, there is no word that accurately describes what is required – a general purpose, non-mathematical, view of an isolated observer's surrounds. An observation only occurs at our eyes/brain, meaning that light, or some other sensation has to travel from the observed to us. All we know is that it has arrived from ahead of our eyes, but we cannot be sure of the distance; we can only guess a distance by triangulation from our two eyes. But by observer, for my use of the expression 'frame of reference,' I do not mean a two eyed object but a single observation point. Thus, observations are made only at the origin of that frame of reference. Consequently, some form of directional connotation can only arise if one observed object can be seen with reference to another. And even this does not allow a complete geometrical description because the observer cannot tell which object is furthest from him by the mere receipt of light. He can only obtain some idea of direction with respect to himself – and this only if he has a single point of view which we would call his front. I shall use the expression frame of reference, or just frame, in this context. The conventional frame of reference is then a phantasm, even though an extremely useful one, for physical and descriptive purposes (touches of instrumentalism).

In particular, human units, for example feet or metres are used in connection with determining difficult to measure distances such as a straight line between two mountain peaks, or from a point on Earth to a point in distant space. In contemporary terms this can be done by sending a laser beam from a point on one peak to the other where it is immediately reflected back. The time taken for the operation is recorded by a clock which remains stationary with respect to the measuring apparatus. The speed of light is then assumed constant (constant here means that its speed is independent of any form of motion of observers or their frames of reference). The time taken is then divided by two because the light travels out and back. Thus, the distance is determined in terms of the time taken. The question is whether this is an acceptable method and if so, is the distance absolute? Here it is necessary to consider the concept of motion versus stationary, as defined by Einstein ([1923]1905:40) (see section 4.8). For example, again assume the speed of light is a constant and that when the above measurement was made everything was travelling in the line of direction of the mountains according to some observer. Then the laser signal of light will take longer to travel towards the far peak, because the peak is moving away from the signal, and a shorter time to return (because the measuring observer is

[10] I see a difference here between hermeneutics (human interpretation) and frame of reference which, admittedly, has distinct mathematical connotations as a coordinate structure.

travelling towards the returning signal). On the other hand, suppose everything were travelling in the opposite direction to the signal. Then the far peak would move towards the signal, so the signal would take a shorter time to travel out, but a longer time on the way back. So, it makes no difference which way everything is travelling, only that it is in the direction (or anti-direction) of the two peaks. Either of shorter-time-out-longer-back, or *vice versa*, will always give a longer time (see section 4.8) than if we somehow were 'stationary' in the sense that the travelling time of light outwards were the same as its return. Einstein demonstrated this would alter our perceived measurements in accordance with the assumed constancy of the speed of light in all frames of reference (section 4.8 and Einstein1905b). *Thus, from both the foundational* and physical *point of view we cannot consider any measurements we make as being absolute.*[11] We can only say that they refer to time as measured on a clock stationary to ourselves. This means the physical frame of reference (including coordinates) attached to an observer, in which he locates objects according to his clocks and units of measurement, is open to question. Then his ancillary deductions depending on his readings such as motion, force, et cetera, are also open to question reducing them to a mere set of ideas that influence his opinions and decisions. This question needs to be removed through developing the foundations of the universe to give his observations the validity that can be gained from a tested first principle. As explained in sections 1.1.2 and 2.1 this will require non-mathematical reasoning as mathematics, being an autonomous discipline, determines its own rules which may go far beyond what is needed to make sense of observation. Thus, physical principles derived by observation may not necessarily agree with the natural world.

These questions became known from an experiment by Michelson and Morley (1887) using an interferometer. Their original experiment was to test the Earth's speed through an expected ether, one which was shown by their experiment not to exist. Instead, it appeared that it made no difference to the speed of light irrespective of our motion. This was originally assumed to indicate a possible contraction of the interferometer in the direction of its travel – the so-called FitzGerald contraction used by Lorentz in his electromagnetic research and used by Einstein (1905) to explain the contraction in terms of space and time. Einstein realized that this amendment of time and space measurements occurred in the direction of motion. But as Tal (2015:1) points out, it is what humans regard as realism, in the form of being measurable, reaching back to the beginnings of sapience, that raised the possibility of measurement.

[11] Physicists overcome the problem by declaring that the time measured by our stationary clocks is our proper time and clocks travelling relative to us will experience a time dilation relative to our clocks. It then becomes legitimate to use our 'proper' time as a general time and apply a built-in correction to the traveling clocks so that they maintain their time with ours. However, here I am only referring to a problem of measurement and not a solution.

Thus the point to be understood is that we do not need to know whether we are moving or not; we only need to know that we *may* be moving, in order to cast doubts on our perceptions of what may be to some people their most fundamental beliefs – the absolute concept of space and time and thus, with it, the accuracy of measurement (van Fraassen 2013:146). This questioning is not due to the discovery of a physical theory (special relativity) or uncertainty principles, although the former appears to have been proved through for example, satellite navigation systems. It is due to a natural difficulty over measurement which had not been expected until Michelson and Morley's experiment.

This measurement problem passes far deeper into our human understanding of the space surrounding us than might be imagined. So, it must come before any explanation of the so-called laws of nature, for I shall argue that an explanation of the reality of the space we see around us will in fact determine everything that follows. Thus, explaining this space should be first in explaining the failure of mathematics to provide a final theory. Many perceptions may need to be overturned in the process. Further uncertainties, with quantum mechanics, will be questioned later.

So, returning to the measurement problem, if we are in motion relative to another object then equally that object is in motion relative to us. Then its length and time measurements will be similarly affected. This provides a simple physical test which it is important to consider. Suppose we observe a star similar to our sun travelling with respect to us. We assume it has the same constitution as ours and that light has a measurable wavelength and frequency. Then the light it emits will have the same colour configuration as the light our sun emits. If its time units are dilated, then we would expect to see the colour of its emitted light to change. Assuming the physical laws are correct, a time dilation is equivalent to a lowering of its frequency. But physics dictates that light travels at a constant speed and that this speed is given by frequency × wavelength. Consequently, we must have that its wavelength is also dilated. Similarly, an observer nearby the distant star would see the same effect in our light. This effect has been established by experiment (Kündig 1963, Ives and Stilwell 1938) (see also section 4.8).

Since everything physical is being questioned, I should also mention here that there is a question over the absoluteness of the speed of light which it will become apparent is completely fundamental to the construction of the universe, but only in terms of its absoluteness. That is: its value, approximately 300 000 km s^{-1}, is a purely human concept in terms of human units.

Before leaving this section, further consider the following thought picture. It is purely to sow an image for future use to aid in understanding the principle of the relativity of measurement. Imagine a sphere with a man inside it holding a rod which he, inside the sphere, would say was one metre long, half his height, and a third of the diameter of the sphere. Now suppose that the sphere and *everything* inside it can shrink. If the man could not see outside his sphere, he would have no idea that any change had taken place. He would still measure his height as twice the length of his rod, and the sphere three times the rod's length even if the sphere became immeasurably small to us. Similarly, if the sphere were to grow from a minimum size the man would be none the wiser if he cannot see beyond it. The same would apply to time if, for example, he noted that it took approximately one minute on his clock for a beetle to travel the length of his rod. That would not change for him inside his sphere. Nor would we expect him to see any change in, say, his mass because, for example, the beetle travels at the same rate in the man's sphere and the rod does not change relative to the man (no change in momentum); a point that will have value later. Everything would be exactly the same to him. How we interpret these measurements is more complicated but will become apparent in section 4.8.

So, whilst we adopt units of measurement suitable to ourselves, the fundamental concept of measurement is not as easy as human perception sees it. That is, the application of measurement in a human frame of reference depends very much on how the foundational cause of the universe is constructed. Measurement is, then, purely a form of comparison, and a question mark remains over the basis of this comparison in the universe beyond our immediate perception. And this must form a consideration of philosophical reasoning since it should articulate on the quiddity of our concept of unity (cf Aristotle 1923:Δ§6(3)). Even the Planck units adopted by physics must be considered suspect in this respect for they are based on human constructed units.

So far time has been used in terms of measurement as a part basis for referring to human surrounds, that is, frame of reference. It turned out to have an effect on another important human concept, that of length (wavelength) as observed from rapidly moving celestial bodies (see e.g., Goldberg and Scadron (1995:37-38) and the above mentioned Kündig (1963) and Ives and Stilwell 1938). This in turn relies upon the human sense of space or volume. But neither of these ideas say what time (or space) actually is. Without this knowledge there is always going to be a question over human understanding of anything perceived, especially from the point of view of existence. Thus, what is real to us through measurement may not be as real as thought, ostensibly validating the quantum mechanical derogation of reality below the level of human vision. As Tal (2017:3) says "*realism is concerned with the metaphysical status of measurable quantities*;" in this thesis realism in human perception is concerned with 'the foundational state of measurability'.

In this respect the human concept of space has been an enigma: from Aristotle's works, his *Physics* ([350BCE] 1991 Books III-VIII) and *Metaphysics* ([350BCE] 1923 Book K:10-12), to the present day (Bruce Reichenbach 2019). As with time, the concept of space seems to have been taken as a fact of existence rather than as needing to be questioned over its fundamental nature (Maudlin 2007; or van Fraassen 2015:122 citing Leibniz and Newton in terms of its geometrical nature or its relation to motion and force). Space has been assumed to be a continuum (Maudlin 2007; Ashtekar

2008:2) although Regge (2000:2) and Chiou (20014:2) raise the possibility that it has a discrete or grainy nature. Einstein with his theory of special relativity ([1905b] 1923) challenged its previously assumed absolute nature of measurable length followed by his general theory ([1916] 1923) which tied space to Riemannian geometry. Since then, several geometries have been considered as a solution to the Riemannian field (Ashtekar 2008) but none of these question the fundamental nature, or existence, or boundedness of space, (cf the concept of fields in section 5.2). Furthermore, quantum mechanics seems to challenge its reality, in the sense of consistent measurability, through the concept of entanglement and Heisenberg's uncertainty principle – a major issue in Chapter 4.

I cannot see how it is possible to say anything truly worthwhile about universal structure without an attempt to understand the fundamental nature of space just as with understanding the nature of time. Leibniz ([1714]§32) believed that everything "real, or existing," must have a cause, an opposite view to the principles of quantum mechanics. As already pointed out, these QM principles deliver a denial of causality as well as absolute reality, in a way reminiscent of Hume's (1777 XII part3§29) rejection which worried Einstein [1944]1960:22) (cf sections 4.10-4.11). On the positive side there is also the *kalam* argument (Reichenbach 2017) that everything that begins has to have a cause – which rests on the assumption that the universe did begin, a position taken by both religion and the physical 'big bang', but a question that must rest on the question of causality being examined in this thesis. The theistic views were aimed primarily at demonstrating the existence of God and will not be raised here as this thesis is aimed at a deterministic Universe – again contrary to QM. Consequently, the nature of space is of paramount importance.

Therefore, we should expect that space, or rather the fundamental cause that gives rise to space should equally explain these problems, but not through specifically taking this into account when explaining space. That would be projecting an *a priori* thought (as proscribed in section 1.3.3) onto the fundamental cause instead of that cause naturally leading to the answer.

These fundamental concepts of measurement, although showing a highly indeterminate base – characteristic of human susceptibility to misinterpretation – have a major bearing on considering a foundational, or first, cause. I now turn to establishing a suitable premise.

3.3 Towards a fundamental premise

Previous sections have raised the possibility that a single first cause might exist together with an associated definition based on what a human might believe to be a self-evident truth. I do not know whether any humans can imagine anything outside of this universe to weld into a fundamental concept; consequently, it seems that, as suggested, the basic premise will have to be an assumption, which implies it must come from analysis of human beliefs. It therefore has to be a metaphysical-foundational assumption because it deals with humanity's most basic questions – the so-called nature of reality. In view of the conjecture required, such a foundation can only be justified by the total deductions attained. If it produces answers in line with experimental measurements, then *perhaps* the conjecture is correct. Even if it agrees to an extraordinary degree with human observation and common sense/logic it cannot be considered absolutely correct because there could always be a better guess. Only in this sense should foundational philosophy be open to question. It should otherwise be closed in its overall internal structure.

I shall first deduce a possible first cause and then turn to its relation to reality.

3.3.1 The fundamentals of universal being

The acknowledged fundamentals of physics are space, time, mass, and electric charge, none of which are defined in standard physics as there appears to be nothing more fundamental on which to define them. On the assumption that our universe, as we see it, is a reflection of all the processes available to it, the first choice of a single premise should then fall upon one of these. Mass and electric charge are comparatively innovative ideas as they had not been identified until the last few hundred years, although 'weight' must go back to perhaps the age of the first sapient beings. Both mass and electric charge have been subject to many different explanations over time so they can really be no more than hypotheses, leaving the possibility there may yet be another better account of the properties they convey to objects. Thus, it is fruitless to try to find a premise based on them.

In any case, the most fundamental perceptions we have are of time and space, neither of which have been defined. They are also the most abstract. First space: is it necessary? The question of a pre-existing space has already been raised into which a universe could be placed, and I imagine most humans could not consider the existence of anything without space for it to exist in. But suppose there was no such thing, maybe just a mathematical world, or even a dream world (Tegmark 2007, Berkeley 1713). Then what of the supposed existence of particles? Do they actually need space to exist? Point particles such as photons or even leptons are said to exist in mainstream physics, but if they live in a pure mathematical world then one could consider the existence of these pure points without the need of a volume. Furthermore, it should be mathematically possible to consider that all objects could be manipulated in point form for calculations without the need of an actual volume[12]. Even more so in a

[12] I distinguish between space and volume. Space has multiple connotations being used as in 'deep or outer space', mathematical space, fields, surrounds, gap, et cetera. Volume is simpler. It must first be deduced from the foundational principle and then shown to be three dimensional. It may seem that this is a form of space, but the volume's nature will be seen to strongly contradict current human interpretation of this concept.

dream world, but I think the latter can be left as an idea raised to answer some of the problems in earlier philosophies. So, the question of a pre-existing volume, or space, is a non-trivial problem that requires a solution. I will only consider it from the human view because humans have the ability to debate its cause and existence. We are aware of space because we can move through it without apparent interruption (we displace gaseous substances), and we can estimate how far we can move without colliding with some object. That is, we see space in terms of other objects. Consequently, it seems space would need reference to something else. It cannot, for example be defined in terms of distance or measurement as that would be equivalent to defining it in terms of itself. There is also no certainty that it is completely abstract, it could have some concrete existence (being) of which we have no perception which allows or causes objects to be separated, for example some form of force which brings us back to Newton's problem. If it was defined in terms of something else, then it would not be fundamental. As a result of these comments, I feel justified in turning to the last of the four fundamental physical concepts: time.

Time is perhaps the most difficult to define because without a clock there is nothing to see. It is only detectable through visible changes to one's surrounds or to one's almost subliminal feeling of time passing which may indeed be a note of our beating hearts. Consequently, it seems necessary to first analyse its apparent (to us) attributes. It, at least, is abstract enough not to require a questionable space in order to exist. It could exist perhaps as a single point or even set of points. So, it is upon this that I shall concentrate. I shall first consider existing philosophical ideas by other authors, and then analyse my perceptions of time.

As suggested in section 1.3.3, this leads to a major problem: How do we suggest, or describe something that might be outside of human perception, but perhaps not conception, when we only have language based upon perception and not conception? For example, if I produce a fundamental definition for time, it can only be given in terms of words such as 'point' for which there is no *satisfactory* definition in human semantics. The same is true of space and volume. In terms of physics 'space' is one of the fundamental elements and is considered so fundamental that it cannot be described in terms of more fundamental elements. This has left it open to questions such as: is it a continuum or discrete (grainy); is it isotropic and isomorphic; what is its form; and if a field, what is meant by field (see section 5.2), and so on? Similar problems apply to time, so it is not only a lack of unimpeachable words to define it. Space and volume should then become easier to define because if Time is the fundamental cause, then space and volume would have to follow from it, otherwise, as above, there would have to be a more fundamental cause to accommodate both space and time.

3.3.2 Time and existence[13]

Most people have an intuitive idea of the inexorable passing of time, but philosophers have spent many hours trying to decide exactly what it is. There are probably as many views of time as there are people who write about it. I have not managed to find a single unequivocal definition, but many passages that avoid the issue. The issue itself seems to be mainly decided on disciplinary lines: physicists are not concerned with its quiddity but only with its apparent effects leaving its true nature to the philosophers to wrangle over (van Fraassen 2015:108, Baumgarten 2017:5, Ellis 2012:27).

Markosian (2014:1) says the question of time has always been a problem for philosophy. Shevchenko and Tokarevsky (2011:1) say it (and space) are foremost metaphysical problems. Ellis (2012:27) concurs – physics does not answer "ultimate" questions. Baumgarten (2017:5) says "The impossibility to define the concept of time is insofar unproblematic … as the concept of physics itself presupposes time." Rovelli (2018) would disagree believing it to be a complete illusion (cf Page and Wootters 1983 who consider it an internal concept of the human world), a thought tentatively raised by van Fraassen (2015:108) and for varied reasons by McTaggert (1908). Van Fraassen (2015), and Markosian (2014) discuss a host of views on time without leaving any concrete conclusions; as Bryan and Medved (2018:2) say, the ideas are wide "leading to disagreement amongst the wide range of contributors." Time, importantly, is also a problem through quantum mathematics based on Schrödinger's equation, which itself was constructed (as a guess [Renn 2013]) from Hamiltonian mathematics (Synge and Griffith 1959:411). Hamiltonians are generalized equations based on momentum and position rather than time, although time can be regained using additional equations where required. Nevertheless, it means that time is extraneous to the fundamental ideas of QM. As a result, as above Page and Wootters (1983) followed by Moreva et al. (2013) introduced a concept based on entanglement to explain changes in physical conditions, that is, what most people regard as time.

Rovelli's opinion is interesting. Being obtained from quantum mechanics it carries the problems of time over into the problems of observation. That is, a system in a given state can have different observed states, depending on the observer (Schrödinger 1935:3, Zurek 2003:1). This is close to Hawking and Mlodinow's view (2011:103) that an observation depends not only on the observed but

[13] Since writing these sections I have discovered there is a mathematical method of defining time but as I have rejected the idea that the universe may be mathematical in structure, or even that mathematics is necessary for the universe to exist, I shall remain with my, in a sense 'classical', word definition. The mathematical definition may be found in Costa and Sant'Anna (2008). In any case it contains a fundamental problem, that of a mathematical space, bounded or not (cf Costa and Sant'Anna (2001). And it is not simple in the sense of the uniqueness of a fundamental cause expressed in my section 2.3.3.

on the observer as well; in quantum mechanics it changes the state for all other observers. Some of these states are, in QM, observably mutually exclusive, for example, momentum and position of a particle; determining one changes the state of the observed particle so that the other has to be determined by a new observation at a later time. A basic concern is that these statements are only human perceptions allied to so-called physics rules; rules that are largely entrenched to the level of dogma without a fundamental foundation (QM monism). Persson (2018:58) for example, doubts that physicists will ever unearth the fundamental concepts, but philosophers might do so by the nature of their uninhibited arguments (cf Chapter 4).

Many authors consider time as something measured on a clock (for example, even Einstein balked at a definition of time [1905b:39]) or the concept of an interval (as does Aristotle ([350BCE]1991:§218-220) although he sees an incongruity – see section 4.11).[14] If an early clock is considered, it has a round face marked into sixty intervals each representing a circular movement of a hand by six degrees of angle. So, the measurement is actually an interval of change by one unit of circular length, or six degrees. A number of these add up to one rotation by the Earth; and an even greater number to one revolution of the Earth around the sun. But that does not tell us anything about the fundamental concept of time; why or what in the universe leads to the passage/expression known as time for which we invent mechanical systems to represent it. Or more recondite still, is time continuous (a continuum) or discrete (grainy)? Nor will it prove satisfactory to consider time as the difference between changes of one state to another, because that requires a specific extra definition of an interval from one condition to another, where interval is defined by dictionaries as between two events (or space between two points).[15] How is that difference measured? As the differentiation between points on a clock face, all points of which exist simultaneously irrespective of the moving clock-hand. That is, if an event occurs when the clock-second hand is at *A* and another event occurs when the second-hand is at *B*, we can at time *B* count back the number of seconds between the two events because *A* is still on the clock face when the second hand is at *B*. But if we note an event without being able to record its time, and we cannot count until we can find something to compare it to, we cannot say how long ago it actually occurred. In that respect events are fleeting as is the interval between them. Furthermore, what if a clock (of any form such as an egg-timer) should not exist? The suggestion shows that the concept '*something* that can be *read* on a clock' is even more mundane.

The questions are still, then, (i) whether time does exist in nature rather than being a spiritual quantity in human imagination; (ii) what it is; and (iii) whether its existence could be concrete –

[14] See for example https://www.exactlywhatistime.com/definition-of-time/ which contends "There is no one simple definition". It gives many ideas of the form 'a measure in which events can be ordered from the past…." which is a definition of what time does but **not** of time itself.
[15] E.g., World Book dictionary 1989, Cambridge English Dictionary 2020.

meaning being involved with the reality of objects. But on what can arguments be based? Only on human ideas which may be false in relation to the actuality of the universe. To have any chance of success they must be based on a fundamental truth. But then, arguments can be made on the existence of a single fundamental truth, or what that truth actually is (cf Reichenbach 2019:§6.1). Consequently, the best answer is to take a flying guess and ignore open ended arguments that can never be decided. Metaphysics as envisioned by Aristotle ([350BCE]1923), it seems to me, was not to be inconclusive but to arrive at a final resolution by reasoned analysis. The fact he did not succeed in uncovering this cause is not an excuse for half measures but a challenge to bring his idea of a first cause to a conclusive finality (see section 3.4). Consequently, let the result of the fundamental assumption determine its efficacy. If it does not provide a suitable outcome, refine it to something else and try again.

In view of this approach, I enter two further views both suggesting that trying to find a definition for time is impossible. In my view a 'cop-out' because the first order must be to find a fundamental principle on which to base the so-called laws of nature.

> We can not 'explain' time to someone who does not know what it is because it is unique. A unique concept can not be explained by other similar concepts since it is unique. But though clocks don't explain or define what time is, clock's [sic] define how we measure time. And this is all that is required: Physics is neither able nor obliged to tell what things are, but physics can tell us how things behave (Baumgarten 2017:5).

> The concepts of the laws of nature and of the passage of time play central roles in our picture of the world, and the arguments that these can, or need to be, reduced to something else strike me as flimsy (Maudlin 2007:5).

Despite these two views, as time appears to be possibly the most important entity in a frame of reference, I will assume that time does exist. Then I must take a more ontological view of its apparent traits so that some idea can be formulated of its most fundamental attributes – that is, to ascertain precisely what in its structure causes our perceptions.

Aristotle raised the problem in Book IV of 'Physics' [350BCE](1991) from §218a4 onwards, noting apparent contradictions: 'now', for which 'nows' cannot be simultaneous, so must be separate but cannot be separate. Time forces change which can be fast or slow, but the flow of time must be constant but not movement (§218b10-20) which implies time "is neither movement nor independent of movement" (§219a2). In 219a30-219b1 he gives the principle of ordering, which is 'before', 'now' 'after' using this as an argument for the fundamental existence of time (217b29/218b21). Thus, he believed that everything in the universe is in a constant change of state but that this could not allow the fundamental construction of the universe. There must be a group of 'first causes' that would be unchanging; something that would motivate the changes in the universe and would cause a single first eternal motion: “The first principle or primary being is not movable either in itself or accidentally, but produces the primary eternal and single movement.” ([350BCE]1923:123§8).

Surprisingly, Aristotle’s views can be tied to a modern context. Our basic experience tells us life begins, it ends. The sun comes up, it goes down. Everything changes. The universe is not static. Clocks have been invented to mark the passage of time between events. These may click every second or may run at atomic rates. These last two statements have an ontological significance. The first is that in our frame of reference time creates an interval between events which we can measure; and second, that humans need discrete intervals for this measurement. For example, even the running of a caesium clock has a defined frequency/period[16] between ground states. The defined nature of measurement is essential to the concept of time because humans believe in the ability to determine time precisely so that two measurements made of the same event, or type of event, can be compared with prescient knowledge of accuracy. For example, assuming, just for this argument, the homogeneity of space and time throughout the universe, measurements of light emitted from celestial bodies moving at relativistic speeds relative to us can be measured in terms of frequency. This gives a spectral shift due to a number of possible effects. Take, for instance, the special relativistic, or transverse Doppler effect (e.g., Goldberg and Scadron 1982:36): we need to be certain that the period (of time) in the emitter’s frame of reference is exactly the same as in ours (if both of us were at relative rest). Then we are able to compare the spectral shift observed of the celestial body to the spectrum seen in our frame of reference.

Proper comparison requires that the start and finish of the period, called endpoints by humans, in the emitter’s frame must be precise, as also must be ours. This at present we have to assume to be the case. But it leads to a specific suggestion that in nature’s construction of the universe, time is ‘constructed’ in such a way that this sort of determination can be made exactly. That is, the ends of the period are not blurred into either a preceding or following period. The question then devolves to ever smaller clear-cut periods. To have such periods requires a distinction between the start and finish. (I hesitate to call the start and finish of each individual period endpoints because this will cause confusion later). So, in a continuous stream of periods such as on a caesium clock the question of frequency arises, thus demanding a clear cut distinction between each period. This, of course, does not mean that time itself is not continuous. But one should consider that if each end of a period is to be distinct, the question of ‘is’-‘is not’ for the period arises. Thus, for any period, however small, there must be a clear differentiation between the ‘is’ of a period and its ‘is not’ demarcating the beginning of

[16] “Physics: the interval of time between the recurrence of like phases in a vibration or other periodic motion or phenomenon”. The World Book Dictionary 1989.

that period and the same for the end. Adjoining periods must be contiguous as otherwise an undefined 'empty' gap could exist between any (or all) of them. Gaps might allow an interval of a specific number of identical periods in one frame of reference to have a different temporal length to the same number of periods in another frame, unless the periods can be reduced to a set of minimal (meaning cannot be smaller) units (such as for example Planck units) so that any gaps themselves are minimal.

Without a firm unit no confidence could be given to comparisons between different measurements and, if it was not a minimum, then it could be divided. But it cannot be 'infinitesimal' because then it could always be divided further. Therefore, there has to be a minimum indivisible unit or minimum **interval** (cf Russell 1913:5). In this case I can define such a minimum unit as a **unit of Time**;[17] that is, any so-called gap cannot be of any length, it has to be the same as one or more minimal units, that is, any gaps are themselves minimum Time units (before relativistic considerations). Because a Time unit is indivisible it cannot have beginning and end points, nor can these be external because all external points are also units of Time. Thus, the beginning and end to a Time unit, which humans expect, must be the same as (included in) the totality of the unit. It would then be a point in the sense of existing but without a size – how could it be measured except against itself as there can be nothing smaller? This further raises an open ended but absolutely fundamental question to which I could find no answer, and extraordinarily little consideration in the literature – what is a point? The most basic idea seems to be given by Euclid '*that which has no part*.' A point then would become an **adimensional abstraction** that exists only as a human notion. But this does not give it a concrete form, so that does not, as required here, define exactly what a point of time is other than *something* on a clock. And we are back to 'square one.' I thus see a difference in these considerations between human ideas built upon apparent beginnings and endings to everything, and concepts of a possible fundamentalism beyond human perception. So, for the moment I can only assume that there is an entity, being, or object that corresponds to the human concept of time, and with this in mind continue with the concept of time in the view that a full definition may appear.

3.3.3 Towards a definition for time

Now the question of a definition satisfying the above issues. To be foundational, or as Aristotle (1923: A§1-2) would have, a first cause, it would have to be based on a single premise. Otherwise, it would be a complex premise needing simplification to a single more fundamental form. With a single premise, any growth in the universe would have to be by repetition of a single form. Under the assumption taken in section 1.3.1(i) it will not have a mathematical cause. Consequently, mathematics

[17] I use a capital T from here on to denote Time as given in the following definition as opposed to human perception of time which may differ from person to person.

will not be considered. In the concept of 'building by repetition,' single should not be taken as a number, but as just the human device to denote nothing else but a simple cause. Without prior conception it may be that it will lead to a system which humans see in terms of numbers. That is, a single form may arise as an original stage and produce another single form, or maybe a set of single forms. This, or these, will provide the next stage; and so on. The whole will depend purely on the first action provided; this action must determine everything else in the foundational reasoning and thus the Universe derived. It must be capable of answering any problems that might appear and provide only one route to the formation of a Universe. Without these provisos, the action would require a restriction thus rendering the fundamental cause composite, not singular.[18]

The fundamental cause of time should then form a continuous immutable progression with each stage being distinct from the previous. That is each stage either 'is' or 'is not,' there are no half stages or divisible stages. Thus, a sequence of actions will arise in which every action clearly follows a previous action. Each stage is distinct and must thus be recognizable from any other. It can be assigned some particularity or symbol distinguishing it from any *previous* stage; but not to future stages because the universe is inanimate, just a continuous action. I assume only a sapient object can attain a future thinking ability. Furthermore, if it is to create a universe, which, I assume here, consists of concrete or substantial, material objects, the foundational principle should be one that will have an essence of concreteness about it, even if it is not concrete in itself, – it will provide what humans see as concreteness to the objects produced.

If time is to be assumed as a first cause, then the question must arise: Could anything exist outside of time? The answer would have to be "no" because, if time were to be the foundational cause of Universal existence, everything in that Universe would have to relate directly to that cause. If it is to be a simple single cause, then it cannot be composite. Therefore, it could not contain a subsidiary cause which would remove time from the picture as the Universe developed. Consequently, the entire Universe would have to form around the existence of that time. Thus, nothing in that universe could exist outside of time. So, this case allows the premise, which I will also call a . st assumption, that everything that results from the first principle exists in time, while time is responsible for everything that exists. Such a premise, recorded as 'time exists,' would be recognized in human sapience as a self-evident truth. In fact, this still has to be conjecture because one cannot be certain that existence 'in itself alone' implies time as the first cause. It might imply something completely beyond any human imagination. The best possible outcome of such an investigation is then attained if the resulting development of the premise produces a workable, testable theory on the construction of a universe. As

[18] Note that it will not be possible under the thesis length restrictions to discuss and discard all the possible ideas that arose but led to contradictions. Only the viable route will be described.

Aristotle himself (1991:220a1) wrote: "if there were no time, there would be no 'now', and vice versa" which agrees with human sapience. Baumgarten (2017:3) too, agrees that time is fundamental.

Finally, time in human cognizance is associated with number. The question must then arise: if, as projected, number is not necessary for the existence of a universe why does number feature so strongly in human thought? As with the views of Ellis (2012:27) and Baumgarten (2017:5) this question falls within the class of unnecessary information for physical deliberation and therefore is an ultimate question in the realm of metaphysics and foundational philosophy. The use of numbers in calculation or to form mathematical systems falls under the remit of pure and applied (including physical) mathematics – although, as will be seen in Chapter 4, mathematical calculations can be used in a purely philosophical manner. But if 'time exists' is a true foundational premise it seems possible the causality of the human concept of number must arise from time itself. Even the concept of singleness is inspired by the human concept of number. Humans have the concept of 'one' because they also have the concept of 'one-one' and 'one-one-one' where each 'one' represents an object. To some extent this casts back to the concept of comparative intervals of time based on minimum units raised above (Campbell and Jeffreys 1938: 123-4). One-one is defined as (called) two and one-one-one called three and so on through the natural numbers, each 'one' being defined in turn (Goodstein 1968:73). Using these as groups gives quantity. But humans can also see a number of objects lined up and assign adverbs to give an order of first, second, third and so on. Each adverb (ordinal) is then isomorphic to the sequence of natural or counting numbers, N. Note that in such a sequence zero does not occur, and cannot occur, because it means 'no thing' and so is not seen in a sequence of *material/concrete* objects (cf Tyson 2013). Note that this numbering is purely a human concept that is irrelevant to forming a Universe.[19]

These factors suggest the direction of an unequivocal definition outside of current human assumptions and perceptions, in as far as language allows: a possible first, or foundational, cause from which a structure would follow that would automatically (causally) develop into a universe. This inference does pre-assume a universe might follow, but this is necessary in this instance as a statement of intent. The target will still remain, as in section 1.3.2, to use the definition for deduction without expectation of any particular result.

3.4 Definition of Time

I therefore raise the following preliminary definition, the second assumption of the proposed theory:

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[19] Here I use a capital U to signify a Universe constructed from, and only from, the definition of Time.

The fundamental action of the Universe is one that creates a self-generated ordered progression of recordable points all of the same form but such that each point is distinct from any other.

Some of these words need clarification.

- Self-generated implies some operation, or fundamental action, $\hat{T}$, by which time creates new points in the progression. The determination of the form of this operation will explain the most fundamental processes of the universe.
- Ordered progression here means the orderly operation of $\hat{T}$, so that a point produced in the first instant of the progression can be called the first point and assigned the 'number one.' The point, or points (the possibility of more than one has to be left open until $\hat{T}$ has been determined), generated in the second instant belong to the second place in the progression and so on. In terms of the definition, points are produced in a sequence. Depending on $\hat{T}$, the progression may then have a number of sub-sequences of points, each consisting of a string of single points in order, starting with a first point, second point, et cetera, in a particular subsequence and so on where each point of the subsequence corresponds to a position in the overall progression – similar to an evolutionary 'tree' (see Figures 4.4 and 5). The action/form of $\hat{T}$ must then include the cause for this progression. Humans would say the progression gives the set of counting, or natural numbers (section 4.3). Points themselves cannot be divided because there can be nothing smaller (4th bullet); if splitting were possible the progression would not be well defined. However, as assumed above, nature neither labels them, nor needs to know them by number.
- In terms of semantics, (section 1.3.3), by point I have to use the words 'it is dimensionless', it has 'no size'.[20] The form of the points has to be determined and this, as well as the distinctness principle, will depend on the form of $\hat{T}$. Here, this total formation is assumed to be the fundamental defining cause of the Universe, which for the next few sections considers point as specific to Time, that is a point of Time, and it is this theme that will form the original development of the concept of Time as the fundamental instigating principle of the Universe.
- Recordable. The dictionary definition is "to put in some permanent form; keep for remembrance." The concept that a point is recordable must follow from the form of the points. (Cf section 4.6)
- The distinctness principle depends on the form of the points.

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[20] In view of the absence of space or volume in the premise, the concept of 'volume' will need description. This is difficult to put into words because I suspect that the absence, in other words the non-existence, of a fundamental volume is an unusual thought and thus has no semantic description in a single word. We can reach out and touch objects and look through telescopes to see 'distant' objects from which we infer the existence of space and volume in the three-dimensional sense. It is part of our perceptions of the world around us. The question is the nature of this perceived volume and ultimately the extent of the universe. These have to be determined before a natural definition can be given. Until then (section 2.6) volume and size, or lack of it, will have to be considered in terms of our usual perceptions of a space – since no such physical definition of its nature exists (see e.g., Regge and Williams 2000).

- This definition is absolute, meaning that it applies to each and every point of Time in its frame of reference (as described in section 3.2).

I shall use Time with a capital T to distinguish it from any other human preconceived notions of time. The reason for using 'Time' will become obvious despite the intention of avoiding preconceived ideas. Thus, the following definition becomes equivalent to the above generalization once all the bullets have been answered:

Time is a self-generated ordered progression of recordable points all of the same form but such that each point is distinct from any other.

As can be seen the definition is not complete. It depends heavily on the self-generating operator $\hat{T}$. The action of this operator must also determine the form of the points of Time. It does, however, provide a starting point, a point of Time, as an arguable cause though it does not as yet explain why this point, or Time, should exist; but it is to be hoped a full description of the processes involved may lead to the attainment of the second question raised in section 1.3(IV) (why does anything exist?) – as well as, more immediately, the first (into what is it put?). These will be answered in Chapter 5. As the assumption is that the universe is not mathematical, and needs no number system, the completion of the fundamental cause will necessarily be continued using philosophical reasoning.

