DECOHERENCE
Mount Albert Science Center

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ABSTRACT

Philosophy, Science, and Architecture have ever been engaged in serious interdisciplinary discourse. In various and profound ways, each discipline derives insight from the others. The discoveries and insights held between this triumvirate provide today’s developed world an unprecedented degree of productive and creative potential, comfort, and recreational pleasure.

But as each discipline necessarily becomes increasingly specialised the ability for discourse becomes imperilled, for the ability to apprehend the internal language of each becomes correspondingly more difficult. The confusion described in the mythical Tower of Babel comes to be understood as an emergent property of humanity’s acquisition of insight. To ensure the continuation of the discourse therefore, effort must be made to facilitate it.

This research therefore seeks to compare positions found within theories of Philosophy, Science, and Architecture, in order to consider how commonalities or contradictions might inform aspects of the work of architecture. It also seeks to present an architectural scheme in which scientific and intellectual endeavours may be not only pursued, but also shared openly with the community.
Firstly, it is with immense gratitude that I thank and acknowledge Sue Woods, without whose amazing love and support my entire education would have been considerably more difficult. Many thanks to Dr Christoph Schnoor, whose guidance and insight have been invaluable across many projects, including this one. Also, thanks to my father Ken Storrie for all his support and encouragement.
# Table of Contents

ABSTRACT .................................................................................................................. 1

ACKNOWLEDGEMENTS. .............................................................................................. iii

Architectural Intent ................................................................................................. 1

  Aims and Objectives ............................................................................................... 1

  Scope and Limitations ............................................................................................ 2

INTRODUCTION .......................................................................................................... 3

1.1 METAPHYSICS ...................................................................................................... 5

  Monism and Dualism .............................................................................................. 7

    Dualism .................................................................................................................. 7

    Monism .................................................................................................................. 8

    Pluralism ............................................................................................................... 8

Ancient Period .......................................................................................................... 9

  Plato ......................................................................................................................... 9

  Aristotle .................................................................................................................. 10

Renaissance Period ................................................................................................. 12

  Rene Descartes ...................................................................................................... 13

The Enlightenment .................................................................................................. 14

  Immanuel Kant ....................................................................................................... 15

Modern Period ......................................................................................................... 16

  Husserl .................................................................................................................... 16
**Architectural Intent**

This research acknowledges as a truism that there is perpetual discourse between the disciplines of Philosophy, Science, and Architecture. It is therefore the intention of the research to examine specific contemporary ontological positions associated with architecture and science, and to apply this understanding towards the production of a work of architecture.

**Aims and Objectives**

The aim of this project is to identify recent and contemporary ontological frameworks which underlie the discipline of architecture, at the levels of both practice and theory. These frameworks will be compared and contrasted with those informing the modern scientific discipline of Quantum Mechanics. The objective is to utilise the commonalities and disagreements uncovered by this analysis to derive insights and mechanisms useful in the design process of a work of architecture.

*Part I* of this document will provide a retrospective overview of the competing ontological positions central to this research problem, and will be necessarily (and perhaps mercifully) brief. Beginning with a discussion of metaphysics we will establish the fundamental dichotomy which is central to the programme contained within the architectural brief. Following this we will shift our attention to the key points of Quantum Mechanics, with a brief outline allowing us to properly understand the strangeness of the various ontological models associated with it. Following this will be a
Survey of ontology as it relates to architecture at the levels of both practice and theory. This section will close with analysis of ontological positions regarding architecture, and within the discipline itself. From this understanding we will extract our architectural part, which will inform the architectural design stages of the project.

*Part II* will outline the architectural ‘research by design’ project, beginning with a description of the project’s aims. An architectural ‘kit of parts’ will be developed in response to the discussions in *Part I*, which will then be utilised in the design process wherever appropriate.