Before developing this definition, it is worth considering the concept of reality that forms a basis of human perception and that, as seen, has been a question of debate in the latest physical theories.

3.5 On Reality

Definitions must rest on the concept of reality, which extends to that of why anything exists, but this will entail a full understanding of the structure and processes of the universe. Since humans only have their own sapience on which to debate reality, it can only be conducted in terms of human perception. Reality has been a question over the ages, possibly more in line with the reason for existence and how the universe began, rather than how good our perceptions are. But following the dictates of quantum wave theory and the necessity of our interaction to observe anything, the question of reality in both physics and philosophy pertaining to universal theory has become more a question of tying in the non-reality of contemporary physics with our perceptions and beliefs, especially common-sense beliefs; see for example (Heelan 1965, Fine 2001, Karakostas 2012, Saatsi 2017). It is very much an open-ended debatable subject, so much of it falls outside the scope of this thesis which deals with the roles of physics and philosophy in the determination of a final theory. It is only in this last sense that I relate reality to this thesis; in determining a true (as far as possible) causal basis for a Universe.

The general principles of quantum theory were explained in Chapter 2 including those concerned with the loss of reality leading to the peculiar statements of Bohr, d'Espagnat, Rees and Mermin. Quantum wave theory demands that measurement, here meaning experimental determination of an existence of an object or some specific property, requires us to interact physically with that object. Due to its wave nature the object itself can carry a huge array of different inputs from some previous source. Which one of these is picked up in experiment depends on the measurement process. We can only measure one possible outcome in QM theory from all these inputs and consequently there is only a predictive chance of obtaining any given one. What we observe depends on what we put in with our experiment, that is, attempted measurement. Feynman's (1949) mathematics provides an enormous number of possibilities some of which have practically no chance of being pulled out by our experiment, but all fit together to give possible outcomes. Obviously, a possibility with an exceptionally low outcome expectation is not at all likely to appear. So according to this principle the object has no true underlying instruction that forces it to always react in a given way, and thus it has no underlying defining reality. The only reality we have is the interaction between observer and observed.

This has then been extended to include ourselves viewing an object, for example, see Hawking and Mlodinow (2011:103): "you must interact with the object you are observing. For instance, to see an object in the traditional sense, we shine a light on it." This may be just an illustrative example, but it has a distinct air to those expressed by Rees and d'Espagnat (see quotations section 2.5). The quantum requirement of an interaction between observer and observed has become further extended, as in the pronouncements of Bohr and others above, to the concept that the universe exists because of our observations of it.

On the other hand, it seems clear that we need input through our senses to experience objects and even to experience our own bodies. For example, if a bird flies past us, we receive light from it, but we do not previously send out light from our eyes towards it. In other words, we have not carried out any form of experiment to interact with it. Our eyes do not radiate out light like a radar transmitter. There is little connection between this reality where the flight of a bird past us has nothing to do with us (unless we frightened it), and physical experiments where we *cause* an interaction. Consequently, quantum theory might claim that in the case of us seeing the bird there is a mutual interaction with the light from the bird interacting with the rods and cones in our eyes and thence to our brains. But this is still completely different to the experimental tests where we have to send out detection signals.

We have come to understand various concepts through our experiences and particularly through schooling/teaching by superiors and peer pressure. In particular we have learnt from birth, concepts of space and motion. But these have led to certain problems such as the size of the universe, or the question if the universe started from a miniscule volume, into what is that volume expanding? There is no human definition of space and thus there can be no unequivocal definition of motion so how can we judge our knowledge to be completely truthful about anything that is related directly to space? We only have our experiential belief. For example, take the human concept of rotation as a form of motion. We have a so-called definition based on the proposition of space, position, direction, and time. But these are all reliant on our experiences. Aristotle ([350BCE] 1991 and section 3.3.2) was worried about time as he could understand the concept of 'now' meaning the instant of a current experience, but this was fleeting as our experience moves to the next 'now' giving the problem of past, present, and future all being separate, yet each now exists. So, we have to wonder at reality in terms of existence because what was real an instant ago may no longer be real 'now.' It is only real in our memory or imagination.

Taking for example direction, it depends on space and time. Using human perception if I see an object on my left what do I mean? If I look straight ahead so that it appears at ten o-clock, or 30° to my left (330° from my right – or is it 60°? – it depends on how the direction is measured [clockwise or anti-clockwise]) then it is on my left, but if I turn 90° to my left it is now on my right. Its position has changed in my frame of reference at a different time. So, whilst I might know where it is, another person may not be able to tell from my directions. To obtain a 'real' answer I need another object which we can both determine as a reference-point at a specific time.

Now taking a 'deeper' example for rotation, rotating or to rotate, say in a plane to make it simpler, as it will prove essential to understanding the Universe, there is an important ambiguity arising from the lack of an exact definition. For example, we have the following[21]: Dictionary.com: to cause to turn around an axis or centre point; revolve. Merriam-Webster: the act or process of moving or turning around a crucial point · a complete turn around a central point. Cambridge English Dictionary: to turn or cause something to turn in a circle, especially around a fixed point. Vocabulary.com:.to circle around a centre point. Wheels on a car rotate, planets rotate. Collinsdictionary.com 1. the act of **rotating**; a turning around as on an axis ; 2. Astronomy. the movement or path of the earth or a heavenly body turning on its axis. Study.com: A **rotation** is the movement of a geometric figure about a certain point. Oxford Dictionary: the action of an object moving in a circle around a central fixed point. World Book Dictionary: to move around a centre or axis: turn in a circle; revolve."

[21] All retrieved from the World Wide Web on 13th November 2021.

Consequently, different people may have different interpretations, and thus uncertainty in its exact meaning – very much a Fregean (Shapiro 2005) complaint (cf section 2.4). Furthermore, these definitions all include the concepts of space, time, and motion which themselves are undefined. (And perhaps as an interjection: ‘turning’ is another word for rotation!). Mathematically, rotation can be determined in terms of a rotation matrix using coordinate geometry, but this is no closer to the ‘what is’ question or really any different to the dictionary definitions given above.

Then there is also the classical problem when ancient civilizations imagined the Earth at the centre of the universe with the heavens revolving around the Earth. It is completely possible to be rotating without knowing it. If we see a top spinning we can claim this to be true relative to our frame of reference, but as with Mach’s problem (Einstein 1916:112) it could be that we are in a rotating frame of reference and the top is actually not rotating with reference to something outside our frame of reference-top system. But then again Mach’s problem arises that the outside object is rotating, and our frame of reference is not. Rotation appears to be purely relative. It could even be that all three are rotating at different rates and maybe even different directions. To determine the ‘truth’ of such a case we would need to somehow pass outside of the total system as if there could be some ‘pretend’ or (outside of pretend) a ‘God-given system’ in which everything can be known.

So, what is reality in the concept of rotation? It appears we cannot have a complete definition (taking into account measurement of the effect) unless we can in the same expression also define both space and time. And even then, we have to define the concepts of motion and direction with respect to rotation, or vice versa. That is, should rotation be defined in terms of direction and motion, or should direction and motion (in a circle) be defined in terms of rotation?

Since there is nothing clear in our descriptions, a thought experiment should be raised in an attempt to ascertain whether there are concepts beyond our immediate perception which might provide a solution to the problem. Perhaps rotation should then be considered in the same light as time and space in contemporary physics. Maybe all three are linked: neither motion nor rotation are properly defined in human terms as they, as above, rely on space and time which are undefined in physics. In our perception they only have their action but not how this action arises, that is, what is their essence, quiddity, or nature. It is thus essential that we consider the fundamental cause of how the concept of motion arises and in this respect with ‘no space’ as a fundament it seems rotation might be a strong possibility. Here, we shall have to think outside of anything thought of before.

First: how would this relate to a fundamental reality itself? A fundamental cause can only have one definition (if two should arise then either they are equivalent expressions of the same thing, or the idea they are fundamental must be false because they will be combinable into the true fundament). If this one definition is fundamental, then the cause it defines must be all that is needed to create a Universe. Everything in that Universe is bound up in this one cause. That would be the reality of the Universe produced. If that cause also describes our universe, humans will be bound up in that reality. They will have perceptions of that universe, but only perceptions and it is from these that they derive laws, definitions, and descriptions. But because they are perceptions there is no certainty these perceptions are truthful to an original reality. Thus we get a split into the fundamental reality of the universe as it was caused, I will call it the **natural universe**, and a different idea of reality, that which we believe to be the reality drawn in our minds from our surroundings which fits in with, for example, the concepts of Reiss and Springer (2020) or David (2020). It is only from these perceptive observations that humans, both as scientists and non-scientists, have derived the so-called laws of nature, descriptions, and definitions which humans believe describe our perceptions. The uncertainty of these perceptions, descriptions and definitions can be seen in the 'isms,' which arise in philosophic thoughts and the ever-increasing complexity of our mathematics and physics with a large variety of human-made definitions to deal with the seemingly insurmountable problems that contemporary physics has built for itself. These definitions cannot therefore be considered real because they are not based on an original cause – only on perception. None of these can then have any absolute truthfulness in the determination or description of the supposed fundamental cause. Our arising perceptions have forged a 'box' from which we must somehow emerge if we are to find at least a possible truth. In fact, these perceptions have in some cases, for example quantum theory, led so far from a fundamental cause that they actually deny it. It is therefore imperative that we pass out of our 'box' and consider there may exist two forms of our universe, a fundamental cause or natural universe which encompasses our perceptive universe. I will call this perceived universe, the **relativistic** universe because it is all relative to ourselves – individually and jointly.

Further to the search for reality, or truth, the concepts of objectivity and subjectivity (David 2020, Smith 2018, Feyerabend 1993) should also be mentioned. The principle is that theories should be objective. However, this, I argue, is impossible because just the consideration of any new theory will always have some subjectivity thrust upon it by the author in an attempt to have it established. In the case of empirically based theories the subjective angle is far worse because, as Feyerabend (1993:82) has pointed out, historically based and apparently successful theories become entrenched through continued development and peer pressure. They thus become progressively more subjective, as was seen in the development and argument, for example, with Einstein over the reality of quantum mechanics as an acceptable theory – the famous 'God does not play dice with the universe.' Disagreements lead to subjectivism in the determination of groups (and individuals) to establish group beliefs. In the case of quantum mechanics this has led to the setting up of more and more experiments to prove what has for some time been seen as an established 'fact': QM indeterminacy. The physicist sees what he wants to see – blindered as Einstein often put it, for example see the supplement on EPR.

Arguments have been made, for example by David (2020), trying to link truth, and thus objectivity, with fact, but this misses the point that for the closest ideas to fundamental physics, even for apparently established laws, human perception is purely that – perception. Without definition of the fundamentals (mass, charge, etc) how can any physical theory be regarded as anything but subjective?

New theories start out as objectively as possible within the ambit of the aforementioned prejudices of the author. Subjectivism can be reduced by developing an apparent self-evident truth. Nevertheless, even this still depends on human perceptions of self-evidence – more so when dealing with ideas that are too fundamental to be defined for which human perception, thought and especially imagination are essential elements. This will particularly be the case for the action $\hat{T}$ mentioned under the definition of Time. It is completely subjective in that it can only be described through appealing to human imagination as all definitions can only come from this source. But imagination on the whole depends on prior human experience which follows from fundamental actions instilled by the universe. Definitions are then abstractions from more fundamental principles. The question is the determination of which action could be *the* fundamental one leading to the human perception of a Time interval. Once this has been uncovered it should then be possible to produce a Universe based on this alone without the thought of any other human physical perceptions, but within the natural meanings attendant to normal word usage.

But there is also the subjectivity of the reader to be considered. Most readers will have their own views which may conflict with those written and may have an effect on their consideration of the degree of subjectivity of the written work.

This raises a further important concept concerning human ideas of reality and semantics. Each discipline has its own language, methodology, and mode of arranging its arguments. These again arise from the perceptions of the practitioners of the various disciplines. But the development of a first principle should avoid all these individual differences to attain an overall concept that fits everything. The problem here is it has a different ‘reality’ from the practices of these disciplines and thus its ‘reality’ is different from theirs. This must be taken into account. For example, I have raised the concept of a foundational philosophy to surpass metaphysics and the philosophy of science (and any other philosophies). It should be seen as a different sphere in the same sense that the foundational principle of the universe may have a reality different to the ‘reality’ of our perceptions. As I have said in section 1.3.3 it has to be written in existing human language because even if I were to invent a special language, it would still have to be transcribed into current language. Readers must see this thesis as an attempt to break out from the ‘prison’ (‘box’) of our surroundings, schooling, and peer pressure (social/mythological group) in a new search for truth.

I have already discussed (section 2.3.3) the concept of foundational philosophy in terms of perceived shortcomings in arguing about the structure and processes of the universe. I shall now consider the concept of mathematics from the point of view of its language (and its effect on our intuition and perceptions). Colyvan (2011:1) introduces mathematics as the “most rigorous and certain” of all the sciences. Fundamentally it is an exact science in that its equations are expected to produce exact answers within its rules.[22] These are operated through a series of symbols (formalism). “Because the usual spoken or written languages do not in the least satisfy the requirements of consistency demanded of this symbolic logic, formalists try to avoid the use of ordinary language in mathematics” (Brouwer 1913:84). Mathematical rules and symbolism can be, and have been, expanded over the years. For example, the addition of complex numbers, calculus, matrix mathematics, set theory, lie algebra et cetera have been deduced from the original concepts of addition, subtraction, multiplication, and division of integers, then from real numbers and surds as the desire arises. Nevertheless, these are all done within strict rules. That is the beauty of mathematical physics. It operates within these developing rules. It therefore has to obey a synthetic mathematical reality. It allows physicists and perhaps to a lesser extent mathematicians (Gödel and Russell for example uncovered mathematical ambiguities) to relax in the belief it is the perfect theory through axiomatic processes. But as mathematical physics has been unable to explain the universal structure and also makes peculiar demands as in section 2.4, there appears to be a tacit warning that it might be better to try another approach – as already suggested.

A causal universe is somewhat different. Philosophy does not have such stringent restrictions. If it has a fundamental cause, then that cause will have certain ramifications that follow from that cause but none that lie outside that cause. It can do anything that operates within that cause, but this will not necessarily agree with human and especially mathematical perceptions. In physics human inventiveness has to fit mathematical strictures (the explanation of the universe being expected in mathematical terms see section 1.1.1 Einstein 1936, Dirac 1940). The trouble is mathematical strictures can be advanced according to human needs. It becomes a game for mathematicians to see how far it can go. But mathematics certainly should not dictate what the universe may or may not have done. What the universe does may well lie beyond human imagination to date. This is a fair comment if one thinks about quantum mechanical concepts and particularly the peculiar (from the common-sense point of view) statements of Rees, d’Espagnat, et cetera (see quotations section 2.5). Mathematics has been advanced in quantum theory to cover the concept of Heisenberg’s uncertainty

[22] Allowing for limits to deal with infinitesimals and infinities.

with the superposition of waves. In the philosophical approach the question becomes what can be deduced from the fundamental cause without considering any particular mathematical rules. There are then three different concepts of reality at work: human perception, mathematical and that based on a cause.

There has also been much discussion on what I see as the concept of atomism (Ely 2012) in relation to continuity, in the form of continuum, which will highlight the fundamental difference between these three realities. The discussions centre on the continuity of a line, but this can be equally relevant to the concept of point raised in the definition of Time. Aristotle ([350]1991:187a27-187b21) raised the concept of infinite and infinitesimal in relation to minimal parts as a condition for the existence of anything. Since then, the problem of continuity and minimal has passed through a series of mathematicians (Bell 2017) including Galileo, Leibniz, Kant, Cantor, Brouwer, Dedekind, among many others: as in section 2.4. Into how many parts or points can a line be divided? Can the divisions be infinite, if not then can a line, or a continuum be formed from indivisible objects? Bell (2017:§1) sums up contemporary discussions as "continuum admits of repeated or successive *division without limit*." I suggest that the problem fundamentally depends on the lack of clarity on a definition for point. I have already determined the need for a minimal unit of Time (section 3.3.2) and the continuity of a progression of points of Time in part consideration of the definition of point, but the full concept needs further work.

For example, the concept of surds should be included, numbers such as $2^{1/2}$ or the natural logarithm *e*, which cannot be written exactly on a number line, and therefore, in terms of a number line of exact points, do not exist. Between each rational point in an infinite set of number-line points there exists a non-rational, and vice versa. Dedekind (2007) overcame the problem by formulating a continuum of 'real' numbers (see Rudin 1964:9). The question then becomes that if this is considered mathematical reality, is it imposing such a description on the universe itself. In view of Zeno's paradox and the concept of limits the answer is probably no.[23] But nevertheless it is a concept that needs to be considered as relevant to attaining a possible causal reality. That is, can a causal reality remove such a problem? If so, can it equally remove the problem of the possible infinite requirement of points to a line and the difficulty over atomistic (in the Grecian sense (Berryman 2016) as opposed to the nuclear physics sense) principle of indivisibility as well as how this even refers to space itself. There is thus the possibility of very different concepts of reality between mathematics-physics and causality, or rather philosophical causality as aimed at in this thesis. According to Ely (2012) as an infinitesimal approaches zero some people/students visualize it as collapsing to adimensional.

[23] Zeno's paradox considers the problem that if someone travels to a destination, as he closes in, the distance still to be covered continually halves. Does he ever arrive?

Oehrtman (2009) finds students reactions lead to interesting perceptions on how infinitesimals operate showing a big divide in knowing what infinitesimals are mathematically (in mathematical reality) and what they are semantically (in human perception). It demonstrates the psychological difference in understanding mathematics and causal deductions based on philosophical reasoning. This sort of swapping mindsets between different methodologies (disciplines) has to be considered in attaining a causal final theory of the Universe. What may seem real to the physicist may seem odd to the causalist and vice versa. Perhaps most of all it affects the mathematician, who, notwithstanding Gödel's (1931) and Russell's([1903]2019) incompleteness theorems, believes in the exactness of mathematics against the possibility the universe may not be mathematical, or that mathematics has gone considerably further in its concepts than needed for a universe (cf section 2.4 Frege-Hilbert problem).

This thesis tacitly argues that there is a big difference between manipulation in accordance with mathematical rules and understanding the exact implications of linking them to physics, especially since the thesis argues that the universe has absolutely no need of mathematics in any form in order to exist. As discussed, mathematics is often considered to be exact, or precise in its language. But one must realize this precision is only in terms of synthetic rules which have been shown above (Russell, Gödel, Frege, Duhem, Quine, Wittgenstein) to be suspect. Consequently, the efficacy of mathematics should surely be doubted when it is used to explain the basis of the universe, which has so far remained beyond human understanding? The understanding of the background, the cause which has led to our existence, is the prime 'mover' as Aristotle would put it, the first in importance to lead to a comprehensive theory of the universe.

Having now considered the concept of reality and the problems of space I can pass from pre-assuming its existence to deducing what must follow from the assumed definition of Time.

CHAPTER 4

Foundational philosophy

4.1 Introduction

The previous chapter produced a definition for Time to be used as a basis for the creation of a Universe. At this stage it can only be used as a theoretical possibility, but not necessarily identical to the universe we live in unless it can be tested as suggested in Chapter 1 and found to agree exactly with the universe in which we live. In this case, if Time is the fundamental cause of everything, that is, of being, then it must also lead to our perception of space. The principal aim must then be to define $\hat{T}$ and then to determine how Time can lead to our experience of space. This is where we really do need to consider the 'nature of things' as opposed to our unquestioning acceptance of sometimes huge distances between objects. As the use of mathematics in its advanced forms must be considered suspect, that is, not necessarily having anything to do with the actual structure and processes of the universe, derivations based on this fundamental cause can only be philosophical – the foundational philosophy decided on in the last chapter. To some extent this will cover concepts regarded as physical but then, despite the view of physicists that philosophy should be avoided (section 1.1.4), there is a distinct overlap between philosophy and physics in its basic ideas. Sections 4.2 and 4.3 discuss/derive the relationship of Time to the concept of a minimal interval of Time. The remaining sections then show how a minimal interval becomes synonymous with the production of our concept of space and space-Time. Included is a special section on the philosophy of Einstein's special theory of relativity. The special section argues that the mathematical treatment given in universities, by not taking into account a proper philosophical treatment, has led to incorrect ideas that conflict with nature, that is, with the transverse Doppler effect. Only minor revisions are implemented, linked to Einstein's introductory comments to his theory, but these go a long way in simplifying and explaining more clearly the nature of special relativity.

This chapter then ties our most fundamental perceptions of the passage of time, and space to the abstract definition of Time.

4.2 Into what can a Universe be put?

As noted in earlier chapters, neither space nor time are defined in physics. This reflects on the associated subjects of direction and motion, so it should be expected that an analytic treatment based on the definition of Time between space, time, direction, and motion is likely to form a totally new way of looking at the universe and its structure – unlike anything that has gone before. An exact definition as suggested before is impossible. For example, space? It needs words different from space to define it. But these cannot be invented because they then they then have to be explained – without using the word space. The same applies to words such as distance between objects which rely on space for human understanding. The best then is a description on how and why they arise. These descriptions themselves are likely to be different to what humans may have to date imagined. To produce any reality in human perception they must produce a natural universe that has the ability to generate everything we see by some simple method that follows directly from the concept of Time-points. Herein lies another vital concept of our reality as opposed to that which lies beneath our perception; that is, the attainment of our view of space in relation to the thought that:

if a universe is to be created into what can it be put?

By this question, I mean any form of universe, be it a multiverse, a bubble or even a universe that has existed forever. This particularly must answer the difficulty over the concept of the size of into whatever it is put. Humans have created the word space for this supposed container. But they have not truly defined what this space actually is. Instead, we have our perceptions of what we see around us from which we gather our own belief in its existence. But can we answer with the slightest certainty "Does this space extend forever?" "Is it perhaps limited and if so how?" It is not satisfactory to say the universe is space, or the universe creates its own space or just to ignore the problem; or to argue that its structure is irrelevant, it just exists.

Bishop Berkeley (1713) argued the universe is just in our mind. Quantum mechanics seems to argue a similar view if human existence is needed to realize a universe, that is, the universe exists only because our minds exist, presumably with an ability of our minds to imagine all the things we see. This would indeed suggest a meeting point between religion and contemporary physics by the transcendental nature suggested for our minds. Even if some rejects a Divinity it could well be argued that this problem of a prior space might be solved by our imagination, and that quantum mechanics points to this solution in its necessitating our minds for a universe to exist. I mention this only as a possible argument for completeness's sake and to point out that the solution of the problem must be absolutely fundamental to our perception and therefore of major concern to this thesis. The solution will obviously not be easily determined but it must be established as a possible reason for the failure of physics and mathematics to find a plausible structure for our universe.

First, in the attempt to attain answers to the question of reality and existence from the concept of Time, I will consider the concept of recordability, without which Aristotle's ([350BCE](1991):§218a4 onwards) and the human concept of past 'nows' could not be known. Following that I shall move on to derive the concept of space bearing in mind the semantic difficulties mentioned above.

4.3 Recordability

Although progression, number, singleness, and action have been broached, they have yet to transform the concept of time/Time into a complete foundation of the universe. That is, the definition of what is still an abstract idea (assumption) has to be turned into something ‘concrete’ and recordable; something which humans understand by perception of their surroundings. By ‘understand’ I here mean that it is observed, without which humans could not know of its existence; and too, that it has some meaning, even if this meaning should be faulty; for example, ‘look at that fish blowing a spout of water’ (whale = mammal). This ability has to come from the form of the action $\hat{T}$, which in turn provides the form of the points. In order to project a concrete, or even just an ontic basis, these points have to be recordable so that they have a relative existence to any other recordable point. Consequently, the question arises on what we consider to be material. First and foremost, this must require that Time, as the first cause, should be both causal and recordable. By recordable I mean that the result can be noted by some method whatever that may be. The causality will give the result meaningfulness (as in Chapter 3, correct – real in terms of the universe – or not). An example is, using human semantics as the projected Universe has as yet no derived concepts, the click on a clock giving a specific time: it is caused, it is recordable, and it has meaning.

My definition of Time embodies an ordered progression of points generated by $\hat{T}$, where the ordered progression is seen in human terms as the counting numbers from one upwards applying to the first stage, second stage and so on. The human interpretation is nothing more than giving each point (each ‘now’) a name to distinguish it from past ‘nows’ and possible future ‘nows’ – as above, what humans call the natural numbers[1]. This numbering is irrelevant in Universal terms as it makes absolutely no difference to the action $\hat{T}$; $\hat{T}$ provides a source – from which the human concept of numbers could arise. For ease of description, I will, for this section, use Aristotle’s term ‘now’ in place of ‘point’ as although each stage in the progression is singular, there is no suggestion in the definition that it cannot produce a number of points. If there was such a suggestion, then it would indicate that another factor had to be introduced to govern the fact, and that would render the definition composite. Similarly, there could not be any suggestion that more than one point would emerge from the definition. Consequently, we cannot rule out that deductions in section 4.6 may lead to the

[1] This ties in directly with measurement theory, see Campbell (1938) rationalizing the human creation of numbers as symbols and the properties they develop as human derived concepts, including the recognition of ‘more than’ and ‘less than’ (1938: 123), plus, of course, the idea of addition. He (1935: 128-130) regarded the most important measurements to be mass, volume, length and angle followed by the concept of period which then gave rise to the human idea of time.

establishment of subsequences. For now, we can only say that Time starts from some initial state, call it Φ, to obtain the first 'now,' q_1, and then operates on that 'now' to produce the next, q_2, and so on. The subscripts then run through the natural numbers. This can be written as a foundational definition quite simply as $\hat{T}(\Phi) \rightarrow [q_1]$ and $\hat{T}(q_n) \rightarrow [q_{n+1}]$ where $n \in N'$ is a given instant of Time and N′ is the sequence of natural numbers referring to Time.

Each 'now' is distinct from any other by definition. Consequently, a sequence, or subsequence, may be written as $[q_n]$, $[q_{n+1}]$ … each bracketed term indicating a single (unique) 'now' of Time corresponding to a stage ('now') in the progression of Time. The square brackets are defined as meaning that each 'now' is purely a single unit with no subsidiary beginning or endpoints, or if arranged, as below, as a sequence of 'nows' $[q_i...q_k]$, then each 'now' q_j in that sequence is unique but contiguous with consecutive 'knows.' Furthermore, sequences of 'nows' can be divided into smaller sequences or combined into contiguous longer sequences. Each stage in the generation of 'nows' arises without any break in the progression, or break in the production of the progression, and without any 'now' being a part, however miniscule, of any other 'now' – they do not **intersect** each other or any 'nows' that might arise in a subsequence. Each sequential point will then be distinct. I shall refer to this as the **uniqueness principle** of points of Time.

With this human concept of numbers, a minimal *period* equivalent to a point ('now') may be expressed in human understanding of beginning and end points by the temporary addition of the real number zero. Then the first 'now' can be written in the beginning and end form of a period as [0,1]. This raises the metaphysical (and mathematical) problem of zero because zero fundamentally means 'nothing' (no thing). If it means no thing, then as suggested by a recent conference (Tyson 2013) it cannot exist as a concrete entity because that automatically will be something by the semantic definition of concrete. Then zero cannot be a point in the sense of something concrete. Consequently, the first point of Time only consists of the last point in [0,1] denoted by the human symbolization '1' (the concreteness of the point itself is still an open question). In any case, a single point cannot be split into beginning and end points because the concept of ordering would be lost so that Time would no longer be well-defined. But all points are of the same form and are generated by the same action $\hat{T}$. Therefore, although all points *may* be written in the form $[0,n]$ where n is a natural number to correspond to human ideas of an interval, I shall not adhere to this method. Instead, I shall say that the 'endpoint' of human semantics and the ordered point n are the same thing in the Time scheme.

From this view, although individual q_i can correspond to natural numbers, these do not need to be valued for this philosophical deduction in order to form sequences, thus showing the independence of this Universe basis from specific values. Only when 1 is used as the starting point does a sequence attain ordinal values for each q_i. Nevertheless, it is useful to use the value 1 as the first point of time, q_1, created at the start of the Universe. Time can then be said to form periods represented by sequences $[1 \ldots q_m]$ and $[1 \ldots q_{m+1}]$ from the start of the Universe, or from any other point giving the forms $[q_j \ldots q_r]$. These periods (a) must be distinguishable from each other as they contain a number of points that are, by the assumed definition, all distinguishable from each other; whereupon (b) they are thus naturally comparable to each other (in both cases by a process still to be determined). I want to make it clear again, that these sequences, or the points in them only have a numerical value in terms of human perception. That is, it is humans that give them values although, in terms of the Universe, the progression is ordered.

This introduces a further concern which Aristotle ([350BCE]1991:§218-219), among others, tacitly noted by the difference between 'nows' in the sense of a past instant, a present 'now' and a future instant; the flow of time. That is, every point of the progression of Time is unique so that different 'nows' cannot arise together because their uniqueness (haecceity) is their position in the sequence. Therefore, no point q_i could in human connotation exist[2], or be, at the same instant as a point q_j. So, the foundational question (the first bullet in section 3.4 in the definition of Time) is what in the action $\hat{T}$ causes this instantaneous commutation but also allows points to be recorded. And then, specifically, and more importantly than the human ability to note the passage of Time, how does this provide for a Universe for which Time has been assumed as the prime, or "moving" (Aristotle [350BCE] 1923§4) cause? That is, for any recognition of a past 'now' to be possible that past 'now' must in some way be recordable. The same concept must be possible for sequences to be comparable. Logic suggests that somehow a trace of the old point must be left. More formally, if a point is created as a 'now' but the 'now' instantly becomes the past, then it must be that, as $\hat{T}$ generates each new point of Time, the action of creating the new point from the old leaves a '**trace-point**', *s*, of some form behind. The trace-point becomes the 'recordable' part of the definition of Time. Its nature now needs to be established.

Recordability suggests that points must have a 'substantial' existence within the progression although this 'substantialness' cannot be measured as such because it is minimal and cannot therefore be measured in terms of something less. But it does mean two or more points cannot be placed in exactly the same position in the progression, (which, if it occurred, would be the same as being superimposed in QM terms) and it is in this sense I mean having substance – they are still points as

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[2] Exist is a problem word in the sense expressed in section 1.3.3 in that it has obvious connotations with 'existence' in the sense of why anything exists in the first place. Here the 'exist' arises in response to the definition of Time and the action $\hat{T}$, and will be used in this respect throughout this thesis even for the concept of points of Time which have only an instantaneous or fleeting being. On the other hand, 'why anything should exist in the first place' can only be explained in Chapter 5.

given in section 3.3.2 as an 'adimensional' abstraction for now until their nature arises as the investigation progresses. This distinctness of Time points must transfer through to the trace-points creating a corresponding progression, but one in which the points remain behind as the progression advances. Since their minimalist "adimensional" nature would have to be the cause of 'having substance,' these trace and Time points would themselves be out of human perception although their effects would be noticeable in terms of much larger human measurements.

However, this does not yet have 'meaning.' The nature, or cause of the production of such trace-points is still unknown. So still the metaphysical questions of 'how,' 'why' or 'what is' have to be extracted from the action involved; that is, the foundational existence of points. As declared by Ellis (2012:27) or Baumgarten (2017:5) physics does not consider such questions, only the existence of the flow of time, not what causes it. To further this line of enquiry, the requirement of recordability intuitively implies that the definition must lead to different sequences of points in the progression: 'active' sequences of the form $[s_i \ldots s_m, \hat{T}(m)] = [s_i \ldots s_m, q_{m+1}]$, that is the sequence grows as Time progresses; and 'passive' sequences $[s_i \ldots s_k]$ consisting of a fixed sequence of trace-points. Thus, the points themselves can be considered active (time points) or passive (trace-points), the latter being able to exist independently of Time – that is, once generated *trace-points exist for the duration of the Universe*. With the existence of the trace-points, sequences of a number of points *can be countably* compared – in human terms, but without significance to the Universe – reaching Aristotle's assertion ([350BCE]1923:16§2) that nows correspond to numbers created from a first cause.

The condition that the operation of Time production leaves a trace must then be a fundamental natural effect. $\hat{T}$ then only operates from points of Time (which suggests that Φ must also be a point of Time, but this can only be clarified once the question of existence has been finally concluded in Chapter 5). The trace-points exist independently of Time as soon as they have been generated by $\hat{T}$. Countable comparison (bearing in mind, as always, that this refers to human perception) means here that if one sequence contains more trace-points than the other it must be greater. But the points, at this stage, are nothing more in our minds than an ethereal abstraction so, in Universal terms, the sequence is nothing more than an abstraction. Furthermore, the action of $\hat{T}$, which is part of the principle cause, and thus begets concrete objects, has not been defined; it should be expected that knowledge of its active process will give 'meaning' and thus 'concreteness' or causality and clarity in our minds. We can already gather that the points cannot all be produced together as the progression of one point only follows the Timed destruction of the previous point and that trace-points are similarly produced only on the **collapse** of each Time point; that is, each Time point only has a fleeting, or instantaneous existence that shuts off as soon as it arises. The automatic generation therefore suggests an 'abstract' but constant (as each point is identically produced within the minimal interval as described above) rate of generation. As an example, in the human perceptive context of 'the man in the minimal sphere', he would note a rate at which the points of Time increased on his clock (which he would call the passage of time) although we outside the sphere believing it to be sizeless (if we could actually see it) would not be able to note any increase. So the action itself provides what the man in the sphere would call the rate of the passage of Time, by which I mean we note that, for example, the Earth takes time to pass round the Sun and in that time we can do many things, but not everything that takes us many years to achieve. We do not travel from one city to another instantaneously. An action cannot occur faster than a minimum interval – but how do we recognize this? Put another way: how does a mere point convert in our experience to what we recognize as a minimum interval?

The answer lies in the existence of a trace-point being established for every Time point. This allows comparison of sequences as the progression grows. In particular, this growth implies that a sequence of just one trace-point (for example, the first point, [1], in the progression) can exist, for which this sequence must be comparable to sequences of more than one point; it therefore should give meaning to an interval, as defined in section 4.2, albeit the necessary minimum interval. That is, it should somehow allow for an interval between two Time-points to become recordable, in human perception, even though the first *Time*-point has passed and been destroyed in the creation of the second. This means that as the trace and Time-points are both created from the same operation, the operation must provide some sort of connection between them that creates a recordable period. That is, one which humans can record and mark down.

Being minimal, but not zero, that is ‘not nothing,’ implies points must be finite and, in this respect, have substance. The question then becomes how can a supposed volumeless trace-point be both not-finite and finite? The answer will be seen to lie in the concept of special relativity. But to see this, the concept has to emerge automatically from the foundational concept of Time. It is thus looped. But we can turn to the ‘man in the sphere’ to fuel our imagination. This would require, at its minimalist limit that the sphere be completely reduced to what humans would believe was zero – the man in the sphere would obviously not agree because he still has his clock and ruler with which he measures. This is obviously not mathematical or physical, but should it prove incisive then it would demonstrate that something is missing from both mathematics and physics as suggested in section 1.1.1 (cf Nature 2005). So, it has to be checked out – it requires a total knowledge of all the processes of the Universe to be proved, in as far as anything can be proved (see reality section 3.5) – an elucidation of the concept of space and volume will go a long way to understanding. It does, however, reflect on the concept of atomism raised in section 3.5: that is, if humans can consider a continuous number line consisting of points, then they should be able to consider a continuous geometrical line consisting of a number of substantial and contiguous points all of which according to Euclid[3] have 'no part' or size. Equivalently, in the projected natural Universe, as each Time-point in a continuous progression of points generates a trace-point, the trace-points become a contiguous set of points. Then by the definition of Time and the continuity (contiguity) of the progression derived in section 2.5, Time-points can be considered to make a continuous Time-line, or continuous Time-lines bearing in mind that subsequences may be possible in the progression of Time; nevertheless each point in the subsequence will still bear an exact relation between its production and the overall Time-line. That is, a point q_j in any subsequence will be formed at a point q_j on the Time-line, and for trace-points a continuous, or contiguous, set of corresponding trace-points – but these trace-points, as already stated, exist for the rest of the Universe so long as it may exist.

The first step in providing recordability and substantialness from a progression of points must thus follow from the operation $\hat{T}$ that generates the points. However, this leads to a problem in human logic as it currently stands. How can we imagine a collection of points without a space into which they are placed? Yet we cannot have a prior space into which we place a universe. So, we must assume these points somehow generate what we call a space in which they exist, which is presumably the space we perceive around us.

4.4 Concepts of space and no space

Consequently, returning to the definition of Time: the first point of Time comes into existence and instantaneously disappears followed by the second which instantaneously disappears and so on. So no Time point, in the progression of Time at a given stage, exists at the same instant as any Time point in a different stage. As a result, no two points in different stages are the same point. Furthermore, the operator $\hat{T}$ on the creation and destruction of the Time point produces a trace-point which is not a point of Time, for every point of Time produced. Each trace-point is therefore different from every other trace point, but as they last for as long as the progression of Time, they accumulate. Even if they have no volume none of them can be the same point as any other. They therefore must be separate points. It is then even more difficult to imagine a collection of many distinct points with no space for their existence and it is here we have to pass into the transcendental and noetic areas of the proposed foundational philosophy. That is, if the universe in all its totality is to emerge from nothing, or rather a single first cause, then it seems, as stated earlier, illogical that there must have existed a prior empty space into which it can grow or be put. And without that space into what could a space to carry the trace and Time points grow? Surely it cannot just be a figment of our brain as we are presumably made of more than just trace-points. Therefore, current human knowledge now has two problems,

[3] Cf Bell (2017), Euler also considered this concept.

how could the space we see arise and how can the points of Time and trace-points be accommodated as these obviously, in the light of the way this theory based on Time is constructed, must be the cause of space? That is, we must expect that the fundamental operator $\hat{T}$ causes our perception of space.

This brings into context the human concepts of point, 'adimensional abstractions' and zero (Tyson 2013) – a problem that was considered in a full conference on the subject without a definite conclusion. If we place an image in our minds of a line of trace-points it would seem like a set of little dots expanding outwards, but this is pure human perception built into our brains by lifelong experiences. We cannot imagine anything concrete having an existence without space. But in trying to emerge from the prison of our perception we have to consider there may be a way round the problem of many points without a space, especially if those points are only points of Time.

This is a similar problem to that of standard mathematics concerning zero. For example, mathematics allows the equation $3 \times 0 = 0 = 2 \times 0$. If we interpret this as meaning that three lots of zero equals two lots (or any number) of zeros and still gives zero, then the connection to the Time problem becomes obvious. It is even possible to state that three lots of zero equals two different lots of zero meaning that it does not matter on what the lots represent – they can be the same or different. But then, we could suggest that although the outcome (the middle zero) is zero what do we actually mean by zero. As Tyson (2013) after the indecisive conference on zero, stated 'can nothing exist?' For example, if we have three trace-points with no volume on one side and two Time-points also with no volume on the other, we can say the result is no volume; but we cannot say that the two sides are the same or the objects do not exist. We cannot abstract this in terms of volume because the three trace-points will remain three trace-points on one side but the two Time-points on the other side can generate two more trace-points to give five volumeless points and so on. So, there is a clear difference between the two sides, but the volume remains zero. So, we cannot cancel the zeros as also disallowed by mathematics. The problem is that a volume is something real and measurable in human terms and humans cannot conceive of something concrete existing without a volume. In fact, as so far presented in this thesis, neither Time itself, nor volume is concrete, both are ethereal or abstract but what Time produces may have in human sense some concreteness attached to it. This may then give a meaning to volume. The suggestion must be that there is something missing from our knowledge of the fundamentals of our universe. We should also understand there are more than two ways of looking at zero. The zero that means absolutely nothing and, as above, which would include the zero between -1 and 1 representing a number or point on the number line.

Then there is the zero in the context of no space which precisely means no space. It does not necessarily mean no thing. It is just a human trait to visualize, as a method of interpretation, a whole set of spaceless points *in a space*. But this is purely imagery and should not be allowed to determine our logic; rather logic suggests a collection of volumeless points with no space between them does not constitute a volume. Nobody can categorically state that spaceless points need space in which to exist because nobody knows how the universe actually exists. Therefore, the concept that volumeless points can exist without a space in which to exist may be possible, however peculiar it may seem, and thus should be considered. Failure to do so could end in incorrect mathematical descriptions of our universe. The concept may also explain the question of how a universe can exist without a prior space into which it might be placed.

The problem here is a human ability to think beyond our normal concept that zero means nothing, or going one step further, absolutely nothing, for one can imagine the relative zero between say having a zero-bank balance rather than an overdraft or credit balance. But when it comes to the universe, especially if it was created from nothing, as has been discussed by physicists (see Chapter 5), one assumes absolutely nothing. Therefore the concept of a collection of volumeless trace points becomes beyond logical imagination, though Chapter 5 will bring up ideas by physicists that consider a similar concept of nothing, the zero point energy.

Now one should also consider the concept of position as this does have connotations in terms of human visualization – it is very much an intuitive word defined by human geometry allowing measurement and calculation in terms of human visual understanding of what humans see as space. It is thus a word apparently requiring the human concept of space. However, if we imagine the reduction of a space in terms of the man in the sphere being reduced to what we would see as a mere point in our view, we should be able to imagine that position and direction still have a meaning without the human view of space. That is, if in terms of the definition of the frame of reference I gave in section 3.2, the man has a ‘front’ then we, observing him, are at some position or direction with respect to his front. Thus, what follows for a spatial system should equally well apply to the spaceless concept of the fundamental construction of the Universe being formulated.

Humans think of position in a variety of ways, for example, it can cover a small area where some object such as a building or tree might stand. In this case it has a connotation of volume and may contain a large number of points. On the other hand, it can distinguish between two or more points, as for example, in a graphical coordinate system with reference to an origin and perhaps a frame of reference as previously described (section 3.2). As a mathematical system, the coordinates must define position precisely in terms of the human concept of spacetime (in the three-dimensional space system as x, y, z, plus one time dimension as read by a clock, at each xyz point, synchronized with a clock at the frame's origin thus allowing, in this case, a four dimensional spacetime system).[4] Under this principle, precision demands a specific point can only occupy one set of coordinates, that is, it cannot be at two different positions at the same time. So, we again have to be careful not to confuse human imagery and mathematical descriptions being used to construct ideas that may not agree with the reality of the universe. For example, if two volumeless points of the same form were to occupy the same position they would be indistinguishable therefore two different trace-points cannot occupy the same position. They cannot be superimposed. According to this principle two different objects in exactly the same position is an impossibility, which is occupying the same geometrical point in mathematical terminology: if they have no volume and are of identical form then there would be absolutely nothing to distinguish one from the other. They could not be distinct as required by the definition of Time. Therefore, it is illogical that two different points under this definition could occupy exactly the same position and be different. To make this absolutely clear, I say that no point can intersect another (see next paragraph*), which they would do if they occupied exactly the same point. Therefore again logically, we must accept that they are separate even though they occupy no space (or volume). But this condition has to be qualified by the concept of 'no volume': as they are separate (in the sense of being distinct – not in the sense of having distance between them) they have to be contiguous (touching). It is not satisfactory to claim this is illogical because we do not know how space and the universe is formed at its most basic level. Therefore, we should, at least for the sake of exploration allow that it may be possible without any space being involved – many points without volume can occupy no volume without the need to be superimposed. Any idea of superimposition is only a human assumption based on the human *ideas* of space, which in turn are based on what we *think* we understand but not necessarily on how the universe is actually constructed. This is what has to be ascertained and requires an answer to the fundamental problem of if a Universe is to be constructed into what is it put?

*This concept needs further consideration as, returning to Euclid's concept of that which has no part, intersection suggests in the human mind that one point may not completely overlap, or be superimposed on another. However, one also has to consider that we do see space. So should there be some reason that points can somehow lead to us seeing space, the concept of non-intersection rules out that any space generated by a Time point can intersect with any space generated by another Time-point. In terms of the original concept of minimal Time intervals not intersecting, that is, the intervals had to be completely distinct, such an intersection could be imagined. Similarly for the human concepts of touching, contiguous, position et cetera.

[4] cf section 4.8.6.

As a final thought on the concept of zero suppose a reference-point *A* (bearing in mind that a point of any sort itself has theoretically no volume or radius) moving around *O* is actually adjacent to (touching) *O*, then it has no radius of rotation (points have no volume). But we still have a rotation. This may be as equally a difficult concept for some people as the idea of many points occupying no volume, but then humans have been trying to decipher the fundaments of the universe for thousands of years, so we have to consider ideas outside of our experience. If two points are pure points without any volume, human sapience, purely for the sake of trying to imagine why physics has failed, should be able to consider that there is nothing to stop two points from passing round each other or, speaking relatively, for one to pass round the other without the need of space to do so. In this circumstance the concepts of space and time would become extraneous to the actual idea of rotation although they become of use in *measuring* the concept. The question then is what is meant by the fundamental meaning of rotation. Do we mean what it does or what it is? I would expect the 'is' to be the definition and the does to be a description – an example of what I mean in saying that mathematics needs to go further than mere calculation to understand its fundamental meaning. That is, we have to allow those points, having no volume, may exist without being superimposed, which implies they may exist in an arrangement thus giving a positional conception, without an actual volume as humans believe it to be – and to see where it takes us.

4.4.1 Rotation and units of Time

Bearing in mind that only Time has been the subject of a foundational definition, the 'period defining' connection must be caused within this foundational entity. This connection must be through the action $\hat{T}$ that causes an interval to appear without an *a priori* interval existing – (an apparent something out of nothing?) This produces a new situation. For each 'now' the trace-point produced, being distinct from all others, takes an ordering-place relative to the others. But this relies on notability. That is, any two successive 'nows' must attain, in the inanimate or abstract sense, a representation of the ordering between them. It is not entirely satisfactory to say that trace point *A* comes first and then 'sees' trace-point *B*, and then *C* because this assumes an *a priori* interval without any cause for it. But as the definition of Time stands, the assumed cause of the universe is an action, $\hat{T}$, on Φ which leaves a first point (of Time). The next automatic action of $\hat{T}$ turns the first point, q_1, into a trace-point which exists for the duration of the rest of the progression. However, as no such entity as space has been considered as a fundamental cause we have to assume that $\hat{T}$ can operate independently of space, at the same time allowing the definition of the minimum interval, so that they are clearly recorded at different times (different q_i). To maintain the ordering of the progression, this action must also include the possibility for a record of a first point and any other point with a clear difference for each and all intervening points. They must gain a sense of placement with respect to each other in the progression.

What we need to consider from our vantage point of being humans is how this would be interpreted into our perceptions.

As $\hat{T}$ is the operation that generates Time, this action within $\hat{T}$ must be the most fundamental part of the foundational principle. As already stated, all points are classable as minimal intervals and sequences of such points must be comparable to each other and to single points. In other words $\hat{T}$ must generate an interval almost as if it can, using human conception, unravel the point *A*, or other point, much as a tiny ball of cotton can be unwound to produce a usable length.

This suggests that the final part, the action $\hat{T}$, of the original assumption is a primitive cause of, in human perception and parlance, rotation which I will call **p-rotation**.[5] Then, the first point of Time, and all succeeding points of Time in the progression, since they are of identical form, would be p-rotations. This would become the fundamental action, or cause of the progression. It cannot be more fundamental than time because Time produces objects – points. P-rotation does not produce objects – it acts on objects. It is this factor that allows Time to be adopted as the possible foundation of the universe rather than rotation. But p-rotation cannot be less fundamental than Time because it is the progression-generating-action, $\hat{T}$. It is therefore as fundamental as, and is irrevocably linked to, Time. It cannot, then, be defined in terms of anything more fundamental. Nevertheless, its form and result *can* be determined through a series of thought experiments as follows. (This, of course, has to be expressed in terms of human perception).

First, I return to the concept of point with the view that a point has an automatic relation to position, through its generation in the progression of Time, and size in that it has no size. I will deal with size first as it will help to build an account of the transcendental idea of p-rotation. Again, lacking suitable language to deal with the concept of a fundamental spaceless natural Universe we have to think in terms of our concept of size and abstract it to what we would consider reduction to a point.

Size can be related to the general concept of rotation relative to the idea of infinitesimal. The definitions given in section 3.5 all consider 'turning around a central point.' But this does not determine whether the central point itself is rotating. If one considers a rigid line in a rigid body from the centre outwards, then the rigid line represents a series of points controlled by the central point where the central point itself rotates. On the other hand, it is possible to operate in the same sense as a power series expansion converging to zero, to give the central point, where, as with Zeno's paradox,

[5] P-rotation is at this moment undefined and must be more fundamental than the standard human idea of rotation which has connotations of space whereas $\hat{T}$ is an action arising in a volumeless circumstance. Its action is figuratively defined in the text and leads to the standard definition of rotation as humans perceive it.

the expansion approaches zero ever more infinitesimally without ever reaching the limit. In this case the central point is merely a point (axis) about which the rotation takes place but without the axis rotating itself. This reduces our human view to the question of an infinitesimal with relation to the axial point. The series never actually reaches that point but all rotating points other than the axial point have a tangential velocity which itself must have a maximum *limiting* value for the particular rotation. This limit would represent a limit value corresponding to the axial point rather than to the nearest rotating point at infinitesimally small distance from the axis. So, either with a rotating axis or a non-rotating axis we arrive at a maximum tangential velocity, and via the geometrical principle 'tangential velocity = radial distance × angular velocity' an equivalent angular velocity.

Now take Zeno's paradox as the power series converges. Ever more steps can be added as the axial point is approached so in theory it is impossible to ever arrive at the axial point itself or even the closest point to the axis. Thus, I would argue that mathematically a pure continuum could never arise. There would have to be, as suggested for Time, a minimal interval. As this is a minimal interval it cannot be measured by anything other than a minimal interval so it cannot be considered smaller than a minimal interval. It will therefore appear to be a point. But this would seem to lead to the possibility of two such points being partly imposed on or intersecting each other. The fact we cannot measure them does not say they cannot intersect. Thus we need the concept that to be distinct, no points of Time or trace-points can intersect each other.

Now suppose, just for the sake of argument, instead of a continuum created by taking ever smaller distances in the infinitesimal approach to the axis, a cut-off is imposed which limits the infinitesimal to a smallest radial distance from the axis, be the axis rotating or not rotating, then a limiting tangential velocity still applies with an equivalent angular velocity value (and all steps to the limit now have a constant metric, and, as above, all steps as well as the point itself would appear as points). There would then be no difference measurably, or mathematically, between no-space and a minimal metric as such a space would be smaller than that minimum measurement and thus be unmeasurable. From this it should be possible to finally imagine that a reference-point *A* (bearing in mind that a point of any sort itself has theoretically no volume or radius) can pass around *O* and be actually adjacent to (touching) *O*, with no radius of rotation (points have no volume). But we still have a rotation.

Hopefully, these last paragraphs have opened up a more transcendental view of the concept of point, infinitesimal, direction, position, and our *human* view of space and size. I will now turn back to the concept of a *spaceless* p-rotation to treat it in the form of an axial point, whatever point may be in reality.

In order for $\hat{T}$ at Φ, to be a p-rotation operation it must have a background (section 4.3) – which would be created if $\hat{T}$ consists of two contra-rotations of equal magnitude defined as $\dot{\theta}^-$ and $\dot{\theta}^+$, working in opposite directions. As they have the same magnitude of angular velocity their rotation over a minimal interval, as required by Time, would be identically opposite while the net result would be no *overall* rotation because $\dot{\theta}^-$ and $\dot{\theta}^+$ together, having equal magnitude, cancel each other. Nevertheless, there *would* be the possibility of developing a recognizable rotation if Time is generated from one of the rotations. The other would then be a backing rotation removing Mach's problem of which one would be rotating. For future reference I will call this fundamental system the **null point)**.

Suppose then that $\hat{T}$ operates on Φ from one spin, say the positive spin $\dot{\theta}^+$, to create trace-points.[6] Now imagine, as an example, three trace-points, call them *A*, *B* and *C* produced in order by $\hat{T}$. They would consist of two equal p-rotations, defined as $\dot{\theta}^-$ and $\dot{\theta}^+$, working in opposite directions with $\dot{\theta}^+$ being the 'observable' rotation relative to $\dot{\theta}^-$. Then, from the fundamental definition, if *A* represents the first trace-point (originating from a Time-point), *B* appears at some contiguous placement (section 3.3.2) with respect to *A* in the progression of points. (*B* cannot be superimposed on *A* (in the QM sense) because they both have, by definition, to be distinct (cannot intersect)). Furthermore, as the points have no volume any number of points has no volume, as detailed above. As *B* cannot be produced where *A* was (intersection or superposition not allowed by the definition of Time), *B* must be adjoining *A* but not surrounding *A* because then *A* would be inside *B* which would be the same as intersecting *A*. The contact between *A* and *B* I symbolise by $\overrightarrow{ab}$.[7]

Similarly, *C*, when it is generated through the action of $\hat{T}$, cannot be produced where *B* (or *A*) was, so must have connection $\overrightarrow{ac}$ (and $\overrightarrow{bc}$) via its production, and placement in the progression. As $\hat{T}$ causes rotating trace-points, both *B* and *C* must also rotate with respect to *A*, and with respect to each other, with the same rotational value since they are all identical. (The thought that each of *A*, *B*, *C* has both contra rotations does not affect, for example *A*'s frame of reference (allowing for having to anthropomorphize *A*) because $\dot{\theta}^-$ is the backing rotation which gives *A* as the distinct, or operative for this description, rotation so that *A* rotates relative to the other points, and vice versa. It could also be said that *B* and *C*, by not being able to appear at the same point relative to *A*, cause the 'appearance' of a rotation by *A*, or *B* revolving about *A* from *B*'s point of view, but I shall stick with the assumption that $\hat{T}$ is a rotation operation. Both interpretations are equal in result).

[6] It makes no difference which direction is defined as positive because the other will be negative.
[7] This is intended purely as a mutual connection between *A* and *B* in the progression and not as a direction in a volume, nor as a vector.

It also needs to be said that, following the concept of zero and no volume raised above, and the devolution of $\hat{T}$ as a rotation, 'contiguous' needs some thought because, although all three points *A*,*B*,*C* are touching, the rotation shows that they are not everywhere contiguous. The rotation produces single abuttals (I hesitate to use the words 'point of contact' as it might be confusing) between them. That is, it differentiates the abuttals from non-abuttals (see Figure 4.1 where *B* has a contact abuttal B_1 for example in the expanded representation but abuts *A* nowhere else – bearing in mind the structure of p-rotation having a maximum tangential velocity). Here again, abuttal must be taken in the same spirit as position, size et cetera, as mentioned above. These non-abuttals now gain relevance as not only referring to non-intersection but to not touching. Thus, the fact that the points occupy no space and are themselves spaceless does not preclude that there may be what humans would see as gaps between their abuttals. This may run against intuitive present human perception, but then, as Tyson says, the concept of zero is an enigma. This formation of gaps will become easier to understand once the full expression of space and volume in human perception is fully explained at the end of Chapter 4.

There are four following thoughts to be made here. First, the concept I have already referred to, that in terms of points having no space, the abuttal or contact of points, although with no human thought processes (until now) or words denoting 'outside of space,' should not mean that the concept cannot exist. Second, such ideas automatically lead to the concept of space in the form that two points cannot be everywhere contiguous because that would lead to complete intersection, that is, superposition. Third, and more importantly, this is no immediate help to determining the concept of space, as such, because it does not explain how 'no-space' or spacelessness can become what eyed individuals understand and believe they see as space. Fourth, nevertheless the concept of positioning which arises automatically from the appearance of *A*, *B* and *C* introduces the nascent concept of a space. Actually, I suppose we do not see space as such but distances between objects which we call space. So, the explanation of space becomes determining how these gaps arise from the realization that two points, particularly trace-points, cannot be everywhere touching each other as that would imply super-positioning.

Having explained these problems, I can now turn to the as yet unformulated concept of p-rotation and its influence on our perception of space. This explanation first requires some method of interpreting the action of p-rotation into human language which can be done by anthropomorphizing the points as follows.

If *A* was able to observe anything in a frame of reference as described in section 3.2, he would note either a change in the position of *B* as *C* appeared, or *B* appearing followed by *C* at a different position followed by further trace-points. Thus, he would notice a difference in direction between the trace-points and himself. This is somewhat analogous to Euler's concept of infinitesimals maintaining 'shape' (Bell 2017§4) – in the case being developed as a fundamental relative positioning with respect to each other as the trace-points *A*, *B*, *C*, are distinct from each other. This system from our external viewpoint can be represented for human perceptive purposes as in Figure 4.1 bearing in mind this is only an ostensive representation since, as yet, I have not yet derived the human *idea* of space. I should mention here that relativistic concepts of rotation are dealt with in section 4.8.7.

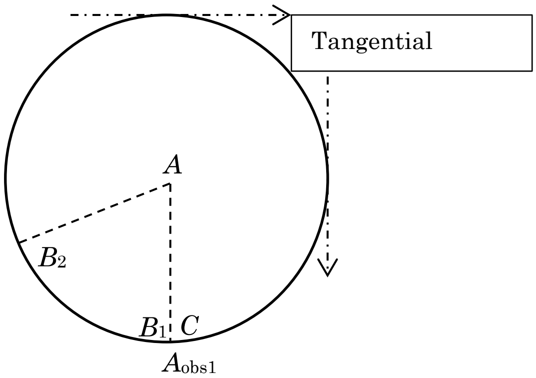

Figure 4.1 A p-rotating point *A* blown up to make it readable, as seen from the view of an external observer. P-rotating point *B* is initially at the point B_1 observed by *A* at A_{obs1}. When *C* appears at B_1, *B* will have apparently, as viewed by *A*, moved (rolled round) to B_2.

In terms of the mutual connections, we then have the apparent case that the connections $\overrightarrow{ab}$, $\overrightarrow{ac}$ and $\overrightarrow{bc}$, have appeared over the period of a minimum interval or unit of Time (*bc*) as defined in section 3.3.2. Thus, a distinct interval (of a minimal abstract nature as in section 3.3.2) has formed with distinct differences between connections $\overrightarrow{ab}$, $\overrightarrow{ac}$ and $\overrightarrow{bc}$ in our external (God-given) frame of reference and distinctness of points in the natural frame[8]. The caption to the Figure mentions 'rolled round' which *A* could also imagine, thus suggesting that *A* could believe he (*A*) was fixed, and that *B* was rotating around him.

In *human perception* in our universe this would be recognized as 'change in position over a period of time about a central point (*A*)' so giving the *sense* of what humans would call spatial rotation.[9] In other words the positioning of *A*, *B* and C has introduced what humans recognize as a spatial meaning word. However, there are essential differences between the p-rotation and the human concept of a rotation as in, for example, a rotating wheel. If *A* is given a spaceless frame of reference of the form defined in section 3.2, *A* will have a 'front' defined in terms of, say, trace-point *B* as in Figure 4.1. That is, $\overrightarrow{ab}$ can be used to locate a frame of reference in order to show what p-rotation

[8] $\overrightarrow{ab}$, $\overrightarrow{ac}$ and $\overrightarrow{bc}$ may appear quite large in the Figure but it must be remembered they represent the minimum possible interval.

[9] This assertion may not be completely clear at this juncture but becomes perceptively meaningful as the chapter develops. See also section 4.2.

means with reference to the construction of the Universe. *A*'s p-rotation causes jumps so that *A*'s front relatively changes from position to position away from *B*. That is, p-rotation defines, in this case, a change of position over each minimal unit of Time as each new trace-point is generated. From this point of view the change of position is not continuous – it jumps. However, since these jumps are in minimal units, this discreteness will be hidden below human perception (cannot be measured in terms of anything smaller) and therefore would not arise in either human perception or empirically derived physics. *B* will lie in uniform contact with *A* as *A*'s point of view is, according to the concept of p-rotation, that *B* appears to move around him (*A*) uniformly. Thus, one can state that although *A* would not necessarily know he was rotating, p-rotation would give, and is defined by, in human perceptive terms, a change of position about a central point in what humans refer to as a plane[10] in the period between the appearance of *B* and *C*. For a continuing series of generated points *A* would note a continuing change of position, and this change of position would continually repeat itself as more points were produced. He might then consider he was rotating although in this respect one has to recall the fact that it took many hundreds of years before humans realized the Earth was rotating rather than the sun traveling round the Earth. Humans would define this repetition as curved and if in a plane as being circular. Thus, both the human concept of rotation and circle are formed by the action of Time generating points. Note that this description states both what rotation is and what it does. Thus p-rotation, although too fundamental to be defined in terms of something more fundamental does define the human concept of rotation. But in the case of human perceived rotation, it must be remembered that it requires a background to remove ambiguities such as shown by the Earth and Sun: from the Earth, the Sun passes round it; and vice versa from the Sun's frame of reference.

Note that Time space, rotation, position, and direction are all linked to the single definition of Time. Rotation cannot be defined in terms of space because space and position are both derived from rotation (p-rotation) which itself is the self-generating operator for Time.

Since, as above, p-rotation represents, and thus defines, a minimum interval of Time, the connections $\overrightarrow{ab}$, $\overrightarrow{ac}$ and $\overrightarrow{bc}$, each define minimum directed intervals, $\overrightarrow{bc}$ equal to $\overrightarrow{ab}$ and $\overrightarrow{ac}$ (*AB*1= *AB*2 = B_1B_2) – again recalling the similarity with Euler's concept of infinitesimal. These minimum directed intervals, not only clarify a minimal Time-interval, but they also evoke what humans would call 'spatial length.' That is, they would form the basis of our perception of space even though only in the infinitesimal or natural sense.

[10] The change is a jump not a continuum so it will always appear planar in human terms.

Taking this a step further, the p-rotational action of $\hat{T}$ thus creates minimal intervals of both space and Time carried by trace-points. This will be denoted by **space-Time** with capital T to distinguish it from Minkowski (1909) spacetime which is not the same thing. It also brings up a basic concept accepted equally in human cognisance with those of time and space: that of velocity and speed as, respectively, the rate of change of spatial distance over a period of time in a given direction, or just the magnitude of the change with no specific direction. As velocity (speed) is not considered here as fundamental, it must be caused. But p-rotation, as above, generates 'a change of position over each minimal unit of Time as each new trace-point is generated.' That is, it defines a velocity which humans would recognize as orthogonal to the axis of rotation – a **tangential velocity**.[11] Additionally, in terms of the circle also derived above, the apparent production of space produces the concept of an arc and thus velocity along a line. Consequently, we have the concept of caused lineal velocity according to p-rotation and the definition of Time. Also, at the same instant as the circle and an arc along it are produced, a radial distance from the rotating centre to the circle is produced, which in human thought is generated over the minimal time interval and can thus be thought of as a radial velocity. But if Figure 4.1 is shrunk to represent a rotating point, the tangential and radial velocity directions will 'lie on top of each other' and thus have no distinction between them – the tangential velocity has the same magnitude as a radial velocity and vice versa. Consequently, if *A* 'sees' the difference between *B* and *C* emerge he would equally believe a distance had opened up between him and *C*, or *B*. This 'seeing' would, of course, rely on some overlying principle that converts what is essentially no-space to an observable space; a relativistic principle.

Overall, the action involved should be interpreted as saying:

Due to rotation, given two volumeless points A and B, B appears to pass around A at a unit distance in A's frame of reference.

In other words, the fundamental action of rotation, p-rotation, causes trace-point *A* to acquire an apparent size, and *vice versa* for *B*. It will be seen over the rest of this thesis that this explains the principles on which Einstein raised his 'special theory of relativity' – see special relativity 4.8 following next.

Finally, because the action of $\hat{T}$ is identical for all trace-points, in human perception it gives a constant rate (production) of jumps defined by the minimal indivisible units, that is one unit of length per unit of Time which can be considered a tangential velocity of the generated circle, with what

[11] Cf section 4.8.7 for a relativistic treatment of rotation proving that π remains constant w.r.t the centre of rotation for Time and trace-points.

humans would call value *c*.[12] As by the definition of Time every such interval will be identical, *c* will be an absolute constant of the production of space-Time and thus, of a Universe created from it. Thus, space and Time intervals are both representations of the same fundamental thing.

The main difference between p-rotation and human observed perceptions of rotation is then that the natural Universe has no space or Time interval as such, but p-rotation produces both the Time and space intervals from which the human idea of rotation has arisen. It is the 'is,' or cause, which produces the 'does'. P-rotation is the essence of rotation rather than what we see such as a rotating wheel which is the *effect* caused by rotation. As such it occupies no space. It is a rotating point. We also see that all the generated points keep within the null point as if they are, in human ideas, infinitesimals within an infinitesimal. The difference between the rotations explains why humans have been unable to produce a fundamental definition (one that does not depend on physically undefined entities such as space and time). On the basis derived here space and time are generated in the human frame of reference by rotation so that the dictionary 'definitions' of rotation given in section 3.5 are looped.

Furthermore, the p-rotation is an abstract item in both the Aristotelian sense of not having substance, and the human sense of not being concrete or having a material nature about it. It is ethereal. The human instinct is to interpret a point as a solid thing in space. But as Euclid said, a point is that which has no part. In the case under review its p-rotation generates a perceived space, perceived by living things. Consequently the points it produces of space, made up of p-rotations, and Time (and time) are equally non-material. The question will then be how do we obtain our notion of solidness of anything if only these three concepts, being only ethereal/abstract in the sense I have derived, are responsible for everything in the Universe? The answer revolves around the concept of p-rotation being such that it has a rate of rotation (angular velocity in physical terminology) that gives it an automatic constant 'tangential velocity.' As a result, two p-rotations, that is two p-rotating points, cannot be superimposed, whereby superimposed I mean, they intersect or add together at one and the same point – though they can touch each other. For if they were superimposed, the total tangential velocity would be $2c$, which conflicts with the fact a p-rotation has only the constant tangential rotation of *c*. That is, the p-rotations are points which produce the connotations of both space and Time. Thus, if p-rotation is a fundamental part of a fundamental cause everything produced from it will have the same non-intersection rules. Thus, if this system should automatically lead to the production of points with coordinated rotations created out of just this space-Time, the rule will exclude them from being superimposed. That is, if we could imagine them for the sake of explanation, moving towards each other they would be forced to change direction as if they were solid. However,

[12] In human perception with units of length = units of Time, $c = 1$. But in SI units this would not be the case.

this will require more thought to describe how such objects can come into existence than is possible in this thesis so is left to another place (see Chapter 6).

This first thought experiment was only to attain the general idea of a rotational basis for Time. Consequently, it provides a specific condition for the three points *A*, *B* and *C*. Two questions need to be asked: (a) whether the outcome can apply to all future Time-points as they are added individually; and more fundamentally (b) whether the point of Time is only recognizable through trace-points. That is, two consecutive trace-points generated over the progression of Time indicate the minimum Time-interval. What is the difference that allows this?

There are six factors that have to be considered.

(1) The p-rotation leads to a minimum interval.
(2) From the definition of Time 'all of the same form' implies that every trace-point's apparent minimal interval in our frame of reference is the same as every other.
(3) The planar form of rotation deduced creates a mutual connection between points, which implies the minimum interval must be the same for all mutual connections and relative directions.[13]
(4) (3) implies any space itself must also fit the minimum interval format.
(5) Are the formats of the space and mutual connections completely described?
(6) And finally, from a human point of view: Does this process lead to the human perception of a space, or volume? The answer is surprisingly easy to conceive but requires Chapter 5 to rationalize it completely. However, I shall partly explain the problem in section 4.12.

4.5 Three dimensions and the simple building module of space[14]

Starting with question (b) 'whether the point of Time is only recognizable through trace-points' as it will also answer (a), I shall consider this final thought experiment in two parts, equivalent to finding a representation of the above natural action in human perceptive terms. If we take a single point, it has no size or spatial connotation. But if it rotates relative to another point then its act of rotation develops a positional change as above. In this respect it develops a level of measurability which can be

[13] Surprisingly, direction, philosophically qua direction, was not tackled by Aristotle. It is a fundamental difficulty of physics, and thus equally of this foundational approach relating connection to direction without, as yet a volume for reference. Although we have the concept of directed connections within the framework of infinitesimals this is only relative to the fundamental universe. For a proper explanation the concepts of a spatial plane and volume must be derived.
[14] A full definition of space requires the ability of a body to 'recognize space ' derived in Chapter 5.

illustrated in human experience by reason or geometry. As above, the action/rotation of each point will create the relative condition of one point 'rolling' around the other.

In view of the absence, as yet, of space other than as a possible plane (in human language) it is necessary to consider various human perceptions that are construed as 'geometrical.' Euclid is generally considered the father of geometry through the axioms he derived in his Elements (300BCE). However, these axioms were argued by Kant ([1781]1998:B16-17) to be "synthetic", that is, only based on human intuition. For immediate purposes two of these intuitions are a straight line as being the shortest distance between two points, and a square as being a four sided figure with right angles at each corner – right angles being defined as given by the angles between two intersecting straight lines (thus in a plane) such that the angles between the lines are all equal. Here I shall consider these two human concepts as pure intuition as they would have been before the concept of geometry. That is, the formation of these concepts must follow from the construction of the Universe and thus precede the human idea of geometry without being considered an *a priori* necessity. I have therefore to convert the natural operations above, which have been outside of, and are still beyond human perception, into humanly recognizable terms according to the human intuition of geometry. This will then provide a pointer to how and why the Time process gives humans the concept of volume. That is, we will have the how, why, and what is concept, or missing definition in human terms, of volume.

The jump between points in Figure 4.1, representing the expansion of Time across a prospective rotational plane, can be imagined in Euclidean (or current human) geometry using two directions OP1 and OP2 between O and two points, $\Im$**,** where each $\Im$ is identical except in its separation from the other, and each $\Im$ represents the advance of space-Time in human perceptive terms from point O. In keeping with the requirement of a minimum interval, the distance between these $\Im$s has to be the same as the distance they have jumped. This *jump* can be intuitively imagined and drawn as a straight line. Furthermore, in terms of the rotation in the human Euclidean system, and factors (2)-(4) above, a full rotation in the plane must equal an exact number of jumps. The smallest figure with equal sides that fits this requirement is what humans call a 'square' as in Figure 4.2d whereby each jump is one quarter of a complete rotation. The fourth rotation would then bring OP1 back to its starting line-up. Thus, the unit has constant form in itself.

Figure 4.2 is then, in human expectations, equivalent to 4.1 – it is merely a different (geometrical) way of expressing the action of $\hat{T}$ in a plane over a continuous rotation suitable for transferring to human mathematical systems. In this case, although the $\Im$s actually jump in the natural system, the mathematical expression treats the action as if the $\Im$s pass along a continuous spiral. This would allow the use of trigonometric functions to describe the action. It also allows us to imagine the production of space-Time as a rotation, but it must always be remembered this is only a useful view and not exactly true to the underlying process.