**Scope and Limitations**

It is not necessary, or even possible, for this research to examine and paraphrase the histories of ontology, science and architecture in full. Rather, the opposite is the case; it is necessary to confine its scope to the specific areas of thought which relate firstly to the research project’s stated aims and secondly to the architectural design process. Therefore the pedigree of the ideas presented will be elaborated upon only where it serves the project’s aims, and countless fascinating schools of thought will remain unexamined. Similarly, it is not possible to be deeply analytical about the theories mentioned, other than to uncover the similarities or differences between their positions which may be relevant to the design process.
INTRODUCTION

Philosophy, Science, and Architecture have ever been engaged in serious interdisciplinary discourse. In various and profound ways, each discipline derives insight from the others. The discoveries and insights held between this triumvirate provide today’s developed world an unprecedented degree of productive and creative potential, comfort, and recreational pleasure.

But as each discipline necessarily becomes increasingly specialised the ability for discourse becomes imperilled, for the ability to apprehend the internal language of each becomes correspondingly more difficult. There is a perceptible delay between theories of architecture (and indeed the wider community) and contemporary theories of science. The scientific discoveries of the Renaissance period, for example, did not manifest in architecture until the Enlightenment, well over a hundred years later.

The effort must be made to continue the discourse, to ensure the intellectual distance is not permitted to widen beyond repair. Architecture, faced with uncertainty over future environmental conditions, requires scientific insight today with a tangible sense of urgency. Architecture also has its own insights and abilities, which may be employed to provide facilities which encourage and enable scientific endeavour.

Examination of key intellectual positions shared by all three disciplines forms the backbone of this research project. This is not to say that the work seeks to formulate a quantum mechanical phenomenology of architecture, but rather to apply an understanding of these positions in the production of a work of architecture which aspires to support and promote scientific discovery into the future.
1.1 METAPHYSICS

A unifying aspect of human intellectual endeavours throughout history has been the pursuit of theoretical frameworks which reliably explain our observations of the natural world. The philosophical analysis of such frameworks is broadly referred to as metaphysics, which may be considered to encompass the study of reality, knowledge, and experience. Simply put, ontology is the philosophical study of “what there is” or, more broadly the nature of being and existence\(^1\). Almost any given intentional human activity has an associated body of theoretical knowledge pertaining to it and most of these theories contain some kind of ontological component, whether clearly expressed or merely implied. For instance, there is a clear ontological component to various human endeavours such as religion, politics, or science. For others such as architecture, the ontological component is typically less overtly stated, but still present and often able to be deduced.

For reasons that will be expanded upon later, this research focuses on two oppositional ontological models. First is a worldview in which nature is composed of two components, a physical component (matter or substance), and a non-physical component (ideas, souls, perfect forms/proportions, etc.). The second is a worldview in which nature is made only of a single unified component, and non-physical things are

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products of the behaviour of that component. *Dualism* and *Monism* are the labels for the broad categories of ontology under which these conflicting views fall, although some monist positions are perhaps more closely aligned with the dualist position than with the monist *materialist* positions favoured by scientific method.

Pythagoras’ discovery, in the 6th century B.C.E., of an apparent hidden mathematical order in nature is arguably the point at which humanity began to understand the universe in a scientific way. The formulae he discovered proved particularly effective, especially in the areas of geometry and music, and remain useful today. However, the important ontological question raised by his discovery is: what is the nature of the relationship between these abstract numerical entities and the physical world?
Monism and Dualism

Dualism
A dualist description of nature proposes “two equally powerful and antagonistic metaphysical principles which compose all of existence”\(^2\). The first principle explains immaterial things such as thoughts, ideal forms, or human souls; the second explains the physical world composed of material entities, objects, and is occupied by human bodies. Within the broader context of philosophy the term dualism may also refer to several other distinct arguments. Moral Dualism is a discussion about the concepts of good and evil; Substance Dualism refers to the apparent division between mind and matter. This is most often referred to as Cartesian Dualism or the ‘mind-body problem’, and is this position that we are primarily concerned with in this research.

Human beings appear to have dual sets of characteristics, both immaterial and material. At a base instinctual level, we perceive our minds to be somehow made of different ‘stuff’ than our bodies and the objects within the physical world. The question of how something non-physical might have a causal relationship with something physical is one of the crucial problems inherent in the dualist position.