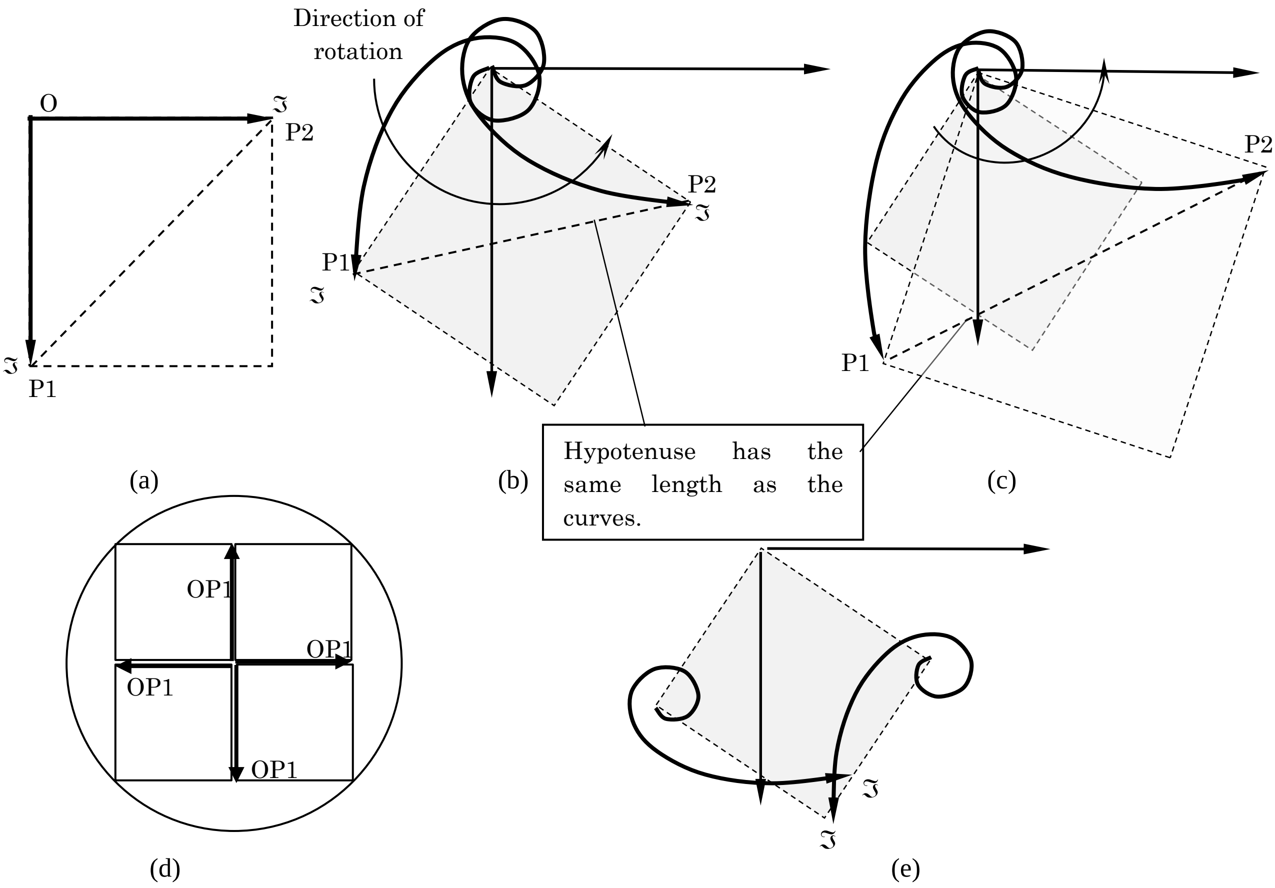

Figure 4.2. The transformation of natural space-Time generation to a Euclidean planar space-Time in the form of a rotating square using the human concept of a continuum. Diagram (a) illustrates the advance of space-Time along two sides of a non-rotating square. The heavy lines represent orthogonal axes, OP1 and OP2, along two sides of the square. The tips of the arrows and the two symbols ℑ indicate how far space-Time has travelled along the axes in an arbitrary time. If the square rotates, the ℑs follow a curve so that the distance they travel along the sides is the same as the distance along the hypotenuse, as in diagram (b). As Time progresses the arrows and ℑs move further from their origin and the square on which the axes lie grows ever larger as it rotates (c). The result is that the ℑs move around their origin, O, in spiral paths and the distance between them is always the same as the distance each has travelled along its spiral. (d) A complete rotation of the plane about O must be equivalent to an integral number of minimum intervals as otherwise a complete rotation would lead to a non-minimum interval appearing. Diagram (e) shows that extending the process to another generation would lead to the ℑs paths and thus the space-Time generated intersecting each other.

Then factor (4) is filled if each ℑ denotes the position to which the Time interval has expanded along OP1 and OP2 during a jump; or the rate of rotation is such that the *curved distance* (as opposed to the rectilinear distance along the axes OP1 and OP2) travelled by the ℑs is the same as the distance between them. If this last description also represents a direct jump during which p-rotation allows a minimum interval in human view, it is understandable how humans imagine the curved representation of the jump as a continuum. As the $\Im$s represent Time which jumps from one point to the next they are themselves points of Time.

Note that (i) this rotation has to deliver (as defined in section 4.4) a constant tangential velocity, *c*. (This appears to imply a reduction in the rotation as the representative $\Im$s jump, or progress, from O (*A* of Figure 4.1) to P1 and P2; but, due to the jump, this change of rotation does not arise; the tangential velocity is merely that at the final formation of the trace-point remembering that, despite the illusion of a space, it is still merely a point). (ii) Even though spaceless, p-rotation has the human connotation of circularity and thus tangential velocity. Then if that circularity is divided into four equal parts (Figure 4.2d), the tangential velocity at one of those parts is orthogonal to the tangential velocity at the next part (see Figure 4.1). (iii) This system does not allow for the formation of further points from P1 and P2 under the action of $\hat{T}$ as this would cause intersection. For example, repeating Figure 4.1b from each $\Im$ in the Figure, the squares formed on P1 and P2 would rotate into each other as in Figure 4.1e.

However, the fundamental definition by itself using volumeless points cannot restrict p-rotation itself to any particular direction. It is only a convenience that Figure 4.1 is shown flat on the paper. Without a volume one cannot consider the generation of the three trace-points in any specific direction, they could be vertical to the paper, but they will still form what humans would call a plane – just a vertical one. Here we should think transcendentally because we are used to planes and volumes, but it should not be considered prior knowledge to question how a fourth point (*D*) fits in.

I have before referred to the concept of dimension using the human intuitive concept. However, here there is a semantic problem which clearly illustrates the contents of section 1.3.3. Dimension in the sense I need to use it has a definitive spatial context. But I have not as yet described a dimensional space other than in the human sense of a plane, here having been defined in terms of the p-rotation and three points. I now want to consider whether this is sufficient to describe a complete space without pre-allowing that there might be what humans recognize as a volume. Or worse still, there might be something that mathematicians refer to as n-dimensional space. The best I am able to do is to take Figure 4.2e which shows that time production would have to come to a halt at the points of intersection as this would break the fundamental rule. Thus, there must be some way out which the production of Time points would take.

This raises a further point about the strength of the Time definition. That is, *it is not an action of the form seen in human perception* – cause followed by reaction. It is of the form which humans would call proactive. The fundamental rule featured by $\hat{T}$ automatically locks out any violation. Avoidance is thus spontaneous. Consequently, the formation of new points must bi-pass this blockage thus opening up another possible direction. But this direction must also fill the other parts of the fundamental definition.

Consequently, consider the generation of a trace-point from *C* to *D* with direction $\overrightarrow{cd}$. Any change in direction has to maintain the principle of the minimum interval of the Time definition so that if the change cannot lie in the (*ab*, *cd*) plane (as determined in (iii) above) it must be orthogonal to this plane, the reason being that the minimum interval has still to be met between the two directions $\overrightarrow{bc}$ and $\overrightarrow{cd}$, for exactly the same reasons as the planar case with $\overrightarrow{ab}$ or $\overrightarrow{ac}$ and $\overrightarrow{bc}$. That is, $\overrightarrow{bc}$ and $\overrightarrow{cd}$ must be representable by an identical square to O(P1)(P2) of Figure 4.2 which rotates about O in a direction other than the original plane. But it must still uphold the principle of the minimal unit with respect to both $\overrightarrow{ab}$ and $\overrightarrow{ac}$. Thus this additional direction of rotation must echo the planar description, and thus *ab*, *cd* must be orthogonal, that is, the combined system must rotate orthogonally as in Figure 4.3.[15]

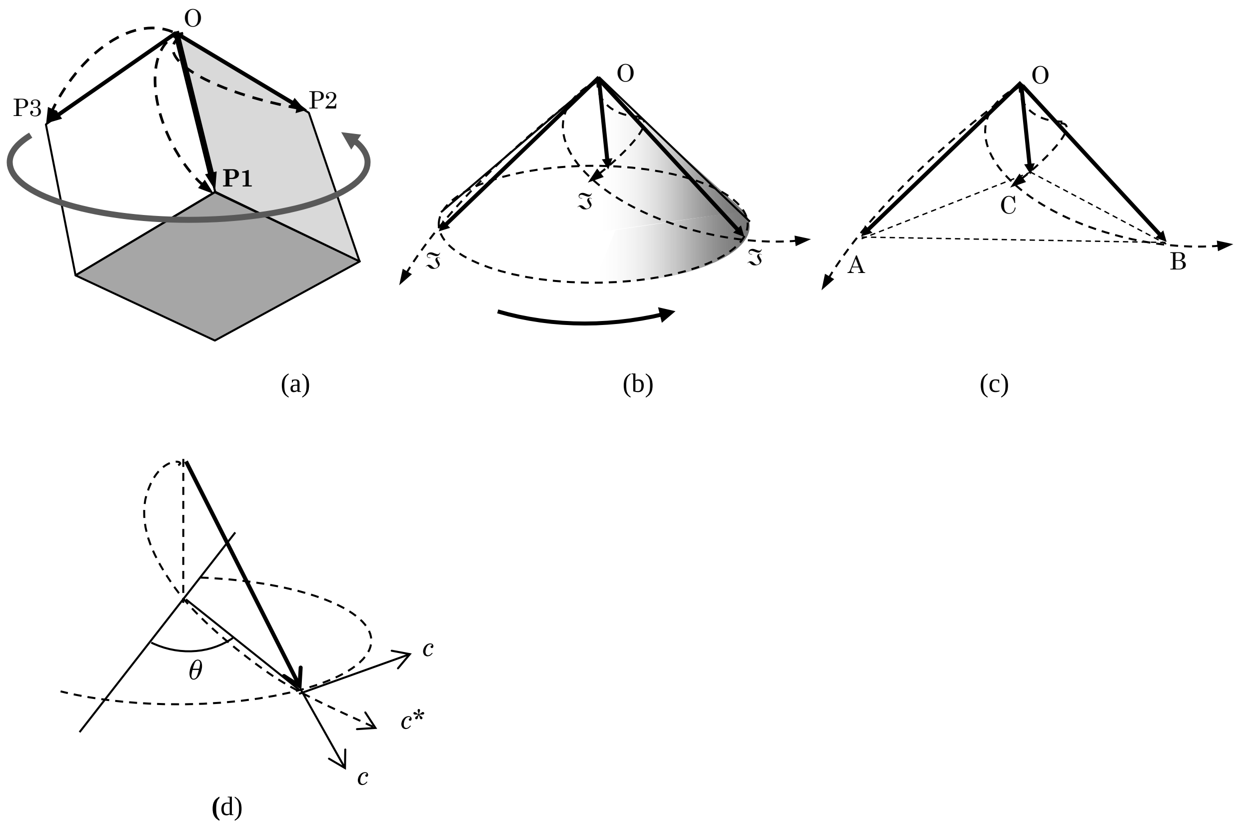

Figure 4.3. Different representations of space-Time.

[15] An alternative view giving the same result: In Figure 4.2a, the OP1 and OP2 axes themselves rotate as the space-Time flows expand along each axis. These axes then can be described as curved axes. Then each axis can be equally represented by two further curves and so on. Inspection shows that only one extra direction is required to completely specify the form of the space-Time interval, provided this axis is orthogonal to the original axes which it will be by the principle of the minimum unit. It might also be imagined that a volume based on an equilateral triangle producing a trihedron might work but this is easily shown to be impossible by constructing a model of a repeating volume using such objects.

Figure 4.3a represents the rotation of a cube with P1, P2, P3 arbitrarily placed on a horizontal plane. Space-Time now expands down three adjoining edges (OP1, OP2 and OP3) of the cube as it spins in the direction of the grey arrow. As in two dimensions, the route taken by each of the ℑs is a spiral (dashed lines). The triad of axes marked as P1, P2 and P3 is orthogonal. O denotes the origin of the expansion but in the Time scheme the axes do not physically intersect at this point. In this construction each period appears, or **materializes**, when each curve represents a space-Time unit as designated in the planar case. Diagram (b) represents the rotation of the space-Time axes as forming a hollow cone, but this is in the human view of a spiral formation rather than the straight jump of the natural production of space-Time. It would appear to produce intersection between two cones which does not occur in a straight jump. Diagram (c) represents (b) as a **right tetrahedron**, which is the most useful form for developing the principle to continuous space-Time production. Diagram (d) gives the relationship between the tangential velocity of the rotating cone and radial motion of the ℑs and resultant *c**.

Figure 4.3c is a relief diagram showing the volumetric arrangement of the trace-points in the form of an orthogonal triad left by the operation of $\hat{T}$ where $\hat{T}$ operated first on Φ to produce the first point of Time at the apex, and then operated on that to produce three points of Time (ℑs). These ℑs then jumped to the three basal points P1, P2, P3 where they formed trace-points as $\hat{T}$ once again operated on them. This operation leads to a volumetric, or Euclidean interpretation for the minimum interval. Thus, although the description round Figure 4.1 was conducted by considering points produced in succession, the operation of $\hat{T}$ produces a volumetric (3-dimensional) space-Time with three trace-points produced simultaneously.

This result will be called a **quantum unit of Time**[16] or **qut**, and the positional and eventually length, interval a **qul** (both qul and qut being along the spirals). Note that these units *must not be confused* with the Planck units of physics. From the derivation of these units, it should be clear that they only have a size (of one unit) in human perceptive terms. Obviously, an inanimate object cannot see the space its rotation apparently creates, where I use ‘apparently’ in the sense ‘it appears to an eyed observer’ not in the sense it may or may not exist. One qul per qut will then be a velocity denoted by *c** which, as the relativistic production of space and Time are intrinsically linked by the process derived, becomes the rate of creation of space-Time. But this velocity is purely abstract in natural terms though it has connotations with human ideas of universal expansion. It again does not have a natural value since it is purely in terms of units. The form of *c**, as well as its relationship to *c*, is determined in Figure 4.3d as, in human measurability based on Euclidean space:

$$\boldsymbol{c^* = 2^{1/2}c}.$$

[16] The concept of a quantum unit for time is not new, for example Planck units. Caldirola, P. (1980) gave a value of ~ 2 x 10^{-23} to the quantum unit (chronon) which is slightly larger than my 4.1696 x 10^{-24} seconds.

c being an instantaneous tangential velocity and c^* being the speed along a curve. Note that a generation of space-Time can be referred to simply as a 'qut' in either the natural or human interpretations of space-Time.

The quantum unit defined here, being indivisible and the smallest possible entity, cannot be measured by anything smaller since it defines the smallest unit of anything. Consequently, anything with a measurable size must be at least as large. It matters not whether it has beginning and endpoints; it only needs to be a qut or qul since the intervals are exactly equivalent being merely different representations of the same action $\hat{T}$. The use of a qut or qul will allow development of space-Time in more easily understood words. If this system eventually produces a Universe similar to ours it should then support the production of everything in this universe including sapient beings with similar attributes to ours. That is, they will believe in measurement and mathematics. Then it becomes possible to convert these quantum units to human measurements and thus give them values in human terms. Nevertheless, the fundamental process is according to human physics, still deep philosophical reasoning not required by contemporary human physics – as yet! So, in our sapience it remains foundational philosophy until a complete description of all the fundamental processes is deduced.[17] As these units are an explicit part of the foundational principle, the entire system (Universe) being produced must be formed around them. That is, again if the system eventually produces a Universal structure, then it must in entirety be centred on these units and *no* others. This should not preclude comparison to human invented units such as metres and seconds or even kilograms and ohms.

Note that the last two paragraphs dealt with Euclidean space-Time formed by direct jumps of the $\Im$s under the action of $\hat{T}$. But the human representation/perception in which measurement can be applied requires the rotational form of Figures 4.2b,c or 4.3a,b which produces a curved space. Thus, there are two possible systems, curved and rectilinear, for viewing space-Time both of which produce a three-dimensional volume for the Universe. Furthermore, both appear to be equally valid.

The basic construction of space-Time produces what humans call a triad or **right tetrahedron** in which the $\Im$s jump to their positions, the jump being in human connotation a straight line. However, if the contra-rotating spins are taken into account and the complete production of space-Time over the progression of Time is taken into account, the whole space formed by the $\dot{\theta}^+$ rotation can be said to rotate or spin. If this represents the Universe, then the whole Universe will spin (relative to the $\dot{\theta}^-$ spin). Consequently, I will refer to the Universe as if it is encapsulated by the $\dot{\theta}^-$ spin. That is, from human perception the effect would be as if the spins operated such that one is contained within the

[17] I am not sure whether other living creatures in general have the sapience to be aware of such a concept!

other although a more accurate description is that it is 'backed' by the other. If we take the Universe origin as the centre of the system, it is Euclidean. An interesting point here, is that in order to pass from a curved system to rectilinear system or vice versa, instead of the highly complex Riemannian mathematics only multiplication or division by $2^{1/2}$ is required.

The curves described for space-Time in Figures 4.2 and 4.3 are equivalent to coordinate axes in curved geometry, while the heavy lines correspond to the standard (Cartesian) coordinate axes in human rectilinear representation of space. (Note (1) that as zero does not exist in the Time number system, the Time axes do not intersect at zero. This maintains the principle of non-intersection, or distinctness of points required by Time definition. (2) As the qul is curved, the rectilinear equivalent is shorter so cannot be measured, but this is not important in human measurements of straight lines as these are always longer than a qul because any measurements must involve distances of at least atomic radii in the measuring equipment. For future reference, as humans 'see' space as rectilinear, rectilinear units can be given as **qul$^{\mathbf{r}}$** (= $2^{-1/2}$ qul). As $2^{-1/2}$ or $2^{1/2}$ is a surd, a qul^{r} can only exist as a theoretical point between two adjacent quantum units in N′).

Additionally, the foundational premise with a single cause produces a first space-Time point from a rotation $\dot{\theta}^{+}$ which exactly balances the encapsulating rotation. It is only the encapsulated $\dot{\theta}^{+}$ rotational system which produces the Time points for the Universe.[18] The $\dot{\theta}^{-}$ remains as a controlling system purely as a boundary holding the total system to occupying no space. The space we see is therefore, as already suggested by section 4.4, an internal structure arising from the Time and trace-points. Since the $\dot{\theta}^{-}$ spin carries this backing role, it remains constant. Then if $\dot{\theta}^{-}$ is constant, the rotation of $\dot{\theta}^{+}$ relating to the tangential velocity of *c* must correspond in magnitude to $\dot{\theta}^{-}$. The value of this rotation will be called ***w***. The space-Time of section 4.4 therefore arises due to a rotation, *w*, the value of which is by assumption (section 1.3.1(i)) immaterial to the formation of the Universe. It is then only of interest to humans in their belief in measurement. This raises an important foundational point which helps explain the whole concept of measurement and its existence as only having been created by sentient-beings. *The initial rotation, w must have, in human terms, a definite value*, otherwise it can always be subject to an earlier starting point and/or different value – which makes no sense. Thus, as far as the Universe is concerned, infinities cannot exist, in which case, as *w* can in human terms have a numerical value, w/w = 1 must be the smallest value for the Universe so that infinitesimals also cannot exist except in theoretical mathematics.

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[18] See section 5.5. *w* is a maximal rotation which reduces every qut until it has the value w/w whereupon the spin system reverses to eventually create an antimatter universe starting at *w*.

Finally, turning to the most important factor (6) from those listed at the end of section 4.4: How does the human perception of a space, or volume, fit in with the necessity of an absolute constant Time-point rotation corresponding to a tangential velocity of *c*? In the above derivation of space-Time, I have consistently referred to an apparent volume in the knowledge that the two contra-rotating p-rotations negate the possibility of what humans would regard as an ‘obviously’ existing volume (cf Chapter 5? on the macro-Universe which adds to the explanation). Based on this I will first ask an unexplored consideration in the above derived process: what triggers the completion of a trace-point and production of the next? It is quite simple. The problem of the timing (completion) of the jump only appears in human perception where a trace-point expands from the human idea of zero. In the Time-reality, at its instant of creation the Time point’s three $\Im$s all have a tangential velocity *c*. The trace-point itself must also rotate at *w* to give its tangential velocity when it materializes at *c*. If the Time point could expand further the $\Im$s would attain a velocity greater than *c*. Consequently the concept never arises. The $\Im$s jump spontaneously, each to form a new Time point (and thus trace-point), with exactly the same construction as the first. Returning to the human timing problem, the expansion from zero would have to halt at *c*, that is, when the apparent radius is a qul^{r}. But as *will* be seen this does *not* preclude the living creature perception of (or ability to move in) a volume. On the other hand this duality of natural versus relativistic representations does answer the question of the size of the universe. It is atemporal and has no size. The size we see is purely relativistic as will become clearer in section 4.8 on Einstein’s discovery of his special relativistic principles.

There is then no ‘magic’ in $\hat{T}$ creating a series of trace-points. It is a purely spontaneous process forced on itself by its own action. I shall call its existence[19] without any space the **natural** Universe and the human perception of this Universe, in which objects exist with apparent directions and space-Time intervals between them, the **relativistic** Universe. How it relates to humans observing and moving through a space-Time in an atemporal and sizeless Universe needs far more foundational reasoning, given in Chapter 5, despite its final simplicity.

4.6. Form of trace-points

In the above process $\hat{T}$ produces an object, or **space-Time module,** that in the human view becomes an orthogonal rotating triad of axes. Thereupon $\hat{T}$ passes on to produce the next Time point leaving behind a set of trace points. These trace-points are not points of Time and therefore do not produce triads of their own. They are merely p-rotating points. Nevertheless, as shown in section 4.7 it is this p-rotation that forms the relativistic space interval, equivalent to the minimal interval of Time taken between the forming of two successive Time points in the progression. In our perception of space

[19] Remembering that the reason for existence itself will be discussed in chapter 5.

(given by the relativistic representation) these trace-points are arranged according to their original formation from a Time point. That is, they are arranged in a grid like structure that has the shape of a right tetrahedron as in Figure 4.3c.

However, the action forming this arrangement has a palpable difference when described in human mathematics compared to the Universe processes. The Time process jumps to the trace-point or new Time point so that the rotation only has the value at the jump; see section 4.5 where the angular velocity is called *w*. This constancy of rotation is obviously not possible in the human mathematical system (used only as an aid for explanation) which expands as in Figure 4.3 so that the motion[20] of each $\Im$ is always made at one qul per qut = c^* along the curve. But it is useful to have this humanised view because it can be fitted to measurement using human mathematics, which we now know does not agree with what actually happens. But on the other hand, it does express the action in terms of a continuous system which is how everything we see appears to be arranged. And therefore, it is easier to understand provided one remembers everything happens in jumps, or if you prefer, in quantum units. That is, in the natural system the space-Time at the instant before a qut has a fixed condition, and at the end either the same condition or a different condition, but there is no gradual change of condition in between.

To clarify, the triad of axes (OP1-OP3) in Figure 4.3abc represents, or defines, the first point of space-Time expressed as a 3-dimensional minimal period using the human Euclidean view of the process. Space-Time, as derived in this humanistic view of the Time system, is therefore 3-dimensional and is formed from three space-Time flows. Note that this appearance of space-Time is specific to ‘bilateral observation,’ or ‘relativistic-observation’ of p-rotational objects in this thought experiment. It anthropomorphizes something purely spontaneous. This is particularly evident in the three space-Time spiralling flows which arise in adjusting the Time system to the human concept of a continuum in human mathematics. By contrast, the appearance of a space-Time period, in the strict sense of trace-point generation, only arises at the instantaneous change from a single point of Time to a trace-point. There is, therefore, no actual flow, just the jump. Such a view shows a clear difference between human physical principles and a causal explanation for the universe. In any case, should these flows actually exist they would be undetectable as the space-Time generated by them has length one quantum unit which is the minimum measurement possible. Thus:

[20] which is only imaginary to aid this concept being described in humanly imaginable terms.

the appearance of what humans see as time (as a time interval) and space (as a volume) becomes purely due to a p-rotation producing an apparent velocity (c) between each of two touching, timeless, volumeless trace-points.[21]

Due to the point form of each trace-point mutually observing the other, this statement will be true for any apparent direction between (connecting) the two trace-points.

However, this has only explained the first point of space-Time. The three ℑs produced in Figure 4.3c must, by the continuing operation of $\hat{T}$, pass on to generate the next stage in the progression of Time. Section 4.7 develops the foundational principle, building from the philosophical point of view on Kant's (1998:134§B27) argument that the principle should be extended to its logical conclusion. It extends the foundational principle to a Universal background structure.

4.7 Expanding space-Time

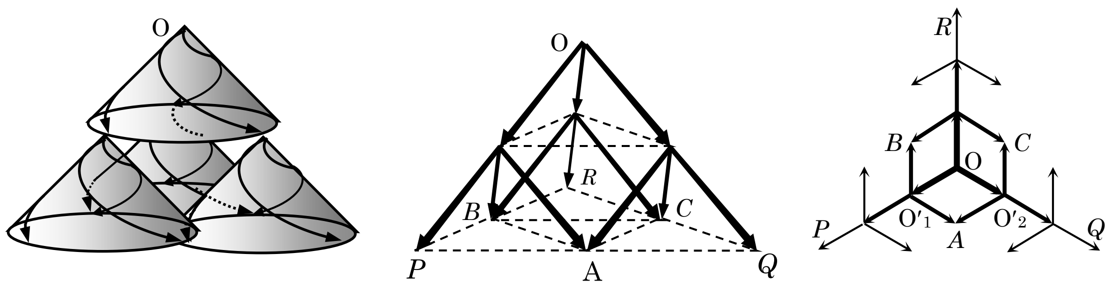
As word descriptions of unforeseen (noetic) deductions are difficult to visualize, diagrams continue to play a large role in this conceptualization – visualization from words alone only being possible if the brain has an embedded image on which it can draw. In any case, the human concept of reality demands the ability for figurative reproduction in keeping with the three-dimensional volume derived in section 4.6. (Four-dimensional spacetime cannot be drawn in a single diagram, three dimensional spacetime can, but only in relief, or as three separate two dimensional diagrams).

Due to the action of $\hat{T}$ every new space-Time module starts with the same conditions as every other avoiding an 'addition of velocities' problem of a new trace-point building upon the rotation of another. That is, if the original triad of Figure 4.3c is itself rotating then one might expect that each of its three ℑs are moving around it at *c*, its tangential velocity. Then one might expect the new triads produced from each of the ℑs to start their 'life' with this velocity. However, $\hat{T}$ is identical for all generations of space-Time which means it carries both $\dot{\theta}^{+}$ and $\dot{\theta}^{-}$ spins with $\dot{\theta}^{+}$ encapsulated by $\dot{\theta}^{-}$. Thus, each new ℑ starts its 'life' with no prior rotation as it is automatically annulled by the $\dot{\theta}^{-}$ spin carried by $\hat{T}$. Therefore, each new space-Time module (triad) produced is identical to all the others.

[21] Both trace-points have the same direction so that ostensibly they will have opposite rotations at the point of contact. But there are two factors to be noted. (i) Each point is a point and sees the other rotate with tangential velocity *c*. (ii) If the points are regarded in human perceptive terms, then Einstein's deduction on special relativity shows that if *c* is regarded as an absolute maximum velocity his addition of velocity formula applies. In fact, it will later be shown that the tangential velocity of the trace-points *c* has the same value as the speed of light. Also note that it is the $\dot{\theta}^{+}$ rotation of each point that causes the appearance of rotation inside $\dot{\theta}^{-}$.

The action of $\hat{T}$ passing from stage to stage in the progression of Time leads directly to the noetic principle of a network, or **lattice**, as suggested in the last section, of identical trace-points building up in tetragonal form. The first three stages are drawn in three equivalent formats in Figure 4.4. According to the original argument, this lattice in the *natural* representation of section 4.5, has no measurable volume in the sense which we as humans would see it. Nevertheless, it has a 3-dimensionality about it in the sense that the points are arranged in lattice form. Figure 4.4 is therefore purely to give a visual impression of how the process would appear to humans using our perception of a real space-Time. It depicts the generation of Time-points (ℑs) and resulting trace-points using the generation formats of Figure 4.3 depending on whether a continuous space-Time or jump formation (materialization) is contemplated. There are some further factors to the concept of this lattice that need to be developed following which it will be possible to explain in section 4.9 how the paradox of no-space and space resolves itself.

Whether the natural or relativistic representation is used the result is the same: when the first generation (first qut) of space-Time points materializes, it is actually the ℑs that materialize. Each generates a new Time-point for the second generation in the progression leaving behind a trace-point as described in section 4.4. When these ℑs of the second generation materialize they, too, leave behind trace-points, and so on as the progression of Time advances; a third generation is shown in plan-view in Figure 4.4c. In (b) and (c) the imaginary triads of rotating axes are drawn for each generation in their final directions at the end of the space-Time expansion, which becomes the starting direction for the next qut (fourth generation). The tips of the arrows represent the positions of the ℑs at this instant, which is also the instant when the new space-Time points generated by these ℑs form.



(a) (b) (c)

Figure 4.4 Space-Time generation following from extending Figure 4.3b,c. to a second generation in diagrams (a) and (b) and adding a third generation in (c). (a) and (b) are drawn in relief and (c) in plan view starting from the first qut – heavily lined, the second – medium lined the third – light. As in Figure 4.2b,c the cones and triads are just different representative methods of drawing the process of space-Time (trace-point) formation, (a) representing the human view of the ℑs spiralling to form the trace-points and (b) jumping. The tips of the arrows represent the final positions of the triad axes at the end of each qut and thus the position of the points forming a grid or lattice. In all three diagrams the first generation produces three new triads in the second generation. The axes of these second-generation triads meet at the points designated *A*, *B* and *C* which causes interference in space-Time production at these points. However, the outer three points *P*, *Q*, *R* can continue normal production of a space-Time lattice as seen in diagram (c). The lines connecting the arrow tips to the triad origins are imaginary to show the direction of motion, or jump, of the relevant ℑs in human view.

It may be noted that in Figure 4.4 diagram (a) represents the human trigonometric view that the ℑs spiral outwards whereas they in fact jump. It can be seen in this view that although the cones clearly overlap, in diagram (b) only the points *ABCPQR* exist. This is another case of a possible human perception, caused by using human invented trigonometry, not actually representing the true state of affairs. However, this representation is important as it corresponds to a trigonometric method which will allow testing of the Time mechanism to give measurement using trigonometric equations. The axes themselves do not exist as such – they merely demonstrate the action of space-Time creation as it would appear in Euclidean geometry (as in section 4.5). Nevertheless 'axis' is a useful way of describing the action of a ℑ and the direction in which it jumps. Similarly, the arrows also give the direction of formation of the next points.

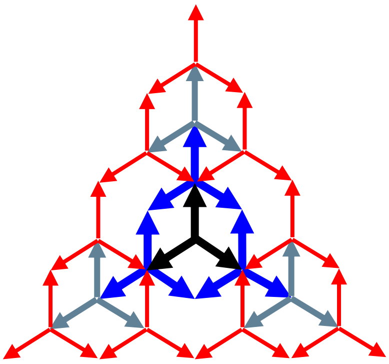
However, although having said that either the jump or the continuous rotation in the form of the cones is extremely useful as a visual representation of the rotational aspect leading to space-time formation, it leads to a major problem not seen in the natural representation and the jump formation of the triad. To some extent this is useful as it shows up the difference between human perception and what lies beneath that perception. The spiral or cone formation is purely how geometry would produce the space-Time production from rotation and thus through human education how humans would imagine it. Through the use of trigonometry mathematics would follow suit.

In the natural representation, on the other hand, there is no 'starting' and 'end' point – just a spontaneous jump. Therefore, there is no interval. This is a difference between the p-rotation or the 'is' or 'being' of rotation. It is an instantaneous rotation. If one views the rotation as forming a cone, it stops at the instant of the ℑs reaching their materialization. Thus the ℑs never overlap. They only instantaneously meet at the point of contact when they materialize, which also happens to be the point described earlier (item (6) at the end of section 4.4) which triggers their materialization at tangential velocity *c*.

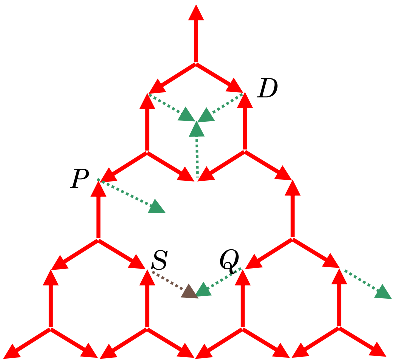
The result is the formation of a lattice of identical space-Time trace-points. In the relativistic representation each point appears separated from each other for the reasons given in sections 4.4-4.5. However, this separation is in terms of curved quantum units so that the straight-line distance between points is too small to measure and thus the overall impression is of a continuous volume, or continuum. Nevertheless, it should be interpreted as a collection of quantum unit-volumes (space-

Time **building blocks**). The natural representation (to which, as above, the drawn diagrams shrink) will have the same arrangement of points without volume and space.

However, this process produces an anomaly as early as the second generation: the identical formation of all points automatically leads to coincidences of some of the trace-points (*A*, *B*, *C*) as in diagrams 4.4b,c. Here, these points form a hexagonal 'ring.' These coincidences, as might be expected, would lead to different processes appearing. These processes lead to the production of particles, but I have not covered these in this thesis as the process requires a strongly geometrical treatment adding complications outside the scope of this thesis – which is only to determine a possible first cause (see section 6.4.2). Extending the process of Time formation from the free axes, the axes that do not lead to coincident points, for example those in Figure 4.4c at the corners of the diagram, could lead to ever larger (not necessarily hexagonal) rings appearing every few generations.



(a)



(b)

Figure 4.5a shows four generations of space-Time in plan view starting from the black triad for the first stage through to the red axes at the fourth. When any two axes meet, unstable proto-particles form. As the lattice grows the outermost axes are always **free**. (b) The red triads form a larger (heart-shaped) ring than the blue ring in (a). Coincident points also form free axes, but these may extend in any one of three possible directions some of which are shown at points at *P*, *Q*, *S* and *D*: each can generate new space-Time triads. Note: in order to avoid clutter not all the axes emerging from coincidences have been drawn.

The formation of this lattice also leaves **free** axes, ones with an unfettered ability to generate a regular space-Time expansion, thus continuing the growth of the lattice. The axes at the extremities of the tetrahedral lattice as it forms, as with arrows *P*, *Q*, *R* in diagrams 4.4b,c are always free, but so too is any axis that does not form a coincidence with another axis. Diagram 4.5b, drawn to show larger rings of coincidences, again has the three free axes at the corners of the enlarged tetrahedron. Where the coincidences arise, the space-Time coinciding points may be said to interfere with themselves and in doing so produce one free axis each – as do the coincidences at *A*,*B*,*C*, in Figure 4.4c. The green dotted arrows in Figure 4.5b represent some of the possible directions that these free axes can take (all pointing downwards into the paper to maintain the shape of the overall triad formation). Those at

P and Q, provided they do not form coincidences with another free axis, such as the orange arrow from S (which could have pointed to the left instead) can form new sets of triads such as the set in Figures 4.4a,b. Thus, the hole left by the central ring can be filled in over a period of Time. As can be imagined, as the lattice grows much larger rings can be formed and filled in in various ways so that the lattice grows in a somewhat random formation, although as the holes fill in the lattice becomes more regular. The coincidences where the space-Time interferes with itself to produce particles will thus also be produced in a random pattern. This will be referred to again briefly in section 5.6.

I shall now turn to Einstein's theory of special relativity to show how it both follows from the construction of space-Time derived here and also helps to explain how our view of space arises.

4.8 Special relativity

In Chapters 1-3 I mentioned entrenchment and group psyche. This now comes to a focus here, in combination with the concept of zero again, particularly with the development to a volumetric space which I claimed was the forerunner of Einstein's recognition of the constant value of the speed of light. This connection now needs to be demonstrated and in doing so I shall point to the problem that there are two distinct parts to the special theory of which only one has been recognized in mathematical physics. This points to some revision of the theory as currently accepted to bring it in line with the foundational aspects just derived. As a result, the theory should become easier to assimilate.

Einstein is said to have complained:[22] "*since the mathematicians have invaded the theory of relativity, I do not understand it myself.*" In order to show that this comment may be a valid criticism I shall take it first as the treatment below does not depend on the fundamental elements described in the previous chapters. Einstein's overall deductions are however connected to the first cause just derived as I shall demonstrate in sections 4.8.7-4.8.9

In sections 4.8.1-4.8.2 I assume the reader is conversant with the general derivation of Special Relativity as taught at most, if not all, universities and written in most textbooks[23]. What is not so well known are Einstein's original thoughts in his 1905b paper. I argue that there are flaws in the deductions used by universities and textbooks in general, and that these methods do not agree with the concept as presented by Einstein in his original paper, particularly with the comments he raised in his

[22] in Paul A. Schilpp (ed.) *Albert Einstein, Philosopher-Scientist*, Evanston, 1949. Footnote in a contribution to Albert Einstein: Philosopher-Scientist p 683-684 see (Stanford Howard 2004).
[23] E.g., Møller 1962, Rosser 1968, Resnick 1967, Heading 1964, Synge and Griffith 1959, Tolansky 1956.

introduction ([1905] 1923:39-43). This section focuses on what I, and the Time theory, see as flaws, and then details the methods that should be adopted.

For these sections I take a frame of reference as given in section 3.2 but with an *xyz* spatial coordinate system attached with *x*-coordinate lying in the direction of the observer's 'front' and, in general with the relative velocity between two observers lying along this axis.

4.8.1 Considerations arising from Einstein's special theory (1905)

In the introduction to his special theory Einstein ([1905] 1923:39-43) made the following points: (a) given two separated frames of reference, A and B, it is not possible for an observer in either to know with absolute certainty the spatio-temporal conditions in the other. To overcome this problem he assumed the speed of light might be constant and (b) then defined what he meant by common time between the two frames of reference as follows: If a ray of light leaves A at time t_A and arrives at B at B's time t_B from where it is instantaneously reflected to A to arrive at A's time t_A' then the two clocks would be synchronized

"if $t_B - t_A = t_A' - t_B$." ([1905] (1923):40)

i.e., the time taken for the light to travel out is equal to the time taken for it to return. In this case

$$\frac{2AB}{t'_A - t_A} = c \qquad (1)$$

as the light had travelled both out from, and back to, A. This defines time for "stationary clocks in a stationary system." It is therefore necessary to consider the situation for a moving system.

For a rod moving with respect to a stationary frame of reference Figure 1 gives

For the outwards motion of light: $AB' = l + vt_{out} = ct_{out}$ or $t_{out} = l/(c-v)$ (2a)

and for the return: $ct_{back} = l - vt_{back}$ or $t_{back} = l/(c+v)$ (2b)

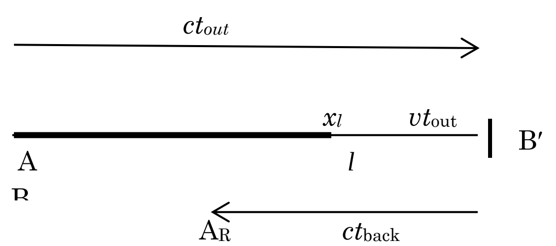


Figure 4.6. The motion of a light-wave travelling along a moving rod length *l*. The wave leaves an observer A at the origin end of the rod at t_o and travels to a mirror at the end B of the rod. In this time the far end of the rod B moves at constant velocity to B′ where the light is reflected back to the wave source which has now travelled to A_R and is received at time t_b.

Consequently:[24]

(i) Equation (1) only defines what is meant by "stationary clocks" in a motionless system. That is, looking at Figure 4.6 equation (1) is exactly the same as the length not moving, that is, B′ coincides identically with B.

The question of stationary is a major problem in special relativity which Einstein overcame but without complete clarity. The problem is the concept of motion, as is well known for example, the Earth travels around the Sun which travels around the centre of the galaxy which moves through space relative to other galaxies, and so on. Consequently, there is no measure of 'being stationary.' But he did derive equation (1). Therefore, I shall take it in the following concept.

Looking at Figure 4.6, the light (in the form of a photon, say) travels from A. If A remained at exactly the same point, then B would not change position and the reflecting mirror would remain at B and the light would return to A. But if A travels, this does not change the speed of light, *c*, on the assumption the speed of light is constant; then A has a velocity in the direction of the light. There are two problems. (1) the photon has a velocity with respect to A and vice versa. (2) The speed of light is measured according to A's units of measurement which Einstein showed can vary according to his speed. It is here we run into the problem of what do we mean by his speed or velocity? That is, what does it refer to? He could only use another observer. According to this observer, A's units would be altered in relation to his motion. Hence the difficulty in interpreting the concept in terms of which observer (frame of reference) is travelling and which is stationary. (It will be seen in the form of relativity that follows from my Time theory that this problem is removed as it depends only on who is observing whom). It is not really even possible to consider the forming point of the universe on the assumption it started from a single point.

We could, of course, assume that there could be a point at absolute rest in which case a continuous circular wave of light would emanate in all directions such that any point on that circle was the same distance from A as every other point. Then A would have no velocity in any given direction. In this case Einstein's equation (1) would hold and could then be defined as the concept of

[24] While (ii), (iii) and (iv) may appear repetitious they all represent slightly different concepts.

‘being stationary’. Then equations 2a and 2b can be used to determine how a moving point A will vary its measuring units so that it always measures the speed of light as a constant *c*.

If we turn to the concept derived in Chapter 3 based on Time, we do have a fundamental point at absolute rest in that it is at the centre of two contra-rotating spins which are the Universe itself. As in their natural representation they have no volume, this centre has no motion with respect to that Universe. Thus, Einstein’s equation (1) automatically holds to that condition and as the Universe develops, the space that eyed creatures see relativistically develops allowing for the possibility of motion (not included in this thesis as outside its scope of merely demonstrating the fundamental cause) whereupon equations 2a and 2b come into effect. Thus equation (1) defines the concept of being absolutely stationary and 2a and 2b allow us to determine (define) how and why we measure the speed of light to be constant if we are moving through the Universe. (A similar concept cannot be made for the universe we see around us as, even if it had a single starting point [about which we have no idea], we would have no reason to assume it was stationary. Nevertheless, the concept of absolutely stationary can still be rendered by the fundamental provision of equations 2a,b).

**Note: It may mistakenly be thought, at this preliminary stage, that because the time on a clock travelling with the rod records length/*c* that this overcomes the concept of time out not equalling the time back for all cases on the principle it is the clock in the so-called stationary frame of reference. This cannot be the case.[25] Because, as will shortly be derived, the clocks are moving with the rod they suffer the same length and time dilation as the rod. Special relativity is not about how we see our own frame of reference. Special relativity is about the actual time and length modifications as described in the remainder of this and the following three sections. Consequently, the fact that our clocks give us the so-called proper length in our frame of reference does not mean that we are stationary in the absolute sense. We could be moving close to the speed of light with respect to another observer.

The rest of this section covers the standard derivation of SR with some clarifications to overcome flaws I perceive in it. The second, section 4.8.2, refers to the Michelson-Morley experiment with an interferometer and the FitzGerald contraction. The third (section 4.8.4) is the two-way comparison between frames of reference/observers. To see how these fit together I will first deal with length/time in both directions: even our eyesight in both directions will be moving with our frame of reference so we will always think we are seeing the same length/time in both directions. In any case in practice our velocity is so low compared to relativistic velocities that we would never notice any difference.

[25] Cf end of this section for further clarification.

Moving to the derivation of the Lorentz equations: If the system shown in Figure 4.6 moves, equations (2a,b) imply the time taken for the outwards motion of light is not the same as that for its return: $t_B - t_A \neq t_A' - t_B$ as found by Einstein ([1905b] 1923:42). That is, a simple comparison shows that the time observed is different for an observer travelling in that moving frame compared to the stationary frame (equation (1)). As Einstein ([1905] 1923:42) pointed out: if two different observers travelling with respect to each other believed their clocks to accurately record the times taken for the light to travel to the mirror and return, the clocks of the two observers would no longer be synchronized.

(ii) All A can know is the time the wave, or photon, of light left him and the time it returned. He can*not* be certain when it arrived at B because he has no method of knowing whether he is stationary or moving, that is he cannot be sure whether it is he, or any external objects he sees, that are moving. He can only say that he is stationary with respect to his frame of reference AB.

(iii) So whilst any observer A records the speed of light as c in his moving frame of reference (that is, a frame of reference as defined by Einstein – for which the time for the light to travel out is not the same as the time for it to return) A's length and time units of measurement have changed in relation to his velocity. It is this change that produces his measured speed of light in his frame of reference as c, despite the fact he is moving with or against the light (see section 4.8.2).

(iv) The same applies to all frames of reference. The problem is no observer in his frame of reference knows, or has any means of determining, an absolute velocity because he has no reference against which to judge it. He can only relate his velocity to another co-moving object (observer) – depending on which one he picks from all the different objects he might observe.

For the purpose of giving a general derivation of Einstein's theory it is assumed the *relative* motions of two observers, A and B, can be taken in the same direction with both observer's x-axes lined up with the direction of *relative* motion. Here it must be understood that relative motion states nothing more than the fact of relative motion between the two observers. It is possible both objects are moving in the same direction at different speeds which if *relatively* in the + x-direction could be either B moving faster than A both in the + x-direction, or A traveling faster than B both in the –x-direction) or one travelling + x and the other – x depending on their relative speeds.

The Lorentz equations of space-time are derived in the literature and most university courses along the following lines (see references at end of section 4.8). If a wave of light emanates from origins A and O′, as in Figure 4.7, respectively in the frames of reference of an observer at each origin at a common time $t = t' = 0$ it propagates as $x^2 + y^2 + z^2 = c^2t^2$ and $x'^2 + y'^2 + z'^2 = c^2t'^2$ according to each observer respectively. If the observers move relative to each other at a velocity v in a common direction taken arbitrarily as along the X-axis, the equations can be reduced to $x^2 = c^2t^2$ and $x'^2 = c^2t'^2$ where x is the distance travelled by a photon of light in time t and similarly for x' and t'. By a variety of methods these two equations can be combined to give (see e.g., Møller 1962:35-39)

$$x^2 - c^2t^2 = x'^2 - c^2t'^2. \tag{3}$$

Assuming, as suggested by Einstein, that there is a linear connection between the observers in terms of the time and length parameters, points in one frame of reference can be expressed in terms of the other to obtain

$$x' = ax + bt \tag{4}$$

$$t' = gx + ht, \tag{5}$$

where a, b, g, h, are constants if v is constant during the expansion of the light wave. The first procedure is to ascertain two of these constants (b,h) by taking transformations between the frames of reference.

But that is only a transformation between the frames. The whole point of Einstein's theory is the travelling of a wave of light in both frames of reference. This is clearly given by the condition that in one frame $x = ct$ and in the other $x' = ct'$. The other two constants (a,g) are removed using this condition. It is therefore a condition of the Lorentz equations which Møller subsequently derived after removing all four constants. It refers to the wave of light. Looking carefully at diagrams 4.7-4.9 it is clear that it is the wave of light that matters. Therefore I repeat $x = ct$ and $x' = ct'$ are conditions of the Lorentz equations and cannot be removed or replaced.

Constants a and g are determined using equation (3) to give $a^2 = (1-v^2/c^2)$ and $g = -av/c^2$. This result requires the square root to be taken for a which is $\pm\,(1 - v^2/c^2)^{1/2}$. Figure 2a shows that only the + square root applies for the *drawn condition*. The transformation equations (4) and (5) then become

$$x' = \gamma(x - vt), \qquad t' = \gamma(t - vx/c^2) \;\; ; \;\; \gamma = (1-v^2/c^2)^{-1/2} \tag{6a,b}$$

known as the Lorentz coordinate transformations. I will not call them Lorentz-FitzGerald equations, as is sometimes done, for reasons that will become obvious. (The Lorentz-FitzGerald equations will be raised as a subsidiary equation applicable to a specialized condition).

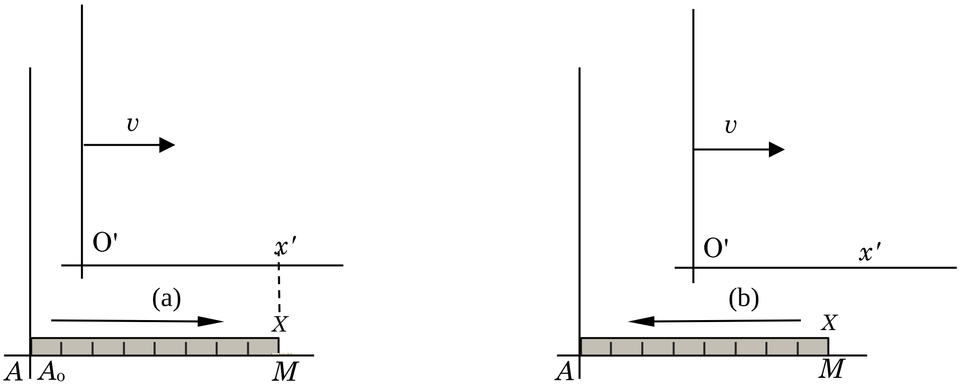


Figure 4.7. Given two observers A and O′ at the origins A_O and O′ of their respective frames of reference *A* and O′, a meter rule (or rod) of length *x* is placed along the *x*-axis of the *A* frame with one end at A_O. A photon of light (lower arrow) is dispatched from *A* at time t_o to a mirror *M* and reflected back to A. O′ moves with velocity *v* to the right in relation to *A*. In the right-hand diagram (b) the wave reflects off *M* and returns to *A*.

Now the crux: To obtain the length and time modifications we *must* take into account that the Lorentz equations (6a,b) were derived under the strict condition that $x^2 - c^2t^2 = x'^2 - c^2t'^2$ (equation 3) **where *x* is the distance travelled by a wave of light in the *A* frame so that *x* = *ct*.** Correspondingly, $x' = ct'$ in the O′ frame. Therefore, for the wave travelling out:

$$x' = \frac{x(1 - v/c)}{(1 - v^2/c^2)^{1/2}} \quad \text{and} \quad t' = \frac{t(1 - v/c)}{(1 - v^2/c^2)^{1/2}} \qquad (7a,b)$$

(From this we should note that $x'/t' = x/t = c$ as it should).

But this is only for the outwards motion of the photon before reflection. As both *A* and *B* have *no* idea who is moving, or not, they have *no* idea of, *nor can they calculate*, when the light arrives at the mirror *M* in the Figure 4.6. If either is to know anything, each can only gain such knowledge when the light has returned to *A*. *As stated by Einstein the return time* ([1905b]1923:42 and equation 2a,b)) *is* **not** *the same as the time out! Therefore, we have to calculate this time of return to determine what A would record on his clock*. ***Only in this way can we make a proper determination of the relativistic effect***. The two-way calculation is possible because although the time is different, the magnitude of *v* (and of course *c*) is the same for both ways.

It is often said, for example, see Synge and Griffith 1959:512 Fig 180, that given two frames of reference/observers *A* and O′ moving such that *A* moving to the left (say) with O′ stationary is equivalent to O′ moving to the right with *A* stationary. This may be correct if *A* and O′ are exactly equivalent but most certainly it is not correct in terms of special relativity as demonstrated in Figure 4.7a and b. They are not the same. In one the wave of light is moving in the same direction as the travelling frame. In the other it is moving in the opposite direction. Therefore, the two have to be treated separately and as proved in equation (2) the time for the light to travel out is not the same as to travel back. Therefore, both the time out and the time back must be calculated. They are not the same unless the stationary frame is absolutely stationary in terms of note (i) above.

The return can be calculated by a number of ways, (a) by noting the difference in the arrow directions of Figures 4.7a and 4.7b so that we can keep v as $+v$ as in equation (2b) and c becomes $-c$ for the return, or vice versa; (b) we can recalculate the standard method of e.g. Møller for the difference in motion bearing in mind that the return wave of light travels in the opposite direction to motion of B (see Figure 2b);[26] or (c) equations (2a,b) show that both $(c + v)$ and $(c - v)$ arise for the time measurement suggesting that when the square root is taken to obtain equations (6a,b) the negative square root indicates the opposite motion to that which gave (6a,b). All three methods give (using $x^\wedge$ to distinguish from x' for the return),

$$x^\wedge = \gamma(x + vt), \quad t^\wedge = \gamma(t + vx/c^2) \quad ; \quad \gamma = (1-v^2/c^2)^{-1/2} \qquad (8a,b)$$

which gives

$$x^\wedge = \frac{x(1+v/c)}{(1-v^2/c^2)^{1/2}} \quad \text{and} \quad t^\wedge = \frac{t(1+v/c)}{(1-v^2/c^2)^{1/2}} \qquad (9a,b)$$

with again $x^\wedge/t^\wedge = x/t = c$ as it should.

Adding (7a,b) to (9a,b) and dividing by 2, as specified by Einstein, then gives

$$x^* = \frac{x}{(1-v^2/c^2)^{1/2}} \quad \text{and} \quad t^* = \frac{t}{(1-v^2/c^2)^{1/2}} \qquad (10a,b)$$

[26] In which case it will be found that this is equivalent to taking the negative square root of equation (3) thus agreeing with the general mathematical principle that *the square root of a number has both positive and negative roots*. It must be recalled that as Einstein pointed out (1923:40-42) the time for the wave to travel out from the observer is **not** the same as for it to return to him after reflection. This is covered by the difference between the positive and negative roots. *If the time was the same for both time out and time back then, as defined by Einstein (1923:42), the rod being measured is stationary, that is, not moving!* – see section 4.8.8.

where * replaces ^ to signify the total photon travel time and consequent distance out and back.

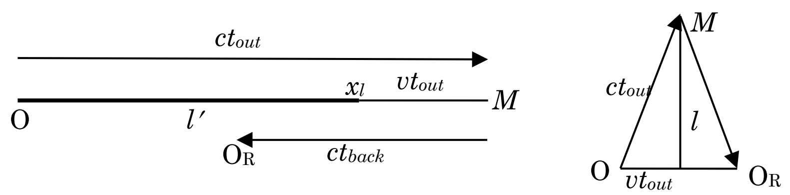
Note particularly that equations (10a,b) agree with the transverse (relativistic) Doppler red shift described in section 3.2 and therefore agree with what humans observe in nature for fast moving objects. That is, in nature time dilation and length dilation work together in the same frame of reference.

I will now return to the problem of length/c = *t*, Figure 4.6 applies. It is impossible to determine that any frame of reference has no velocity because in recording the speed of light it is impossible to determine the time when a mirror is actually struck by the outwards moving wave of light (we are not at the mirror). So even if we had a clock at the mirror which triggered when the light arrived, it would not tell us the true situation unless we were absolutely stationary – and then stationary with respect to what? The origin of the universe which may not in any case be absolutely stationary? So here we have a clear-cut difference between mathematics and fact. We can make mathematical calculations based on *assumptions* of our velocity with respect to another object, but it is impossible to test those results (measurements) to be certain of the true situation. But that 'true' situation is essential for understanding the universe.

To problematize this issue our clocks run at a rate such that the speed of light measures the same in all directions. This even applies to the Michelson-Morley interferometer experiment (see section 4.8.2) where the interferometer is adjusted so that the wavelengths of the light travelling up one arm coincides (on reflection) with the wavelength travelling up the other; the reason is because one does not know for certain whether it is the thousandth wave length (say) on each or maybe the one thousandth on one and 987th on the other that coincide. (One may for example very precisely check the measurements of the interferometer arms to be exact but there is no way of being absolutely sure the waves of light 'see it this way' for a travelling interferometer).

I will leave the very important consideration of exactly what this length and time variation means to section 4.8.4. For now, I will turn to the Lorentz-FitzGerald contraction and its derivation.

4.8.2 FitzGerald contraction



a b

Figure 4.8. The motion of a light wave travelling along a moving rod or interferometer arm. The wave leaves O in its frame of reference at t_o and travels to a mirror at the end x_l of the rod length l'. In this time the far end of the rod moves at constant velocity to *M* where the light is reflected back to the wave source which has now travelled to O_R. In Michelson's experiment the interferometer is rotated through all directions so that there will be a result where one arm (diagram a) is lined up with the Earth's motion while the other arm is normal to the motion as in diagram b.

The result for Figure 4.8a was calculated in section 4.8.1 as

$$t_{out} + t_{back} = l/(c-v) + l/(c+v)$$

but if $v = 0$ then $t_{out} + t_{back} = 2l/c$ so that if v is not 0 the length of the rod changes or the time or a mixture of both changes with velocity. From the Michelson-Morley experiments it is the rod's length that reduces[27]. Call this length l' and the time taken as T' then as with Tolansky (1956:417-418) we get:

$$T' = t'_{out} + t'_{back} = 2cl'/(c^2 - v^2)$$

From Figure 4.8b, being an isosceles triangle, Pythagoras theorem gives

$$T = t_{out} + t_{back} = 2l/(c^2 - v^2)^{1/2}$$

If we find these two times are equal as was suggested by the case of the Michelson-Morley interferometer, then

$$l' = cl/(c^2 - v^2)^{1/2} = l/(1 - v^2/c^2)$$

where l' is the contracted (FitzGerald) length.

Equations (10a,b) are a general form of Einstein's equations between *two* observers. The Lorentz-FitzGerald contraction is found in the specific case of an interferometer as in the Michelson-Morley experiments where one arm of the interferometer appears contracted in relation to time dilation, see for example Tolansky (1956:410-416). It therefore describes how and why an observer *A*, for example us, measures the speed of light in his frame of reference to be constant. The conditions between observers in two different frames of reference and a single observer in his frame of reference are thus different and must not be mixed up. However, in order to ascertain what *A* sees, a comparison to

[27] The rod in the Michelson-Morley experiment would be the arm moving in the direction of motion of the Earth.

something is needed and, as with Tolansky (1956), this is usually taken to be an external observer, but it must be clearly understood this is an observer external to the total system and completely isolated from it. The standard university methods apply to this situation ***but not*** to the general length and time comparison between two observers, for which a clearer account is described in section 4.8.4. First it is important to consider the often-quoted concept of simultaneity.

4.8.3 Spatially separated simultaneity

The idea that two spatially separated events simultaneous in one frame are not simultaneous in another co-moving frame is one of the mainstays of special relativity as taught and used in contemporary physics. The concept is obtained as follows (verbatim from Rosser (1967:45-46):

> Let two events occur at two separated points x_1 and x_2 in the inertial frame Σ. Let them be measured to occur at the same time t in Σ. According to the Lorentz transformations these would be recorded at the times t'_1 and t'_2 by clocks at rest in Σ', where t'_1 and t'_2 are given by

$$t'_1 = \gamma\left[t - \frac{v}{c^2}x_1\right] \quad \text{and} \quad t'_2 = \gamma\left[t - \frac{v}{c^2}x_2\right] \qquad (11)$$

Since x_1 is not equal to x_2, t'_1 cannot be equal to t'_2, so that if the Lorentz transformations are correct, then two spatially separated events which are simultaneous in Σ (A frame in Figure 2) are not measured to be simultaneous in Σ' [O′ frame in Figure 2]"

Equations (11) are clearly Lorentz equations dealing with emitted waves of light which require the condition $x = ct$. Then if t is the same for both parts of (11), then $x_1 = x_2$ so that $t'_1 = t'_2$. This gives $t'_2 - t'_1 = t - t$) i.e., a '0 = 0 equation' – which does ***not*** allow the deduction that what happens at two different places simultaneously in the 'stationary' frame of reference occurs at two different times in the 'moving' frame – see next section for the general principle of two-way observation. What such derivations forget is that in the Lorentz equations t_1 is the time taken for the light to travel from the Σ observer (in Rosser's case) to x_1 and similarly for t_2, that being the time taken to travel to x_2 so if $t_1 = t_2$, $x_1 = x_2$. The meaning of these symbols cannot be arbitrarily changed in order to obtain a desired effect.

Yet this idea is the most often quoted sentence, and probably the most deeply rooted argument, in contemporary theory. It allows the reversal of time sequences which has become an accepted part of special relativity. For example, consider the following for which, despite many discussions, I have been unable to obtain a satisfactory standard physical answer. Suppose I get out of bed in the morning, get dressed, have a cup of coffee, go outside for a run, have a heart attack, and fall down dead on the road. According to standard theory it is perfectly logical that in another frame of reference: I can be lying on the road dead, get up, have my heart attack, run backwards to my house, undrink my coffee, get undressed and go back to bed! After that bit of nonsense let us have a less jocular look at the situation.

First of all, I will just briefly give a rationale to this problem, one often used by lecturers. For example, if two explosions occur at the same instant in one frame of reference, but I am closer to one than the other, then I will hear the one before the other and I may then assume it took place before the other. Now suppose the one takes place earlier than the other and I am sufficiently close to the other so that I hear the other first, then I may assume the other took place first even though the other actually took place after the one. Relook at the 'proof' of equation (11). Have its assumptions gone a 'step too far'?

If one considers that every observer has a frame of reference then these frames of reference must all extend to infinity, or at least the edge of the universe. Even if observations are bounded by, say, a wall, the frame of reference still carries to the edge of the universe. Thus, what happens at a given time in any frame of reference happens at that instant[28] in all frames of reference (whether they can observe it or not). It is (see next section) the observer's units of measurement that are different to another's depending on their relative velocity. As above, it is an observer's *units of measurement* that always give the constant speed of light that relates all frames of reference to each other.

Suppose I bang both fists on a table together. As above, it happens in all frames of reference throughout the entire universe whether their observers are looking or not because all frames of reference extend to the edge of the universe. Even if they are bounded in a box (or well) as in QM or QFT to limit them to a specific volume for mathematical purposes, they still extend beyond that imposed boundary. However, suppose we only take those frames of reference that observe me banging my fists on the table. Those frames of reference overlap because they all extend to the edge of the universe, and they specifically overlap where my fists are. My banging the table therefore happens in all frames of reference at the instant I hit the table. Note I use the word instant, not time, because time refers to a clock in this case. How do the other observers see my action? By the wave of light that leaves my fists as they hit the table. It travels at the speed of light in all those frames of reference.

[28] I use instant meaning simultaneously without considering a specific time as recorded on a clock because two observers holding their own clocks may not agree on their specific times nor on their units of time. For example, one clock may run faster than the other.

This can be formalized as a general physical principle for comparing observations made of an object by two different observers. To make the measurement principle clear, I take the object to be measured as a metre rule. It is assumed, as is usual for special relativity that all clocks and units of measurement in all frames of reference when at rest with each other are identical. It should be apparent it fits completely the general deductions made by Einstein in his 1905 paper.

4.8.4 General principle of two-way observation between two observers

Take two frames of reference A and B orientated as in Figure 4.8 and take the unit of measurement as a meter rule, with endpoints x_1 and x_2 in A. Initially imagine a perfect frictionless contact between the rule and a photographic film attached to B's *x*-axis as the two frames travel past each other.[29] Then if A transmits a photograph of his meter rule, the two endpoints of A's rule x_1 and x_2 must be marked simultaneously onto B's photographic film at x'_1 and x'_2 according to clocks carried in the A frame and placed at each end of the meter rule (taking into account the fact just quoted that all frames of reference overlap and an event in one frame occurs at that position and instant in both frames simultaneously). Note (1) The simultaneity of transmission is essential otherwise B will have moved during the period of transmission (as expressed in all university courses). Note (2) A single photon from each point could make the mark but these photons must not be confused with those used by A and B to measure the length of the meter rule or its photographic image, respectively. Note (3) If the frame of reference is homogeneous then the clocks at x_1 and x_2 will be synchronous with a clock placed at A's origin A_o as required by Einstein.

Then at the precise *instant* that the marker in A's frame is emitted from x_1 it is recorded at x'_1 on the film at time t'_1 as recorded by a clock in B's frame at x'_1. Similarly, at the precise instant when the marker is emitted from x_2 it is recorded on B's film at x'_2 at time t'_2 as recorded by a clock in B's frame at x'_2. Since these clocks are stationary with respect to B's origin $B_{O'}$ they must each be synchronous with a clock carried by B at his origin $B_{O'}$ as required by Einstein. From the definitions of x_1 and x'_1 and x_2 and x'_2, if the markers are emitted at the same time in A's frame then t'_1 is identical to t'_2 in B's frame. But note that here t'_1 and t'_2 are the times when x_1 and x_2 are recorded on B's frame (at x'_1 and x'_2).

In case this is not clear due to differences with standard methods as explained above, I will further expand on the condition of the event. The frames of reference of both A and B overlap so that an event in A occurs simultaneously in B because the event is a singular operation that occurs

[29] Suggested by Douglas Gough FRS during a conversation on the principles of special relativity.

in both frames at the same instant and local placement[30] of the event. In this case I have placed the event specifically on the x-axes of both observers. I will later take this condition out but will still use the *fact* that a single event occurring in overlapping frames of reference occurs simultaneously in both frames. However, despite this event occurring simultaneously in both frames of reference, it does not mean that both observers measure the outcome in identical terms. The event is recorded by each observer in terms of his coordinate system (arranged as above). How each observer views it, depends on their units of measurement. Note that this action of recording the event simultaneously is ***not*** part of the Lorentz transformation. It is a purely a simple action of an event occurring in all frames of reference – nothing more. Hence the given use here of t'_1 and t'_2.

This completely simultaneous transmission is necessary as otherwise A and B would have travelled relatively during the transmission of signals thus giving spurious results. This does not mean that A's clocks will be synchronised with B's (they will not because the two observers are not at relative rest), nor does it mean that B will physically see light from the marking system at x'_1 and x'_2 at the same time by his clock at $B_{O'}$. Should light have been instantaneously emitted from x'_1 and x'_2 when they appear on his photographic film it still does not tell him anything other than their arrival because he has no way of telling from exactly how far away the light has travelled to him from x'_1 and x'_2 until he measures the distance with his meter rule. He merely measures their time of arrival at the clock at his origin, but he does not know for certain that they arrived at the same time by his clocks at the arrival points. Even if he is midway between the arrival points he cannot tell because he is travelling so in that condition the two flashes sent to him will arrive at different times. If the flashes from each point arrive at the same time from exactly opposite directions, then, because he is travelling, he must have been closer to one than the other.

But B, in his frame of reference, can at his leisure carry out the measurements of the distances of x'_1 and x'_2 from $B_{O'}$ according to Einstein's principle of photon out–photon back if the clocks at x'_1 and x'_2 each have mirrors; or by using his meter rule against the photographic image. There are two ways of looking at B’s rule. (I) If A’s motion creates dilation of his unit in B’s frame (as in the relativistic Doppler effect) for a given wavelength when both A and B are at rest w.r.t. each other, then B’s unit of measurement must be shorter than A’s; or (II), consider the Lorentz-FitzGerald ‘contraction’ as in section 4.8.2.

[30] I have already stated instant is irrespective of the time on a clock and here I have used ‘local placement’ to mean w.r.t. the event itself as opposed to a ‘position’ in a given frame of reference which is usually taken physically to mean according to a set of coordinates carried by the frame of reference. The ‘placement’ of the event can then be recorded at a ‘position’ according to the relevant frames of reference. It is here that relativistic principles become apparent when the observer in that frame determines the ‘position’ according to his measuring units.

Either way he will believe A’s wavelength and (time) period to be dilated as in natural red shift observations. Note that because *c* is constant the same results can be obtained if B’s x'-axis travels parallel to, but some distance away from A's *x*-axis.

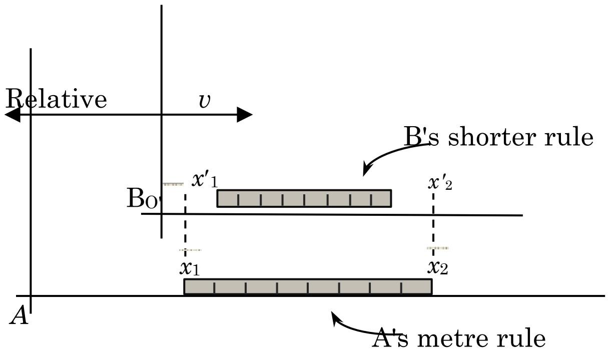


Figure 4.9. B takes a photograph of A’s metre rule. Due to the relative motion, B’s metre rule will be shorter than A’s metre rule. In terms of his rule he therefore measures $\Delta x' > \Delta x$. The inverse condition with A travelling past B and photographing a metre rule placed on B’s *X*-axis would show the equivalence of the two frames for this physical action.

The principle can also be applied if A and B’s *x*- and x'-axes are lined up some distance apart because light from the end points of A’s rule will travel in parallel lines to B’s x'-axis at *c*. In either form the emphasis is shifted away from Einstein's principle of 'moving' and 'stationary' frames to the principle of determining the origin from which the transformation is being made irrespective of whom is moving.

Furthermore, according to this principle, length alteration is real as follows. For example, according to Einstein ([1905] 1923:40-42) the shortest time interval is attained when a clock is stationary in a motionless system, that is, $t_B - t_A = t_A' - t_B$ (see section 4.8.1). Consequently, imagine a strand of atoms along the length of a metre rule. These are held apart by electromagnetic forces. If the ruler travels in its length direction, then these forces, mediated by photons, take longer to move to the next atom and back than if the ruler is stationary. Therefore, the metre rule would expand in its direction of travel. If the metre rule is held orthogonally to its direction of travel, then the time taken to travel between the atoms along its length will *not* be affected but those across its width will be.

However, this is where we have to be very careful. We do not know whether we are stationary or not because our rulers adjust to our motion as above so that we always measure the speed of light as *c*. *It is not who is moving and who is stationary that matters, it is who is observing and who is being observed.* If B observes A as in Figure 4.9 then, as A is moving relative to him, A’s transmissions are dilated, just as for the transverse Doppler redshift of section 4.8.1 and equations (10a,b). Then B’s ruler is shorter than A’s dilated ruler and he measures A’s so-called proper length projected onto his frame of reference as dilated.

Returning, now, to my fists hitting the table with a slightly different example:

I hit the table with my left fist a little before, at a small distance from, my right fist. Again that happens in all frames of reference at exactly the instants the two hits (events) occur in my frame of reference. I shall now add one refinement which can also apply to the example in section 4.8.3. Imagine that what happens in my frame of reference is recorded on a photographic sheet by the observer in his frame of reference. The waves of light from my fists hitting the table travel to this photographic sheet carried by the observer along his x'-axis which moves as usual in SR descriptions parallel to my x-axis and my fists land at different times along my x-axis. First consider the simple case that his x'-axis runs alongside and touching my x-axis. As his frame of reference overlaps, mine, what happens on my x-axis (the banging of my fists) happens at exactly the same instants on his x'-axis. That is, the time order has not changed. *It is how he measures those times and positions that matters* which as in section 4.8.4 depends on the rate of running of his clocks and the length of his ruler.