Monism
In opposition to the worldview of dualism is that of monism, the position that the world consists of only one domain or one kind of thing. Monist views differ widely in their finer details, with positions ranging from the theological (there is only God) to the materialistic (there is only matter). The monist position is that a single principle explains all of reality, and apparent dualities or pluralities in natural phenomena either derive from this principle or are illusory.3

Pluralism
In contrast to both dualism and monism a pluralist position exists, which rejects both absolute dualism and absolute monism in favour of a more inherently ambiguous state of reality. Within this view an individual’s phenomenal notions about reality are always influenced by a mix of individual factors such as cultural and historical context.4


Ancient Period

Plato

In his dialogue *The Republic* of c.380 B.C.E., Plato (c.429-c.347 B.C.E.) details his *Allegory of the Cave*. This takes the form of a dialogue between Socrates and an interlocutor, Plato’s brother Glaucon. Plato has Socrates describe a scenario in which a group of humans live their entire lives with their legs and necks chained to the wall of a dark cave, facing one of its walls. Above and behind the prisoners and unknown to them is a ledge, upon which a large fire burns and puppeteers walk by carrying various items and making noises which echo within the cave. These performers cast shadows on the wall below, and for the prisoners these shadows and echoes constitute the whole of ‘reality’; their ontological model is derived from what amounts to an illusion⁵.

This allegory continues a line of thought Plato had earlier discussed in *Phaedo*, that there exists an independent domain of perfect non-physical, eternal and unchanging *forms*, which he called *eidos*. In Plato’s ontology the realm inhabited by these forms was in fact the *real* world, and the changeable and temporal material world is composed of imperfect approximations derived from these forms. Only these material *instantiations* of the forms can be known to human perception, but we have knowledge of them through our souls’ acquaintance with them, at some point before our own instantiation (that is, our conception or birth)⁶.

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These ideal Platonic forms could include such things as ratios and formulae, shapes, animal prototypes, aesthetically beautiful compositions, or political, social and justice systems. The independence of this realm can be illustrated by considering the equation 1+1=2, which for Plato would remain ‘true’ even if there were no physical world in existence. This notion has implications for architecture as, by extension, perfect and eternal architectural forms must exist and are instantiated in the physical world through the processes of architectural production.

For Plato then, we are like the prisoners in the story. Our perceptions of the world, while entirely rational and appropriate to our observations, are constrained and limited by this dual nature of reality. Implied in this position (or, at least by the allegory) is that our awareness of the perfect forms of this netherworld lies latent within us, and when a human being invents some new thing, such as a work of architecture, it involves a process akin to discovery.

Aristotle

Aristotle (384-322 B.C.E) proposed an ontological model in which underlying categories play a role in the nature of things in the world. Of particular interest to architectural theorists are his notions regarding form and essence.

Aristotle’s metaphysics proposed “universals”, or categories into which existence may be divided, including substance, quality, quantity, relations, and actions. Instead of the duality of Plato’s eidos, Aristotle proposes what are thought of as essences: “what it is

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to be that thing”. Such an essence plays a causative role in the ontic characteristics of whatever substance it is found in but is nevertheless a property of that thing, not a separate ideal. In Aristotle’s view therefore, non-physical things are not to be thought of as being part of another, unseen realm but are instead within a category of non-physical things within the physical world. With this notion, Aristotle rejected Plato’s dualist ontology in favour of a monist one.

Among his categories, Aristotle elevated that of substance to a higher priority than the others, and argued that something from a non-physical category such as shape or colour cannot have an existence independent of a substance in which it is found. The colour green, for instance, could not be said to exist independently of things which are green⁹.

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Renaissance Period

Prior to the observations of the Jupiter system performed by Galileo Galilei (1564-1642) the reigning ontological models unanimously held the Earth and mankind at the center of the universe, with all the celestial bodies orbiting it at various distances. Galileo’s observations served as proof of the theory proposed by Nicolaus Copernicus (1473-1543), in which the Earth was no longer assumed to occupy a position of privilege at the center of the universe, previously believed to be a position held at God’s decree. Sir Isaac Newton’s (1642-1727) laws of motion further refined the new cosmological descriptions of the material aspects of the universe.