Next consider his x'-axis running parallel to my x-axis but some distance away. The waves, or better still single photons, from each of my fists travel at exactly c from the events on my x-axis and therefore arrive *at* his frame of reference at exactly the same distance apart as they left my frame of reference. That is purely a geometric fact following from the constancy of the speed of light as shown in Figure 4.9 for a ruler. Furthermore, the interval between hitting the table with my left fist and hitting it with my right (for which both instants occur in his frame at the identical instants they occur in mine) remains fixed as the light from both events has to travel identically to his x-axis at c. But, of course, the delay between the two waves of light arriving at his x'-axis means B will have travelled by the time both beams of light have been recorded on B's axis. Again, it is how he measures the receipt of the events that matters. As it is recorded on a photographic sheet, he can measure at any time he likes using his clocks and rulers which run at a rate depending on *his* velocity.

Consequently, the *order* of the events in my frame of reference is preserved in his frame of reference though *his clocks* may not agree with mine in the length of time between my two fists landing on the table, nor the distance between them (because he moved between my two blows).

It should be clear from this that the concept of the explosions is different to the fists banging the table. In that explosion case there is no method of knowing which one took place first so one cannot draw any concrete conclusions about their timing, and it was falsely assumed the 'other' took place before the 'one.' In the second case there is a clear connection between the events. So here we can see how reliance on perception can lead to false conclusions and furthermore placing such concepts into a generalized equation (equation (11)) is dangerous even if it appears logical. Furthermore, changing the original concept of t being the time taken for a photon of light to travel a distance x or vice versa used to construct the Lorentz equations to one where $x = vt$ as in equation (11) leads to spurious results.

4.8.5 Muon lifetime

Due to the muon's ability to transfer from the upper atmosphere to the earth's surface despite its very short lifespan, it is commonly used to uphold Einstein's theory. It is easily explained using the above interpretation of Einstein's paper. For example, the muon's rest lifetime is about 2×10^{-6} s. If a muon were to travel for 2×10^{-6} s it could travel about 600 m at $0.998c$. We observe light from the muon, so we are the B frame and the muon, by transmitting its form to us, is the A frame. So its lifetime in its frame is Δt. $\Delta t'$ is what we measure and $\Delta t' = \gamma\Delta t$. If the muon travels at $0.998c$ the equation says that we measure its lifetime to be about 31.6×10^{-6} s. In its lifetime it could travel about 9460 m. Alternatively, if it has a wavelength λ and decays after n cycles we would find its wavelength increased according to $\Delta x' = \gamma\Delta x$ in which case the maximum distance it could travel in n cycles at. $998c$ would be inflated by 15.8 times. $15.8 \times 0.998 \times 600$ m = 9460 m. Thus, special relativity as detailed in section 4.8.4 explains very simply why a muon travelling at close to the speed of light with a very short lifetime can travel from the upper atmosphere to Earth and be observed here before it decays. Note that this short lifetime and corresponding high speed of the muon will agree exactly with the causal generation of space and space-Time raised in sections 4.6-4.7, once it has been established how this generation fits into human perception of space and time intervals in section 4.9.

4.8.6 Minkowski 4-dimensional spacetime

It is assumed that the four dimensions consist of three space dimensions and one time dimension in which time is assumed to be a scalar quantity. Since Einstein deduced that time is dilated in the direction in which the frame of reference (observer) is travelling, but not in any other direction, time must obviously be treated as a vector quantity as in the Time scheme.

Simple mathematics shows that if calculations are carried out similarly to those used for the Lorentz-FitzGerald contraction as in for example Tolansky 1956:417-419, treating the dilated time to apply to both directions of the Michelson interferometer will not give the expected results. The time along the line of motion has to be dilated and that along the other orthogonal shaft of the interferometer has to be taken as undilated to obtain the hoped for result. As it is an obvious and simple calculation (see Figure 4.8) I shall not detail it here to save space.

Note that provided Minkowski space-time is used in only two dimensions such as (x^1, t) as in quantum field theory, the mistake of treating time along all axes as being dilated due to motion along one of them should have no adverse effect – provided, of course, that t is in the same direction as the moving length axis.

4.8.7 Relativistic dynamics and rotation

Dynamics can be expressed quite simply by inserting the relativity factor $\mathbf{R} = (1-v^2/c^2)^{1/2}$ to each space and time term. Thus $v' = (x/\mathrm{R})/(t/\mathrm{R}) = x/t = v$ as would be expected from Einstein's formulation of relativity, $A' = (x/\mathrm{R})/(t^2/\mathrm{R}^2) = \mathrm{R}A$ so that acceleration is relativistically affected. This gives $F' = m'a' = F$ (which in QFT automatically gives $\phi'(x') = \phi(x)$). From these terms it is easy to see that the value of π is unaffected by relative motion as follows.

If an observer *A* at the origin of a rotating frame of reference, were to consider a disc fixed to his frame of reference and thus rotating with it, any measurements he made of the disc would pertain to his frame of reference, and thus would be subject to the Lorentz-FitzGerald contraction. Let the plane of the disc be in his *x* and *y* directions and let him lay a rod as suggested by Einstein ([1916] 1923:116) with its length tangential to the disc circumference at *x*. It will thus be orthogonal to his *x*-coordinate direction. It is, of course, the infinitesimal approximation at point of contact of the rod to the disc that is of importance but, as Einstein pointed out, this would be affected by a Lorentz-Fitzgerald (section 4.8.2) contraction. As the disc rotates in the *xy* plane, the rod's length goes with the disc through to the *y* direction. That is, a point on the disc circumference not only has a tangential velocity but a centripetal acceleration so that the radius of the disc contracts equally as the rod.

Taking one step further: In the view of an external (isolated from the system as in section 4.8.2) observer, a rotating disc with tangential velocity *c* would have no apparent radius, circumference, or size. Consequently, recall the man in the contracting sphere, and, to put the ideas into context let his sphere have a rotation, of which he is unaware because he cannot see outside it. Then if this rotation starts slowly and speeds up towards a tangential velocity of *c*, the sphere, according to an outside observer, will appear to shrink. But because the man in the sphere's rod is affected by this rotation as just described, the man will be none the wiser that he has shrunk.[31] This is merely the reciprocal of the

[31] Einstein's addition of velocities applies.

situation described in section 4.4 where I suggested that *A* would imagine he had gained a space if he was rotating. That is, if he had started out with no rotation and suddenly gained a rotation, he would suddenly see a unit disc, or rather a disc which he would consider to be of unitary size. Since the Time jump gives the trace-point an instantaneous tangential velocity of *c*, *A* automatically believes he has a space around him. Similarly, for trace-point *B* and all other trace-points. Then when they jointly observe each other, the general Lorentz equation (as determined in section 4.8.1) applies so that each observes the other to have unitary volumes. Thus, whichever method one uses π remains constant – it does not change with rotational velocity.

4.8.8 Simultaneity revisited

The simultaneity between two co-moving observers was explained in sections 4.8.3 and 4.8.4. This section covers a more general concept. If we receive signals from different sources, we have no idea when, or from exactly where, they were originated unless we have *a priori* knowledge of the position in our frame of reference of their dispatch. There is no way we can determine such knowledge, nor the source position or time of transmission because we do not know either our or the transmitting object's exact motion; nor, if we send a signal to the object for immediate return, do we know exactly when the signal arrived because we do not know our nor the source's exact velocity (i.e., taking into account relative direction of motion even after several transmissions, as the relative motions can always change). We can only say the signal arrived at our position from a specific direction according to our frame of reference at the time of the signal's reception. Even if we receive regular transverse red-shifted signals from the object we only obtain a relative redshift for our velocity relative to the transmitting object. As is done in astrophysics we can estimate the distance according to known brightnesses of distant objects (Perlmutter 2003). Or we can for closer objects use Einstein's system of time out – time back. Then when we say a star or solar planet is 'such and such' a distance, that is only according to our units of measurement which depend on our velocity with respect to the speed of light. (Einstein assumed this speed to be constant, but in terms of the fundamental cause of Chapter 4 the speed of light is an *absolute* constant; and it will become clear in Chapter 5 that this determines the existence of our perceived space). A general form of simultaneity is irrelevant to the form of special relativity derived here.

I shall now relate these remarks on special relativity to the construction of the Universe according to the definition of Time and associated rotation and space. Note that here *c*, the speed of light, is taken as having exactly the same value as *c*, the tangential velocity of the fundamental rotation.

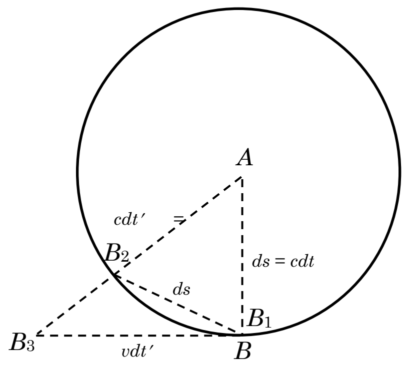


Figure 4.10 Determination of Einstein's special relativity

Let *A* be a point as in Figure 4.1 and 4.10 which in nature has no measurement but in the human interpretation due to its rotation provides what I, as a human, call a minimal interval in a similar vein to the concept of a man in a sphere, which has no volume according to an external observer. Then we can interpret the distances in human mathematics as giving

$$dt^2 = \frac{(c^2 - v^2)}{c^2} dt'^2 \qquad (12)$$

If we interpret equation (12) as a ratio equation with $v = c$, as it would be if *A* is only a point with 'no part', then

$$\frac{dt^2}{dt'^2} = \frac{(c^2 - v^2)}{c^2} = \frac{0}{1}$$

where $ds = cdt = 0$ becomes a unit interval dt'. That is, what appears to *A* as zero (no distance or Time interval) appears to an outside observer as a unitary interval: qut = 1 or qul = 1 ($ds' = cdt'$).

Einstein's special theory automatically follows. (For ease of expression I will refer to *A* (unsigned symbols) as 'he' and *B* (signed) as 'it'). Let *A*, as he rotates, see *B*, and instantaneously marks *B*'s position on the surface of his unit (shown in the figure as a circle) at B_1 as he (*A*) rotates. Because *ds* is a minimal interval B_1 moves to B_2 in time *dt*. If *B* is stationary with respect to *A* then $v = 0$ and $dt' = dt$. But if *B* were to move at velocity *c* it would be at B_3 when *A* had rotated for time *dt*. Thus, *A* would not see any angle subtended between the original position of *B* and B_3. But for *A*, *dt* is unitary = 1 (given) and as he sees no angle subtended ($\theta = 0$) so that his view of $ds' = cdt' = 0$, in which case equation (1) becomes (and vice versa)

$$0 = \frac{c^2 - c^2}{c^2} dt \, .$$

On the other hand, if *B* travels slower than the speed of light *A*, *will* notice a difference in position between *B* and B_3 based on equation (1). Now take the same process with another point *C* close to *B* where *C* and *B* can be solid points of some sort. Exactly the same conditions will apply. Then the same conditions will apply to any points between *B* and *C*. Consequently, the length between *B* and *C* will depend on equation (12) as well. Then, as with the contraction of the interferometer arm in the Michelson-Morley experiment, the length between *B* and *C* contracts as *v* increases. This is as observed in human experiments and predicted by Einstein's special theory. Time in the form of rotation ($\hat{T}$) can thus be seen as providing a causal reason for Einstein's discovery.

There is one further important concept raised by Einstein (1905 [1923]:50-51); his addition of velocities. As it is easy to establish, I will just merely mention that if an object moves through a space with a given velocity and another object moves in the same direction on that particle, it does not matter how fast the particles move, their total velocity will limit to (can never be faster than) the speed of light. For example, if two Time-points rotate next to each other both with rotation $\dot{\theta}^+$ and tangential velocity *c* their relative velocity at their point of contact will not be 2*c* but *c*; i.e.

$$V = \frac{c + c}{1 + \frac{c \times c}{c^2}} \, .$$

4.8.9 Final note

Note that these comments agree exactly with, and follow directly from, the principles raised in Sections 4.5-4.7. In particular it also explains a concept which is currently outside of human understanding but logically fits within Einstein's concept of special relativity; that is, the concept of $\dot{\theta}^+$ being encapsulated rather than backed by $\dot{\theta}^-$. A natural deduction from the above concept of length contraction, as found in the Lorentz-FitzGerald contraction, is that as an object approaches *c* its length reduces towards zero. Consequently, imagine two balls one larger than the other, with the smaller inside the bigger. Now imagine that both balls rotate with tangential velocity of each tending towards *c* then, as in 4.8.7 and considering Einstein's addition of velocities, each ball will have a tangential velocity of *c* and thus will be contracted to no size, but both will still be spinning points, one within the other. Conversely, a point rotating such that its tangential velocity is *c*, will according to sections 4.8.4 and 4.4 gain a surrounding relativistic space when observed by an observer outside of it. (cf section 4.4). This again shows the importance of what is observed and by whom. It demonstrates how an object can have no volume and yet *be seen* to have a volume.

The problem of *a priori* or *posteriori* mathematics raised at end of section 3.1.1 is also clarified. Points with no size and thus measurement produce measurable distances through the concept of rotation, thus settling the problem of Platonism in that mathematics of number and measurement arises as a result of universal structure.

4.9 Into what can a Universe be put and human perception of space.

I can now pass onto the most important deep question of them all posed in section 4.3: if a universe is to exist into what is it put?

The answer arises from the dichotomy arising over the concept of space, where the Time system so far described can be regarded as occupying no space, and every trace-point can be regarded as having acquired an *apparent* space due to rotation. As above, this gives us two pictures of the (Time) Universe:

(1) Existence[32] without any space which I have already called the **natural** Universe and
(2) a Universe in which objects exist with apparent directions and space-Time intervals between them which I will call the **relativistic** Universe. Human perception lives in this Universe.

Equivalently, these are natural and relativistic representations of the Universe.

To open the discussion, I must first take into account the apparent expansion (its relativistic size as derived in section 4.4, Figure 4.1) of the first tetrahedron (from here on unless otherwise specified 'tetrahedron' will always refer to a right tetrahedron) in relation to the lattice. As stated, its rotation at materialization gives it a tangential velocity which must always be *c*. Thus, if in human thought it were to expand, its angular velocity, rotation, would correspondingly reduce from *w*. Furthermore, from section 4.7, the lattice itself, which from Figure 4.4 can be seen to be in the form of a right tetrahedron, will rotate around an axis parallel to the top tetrahedron. This tetrahedron for the entire lattice is again only a relativistic expansion in human (or any other sighted animal) perception. It is also backed (encapsulated) by the constant $\dot{\theta}^-$ spin and in the *natural* representation occupies no volume. The external tangential velocity of the $\dot{\theta}^+$ spin of the outermost part of the lattice still has,

[32] Remembering that the reason for existence itself will be given in chapter 5.

and always maintains, a tangential velocity of c (to match the $\dot{\theta}^-$ tangential velocity of c). However, unlike in the natural representation, in this human perception the appearance of a volume produces a concept applicable to volumes but not to the points of the natural universe. Take for example the relativistically expanded lattice in Figure 4.4. The Universal tetrahedron has a relativistic volume which gives an equivalent apparent rate of rotation of the lattice (in Figure 4.4) as $w/(w\text{-}2)$, the 2 being the number of Time units in the progression, which is the same as twice the apparent distance of the outermost $\Im$s compared to a single tetrahedron. Thus, the rate of rotation of the lattice in the relativistic representation depends on its *apparent* size which is determined by the number of quts that have passed since the formation of the lattice, that is, the number of stages in the progression of Time. Thus, in the relativistic representation, while the tangential velocity of the outermost part of the lattice remains constant at c, the overall lattice rate of rotation reduces corresponding to its relativistic size in human (or sighted animal) perception.

Nevertheless, this does not completely explain how the so-called apparent space is observed by humans to give what they believe is a real space while at the same time maintaining the condition of occupying no natural volume. Section 4.8 detailed how Einstein's special relativity is to be developed according to the principle found by observation that time dilation and length dilation go hand in hand. This fits in exactly with the principles of spatial appearance given in Figure 4.1 together with the text description of the process if c were to be taken as the speed of light.

The effect of the p-rotation is clear if we go to physical observations of the transverse Doppler effect for identical objects travelling at near the speed of light relative to each other: we see a red shift indicating time and length dilation. Now imagine the relative speed of the objects to be reduced to zero, then the apparent dilation will disappear and both objects will appear the same size. A Universe can be correspondingly created with no volume necessary for it to exist. All its points rotate, and it is that rotation which gives us the size we see. But if we also consider the effect of the $\dot{\theta}^-$ and $\dot{\theta}^+$ spins annulling each other the overall size of the universe remains zero and as explained in section 4.8.9 the encapsulated spin of say $\dot{\theta}^+$ gives us our apparent, our vision of, space.

Understanding this concept may be easy for some and still difficult for others. So, I will once more summarize the explanation. A difficulty in perception arises because in general humans associate the concept of point as having a visible attribute such as might appear on a piece of paper, or a position they can see on a graph or map rather than a completely ethereal condition such as a point of Time which has no spatial size. We tend to think in terms of our senses, particularly sight and touch. Consequently, we associate volume as being almost substantial. We can almost feel space around us as if it has a tangible existence; one which we can certainly place measurement upon as between points (say between walls). I say points because these points are then definitely concrete or tangible in nature. As another example we consider Time in the sense of being something concrete because it is something we can measure. But it occupies no space, even though we can divide seconds into milliseconds, or smaller, so that a millisecond arises within a second. Similarly, if one looks at the definitions of rotation in section 3.5 they are descriptions of what it does; but the concept of rotation, in the form of what it is, is like Time: it has no volume though it still has an aura of concreteness about it. (Even in human perception the actual rotation action is abstract but the result, where an object exists to be rotated, *is* visible. It is the same in the micro-Universe. The rotation itself would not be manifest (visible if *A* were sighted) to point *A* but the result of *B* appearing to move round him is manifest).

We have images of points in our mind representing positions around spaces much as we have images of abstract waves in our mind. We imagine these as solid points and it thus becomes difficult to realize that any number of volumeless points needs no volume to exist. There is absolutely no reason they should not at the same time all be distinct points even though they are in contact with each other. What is difficult in imagining an arrangement of points with no volume and no space in between them occupying no volume? Then from here, as above, let these have a motion with respect to each other, which they can do without a volume if they spin relative to each other as described in section 4.7. Then they gain relativistic modification of the form seen in nature with fast moving celestial objects: time and length dilation. That is the zero space (volume) of the natural representation gains both space and Time in our relativistic universe. This may seem odd to many people, but it is a natural consequence of Einstein's special theory as expressed by nature and explained in section 4.8. And, as a consequence, we no longer have to consider the size of the Universe (that is, how far does it extend in terms of our synthetic units) nor the difficult question: if the Universe expands from nothing into what does it expand?

If we now assume that the process of lattice formation leads to the formation of particles from the coincidences of the $\Im$s as shown in Figure 4.4 and that these particles can interact so that they change positions in the lattice larger objects might emerge. (Formation of particles and larger objects (atoms and molecules) is beyond the scope of this thesis for space reasons). As these particles or objects can change position with each other they must have a motion with respect to some fixed point such as a sighted observer. In view of the existence of atmospheric gas particles also changing position we thus think we see space between solid objects.

In terms of changing positions one can think of two rotating equal objects. Relatively they can be thought of each rotating one about the other. In the case of the natural universe this can still take place. In the relativistic universe the lattice still consists of spinning trace-points. It is only the Time points that expand so that the relativistic spaced lattice in the human perception has space between each trace-point. Thus, it has an open volume through which objects can change position or move. (The concept of motion through force is outside the scope of this thesis).

Again, one should ask: what is difficult to imagine about an arrangement of points with no volume, and no space in between them, occupying no space and changing position between them? With an almost exponential increase in particles predicted by the Time scheme as the lattice size grows, one might imagine that particles can connect to each other by binding forces (virtual photon interactions in human quantum physics) so that each body moves as a whole, not only in relation to the background, but in relation to each other. It would thus seem likely that eventually structures could emerge that could undergo automatic and regular changes in their formation and might even be able to repair and reproduce themselves. In this case the possibility does arise of structures capable of sight and observation. These rates of motion are very slow in comparison to that of a photon. On the macro-scale, once the lattice has grown enough points to allow formation of separated planets and stars, the amount of Time to travel between them becomes enormous compared to the motion of a photon. Thus sighted objects, such as humans, would see (be able to measure by visual triangulation) differences and changes in position on scales far larger than the microscale particles from which they are made. These complex structures float in a field of free particles – a gas, in human parlance, sometimes almost completely rarified as in the cosmological space between stars and galaxies – made of little more than trace-points. Humans would thus believe in space and volume as if it were real instead of relativistic. It is purely relative motion brought about by the progression of Time. In terms of special relativity and the transverse Doppler effect, if we measure a fast-moving celestial body, it shows a redshift, or lengthening of its wavelength. Consequently, suppose the wavelength was the same as the minimum interval of Time, and the body moved at *c* relative to us, then its redshift would be a maximum (infinities not existing) giving us what we would call a unitary measurable length. If the body moves round us, then its velocity is a tangential velocity of *c* relative to us. If we now travel at close to relativistic velocity in the same direction as the body, we are observing our relative velocities reduce so that our perception of space would reduce, not that we would notice this because our units of measurement correspondingly reduce. The connection between the Time scheme and Einstein's special relativity is obvious and thus with it the connection between the natural and relativistic representations of the Universe.

> *The magic word is thus 'relativistic' meaning that the fundamental cause produces no natural volume. It does, however, produce a continual change of the state of the Universe which in sighted beings' perception appears as a time and space dilation* and thus our perception of the *Universe.*

Surprisingly, it produces an element of truth in Rees's statement that without living objects (rather than humans or even sighted objects) to see the universe it would not exist. It would still exist but there would be no awareness of space, for non-sentient objects could not be aware of it (space). Thus only the natural universe would exist, with its p-rotation, as opposed to the rotation humans believe in which only arises in the relativistic representation causing the motion that produces our observation of a volume. The reason human sapience has not picked this up before is because the minimal interval is by nature smaller than anything we can measure it with, so the concept of no-space becoming a relativistic space does not specifically arise in human perception.

4.10 Summary of sections 4.5 - 4.6

(I) The foundational cause is assumed to be a single cause as otherwise it could not be fundamental but composite, in which case there would be a still more fundamental cause.
(II) The definition for Time is a foundational assumption so cannot be expressed in more fundamental terms.
(III) A Time point is a fundamental point so again cannot be described in more fundamental terms. It is a pure point although it has a dichotomous existence: a) as the sum/superposition of two contra-rotations giving a point with no rotation, b) as a simple point with rotation within an 'outer' rotating packet. ('Outer [and 'inner'] are merely expressions to aid understanding. The spins are not contained within one or other but back onto each other so that one becomes an overall spin that determines the rotation of the *other* – the *other* being the one that produces the points of Time).
(IV) $\hat{T}$ is a self-generating rotation action which generates a rotating trace-point. As $\hat{T}$ and its action (rotation) are fundamental with Time they also cannot be described in more fundamental terms.
(V) A trace-point is a permanently rotating point-object but not capable of reproducing itself. It has been described as passive.
(VI) The minimal interval (in human geometrical view) appears as three points forming the base of a right tetrahedron, the apex of which is the original point. This entire structure rotates such that the basal points rotate with a constant tangential velocity *c* about an axis through the apex orthogonal to the base. (It can be represented in human visual terms as a triad of axes originating from the tetrahedron apex as in Figures 4.3b,c, but in the fundamental sense it has no size).
(VII) This system is dichotomous in that the foundational cause contains two contra-rotating spins defined as $\dot{\theta}^-$ and $\dot{\theta}^+$. $\hat{T}$ operates on the first point of Time utilising one spin $\dot{\theta}^+$ 'inside' (backed by) $\dot{\theta}^-$ to create the trace-points and their intervals. Thus inside $\dot{\theta}^-$ a relativistic space emerges as described above, but the rotations together constrict this apparent volume to no volume.
(VIII) Consequent upon (VII) the Universe has two representation forms. In the total picture it is a spinning point with no volume, called the **natural representation**. The Universe which humans are

used to is a **relativistic representation** with a spinning relativistically induced volume. Thus, should this reasoned Universe test positively against the universe in which we live,[33] then this outcome solves the problems of the possible size of the universe and the problem of 'into what does the universe expand. It has no volume; the volume humans perceive is purely relativistic due to a Universal rotation.

The above actions, together with the definition from which they are deduced, thus conclude the third original assumption, that of defining a fundamental cause. They can be summarized into the following single governing rule on which a philosophically derived Universe should be constructed.

4.11 The governing, or foundational, rule of the Universe in Euclidean terms

Space-Time is created in such a way that at a specific instant a relativistic volume is created in three rotating orthogonal directions (Cartesian axes) such that the curved distance along these axes is equal to the distance between them. The space-Time modules so generated have the form of a right angled tetrahedron rotating about an axis through its apex orthogonal to its base. Each module must remain distinct from each other, that is, no module can intersect another; *and the space-Time along the curves is created at c*. The space-Time modules materialize for an instant and then collapse leaving behind a trace-point.*

Less formally from the purely human perception view: Space-Time is created in the form of rotating right-angled tetrahedra, each tetrahedron being as described in item (VI) at the beginning of section 4.5 and as described in Figure 4.3abc. None of these tetrahedra, (being space-Time modules) can intersect any other. They can however, touch (see section 4.7). Most importantly, as in Figure 4.3d, each module has to maintain a tangential velocity of *c* (equivalent to space-Time being generated at *c**). Although humans see the result as a volume, this perception is purely due to the fundamental rotation which itself requires no volume. Therefore, a universe constructed this way needs no volume in which to exist. The formal rule given above is then a rule in terms of what might be called a background structure of the Universe in human perceptive language (section 1.3.3). 'Relativistic' means that it produces no *natural* volume at any stage. It produces a continual change of the state of the Universe which in sighted beings' perception appears as a time and space dilation.

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[33] Unfortunately, the test is beyond the remit of this thesis, which is to discuss why physics has failed to produce a final theory, and to discuss the formulation of a fundamental basis that could lead to a clarification of the structure and processes giving rise to a universe. This is under preparation to appear in another place with the test (in line with Popper's falsification concept) which can be created by applying the human concept of measurement to the quantum units of length and Time.

Thus Ellis's (2012:27-28) belief that questions of existence cannot be solved by physics laws but need metaphysical arguments seems to have been justified. And too, Aristotle ([350BC] 1923:A5) can be brought to the front of modern thought through his belief in 'contraries' which sometimes adorn metaphysical arguments. Here there is the single contra-rotation pertaining to the first principle. Being a foundational contra, it is the only one necessary to this construction of a universe. Consequently, this form of open-ended philosophical debate is only raised here just once. It gives a separation which humans recognize, and call, a spatial distance, and the rate of change in this instance is called a tangential velocity – equivalent to the man in the sphere of section 3.2 rotating and suddenly becoming larger. This solves Aristotle's problem ((1991:§218a4-222b) section 4.2) of how to consider the gaps versus no gaps, or boundaries, between the 'nows', the 'pasts' and 'futures'.

The foundational principle is now complete in the sense the original definition has been able to produce space-Time volumetric modules, subject to observability, which could lead to a Universe. Time, space, and rotation are different aspects of the same definition, originally given as just 'Time'. There is still the question of existence to finalize the principle, but this requires the treatment of Chapter 5 in which the fundamental principle is adapted to the Universe at large.

The definitions of Time and space (space-Time) then become:

Time is a self-generated ordered progression of recordable points all of the same form but such that each point is distinct from any other;

where point is a spaceless, timeless, object with distinction only in its position in the progression, and the generator of the progression is a formless rotation operator $\hat{T}$.

Space is a collection of rotating points generated through the progression of Time forming a lattice of distinct identical trace-points;

where a trace-point is itself volumeless but through the action of $\hat{T}$ would, *in an observer's view*, produce a rotating right-angled tetrahedron formed over a minimal period of Time relative to a non-rotating point; and the rotation $\hat{T}$ takes the form of a change of position over a minimal period of Time in a plane centred about an axis orthogonal to the plane.

The similarity of the definitions thus indicates that space, space-Time, Time, and rotation are all intimately linked into one causal entity: rotation-space-Time. That is, they are observed by humans as different forms of the same entity which I have called simply 'Time.'

CHAPTER 5

Macrospace

5.1 Introduction

Chapters 3 and 4 examined the nature of the micro-universe based on a single first cause. In view of Kant's statements on transcendental philosophy (1998:132§A11), its relation to the nature of things (1998:133§A13), to human perception (1998: 134§B27), and to speculation (1998:135§B29), the foundational basis has to explain the macro-universe – including the reason for its existence. This chapter is therefore aimed at logically extending the micro-principles, or fundamental cause, to the macro-universe (cosmos) to explain its beginning and possible end. The central problem in standard physics is gravity, whether expressing the expansion of the universe, dark matter and energy, or the early formation of galaxies and their present distribution among voids. The development of gravitational theory has centred on attempts to combine Einstein's general relativity (GR) with QM, the latest concept being Loop Quantum Gravity (LQG) (Vaid 2014). There are many other unanswered problems in astrophysics and the hope has been that LQG may point the way to a complete theory. I only bring the subject of gravity up in the standard sense as it will be referred to in considering the standard view of the creation of the universe. It goes beyond the scope of this thesis as it requires a complete description of the particle structure determinable from the space-Time of Chapter 4.

This chapter follows on from Chapter 4 to explain the beginning and end of the Universe, neither of which are firmly established in standard astrophysical theory. This is necessary in order to answer the other fundamental question: 'why does anything exist?' The physics of the early universe (up to 10^{-36} seconds) according to standard theory is unknown (Guth1981:347; Ellis2012:5), as is how it led to the creation of particles, and the exact mechanics of force and energy transfer. The so-called laws of physics may even break down (Curiel 2019, Bojowald 2006, Singh 2012:1) in this period, which should not be surprising without a foundational cause for all laws. The end of the universe ranges from never ending (a cold universe with energy density too low for interactions to occur [Goldberg and Scadron 1995:363-365]), to a 'bouncing universe' (Gielen and Turoq 2015) and bubbles in multiverses (Vilenkin 1983, Everett 1956).

In concert with the title aim of this thesis I shall argue, through sections 5.2 and 5.3, that the prime problem with astrophysics remains the lack of definitions of the fundamentals (time, space, mass, force, et cetera) and the lack of a foundational principle. I have to wonder, as with the micro-structure, whether complicated mathematical, and controversial, theories, still outside a full mathematical understanding and formulation, could relate to the macro-universe, the galaxies, stars planets and living creatures.

Current ideas are assessed first in section 5.2. following which section 5.3 develops some philosophical issues. Section 5.4 then develops the findings of Chapter 4 into a background structure for a macro-Universe. This leads in section 5.5 to contraction and expansion epochs in the formation of a never-ending series of Universes from which the concepts of existence can be finalized in section 5.8. Section 5.6 covers some explanations of problems found in standard astrophysics.

5.2 The Standard Theory of the creation.

I briefly mentioned some of the old myths concerning the creation of the universe in Chapter 2. How did it appear, how did space appear? From nothing? To these I will now add the modern concept, not so much a myth because at least it is based on careful observation using the latest techniques: orbiting telescopes, space craft collecting information formerly obscured by the Earth’s atmosphere and radio telescopes; plus, much interpretive mathematical theory. Nevertheless, it has been built up within the physical community (group) by connecting it to the dictates of QM and QFT.

Recent theories of the universe started from the steady state (Bondi and Gold 1948), in which the universe would appear to be almost uniform in whichever direction it was observed. Such an idea would at least overcome the problems of the size of the universe, and its beginning, as they would allow the mathematical concept of infinity to explain the philosophical issues with a never-ending (unbounded) as well as never beginning universe. But in 1927 Hubble discovered that certain faint patches in the night sky were much further away than the supposed size of the universe, which at that time was thought to be limited in size. Instead of being gaseous nebulae he suggested they might be vast groups of stars, now called galaxies, with distances of as much as a million light years between them. It was also estimated that these groups were Doppler red shifted indicating that they were moving away from us.

Hubble (1929) had concluded that the further they were from us the faster they were moving. This implied the whole universe must be expanding and, if so, by working the expansion backwards in time it must have once been an infinitely small point. Surprisingly, it was a Catholic priest, also an astronomer, Georges Lemaître (1931) who first proposed this concept. Work on Einstein's general theory of relativity also backed this view. In 1949 Fred Hoyle, in supporting Bondi and Gold, disparagingly suggested that this must have required a huge explosion now known fancifully as the ‘big bang’ or primordial fireball.

As with the creation of new ideas first comes the idea, then changes as problems are found. For example, one can ponder over the question of how all this energy could have suddenly appeared as if from nowhere. Is it possible that ours is only one in a continual progression of universes, or a bubble in a much larger super-universe, or something else? For now, I will look at the view that it was formed from nothing, that it simply 'became.' I will not consider a divine 'creation' as I would still have to fathom out how a Divinity could have succeeded. Nor will I consider a singularity as such because I have already ruled out that possibility. In this case it will prove valuable to consider the stages of development to the current date. It seems just as mysterious to us as it must have to the earliest thinkers – except now we have mathematical physics to help.

Based on the big bang, physicists believe normal physics is unlikely to have been operative for the first few millionths of a second. The energy would have been so strong that particles would have been unable to exist without being immediately destroyed by each other. As the energy raced outwards the belief was that it would have become more diffuse so that the most basic particles, quarks, and electrons could have begun to form, followed by protons and neutrons and eventually simple nuclei. However, the physics of these formations is still unknown. The original feeling (see e.g., Hawking 2001:78) was that matter started to be created between 10^{-40} to 10^{-35} seconds after the big bang leading to the formation of quarks. Thereafter protons and neutrons appeared round about 10^{-10} seconds later.

This process brings up one of the important questions of the universe: the existence of anti-matter which Dirac (1928) originally hypothesized through his formulation of quantum field theory. According to his theory both matter, and anti-matter should exist in equal quantities. Thus, anti-particles to each of the proton and electron should exist with the same mass but opposite electric charge. His theory was confirmed by Anderson (1932) with the discovery of a positron as an anti-particle to the electron. Then Chamberlain et al (1955) identified an antiproton and the following year an antineutron by Cork et al (1956). These particles have an extremely short life since matter and antimatter annihilate each other rapidly giving back the energy from which they were formed, usually in high energy collisions in accelerators. So, Dirac, and his mathematics which had demanded such particles, was proved correct but without an explanation why they should be so rare, or difficult to produce.

One of the early concepts put forward was that there might have been a production of approximately equal amounts of matter and anti-matter in vast quantities and that as the particles formed what we call matter appeared in slightly greater quantities than its opposite. For example, if there was sufficient formation of particles to produce 10^{100} of which there was a difference of 10^{80}

between the two types then that is a difference of one in 10^{20} which is negligible.[1] But the thought of a slight difference between the two types of matter is only an idea and there might be others.

In particular the following problems had been noted though not completely understood.
The first two are the horizon and flatness problems, a third is the possible acceleration in the expansion of the universe discovered by Guzzo (2008), Perlmutter et al. (1998), Rubin and Hayden (2016) which is raised in section 5.5.

The horizon problem extends from the apparently almost universally uniform cosmic microwave background radiation, CMBR (Penzias and Wilson, 1965, Dayal 2018:7:10, Kashlinsky 2008). This radiation is believed to have been emitted approximately 380 000 years after the big bang and yet is reaching us now from every part of the universe *including the edges*. If the standard theory is correct, it would therefore have had to travel from the big bang to the present edge of the universe and then to travel from there back to us. If the speed of light is constant such a process appears impossible (Guth 1981; Vilenkin 1983).

The 'flatness' problem concerns the energy density of the universe. To find the universe in an almost perfect homogeneous and isotropic state 13.786 billion years after it started to grow seems extraordinary considering all the possible variations in force which must have taken place during and after the big bang. Guth (1981:348) pointed out that this would require nature to have fine-tuned the expansion rate to perhaps one part in 10^{55}.

These problems arise as a result of the big bang scenario, thus suggesting that it might not be a satisfactory explanation of the early universe. For example, if the universe expanded at c there should be a high possibility that different areas would have different states. Put another way, why should every direction be filled with energy identically to every other? Especially if it arises from a singularity or infinity of possibilities. In this circumstance, if energy were equated to heat as is usually done for the big bang it should be infinitely hot and chaotic so that the probability would be that different areas would gain different heats or amounts of energy. But this energy is transmitted at the speed of light. Therefore, no particular area could be affected by another hotter or cooler area because it would be moving away, also at the speed of light. So thus, as the varying amounts of energy transformed to mass carrying particles, considerable imbalances would be expected in particles between areas and thus so would the gravitational effect (based on particle masses). On top of this there is the problem that, at the initial stage, an exact balance cannot be inferred because particles,

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[1] 10^{80} is the estimated number of protons and neutrons astrophysicists believe to exist in the universe.

supposing they would arise, have a theoretical possibility of appearing in many different guises, (group theory and symmetry breaking (Gell-Mann 1956,1961; Vilenkin1983:2850).

These two problems, together with those of gravity and unification with quantum mechanics and field theory have arisen in the construction over the last fifty years of a new astrophysical theory. Trying to extract non-mathematical principles for a philosophical study corresponding to what has become a rather obtuse and highly abstract purely mathematical basis that has rapidly changed over a few years is somewhat difficult. The following is the general principle.

As already mentioned, a major problem in standard physics has been trying to connect the overall theory of the micro-universe, quantum theory, with Einstein’s general theory of gravity. In the case of the universe, Everett (1956:117) suggested that it is possible to build a universe based on a quantum wave function. Quantum theory (QFT plus QM) would require a number of fields, including its own overall undetermined field to build up the universe as humans observe it. If no universe existed, one could perhaps suppose each field had zero effect as might be the case in a perfect vacuum. However, a vacuum field, a field with zero-point energy, is subject to minor fluctuations in much the same way as positron-electron pairs can appear from what, in human superficial view, is an apparently empty space. According to Feynman calculus (Cavero-Peláez, 2021:2) a vacuum state emerges through self-energy: Due to the Heisenberg uncertainty principle a particle cannot maintain absolute rest but must always have a chance of undergoing simple harmonic motion (Cree et al. 2018:063506-2). Self-energy is then an action on the particle’s local environment and ground state, also called zero-point energy.

Quantum mechanics, as has been shown, has some very peculiar hypotheses, and here I do not mean to debunk them for their peculiarity but merely to mention that QM is highly speculative even though it manages to explain some otherwise apparently inexplicable actions, for example the double slit (Young 1802) and delayed choice experiments (Jacques et al. 2006, Wheeler 1978). In the latest ideas of the birth of the universe it again leads to some amazing ideas.

Smeenk (2005) seems to give the clearest account of the development beyond the big bang theory. According to this, Sakharov(1970), Gliner (1970) and Zel’dovich 1968) appear to be the first physicists to have raised the subject of vacuum states in relation to the gravitational effects of a sudden creation of matter in a very small volume of spacetime. Such a creation at the rapid rates imagined by the big bang would cause a collapse of the space. It would thus require a cosmological constant to create an expanding space to overcome the forecast collapse. In terms of quantum theory this would fall within the limits of Heisenberg’s uncertainty principle. For our universe it would have to apply on the grand scale; but this would be just a matter of measurement which can be visualized similarly to the man in the sphere thought of in my Chapter 2 – what would appear a large uncertainty limit to us in our sphere of the universe could be tiny as seen by an outside observer.

The problem with a vacuum energy preventing a gravitational collapse is that instead of forming a singularity as required for the big bang it would create a series of small disconnected spacetime bubbles (Smeenk 2005:243; Vilenkin 1983:2849). The hypothesis thus introduced a zero-point vacuum, out of which minor fluctuations could occur very briefly (sufficiently brief that the principle of energy conservation would not be violated), and could fall into a hypothesized false vacuum state (Penrose:751 Markkanen2018), that is, one containing a higher energy state than a zero-point state. Consequently, the false vacuum would be only meta-stable (stable unless pushed into lower state by some external influence). The most usual way of breaking out of this state is by quantum tunnelling (Markkanen, Rajantie and Stopyra 2018:1) (Quantum tunnelling is the ability in QM to overcome an energy barrier to pass into unexpected regions).

According to QFT, fluctuations in the false vacuum continually generate ‘bubbles’ of true vacuum of which one may be energetic enough to grow (González 2018:2). In the case under review a bubble of true vacuum can be hypothesized to have sufficient energy to grow very rapidly (at *c* Markannen et al. 2018:1) with the ability to ‘tunnel’ through the false vacuum wall (Vilenkin 1983:2851). Incidentally, Vilenkin, (1983:2854), goes on to suggest the universe is “spontaneously created by quantum tunnelling from nothing into a de Sitter space”.[2] In this case, as Guth (1981) suggested, it would be possible for the bubble to expand exponentially to produce what is now called an ‘inflaton’ field.

With this in mind, Guth (1981:349), in examining the horizon problem realized that *if* he inflated the redshift (of distant objects) by nearly 28 orders ($Z > 5 \times 10^{27}$), in effect obtaining an exceedingly rapid expansion of the primordial universe, he could overcome both the horizon and flatness problems. In this case, the energy density of the universe could be rapidly reduced by 10^{28} times. “If the universe supercools by 28 or more orders of magnitude below some critical temperature, the horizon and flatness problems disappear” (Guth 1981:350). Thus, we see that the hypothesis follows the need of the solution to horizon and flatness problems, a method objected to by Kant ([1781] 1998:134§A14) and very much later observed by Grinin (2019:94), rather than being causal in the first place. This cooling, Guth suggested, would produce a false vacuum with, as required by the big bang, such a high total energy it could not be a true (zero-point) vacuum. The cooling also allows an exponential expansion which prevents a gravitational collapse. Further it allows the formation of

[2] A de Sitter Universe is an expanding universe which fits Einstein’s general relativity equations with a positive cosmological constant but with no matter. The FLRW has on average an even distribution of matter.

particles to balance the critical value needed to bring the gravitational attraction into balance with a constant universal expansion. The total action then fits Hubble's observation of an expanding universe (i.e., meeting the Hubble constant).

However, another problem arises with the above false vacuum which Guth (1981:351) originally took to be a Higgs field (the field associated with the QFT mass particle). However, the Higgs field proved unsuitable (Smeenk 2005:243) as it leads to a collection of separate bubbles, which Guth 1981:351) himself mentions, and has since been replaced by an assumed 'inflaton' field providing a transition between the Einstein-de Sitter (EdS) and Friedman-Lemaître-Robertson-Walker (FLRW) universes. The transition then leads to particle formation. However, as Smeenk (2005:244) pointed out, and Grinin (2019:94) confirms, the form of the inflaton field is still unclear.

Before going into this further I will briefly turn to the ultimate, at the time of writing, form of Guth's concept – multiverses. I shall also refer to the problem of an accelerating expansion later (section 5.6). Smeenk mentions that the bubbles likely to be formed in the transition from an EdS - FLRW transition can, using suitable models, be much larger than the universe so that the universe becomes a mere bubble in a much larger object.

The fundamental thought behind multiverses is that if infinity is possible then why should there not be an infinite number of universes (Linde 2017:4; Bodiut2016:3; Tegmark2003:1). Tegmark (2003:13-15) magnified the idea to suggest this provides such an infinity that reproductions of our universe with infinitely many different continuations from our current position in time could also exist[3] – in mathematical theory at least, which he again argues to be the root of universal, or, in this case, multiversal existence. If bubbles expand at *c*, then each universe within the overall multiverse will be beyond the visible horizon of any universe, including ours. If there are an infinite number of possible bubbles, then there must be an infinite number of possible structures for universes – thus as above producing every possible outcome for our own universe. But we could never determine this.

One of the problems of our universe is that its energy density appears to be more finely tuned than quantum theory would expect (Guth 1981:348, 2007:6819; Ellis 2008:2); Weinberg (1989:1,3) gives about 10^{118} times. However, Ellis (2008:2) suggests this may not be surprising under the multiverse concept as an infinite number of possible universe constructions should include this possibility. He also suggests that as time is given by the quantum fields of our universe it is not necessary to define it (he actually states no unique definition on p5). Ellis (2008:2), in common with other physicists (e.g. Tegmark 2003; Bodiut 2016) also considers a subset of all the possible universes: one which contains

[3] see also Guth (2007:6819)

all those universes that allow life to appear; the principle being that it would restrict a description of the supposed inflaton for our universe to only universes fitting that subset.

I shall now turn to philosophical considerations following from the above brief description of the physical views of the birth of the universe, and in effect multiverse, should such an object exist other than in physicists' minds.

5.3 Philosophical issues

It should be fairly obvious from the above ideas on the formation of the universe that they fail to observe one fundamental fact, they cannot ride on the sense of *creatio ex nihilo*. Section 4.4 has already explained that nothing cannot exist. Neither can infinitesimals, nor infinities, nor singularities. I have drawn attention to the odd comment of attaining a vacuum space from nothing and I can add another idea by Lincoln and Wasser (2013:196) who suggest that the universe could have been created from nothing via balancing of 'information' and 'no information' bits cancelling each other; not dissimilar to the concept of $\dot{\theta}^-$ and $\dot{\theta}^+$ spins (section 4.4), except that in the latter case this is only a balancing between spins and is certainly, as such, not nothing – in its absolute sense 'no thing' does not mean a balance between two or more things. So that, too, will have to be determined before I finish. Only then may it be possible to understand why physics has failed in its quest to understand the universe.

It may be that physicists rely on the Platonic concept of mathematics. Then mathematics should be able to explain space and time since, as an *a priori* concept, it would have to be more fundamental than these two. One cannot just assume they can come into existence. Here, I believe, mathematics has taken on a role greater than its ability to solve. If as I have argued mathematics has no role whatsoever, in the construction of the universe, and certainly no role at all in the construction of my Universe, then it becomes limited to measurement, which in its construction based on 1,1 is measurement of number. I shall now represent this view in consideration of the vacuum state applied to the origin of a universe or multiverse.

Vacuum fields/fluctuations arise in, for example, an empty box, that is one without any particle inside it, according to quantum physics (Flores 2010:5). It is a constantly changing field of virtual particles (Daywitt 2009:1). These characterize physical representations of manufactured vacuums, by which I mean vacuums with physical boundaries that can be produced, in theory anyway, on earth. Such vacuums would, in fact, not be zero-point because they would be bounded by particles forming the boundaries producing fields within them. This thought can be extended to any area anywhere in the universe as there are at the very least neutrinos present together with a probability of other cosmic particles/radiation and gravitons. Nevertheless, the temptation is to consider speculation into QM, in particular these vacuum fields, because it has not been shown false, to be absolute for any application. For example, Paraoanu (2014:1) writes:

> We know… that physical properties come into existence – as values of observables – only when the object is measured. Thus, quantum physics allows us to detach properties from objects. This has consequences: one does not need pre-existing real objects to create actual properties.

These fields are mathematically constructed around the mathematical-physical concept of the Lagrangian which specifically operates from a momentum-position basis – a generalized equation similar in fundamental idea to the Hamiltonian (Synge and Griffith 1959:411). Thus it automatically incorporates the sense of energy and mass without this necessarily being physically introduced during the initial formation of the universe/multiverse. That is, energy is not specifically produced as a fact but is an *a posteriori* addition. Consequently, it is a false assumption that the so-called vacuum field depending on the human notion of matter could have produced the universe/multiverse out of nothing. It has an air of a false use of mathematics because it takes an existing theory and adds in an additional concept just to make sense of human ideas. It needs an external reference such as philosophy to rationalize it (no theory can prove itself).

In any case, there has to be a question over the field itself. As with so many physical concepts I was unable to find any complete definition other than of the form 'the lowest possible quantum energy state containing no matter' – zero-point energy state: for example, "In quantum physics, vacuum is defined as the ground state of a quantum field. It is a state of minimum energy, corresponding to zero particles." Paraoanu (2014:4). As already mentioned, there are many questions over complete definitions of field and energy which leaves interpretation subject to the Frege and Wittgenstein-Quine difficulties. The hypothesis is that according to the uncertainty principle there is always a chance that the zero-point may spontaneously produce either virtual particles or simple harmonic oscillations, SHOs (Daywitt 2009:1; Cree et al. 2018:2). Virtual particles are again a speculative mathematical concept to form a connection between actions such as electron-positron scattering, the principle being the carrying of momentum from one particle to another (Peskin and Schroeder 1995:5; Daywitt 2009:1). Because these particles, being matter-antimatter pairs total zero, they only marginally and temporarily affect the no-particle state. In other words, we can invent and incorporate an object into mathematics to produce an effect provided the object can be taken out again as if it never existed to explain what we cannot explain otherwise.

In fact, we cannot even be certain of what a field is, especially a force field. Nowhere have I found a definition that considers the field itself. The general idea in physics seems to be a space where every point can be expressed mathematically, which as a generality avoids considerations of continuity but here I am strictly considering not what it can do, but what it is.[4] If it consists of lines of force, what are these – what makes them? Hobson (2012:6) claims the modern view is that fields are "*conditions or states of space*," which says absolutely nothing about their essence nor how they can support transmission of force. It would appear that it is accepted that a field is a continuum, or at least a continuous set of connected 'grainy' points (Regge and Williams 2000, Chiou 2000, Bahr and Dittrich 2010). But again, what is a continuum without knowledge of a field or space for it to have existence? Again I have to ask: how can a theory be accepted if it cannot answer fundamental questions? ? s state of a continuum, or its falsity, or knowledge of the nature of a field, might be vital points in understanding the universe.

A point I did not draw attention to in the description of the inflation theory is the concept of potential energy (Flores 2010; Grinin 2019 :91; Markkanen, Rajantie and Stopyra 2018). The vacuum field is treated as if it starts from nothing, but it has a potential to create energy. This brings us back to the fundamental QM concept of probability which is purely a mathematical concept. I take potential strictly as a mere possibility or probability. It is an abstract idea that something *could* exist but itself has no substance. By this I mean something 'other' than the potential could exist, and by abstract, I mean that potential has no reality apart from being a thought in one's mind. The 'something other' could have a concrete existence; the potential, in this case of possibility, is not concrete. The concreteness will need a cause from something else. Potential as a possibility cannot be that cause. It can only indicate that a cause may exist or may come into existence.

For example, we could say that the vacuum field has a potential for an SHO to occur, but potential is not the SHO itself.[5] Even then is the vacuum field SHO a concrete entity? Simple harmonic motion is a human observation of an action in which some concrete object oscillates about a point. Here again we come against Newton's assurance (in his letter to Bentley 1693) concerning the human intuition that an object cannot respond to a force unless the force has some form of transmission, that is, it is causal. I suppose that SHO is an attempt to break away from an unexplained singularity to something nearer to human perception. But if physicists wish to base a theory of the universe upon SHO they still have to explain how it can arise as a causal object (irrespective of a supposed indeterminacy). Unfortunately, the concept of potential energy has become firmly entrenched as a form of explaining fluctuations in kinetic energy, that is, for example when an object is no longer being lifted against

[4] See e.g., Bueche (1977:72), Synge and Griffiths (1959:63) for physical definition in terms of coordinates and (1959: 455) in terms of Hamiltonians.

[5] I do not see that a possible thought that an expansion and retraction to an original position can constitute 'no energy'. It is similar to taking four steps to the left followed by four steps to the right back to the starting position. Eight steps have been taken with a change in position even though the net result ends at the starting position.

gravity, the kinetic energy in the lifting is said to be converted into potential energy. Without concrete details of any form of mechanism (cause) for potential energy other than a possibility of somehow converting to a kinetic energy, one which implies a force, I do not feel justified in accepting it as a possible reason for the supposed existence of a field of SHO's, or QHO's, as a basis for a universe. That is physicists will still have to explain how such an oscillation can arise, particularly if it is apparently supposed to arise from nothing. It seems to me more in the line of wishful thinking and some circularity in conflating the explanation of one thing (KE becoming PE) to explain the existence of the other thing (KE) in the first place. Due to the lack of specific definitions in standard physics, the conversion between potential and kinetic energies is merely an accepted but unexplained concept.

The problem goes back to both the lack of definition for force, and the lack of knowledge of the mechanics of force production, for force produces a change of motion, therefore kinetic energy in a body. Energy that causes an action, contrary to potential energy, should not be considered abstract because, in order to have an action, it would have a concrete basis in human realization, such as for example, a particle, a photon (or boson in Standard theory), to carry it. But this would not be potential energy, it is an action energy, that is, kinetic energy. An energy that drives an oscillation, or SHO, creates motion and must therefore, according to Newton, have a concreteness to it, a substantiality about it. Potential energy should therefore not be treated as if it is on the one hand 'real' (in the sense of having substantial existence) zero-point energy, nor should it be treated as if it has the ability to suddenly become a substantial kinetic energy. Thus, physicists cannot escape from the principle of producing something from nothing by the artifice of a potential, or worse a potential energy. Furthermore, it must be remembered that the energy of the inflaton is partly to be turned into particles which humans would regard as having substance or being concrete.

The fact inflation seems to fit observation of the CMBR suggests it may be correct, but one must remember that CMBR and its apparent homogeneity came first together with observations that the universe seemed to be isomorphic. So, the fact that inflation was invented in order to agree with the isomorphic nature of the universe should not be surprising even if the fit is extremely good.

As the history shows the concept has become expanded and entrenched with new ideas. For example, the Casimir effect (1948): an anomalous attraction between two plates suggested to be caused by vacuum energy for which there may be other explanations. Could it be due to perhaps gravitational attraction, for which I have found no evidence that this has been disproved? I am not sure that electromagnetic fields (Flores 2010:6) without exact knowledge of how these actually operate have been ruled out either.

I may seem to have spent more time on this examination of current thoughts, but it shows how empiricism raises ideas which, despite the lessons of the past (e.g., electromagnetics), become adopted and reinforced even though affected by obvious short comings (something from nothing). It is exactly the subjective ideas of physicists in peer groups that I have been suggesting maybe a reason for the failure of physics to find the way to a universe. A view looks good, so it becomes entrenched. On the other hand, as physicists might point out, it is at least a theory that answers some questions even if it leaves others until later. Nevertheless, broad ideas should be examined and expanded to their extremities – the same goes for the space-Time theory presented in this thesis as well (see section 6.4.2), much of which has been excluded for space reasons.

For example, one of these questions I have stressed states contrary to standard views:[6]

To understand the universe it is first necessary to understand space and time.

In this respect recall the question I asked earlier: into what the false vacuum expands. One cannot say that it creates its own space because this does not answer the question in any sense. It should be considered in equal terms as the question why anything exists because existence, in the sense in which humans exist, must also refer to the existence of something in which apparently substantial, concrete, things can exist.

Consequently, I return to the fundamental cause of Chapter 3 to relate it to a Universe.

5.4 The fundamental Universe

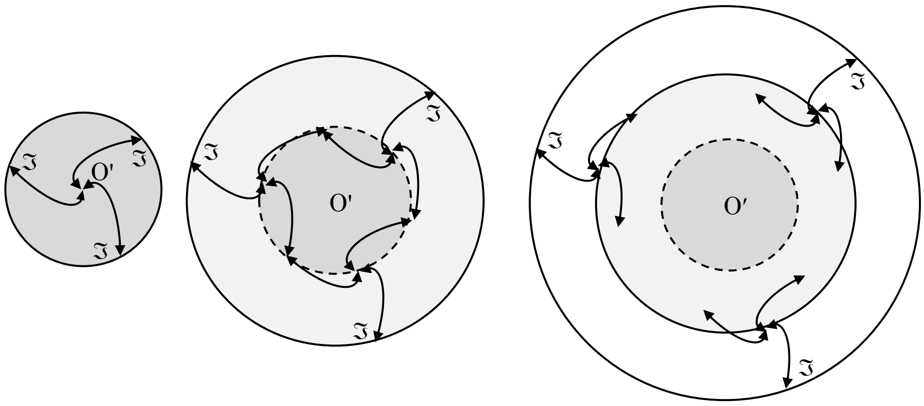
Chapters 3 and 4 showed how space and time can arise from a point Φ (which still has to be explained – section 5.5) coupled to the fundamental concept of (p)-rotation. It was also shown how the natural concept of ‘no-space’ would be maintained by two contra-rotating spins $\dot{\theta}^{+}$ and $\dot{\theta}^{-}$ which had a maximum possible rotation of *w* (no units required because measurement values do not exist in the natural universe.   This can be extended to the concept of a nascent universe as follows.

Expansion of the foundational Universe will take place within a spaceless, timeless, rotating **null point.** It gains an apparent, or relativistic volume due to an inner contra-rotation exactly balancing that of the null point. This gives a constant rate of formation of an apparent, or relativistic space-Time

[6] Stoeger, Ellis and Kirchner 2008:5 “Time is now intrinsic to a given universe domain and its dynamics and there is no preferred or unique way of defining it (Isham 1988, 1993; Smolin 1991; Barbour 1994; Rovelli 2004; and references therein)”.

driven by the Time generator $\hat{T}$ in the form of a lattice of trace-points. These are generated identically from a maximal spin w in isolation of all the other points. The age of the macro-Universe, T_A, will correspond to each stage (Aristotle's 'nows') in the progression of Time; the relativistic Universal radius will correspond exactly to its age in quts. In human cognizance the Universal age in quts would run through the natural numbers.

Furthering this theme, the concept of Chapter 4 projects that there exists an outer rotation, $\dot{\theta}^-$, which can be considered as a packet (null point) with a surface – **null surface** – with an inner rotation, $\dot{\theta}^+$, as a packet rotating inside the null surface. As the Universe ages, the null point spin, $\dot{\theta}^-$, remains constant and the tangential velocity of its 'null surface' (bearing in mind it is a point) is c. Consequently, the surface velocity of the inner packet rotating at $\dot{\theta}^+$ is also c – these velocities being relative between any two positions (so-called observers) one on each sphere, see section 4.5. These concepts lead to two obvious problems. The first arises from the human view that if the inner packet spins and produces points that also spin, there should be an 'addition of (tangential) velocities' affecting the trace and Time points. The second problem is that, again from the human point of view, if the universe develops as projected by the foundational principle, how can a relativistic expanding inner packet maintain its tangential velocity at c and its angular rotation at w (the maximal value of $\dot{\theta}^+$) in an apparently expanding Universe? That is how can it balance the constant null point rotation of $\dot{\theta}^-$ which must have constant value w^- (meaning same magnitude but opposite direction to w).



(a) (b) (c) (not to same scale)

Figure 5.1. The *expansion* of space-Time as given in Figure 4.1 seen from both inside and, imaginatively, outside the universe.

The first problem is answered by looking from the relativistic observational point of view that created the space-Time in the first place. An 'observer' inside the relativistic space can treat the spin as if the background is fixed and he is spinning or that he is fixed, and the background is spinning. Figure 5.1 shows the generation of the first three sets of building blocks according to the latter condition. An 'observer' on the null surface (of the null point) would see space develop inwards due to the spin, starting with the first qut, somewhat equivalently to the measurable concept given in section 4.4. Then the second generation of building blocks would appear next to the null surface and so on, each set increasing the relativistic size of the universe as viewed by him.

But an observer (an eyed one as opposed to Chapter 2's anthropomorphized one) would not see the Universe spin relative to his origin as, although both $\dot{\theta}^{+}$ and the counteracting spin $\dot{\theta}^{-}$ exist, $\dot{\theta}^{-}$ only exists as an invisible containing surface. Section 4.5 derived that the relativistic intervals of space-Time points arise within the inner packet and are due to their rotation within this packet. As this space-Time is produced identically for each point from a maximal spin *w* in isolation of all the other points, every point is unaffected by the external rotation $\dot{\theta}^{-}$. Thus, the observer would believe the Universe expands outwards, and without the knowledge acquired in the last two chapters he would imagine, as nearly everyone does on this planet in our universe, that his Universe is expanding into some vast unfathomable volume. For this reason, the curves are drawn with arrows at each end; it depends on who is viewing as to which way space-Time *appears* to develop, a consequence of the reciprocality of observations in relativity.

The first problem is thus only a problem of human physical interpretation of observation, and not one that occurs in the foundation of the Universe. The second, on the contrary, is one that does not occur in human interpretation of observation, but one that is implicit in the relativistic nature of the foundational principle, as follows.

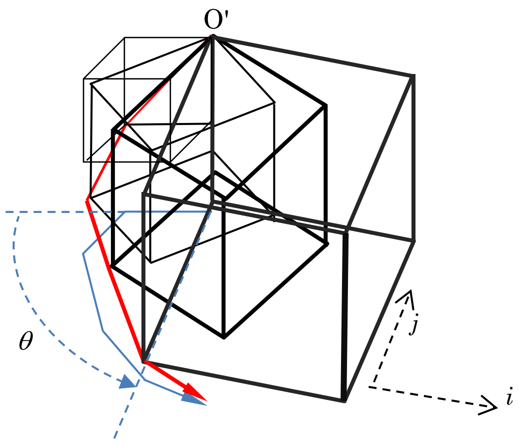


Figure 5.2. 3-Cartesian dimensional representation of space-Time volume production over four quts, starting from the first qut at the origin of the Universe, as seen from an O' plane of reference in which rotation is only observed in the *ij* plane.

In the natural creation of space-Time one of the points would observe the other to move around it (at *c*) and vice versa, both giving the same result as viewed in the contra-rotating system. From this view, the continued construction of space-Time modules, as appears from the origin in a Universal frame of reference,[7] will appear to follow a spiral. For example, there is always a free axis at the basal apexes of the tetrahedron so that the tracking of any one apex can be represented over a period greater than a single qut using a series of cubes, as in section 4.6 and Figure 5.2. In human figurative terms this spiral can be projected onto an (rectilinear) *ij* plane as shown by the blue arrow in which case each change of direction is related to the total angle turned through, θ. This gives the structure as shown in Figures 5.2-5.3. Rotation in the other planes need not be considered as the whole figure can be rotated taking the spiral projection with it.

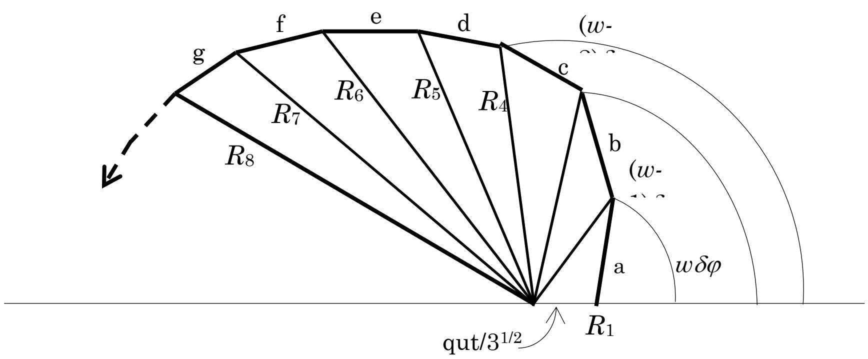


Figure 5.3 The projection of Figure 5.2 onto the ij plane in detail. φ is used in place of θ.

This reasoning suggests that the macro-Universe can be described in both volumetric and planar terms as might have been supposed from the basic construction of Chapter 4. Then the relativistic Universe would expand at a constant rate *c* while maintaining the tangential velocity of its surface at *c*.[8] Therefore, if the relativistic radius of the Universe increases, the apparent rotation of its surface, which commences at *w*, around its origin must decrease. Imagine a given point on the edge of that Universe. It would travel around the Universe origin O' at *c*. Then *as its distance from O' increases, its angular rotation must reduce reciprocally*. Because this change of spin is due to the relativistic expansion of space it would appear only in the relativistic representation of the Universe (which we would see but it would be very small because of the huge distance of fourteen thousand million light years to the edge of space).[9] But this still does not produce the balance between $\dot{\theta}^{+}$ and $\dot{\theta}^{-}$ that must arise in view of the fundamental rule given by the foundational cause.

Consequently, turning to the natural structure for a possible solution, it does not occupy any volume so that the spin of the null surface remains constant, and the trace-points do not have any linear velocity. Accordingly, the natural system would have no 'addition of spin or velocity' problems

[7] Frame of reference still as described in chapter 1 without geometrical connections.
[8] In mathematical terms: resolving *c** by splitting the three-dimensional representation into planes as in Figure 4.2d.
[9] There have been suggestions, and refutations, of measurements of a universe spin (Longo 2011).

(another expression of the condition stated earlier in this section) and forms up with the same basic structure as the lattice described in Chapter 4 – but in point form only. As it is deemed the true format of the Universe, a human viewed relativistic representation must agree with it rather than the other way round. $\dot{\theta}$ in Chapter 4 is the rotation of each space-Time triad during the formation of the space-Time building blocks; to distinguish the difference between this aspect and the rotation of the expanding universe, the rotation of the expanding macro-space will be represented by $\dot{\varphi}$, $\dot{\varphi}$ replacing $\dot{\theta}$ for clarity of expression, as the age, T_A, of the Universe increases. Then, as the age increases, $\dot{\varphi}$ must reduce from *w* at the beginning (T_A =1) of the Universe with the passing of every qut. As in section 4.5 this value *w* must have a finite value as the original spin cannot be greater than itself.

This reduction in rotation, if uncompensated, would destroy the equivalence of the spin of the relativistic space and the constant spin $\dot{\theta}^-$ of the null surface. As the latter is constant, the compensation must arise in the relativistic representation of the Universe. The fundamental rule then demands that a **balancing spin** $\dot{\psi}$ must arise, one which we would not see because it operates *between* the imaginary null surface of the Universe, that is, the inner packet, and the outer packet, $\dot{\theta}^-$. Thus the relativistic form of the Universe would be maintained by $\dot{\psi}$ increasing as $\dot{\varphi}$ decreases so that the two together agree with $\dot{\theta}^-$ which always has the magnitude *w*. These conditions would then apply to every space-Time origin as if it is the centre of its own universe. (But these conditions would not affect the action of $\hat{T}$ and thus the rotation of the space-Time points themselves). In particular, they would ensure that at the end of every qut the formation of new space-Time in our system commences with exactly the same motion as in the very first qut that started the universe. So again, with no difficulty, the foundational cause leads to a balanced expansion of the Universe that meets its fundamental rule. As it turns out, a factor that will answer many astrophysical questions.

In view of this being a new concept arising from a new reasoned formulation there would be no reason in standard physics to expect this process. It is, therefore, what I call a ‘hidden from us’ concept, though we might expect there exists some consequence which we *have* seen. This is gravity which runs beyond the scope of this thesis, but there is another process which also follows from the balancing spin.

5.5 Contraction and Expansion epochs

According to section 5.4, the existence of Time requires the existence of counteracting spins, $\dot{\theta}$, $\dot{\varphi}$ and $\dot{\psi}$, with maximum rotation *w*. $\dot{\varphi}$ places new lattice points, and particles produced, at an increasing distance from a given origin in the relativistic representation as the universe grows. As in section 5.4, $R\dot{\varphi}$ (R being the universe radius) must remain constant at c. If w is the maximum spin of the universe and $\dot{\varphi}$ reduces every qut, there will be an age of the universe T_w when $\dot{\varphi}$ = w/w = minimum (it cannot pass to $w/(w+1)$ because w is the largest possible number of quts if $\dot{\varphi}$ reduces by one unit every qut. Then the balancing spin $\dot{\psi}$ of section 5.4 must start from 1 (one) and increase until it reaches the value w. Humans would give $\dot{\psi}$ the mathematical value $w - \dot{\varphi}_w$ keeping the natural representation volumeless. An observer at the origin only notices the $\dot{\varphi}$ spin so that the space-Time lattice appears to build along spiral paths.

As there is no macro-universe spin smaller than w/w, $\dot{\varphi}$ and T_A must reverse themselves when $\dot{\varphi}$ = minimum = w/w. Then T_A runs backwards towards 1 starting a contraction epoch. $\dot{\theta}$ must also reverse direction and as a result it produces anti-space-Time. As the $\Im$s materialize their rotation additively annihilates with the rotation of the old expansion epoch so that the space-Time lattice disappears. Even though space-Time is contracting it can still produce particles. Furthermore, although particles have been excluded from this thesis as beyond its scope of merely finding a basis for a possible Universe, as the cause of the Universe is rotational space-Time, the particles forming it must also be formed on rotational space-Time. Since the choice of rotational direction was purely arbitrary, the formation of particles is not dependent on a specific direction but takes place according to the direction that forms the given epoch of the Universe. Thus if the rotations reverse under the formation of a contraction epoch, the particles are formed with reversed direction and they will then annihilate with the particles of the previous expansion in the same way as the contra-rotations $\dot{\theta}^+$ and $\dot{\theta}^-$ add to give no rotation.

When $\dot{\varphi}$ has returned to w the universal *relativistic* radius will be ‘zero’ and there will be nothing left other than the counteracting spins of the null point. A new expansion epoch then begins, still with $\dot{\theta}$ reversed (and also the balancing spin $\dot{\psi}$) so that an antimatter universe results until T_w is reached; and so on *ad infinitum* producing a succession of matter and antimatter universes between contractions. T_A is thus periodic but computer capacity at present is not large enough to calculate T_w, and thus w. As the only 'set of rules' are those given in the previous sections all these expansion epochs have the same constants and form, the only difference being whether they consist of matter or antimatter.

Although I have not explained the concept of gravity (see comment next section) I will briefly mention that as the end of the expansion epoch approaches, gravity reduces to zero. When $\dot{\varphi}$ increases after T_w, gravity reverses direction. This will not destroy the annihilation process because the apparent volume of the universe decreases and, as multi-atom objects will no longer exist, the anti-graviton distribution will be approximately uniform. Consequently, anti-gravitons will cause particles and anti-particles to collide with each other as much as separate.

Note that natural causes do not require a predetermined value of w. As zero does not exist in the Time system there is no measuring scale corresponding to the invented concept of $T = 0$. The scale only commences when $T = t = 1$ and continues increasing until $T = T_w$ qut which can then be used to give a 'value' to w. The value itself only arises in terms of the human concept of natural numbers and is only of use in human calculations.

Before passing on to why anything exists in the first place there are a few other points to be filled in which can be explained without full details of exactly how particles are generated and why they have specialized properties.

5.6 Conservation of energy[10]

The law of conservation of energy is fundamental to the standard theory. Fortunately it can also be considered here even without having gone into the concepts of motion, force and creation of particles. These will all have to fall within the ambit of the fundamental rule determined by the definition of Time. If energy is considered as equivalent to rotation with the spin of the 'outer' packet which remains constant, then the overall energy will remain constant. The inner packet reduces its rotation as the Universe ages. Consequently, the energy taken up in its rotation reduces, which means it becomes available for the production of particles together with the operation of force and corresponding motion which are all based on the concept of p-rotation. This would mean that particles are produced as the Universe formed in the inner packet expands, and their anti-particles are produced when it contracts, thus returning energy to the increasing rotation of the inner packet as the particles and anti-particles annihilate each other and their force fields. The equivalent energies of the inner and outer packets then always balance so that the total energy is constant.

Finally, now that I have given the basis of an overall Universal space, I can pass to complete the problem of the human perception of space and follow it with that of existence.

5.7 The human concept of space

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[10] The unit of energy is defined in the Time system as **inertia adjusted minimum frequency** of a particle which is a technical way of defining it in terms of p-rotation. Then all particles follow the standard dynamics equation $E = ½\, mv^2$ which can be deduced from the first principles of the Time system.

Section 4.4 explained how Time and rotation could produce what humans would recognize as space as Time progressed from point to point. This showed that rotation acted on Time to produce a succession of trace-points which formed a lattice of such points with no actual distance between them, thus overcoming the philosophical problems of how big the Universe is and into what could it be put. It has no size, so these two problems are only problems in human understanding and perception. However, the rotation of Time and the points it produces lead to a relativistic appearance of space around each point as viewed by another point and vice versa for all points as demonstrated by Figure 4.1. (What applied to *A* in Figure 4.1 applies equivalently to *B* and to a further point *C*, and so on and vice versa from *B* to *A* et cetera). Section 4.4 also explained the concept of zero which has also been a problem in human sapience leading to the concept in section 4.9 that points with no space could interchange positions. Points remain points (adimensional abstractions) in their frames of reference despite seeing space apparently opening up in the relativistic view. Groups of points rotating together as one whole would also be points, so they can interchange positions through the gaps between abuttals in the natural representation. Trace-points just provide an abstract, or ethereal (transcendental), volume (in the overall shape of a tetrahedron in the relativistic representation). Only the points of Time form the fleeting space-Time triads which collapse (pulse in) at the same instant as they are formed. Thus, we have this transcendental concept so different to the human view of an everlasting space: suppose these expansions (and collapses) take place at 10^{24} times per second, they would be far below the human ability to measure and thus below our concept of what we might consider real.

If we now imagine that particles can form from active space-Time, triad forming points, as opposed to passive trace-points, as the space-Time lattice builds up, we can imagine there will be a corresponding increase in the number of particles. Then we can also imagine there will be a corresponding increase in the number of interactions between the particles leading to more complex structures.

Then, if groups can further combine to form complex groups, what we would regard as chemical structures, we should expect them to also be capable of changing places through the lattice. As stated in section 4.9, structures could emerge that could undergo changes in their formation and might even be able to repair and reproduce themselves and have sight. The changing of position in the lattice represents motion with respect to fixed observers such as ourselves and this would take place at a number of qul^rs per far greater number of quts so that the fixed observer sees what he calls a rate of change of (rectilinear) position or speed. Furthermore, there can be objects at different positions in the lattice from which it takes time at the speed of light to reach us so that we can (using our two eyes) triangulate the objects' apparent distances, bearing mind that there are many gas particles (molecules) between them and us reflecting positions in the lattice. If we consider this on the macroscale (where we cannot judge distances) the concept perhaps gains some sort of comprehensibility when one remarks on a starry night "I feel as if I could almost touch the stars."

5.8 The existence of Time and Earth

Taking everything written in this thesis it is now possible to answer the most questioned philosophical problem: why anything exists.

As seen in section 4.4 the concept of rotation is absolutely fundamental to the Time Universe. To such an extent is this true that it could be considered more fundamental than Time since observed space could not appear without rotation. It is the action of rotation that creates the Time intervals which signify space. But it was Time that led to the concept of rotation. Thus, it can be said that rotation, Time, and space are all different manifestations of the same fundamental object, which should therefore be termed – if it was not too clumsy – rotation-space-Time. However, in our psyche we cannot define rotation without the concept of Time. Therefore, Time had to come first, and it was the deductive process that eventually led to the realization that rotation, or energy if given a suitable definition (outside the scope of this thesis as the subject of force is involved), is the fundamental requirement for a *spatial* universe to exist. Energy was in fact my first thought for a cause of the universe sixty-seven years ago, so if its definition is connected to rotation (see section 6.4) there is a definite correlation between this original thought and the Time Universe.

Why anything exists – in the case of this thesis, Time – is the biggest philosophical question of human existence. The first consideration is somewhat anthropic because humans are used to beginnings and endings and indeed each Universe in a series begins and ends. The question then becomes whether a series of Universes can begin and end:

Suppose there is a state of absolute nothingness and a starting point from which a particular universe springs. Then there must be a separation, that is, a limit between nothing and the start of Time, a boundary point that is neither Time nor nothing. Such a point cannot be a point in a state of nothingness because nothingness cannot contain a point. Then either the point cannot exist, in which case there is no boundary to the start of Time; or if the boundary does exist, it must exist as a preceding point *p* to the start of the given Universe, that is, it must exist timeously – in which case *p* becomes a point of Time. But then the same problem reoccurs between the supposed state of nothingness and that *p* and so on. Induction then implies there would have to be a never-ending set of *p*s, of Time, before the given Universe.

A similar proposition must hold for the end of the given Universe. Therefore it is possible to state that:

If Time exists at any single point, then it must exist forever into the past and into the future.

Therefore, the question of why anything exists, or why Time exists is only a question of the human mind and not of the Universe. This suggests another argument. Why should we believe that just because everything we know begins and ends, that existence of anything itself begins and ends? Our minds are made that way. The concept of ending of life, whether from the view of continuing the species by having offspring, or to bringing up offspring in the case of a parent, is an important concept in the survival of any species. Mutations that support self-protection, such as the fear of an ending – leading to the fight or flight syndrome, for example – become part of the genome through Darwin's 'survival of the fittest.' Thus, the concept of beginning and ending is a fundamental concept of human existence. Rather ask why should there *not* be a continual existence? Arguments on this 'why not' basis must by their nature contain a fundamental perception of beginnings and endings thus showing the difficulty in escaping from such perceptions. Such arguments on our basic feelings of beginnings and endings pass into the realms of biology and psychology, and could fill a thesis in itself, so will not be pursued further here. Existence of a Universe that at its most fundamental level occupies no space-Time interval but allows a relativistic production of a never-ending stream of space-Time intervals to emerge may seem beyond comprehension but that is precisely what Einstein's special theory at its most logical extension provides. It shows clearly the difficulties experienced by humans in tying in the idea of beginnings and endings with the concepts of zero and nothing.

Finally, as in section 4.5, each universe begins and ends so neither the natural number sequences N′ nor N is infinite although the number of Universes into the past or future is without limit. It is now clear that Φ of section 4.3 is the last instant of the contraction phase of the Universe previous to ours.

Answering the two major philosophical questions of the projected Universe thus also leads to a lattice configuration that can develop sufficiently to allow the formation of mega-structures such as we see in the universe around us. The creation of particles and the other processes of the universe using the principles of the foundational philosophy is a major subject which will be covered in another article.

5.9 Hermeneutics

A major problem of all descriptions/theories is whether the factors deduced carry all possible interpretations and outcomes. Throughout the preceding chapters I have contended that physical theories are purely empiricist depending entirely on fallible human perception. Once accepted, because they appear to support 'what happens for given input data,' they become part of the group lore. Unfortunately, there is always a subjective tendency (see section 3.5) which may be infected by group pressures, a wish to move on from the problem under review, or even that the theory has an outcome over and above other possible outcomes that fits a previously unexplained problem or observation. In this case, kudos for the physicist could overcome other nuances that may suggest a different direction. It is therefore important to examine closely for unexpected or hidden factors, with what I would call 'analytic precision.' Apparent superficial or immediate outcomes may sidetrack less obvious possibilities. It is often easy to fall back on mathematical solutions on the basis that mathematics is truthful so the outcome can be accepted. But mathematics is only truthful in the limit to which it is applied and as a result it may lull the unwary into a false sense of security. Therefore, careful analysis of all concepts is required.

To avoid the pitfalls of empiricism (human perception and interpretation thereof) I had to find some prime cause not necessarily based on perception but rather an unexpected idea to be used as an assumption and then check whether it works. This, as Kant says ((1998:132§A11): section 3.1.2) had to be transcendental, because it had to go where no other thought has gone before thus giving it a chance of not being contaminated with human perception. The problem here is that the assumption made involved some peculiar, even if logical when based on the fundamental definition, questions and answers which might have not crossed the human mind before.

A major goal should be to find a new and more powerful method of analysis that can unearth hidden problems in standard physics more succinctly than standard methodology. It should be noted that an interesting pedagogical methodology in science was proposed by Rashford (2009), namely, that education on the nature of science, which he applies through Gadamer's Hermeneutics, should be included in science education. The concept was not then well known (2009:30) but Rashford felt it would bring students to a better understanding of scientific problems with knowledge of how to deal with them. However, Gadamer's hermeneutics "has never been the organon of the study of things" (Gadamer [1975]2006:185). Instead, it is the art of understanding (2006:188, 186) not only statements on science but discourse about it. This includes understanding the parts in isolation as well as in total context of science to attain a form of circularity in relating past knowledge to new knowledge or developments (2006:189).

Nevertheless, I fear this does not go nearly far enough. What physics needs is an analytical precision of meaning, which I argue is seriously missing. We can see such action in the legal profession (Gadamer 2006:xxix) where the law is not only to lay down with absolute clarity how it is to be perceived and carried out but also to include some leadership in preempting the need for unforeseen extensions/problems. Scientific theories should receive the same treatment; sometimes I feel this treatment is lacking, for example in the EPR case of local indeterminacy.

Rashford (2009:4-7) suggests understanding may be developed through learning techniques that mimic experiments:

> The standards put forth by the AAAS in *Benchmarks* concerning NOS [nature of science] fall under one of three, principle categories: the scientific world view, scientific inquiry, and the scientific enterprise. The first of these suggests that the world is understandable and that scientific knowledge, while durable, is subject to change and limited. Scientific inquiry is explained as relying on evidence, involving both logic and imagination to explain and predict, and avoiding biases.

All of these are to bring understanding to existing ideas as opposed to questioning them – which should be an important factor in physics education. Physics' so-called laws are not *definitively* established and therefore can only be 'trusted' as being able to calculate outcomes for given inputs. As has been abundantly argued in the preceding chapters, they (laws) most definitely do not explain the basis on which the results are formed. Just because they work for standard procedures does not mean they work for all. That is where the scrutiny is needed.

Rashford (2009:7) also suggests "the scientific enterprise is characterized as a social activity organized into content disciplines, with generally accepted ethical principles, consisting of individuals who participate in public affairs as specialists and as citizens". Merely increasing the 'understanding' surely adds to establishing group pressures and entrenchment of current ideas which I have argued strongly against (for example, sections 2.5.1-2.5.3).

As an analogy is often a good way of establishing ideas, I can liken my approach to symptoms and disease (not that I would consider hunting for the basis of the universe as a disease!). All that our perceptions see are the symptoms. Science and mathematics deal with the symptoms and their control like a black box: feed data in and algorithms calculate mathematically what comes out. If great efforts have been taken to establish empirical rules, then most, if not all of the time the correct result emerges. But it does not tell us why it emerges other than various mathematical rules have been established. In other words, it treats the symptoms but not the disease. What this thesis aims at is finding the cause of the disease and rather treating that. If the symptoms are controlled the patient recovers but the disease remains as a danger. If the disease is controlled, then the symptoms become irrelevant. Therefore, we should be looking at ways of dealing with the first concept of understanding raised above. A problem with this scheme is that QM apparently denies that the universe is causal so that the disease becomes irrelevant (see section 3.1.2).

Consequently, I see Rashford's hermeneutics as reinforcing perception rather than attaining a new understanding. I view the aim should be more to emulate the legal profession where the laws are framed to preempt misunderstandings through clarification, or loopholes through analytic foresight. That is, the aim should be proactive, which I have mentioned is how the fundamental causal rule works (see section 4.5) and as indeed how the universe must work. In this, the rule does not foresee problems but preempts them by the first cause itself so that everything will follow directly from the first cause. This is different to human experience where the structure of the world has left situations for which humans can see many different outcomes. As a result, physicists can imagine a universe with no foundational cause. A fundamental cause will form a complete framework within which the universe functions, without which new rules could appear rendering any theory non-fundamental and incomplete. This is why I liken the concept as working on the disease, not the symptoms. Gadamer ([1975]2006:238) has a similar thought "That Husserl is everywhere concerned with the 'achievements' of transcendental subjectivity is simply in agreement with phenomenology's task of studying constitution". Gadamer goes on to say Husserl tries to get behind human perception which is similar to Kant (section 3.1.2), but, as I see it, Gadamer does not seem to follow it through. He does not make the connection between subjectivity, objectivity and transcendentalism because he believes ([1975]2006:244) they are all tied to human perception: "Life is experienced only in the awareness of oneself, the inner consciousness of one's own living"; whereas transcendental thoughts will be 'out of the world' guesses.

The problem is that the efficacy of mathematics has become so established that it pervades all of science and cases of inaccuracy are very rare. However, the comments raised in section 4.8 reveal misconceptions that can occur when care is omitted to consider the possible existence of obscure factors; as Persson (2011) questions: do we understand what mathematics is producing?

Chapter 6
Conclusion

6.1 Introduction

The research questions of this thesis were: (1) Is physics on course to discovering the complete structure and processes of the universe? (2) Could there be another method of obtaining a final, or ultimate, theory of the universe? This was of such broad spectrum that it required a number of subsidiary elements to come to a satisfactory conclusion: (i) why should anything exist in the first place; (ii) into what could the universe be put; (iii) could it depend on a single first cause; (iv) what is the role of mathematics; (v) could a complete theory be obtained by pure reason without the use of mathematics? These questions were ascertained to require a completely new methodology to replace standard methods and, to avoid an inconclusive outcome. The decision was taken to answer (v) by producing such a theory, though, for space reasons, only the fundamental cause was considered in this thesis consigning the structure of particles, atoms and their nuclei, as well as the processes such as force, electric charge, motion to another work (see section 6.4.2).

6.1.1 Overview

Analysis of current methods exposed four major deficiencies in contemporary physical methodology: the lack of fundamental definitions, inadequacy of observation, false reliance on mathematics, and entrenchment of ideas, especially in view of group pressure. Philosophical methods were also deficient in not laying open obvious breaches in common sense, partly on the view that common sense was unreliable but also by accepting peculiar physical concepts. Philosophy's open ended argument policy and categorization methods were found to be incompatible with the needs of philosophy of physics. Consequently, a new methodology, foundational philosophy was introduced in order to work towards a conclusive outcome. The result demonstrated that a final, or all-encompassing theory of the universal structure could be produced by pure reason alone.

This philosophy mainly embraced the fundamental concepts of space and time on the basis that it is impossible to produce a comprehensive theory of the universe without fully understanding these two entities. Whether or not the contents of this theory perfectly represent the fundamental nature of the universe, it contains thoughts that are valuable to both philosophy and science in general. It both separates and ties these two areas of knowledge together. Even though it only deals with the fundamental cause of a Universe it demonstrates that a universal structure can be derived by pure non-mathematical reason. Despite running against views of the impossibility of such an action and running against current ideas in both physics and philosophy, it at the very least creates the conditions which can be developed into a workable theory that gives, for the first time a full explanation of the universe origins, fundamental structure and processes.

Although the quantum mechanical concepts of uncertainty, non-determinism, rebuttal of fundamental causality and local reality, are entrenched in physical dogma, this thesis lays the basis that these are all the result of relying on observation at the expense of clear definitions. Fundamental causality, as opposed to interactional cause and effect, is shown to be a necessity for deriving the structure and processes of the universe. Although it leads to the difficult idea that the natural universe is volumeless and timeless, this is no more difficult than Einstein's deduction that time is relative to the observer, which has been proved through observation correct over and over again. The requirement of causality in this thesis has shown that his theory and the universe having no volume are logical extensions of each other. If one is correct, then so must be the other. As a result, the age-old questions of how far the universe extends, and the ideas of infinity, fall away.

When I first conceived the idea, I did not think that a complete blueprint for the universe would be forthcoming, but rather that the existence of Time would open new possibilities. The choice of Time and the realization that the natural universe is volumeless and, paradoxically, timeless (in the sense that Time is contracted to a point) led almost immediately to a single rule, or constraints on universal development, which every process derived must adhere to. This eventuated in only one evolutionary route; a point which may not be obvious from the preceding chapters because I did not mention all the possible alleys investigated that failed the derived constraints in one way or another. Detailing them would have been outside the focus of this work. Nevertheless, the deductions given do provide a causal deterministic universe with local reality.

It demonstrated that neither mathematics nor observation can lead, in the first place, to a 'theory of everything' though once a comprehensive theory has been established (by philosophical reasoning) mathematics can be used as a test and thus perhaps as an explanation 'after the fact'. Indeed, it demonstrated that the Universe derived has absolutely no need of mathematics, mathematical values or even numbers to exist and that mathematics, far from being Platonic, is a result of the human requirement for measurement. As such mathematics and mathematical definitions have become bound by their own rules, and these have expanded to account for difficulties that have arisen in calculations – the introduction of complex numbers, logarithms, approximations through power series et cetera. It is then difficult to validate the physical laws derived from them because no theory can validate itself. Instead, these laws need to be translated into plain (non-mathematical) language so that philosophical logic can be used as a test.

In particular it showed that definitions are vital to understanding the universe. The ascertainment of the relationship between Time, space and rotation automatically led to a complete understanding of all the processes required for the formation of a Universe. In particular the fundamental definition turned out to be proactive in averting problems rather than providing solutions.

6.2 Fulfilment of Aims and Objectives

The first objective was to develop a fundamental principle with an unequivocal definition, one which could be, and was, used to find a single overarching rule for all the processes of the universe; a rule that could be used to demarcate a clear route through expected possible alternatives; one that held to the philosophical assumption that the universe could not be mathematical in construction; and further would have no need of any numerical valuation process. The cause was assumed to be time for which the first ever definition was provided, though it subsequently turned out that time and rotation are inextricably linked, rotation being the self-generating operator for Time. As would be expected from this basis, new philosophical principles appeared supporting this view. These presented workable alternative interpretations to concepts believed to support modern quantum theories, in particular providing a completely different view of the fundamental structure of the Universe.

The new system was aimed to be as far as possible, independent of any existing ideas. Even a superficial look shows that the result is a completely different approach to understanding the universe and all its processes compared to those of the standard theories. Standard theories have failed to produce a workable theory and grow ever more obtuse in attempts to fit the problems arising from their attempted solutions. In particular, their determination to refute causality has led to peculiar concepts on reality that do not fit human intuition. As a result, education in science requires common sense ideas to be overturned. Such an action can lead to entrenchment of ideas and reinforcement of group and peer pressure. This is clearly shown in section 4.8 on special relativity. Consequently, care needs to be taken on which common sense ideas are misleading, and should be changed, versus those in which physics should be revised, as education in these latter cases may be guiding new theory towards dead ends.

The question of ‘accepted’ theories was a major consideration from the outset, particularly in view of both peer pressure in research groups and education leading the direction of new research along traditional lines. Consequently, much attention was paid to the concept of the role of mythology in early group psyche and its effect on human reasoning. It seems its original directions (pack mentality) still survive to this day. Over several millennia it must have shaped our current mentality from which it is extremely difficult to break away; educational methods and the following of accepted doctrines has caused these doctrines to become entrenched. Entrenchment is the greatest enemy of producing original thinking. Paradigms are rare as a result. The influence of mathematics falls under this realm, particularly in the lack of definitions in physics under the view that mathematics could displace the necessity for them.

The efficacy of mathematics was a major consideration, especially from the argument that mathematics is Platonic, and any theory of the universe must be written in mathematics. Mathematical physics has produced more problems over the universal existence than it has managed to solve. The thesis clearly established that mathematics can be no more than manipulation of synthetic rules and since these rules do not take into account the fundamental background for a universe to exist, that is definitions of space and time, it cannot hope that its rules are sufficient. In this way its rules are similar to mythology. Mathematics is not sapient in itself. It can only be manipulated according to its rules. Its derivations in many cases, such as discarding reality in quantum mechanics, lead to more problems than it solves. While mathematics may be precise within the confines of specific rules it was argued using Hume, Kant, Frege, Duhem, Wittgenstein, Quine, Russell and Gödel among others that mathematics is incomplete. A major consideration was that apart from mathematics being incomplete it also does not necessarily lead to clear understanding. Its ideas should always be interpretable (translated) with clarity and precision into common language. Failure to do so could lead to false ideas. This is equivalent to testing in a different discipline as mentioned at the end of section 6.1.

Without this language conversion, so-called physical proofs and experiments can be made to fit desired outcomes thus maintaining the existing status of theory in line with group and peer pressure. This could be particularly true where theory contradicted common sense such as dismissing the view of a causal universe. Building causality from one axiom exposed possible features of the universe that are presently, if not completely, unobservable in experiment; for example, in section 5.4, the balancing spin $\dot{\psi}$ that leads to the conservation of energy and the contraction and expansion epochs or the lattice structure of the universe with its holes. Being hidden from observation, physicists would have no reason to suspect the outcomes provided by the Time processes, suggesting that the current method of observation followed by theorizing is not necessarily the best method – which again reflects on the problems inherent in peer pressure of groups. .

The concept of existence should also be mentioned as it played a major role in determining the fundamental cause. The question of how a universe could exist without the prior existence of a volume into which to put it led to the concept of Time (not needing a volume to exist) and its operator, rotation, which in turn directly suggested the relativistic production of space. As already explained, although rotation appears the most important of the trio, rotation-space-Time – as rotation is fundamentally energy – it had to follow from Time because its defined function is dependent on

Time. Furthermore, Time could be shown to follow the principle that if it existed at any point it would have to exist forever. In this respect it should be noted that the relativistic production of space and Time explained exactly why Einstein's theory should exist (be caused) in the first place.

However, the overarching rationale of the thesis was that the outcome should not be open ended. Consequently, a difficulty arose over what constitutes a philosophy question as opposed to a foundational philosophy question as raised in this thesis. This was aggravated by the problem that to every concept there may always be alternative opinions, especially where there are no firm definitions of fundamental points. This is certainly true of standard philosophy where open-ended arguments and counter arguments are principles of philosophy (Floridi 2013; Russell 1912; and Acar-Erdol 2020) and of philosophy of physics which is to question physical methodology and physical equations. I suggested that this might have provided an intuitive reason for the failure of any discipline to provide an ultimate theory. It then became a reason for enrolling the concepts of metaphysics and philosophy of physics into a special philosophy which I called a 'foundational philosophy' in respect to the thought that the most important questions could only be answered by uncovering a fundamental cause of everything in the universe.

The question of the form of argument as raised by Floridi, Russell and Acar-Erdol – open, closed, or empirical and then philosophical or physical – was demonstrated to follow from the failure of providing definitions for the fundamental entities such as mass, electric charge, time, space, rotation, force, energy, waves, et cetera and thus by implication any other concept involving any of these. This failure feeds the Frege and Wittgenstein-Quine reservations. On the other hand, a clear definition should arrive at a closed answer, though it may pass through several stages before arrival. But even then, there may be other possible answers. For arguments about the universe to be valid they need to be backed by tests from a different discipline. For example, mathematical arguments are within mathematics rules and thus physical tests (which are based on mathematics) only demonstrate the rules which may not be sufficiently developed to cover unknown universal processes.

On the same lines, Russell mentioned three "laws of thought" for philosophical arguments which I suggested were restrictive to human intuition; they seemed self-evident. If the fundamental principle of existence derived could be proved correct then certainly the second and third laws, the laws of contradiction and excluded middle, would fail and the first could be arguable. That is, by their construction, Time and space both exist, and do not exist, at the same instant depending on how they are considered. They do not exist in the sense the Universe has nothing into which it can grow – no real space, nor does the Universe have a Time interval in its fundamental state. On the other hand, the relativistic concept of motion generated by p-rotation allowed a pseudo or relativistic space and Time interval to appear to objects capable of noting this appearance. Thus, from the fundamental definition, space and Time could be said to both exist and not exist at the same instant; and it is the human belief in the three laws of thought that make it difficult to understand this relativistic position. The thought that such a possibility arises refuted the three principles of thought as being laws.

Finally on the subject of open answers, the fundamental concepts for a universe were obtained by pure deductive reasoning from an unequivocal definition and nothing else. Unfortunately, for space reasons, only those parts that contribute to answering the two fundamental questions of why anything exists and into what could that existence be placed have been included in this thesis (cf section 6.4.2). But even here only one direct route was reported on as the number of dead ends was too long and complex for inclusion. The final result thus depends on only the fundamental definition and overarching rule and nothing else for its deductions.

As stated above, the overarching rationale was that the outcome should not be open ended. It is easy to condemn hypotheses that are not producing the desired conclusion. But in the main this is useless unless a positive alternative can be produced. In the case under review, the final result was the production of fundamental conditions that answered the two most important questions of existence why anything exists and into what can it be placed without having a prior volume (existence of volume). Furthermore, not only can a causal universe be constructed, but it can also be constructed without mathematics or numbers. It is the reliance on mathematics and failure to define the fundamental entities that has, in the main, caused the failure of physics to produce a theory of everything.

6.2.1 Ramifications, revolutions, and 'firsts'

(1a) The major revolution is in understanding that numbers, and thus mathematics, play no role whatsoever in the construction or natural processes of the universe. Mathematics *follows* from the requirements of the human mind to allow mensuration and imposition of so-called scientific laws.

(1b) Numbers follow naturally from an original cause which itself is self-perpetuating.

(2) This thesis thus produces a complete and necessary revolution in the method of thinking, not only in physics and mathematics, but of all science and philosophy. It thus affects and broadens the methods and methodology of attaining information. Reliance on old ideas that have not worked is vapid. Originality or 'think tanks' are never remiss if based on rigorous evaluation.

(3) First ever definitions or complete descriptions are given for Time, space, and rotation, the definition of the last in standard dictionaries being semantically incomplete.

(4) Human invention and perception have revolved around the concepts of flow of time and measurement, the expression of which in human theories has led to confusion and complexity of description which is alien to the simple spontaneous actions of the Universe. Consequently, transposing descriptions of foundationally caused actions to human ideas makes them seem difficult and complicated, especially with reference to the human imagination needed to understand them. Thus, human thought and vocabulary (to a much lesser extent) has to itself undergo a revolution.

(5) Humans are used to cause and reaction in time order (irrespective of what QM might consider). The single short rule derived from the concept of rotation-space-Time does not consider possible problems that might arise from its simplicity. Everything must happen spontaneously according to this rule. That is, at the fundamental scale it reverses the concept of 'cause and reaction'. The cause is pro-active instead of reactive so that what humans might see as problems to the cause are ruled out before they can arise.

(6) Using a first cause showed that there could be important natural processes that are completely hidden from observation, for example, the ψ-rotation. Consequently, the physical method of using observation to attain physical laws was always doomed to failure. Worse, it could be driving physics in the wrong direction.

6.3 Common sense

Common sense has been a consideration of this thesis throughout. Common sense has been considered suspect by philosophers and physicists alike, and should still be considered so, as not everyone's common sense agrees with everyone else's. Nevertheless care should be given as physics based on empiricism may not provide correct answers. For example, Einstein's common sense on reality (EPR see supplement) denied by QM and Bell's inequalities (and Bohr's concept of atoms not being real objects – if unreal do they exist?[111]). Chapter 4 and associated articles showed that in their determination to prove the concept of indeterminacy, or the correctness of the QM basis, physicists had not considered deeply enough the disagreement between experiment and statistical manipulation. This seems to confirm the suggestion that physics is more subjective than objective than expected in that several concepts in special relativity are open to question, while Heisenbergs uncertainty principle seems to defy the possibility of a causal universe. Local reality in our observable Universe is a valid viewpoint. We do not need to mutually interact with an object in order to see it. We do not send out photons from our eyes to the object nor do we exchange photons with the object. We only

[111] See section 2,1 or 5.2.2.

need to receive photons from the object to know that it exists. The moon (and the universe) *is* there when nobody looks. If, as seems possible, social attitudes have had an adverse effect on scientific research, then there is a real need to completely overhaul the contemporary method of viewing physics. In this respect the view taken in Chapters 2 and 4, that metaphysicians are remiss if they ‘rubberstamp’ QM dogma instead of investigating its peculiarities, is obviously correct.

Furthermore, educators should give care when they see common sense and physical ideas conflicting. Applied mathematics is based on human devised rules to give outcomes. As a result, though it will give correct outcomes to suitably prepared inputs it is unable to explain fully the ‘how’ behind its results. If the how is known, then conflicts between physical outcomes and common sense may be reconcilable as it fills in the ‘how’ rather than the outcome. The problem arises when empiricism, with accompanied entrenchment of its ideas, reigns supreme and probable false views are taken up by the peer group as if their strangeness gives intellectual power over lesser educated individuals.

6.4 Further research

Considering the novelty and contentious nature of this thesis there are numerous openings for further research. Some of the more important areas are suggested below.

6.4.1 Philosophy

Following directly from the previous section, could Platonism in mathematics be reconsidered from the instrumentalism point of view? As suggested by the foregoing chapters, does the view that mathematics is not immune to the possibility of ‘hidden from us’ effects destroy the view of a Platonic mathematics? This view suggests mathematics cannot completely describe the universe and it suffers from the same problems that empirical physics suffers through these ‘hidden from us’ variables. If so, then mathematics may only be the result of the human need for measurement and not a pre-requirement for the existence of a universe. Thus, it would be only a human invented tool. In these respects, although much work has been done on peer pressure in the workplace very little attention has been paid to peer pressure in academic scientific groups.

Mathematics needs to be examined in relation to reality; for example, the meaning of numbers less than zero. These obviously have a meaning from accounting and measuring processes but as just mentioned, the universe does not need measurement to exist. What do negative numbers mean, then, in terms of the reality of the universe? In particular how can the square root of minus one be interpreted in terms of reality even though it has great use in allowing calculations to be conducted.

There is the concept of wave in quantum mechanics based on sine waves which are limited to the region plus or minus one in amplitude. This is useful, again for calculations, but does it really have any meaning in the reality of the universe?

Turning to metaphysics, there is much room for research and comment on the methodology that has led physics on its current path, and also to the lack of challenging ideas that seem so peculiar to common sense. The question has to be raised how physics could have been allowed to advance so far with only scant attention to some of its most fundamental concepts. In particular, what is the real value of physics, is it purely 'instrumental' in its undoubted contributions to human living conditions? As above the effect of group pressure should be considered.

6.4.2 Physics and philosophy of physics

A new theory is expected to produce novel ideas that can be checked. Some hidden concepts have already been mentioned above, such as the lattice structure of space-Time, and its irregular formation arising from coincidences leading to holes in space-Time; or the balancing spin required to keep the expansion of the universe in line with conservation of energy.

This thesis has covered only the concept of space and time with relation to the causal formation of a Universe. In so doing it attacked quantum theories as not being founded on fundamental definitions and the prevailing view that the universal structure and processes can only be explained through mathematics. It also demanded the concept of a fundamental cause for both the theoretical Universe and the universe we live in to exist. Such radical views must be testable. However, due to length constrictions such a test has had to be left to other documents.

The following concepts are in preparation. Many possibilities for further research follow from them.

1) The structure of particles and their properties with comparison to those of the neutron, proton and electron. This would include investigation and definition of the ideas of mass and electric charge.
2) The electron-proton relations including accurate predictions of electron orbitals for the H^1 atom and energy absorption and emission spectra.
3) Force, motion and energy need to be completely defined, meaning that the exact mechanics of their action is derived from the fundamental cause. This may be of interest in difficult chemical reactions and in spectral analysis.
4) The fundamental rule for the Universe (section 4.11) can be converted to provide for the human predilection for measurement. This involves the construction of an equation of motion which can be

used to test the accuracy of the Time based theory after taking into account 1), 2), and 3) above to give what humans recognize as the mass ratios of the electron to proton and neutron as well as the muon and tau particle. The construction should also give Planck's constant. The main dynamics equations such as $E = mc^2$ and $E = ½ mv^2$ and Newton's laws together with the value of the fine structure constant and its reason for existence should also emerge from first principles.

5) The structure of nuclei should be completely explained and provide reasons for Mendeleev's Table as well as differences in the table's groups. It should also derive the structure of chemical bonds.

6) The peculiarities of neutrinos are unexplained in physics. Their role should emerge from the fundamental cause.

7) The explanation of gravity and its relation, if any, to the so-called concept of mass should be fully explained.

8) The unexpected structure of voids, walls and apparent dark flow in the universe should be explainable from the lattice structure. It can be tested by further research on the Planck satellite measurements.

9) QM and QFT need to be thoroughly investigated, especially with reference to the double slit, and delayed choice experiments. 'Classical' outcomes should be expected based on the foundational cause and items 1) - 3) above. This is especially true of Heisenbergs uncertainty principle yielding both indeterminacy against causality and local reality as expressed by EPR.

10) Schrödinger's equation should be investigated with particular attention to its derivation from the foundational cause and its relationship to 'potential energy' and the wave-nature of matter.

11) Items 5) and 6) might help in the construction of fusion reactors.

12) The basic structure of space given by Figures 5.2 and 5.3 should lead to a spiral approximating the natural spirals found in nature, similar to the Fibonacci spiral.

Outside of physics an explanation of the right-handedness of biochemicals should be expected as well as the possibility that life would automatically arise on many planetary objects, or even asteroids, though not necessarily developing as it has done on earth.

6.5 The motivational problem of Chapter 1

This thesis asks why with all the effort put into science over the last few decades, a standard theory of everything is no closer now than it was years ago. As suggested in sections 6.1 and 6.2 the main reasons are lack of fundamental definitions, inadequacy of observation, false reliance on mathematics, and entrenchment of ideas. Further, physicists tended to divide the quest for knowledge into two, physics and philosophy, even renouncing the latter (deep philosophical concepts). But philosophy might not have helped itself in conducting open ended arguments instead of trying to find a categorical conclusion, as for example might be hoped for in its idea of tropes. Certainly, casting aside new ideas and latching onto ‘naturalistic metaphysics’ based on the ‘truth’ of quantum mechanics suggests a complete failure of the ideals of philosophy.

Not enough attention has been placed in physics and philosophy on ascertaining the mechanisms/ actions of force. On the other hand, too much reliance has been placed on abstract concepts such as potential energy and waves under the impression that if mathematics works in many respects, it must be *the* correct explanation. If quantum mechanics is purely mathematical then it cannot be fundamental to the Universe derived in this thesis because the Universe has emerged without any use of mathematics. Furthermore, the Universe relies on causality which in itself provides definite positions for its particles at any point in Time contrary to the fundamental dogma of QM. In any case mathematics is connected with space and time for its operation which has been argued to be fundamentally measurement through the counting number concept, so it seems unlikely that mathematics could precede a universe of any form but rather must follow from existence of something. The fact that space and time has been ignored in standard physics as anything other than intuitively existing entities without need for definition also affects the use of mathematics as seen in the EPR objections to entanglement. It has also been shown that infinities and infinitesimals which are inherent in human mathematics cannot exist other than in mathematical derivatives. Furthermore, if one considers rotation, a definite mathematical and geometrical concept, it is clear that it is only what it does that is mathematical and geometrical. It is only rotation’s measurable sense that is calculated. Rotation’s ‘is’ is transcendental, fundamental to the Universe, and the fundament of energy. When it comes to the Universe, we have to go beyond measurable to transcendental ideas outside human perception where mathematics has no role.

In view of these deficiencies and the reliance on mathematics it is clear why this thesis had to be written within the discipline of philosophy. Furthermore, this thesis is concerned with the study of the nature of the universe, the nature of its foundational cause, and the nature of its existence. The role reversal that philosophy should produce the theory and physics the test of the former’s accuracy is fully justified, particularly in terms of Aristotle’s view that physics was a result and ‘metaphysics’ was the difficult concept that led to the physics.

One must not forget that human sapience is based on perception of the world around us and that this will have shaped our concept of measurement without measurement necessarily being any consideration of the formation of the universe. Consequently it should not be surprising that one can connect one human idea with another; for example, trigonometry to our perceptions. But that does not make it, nor concepts based on it, absolutely accurate. We need to go far deeper into all the processes of the universe before entrenching ideas in physical dogma. It is not satisfactory to avoid important concepts just because they are difficult to understand. If physics and mathematics cannot explain them then pure transcendental reason should be attempted.

As I said at the beginning there can be no absolute proof that any model of the universe is correct. I can do no better than present a new fundamental concept and leave the decision to which seems more likely; the new scheme or the standard theory.

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