Philosophers of the Renaissance period now found themselves confronted by an empirically verified ontological model in which humans were no longer considered to occupy a special position. In addition to this, all previously assumed facts were now cast into doubt and due for new consideration under the scientific method. These scientific and philosophical developments had major implications for architecture as practiced and theorised in the centuries to follow. For instance, the new ontological Zeitgeist was explicitly promoted by French architect Étienne-Louis Boullée (1728-1799) in his project for a cenotaph for Isaac Newton (1784), or his project for a royal library Bibliothèque du Roi (1785).
Rene Descartes

French philosopher and mathematician Rene Descartes (1596-1650) produced a large
body of work in both disciplines. Among Descartes’ interests was the problem of the
apparent distinction of mind from body, often referred to as the mind-body problem.

Descartes argued that the human body has material properties and behaves
something like a machine, which is to say that if conforms to the apparent laws of
nature. However he argued that the mind is different: non-physical and not constrained
by the laws of nature. Although Descartes offers that the mind interacts with the
physical world through the brain’s pineal gland, he is still unable to overcome the issue
of how something with no physical existence could actually interact with a system
composed of physical material.\(^{10}\)

Through sound reasoning Descartes investigations led him to his famous conclusion that
the first principle that one may be certain of is one’s own existence: “I think, therefore I
am”. But in light of the compelling objections to dualism Descartes’ insight may only be
taken as apparent proof of the existence of the self: the I; the existence of the material
world beyond the self cannot be presumed.\(^{11}\) The problem of the existence of the external
world outside the mind, raised by objections to Cartesian Dualism, was taken up by
philosophers in the Enlightenment period which followed.

\(^{10}\) Gary Hatfield, “Rene Descartes”, The Stanford Encyclopedia of Philosophy (Summer 2011 Edition), Editor

\(^{11}\) Peter Machamer & Francesca di Poppa, “Dualism”, In Gale New Dictionary of the History of Ideas, Editor
The Enlightenment

The philosophical and scientific revolutions begun with the Renaissance came to full fruition during the Enlightenment period. The new ontological climate, which placed high value on reason and science, proved to be a powerful position from which to uncover truths about nature. Of particular interest to philosophers of the Enlightenment was epistemology, the consideration of what is objectively knowable.

The dislodgement of God implicit within the scientific discoveries of the Renaissance, but often suppressed for fear of reprisals from the reigning religious authorities, also came to be explicitly examined during the Enlightenment, beginning the gradual diminution of organised religion’s influence on politics, society, and ontological discourse.
Immanuel Kant

Immanuel Kant (1724-1804) sought to forge a metaphysics supported by both reason and experience. His influential formulation of what can be considered knowable divided knowledge into two categories: *a priori*, which is independent of experience, and *a posteriori*, which is dependent on experience or empirical.

Kant viewed human cognition as a mechanism for creating order from our perceptions of the world. He argued that although we perceive objects as existing in space and time, this is a result of our cognitive processes (phenomenal) rather than a property of the objects themselves (noumenal). We can only know about our perceptions of objects, not about how they actually are. This is not to say Kant was rejecting the existence of the external world: rather, in his view the question becomes meaningless. It is something we cannot know about, other than by cognitive phenomena produced by our interactions with it.\(^2\)

Kant argues that despite this, by using reasoning and a priori and a posteriori knowledge, that we may however form judgements about things. Of specific interest to architects are Kant’s views on the ability to judge aesthetic beauty. Importantly, he argues that the beauty of an object cannot be related to concept, but only to the object’s perceived properties. This connection between beauty and perception means that, in Kant’s view, beauty is a mental state occurring in the observer rather than a physical property of the object itself.\(^3\)


\(^{13}\) Ibid., pg85.
Modern Period

Husserl
With the philosophy of Edmund Husserl (1859-1938) a new approach to the problems of epistemology began to develop, which would be particularly influential throughout the twentieth century and continues to be so today. This position, known as Phenomenology, disregards considerations regarding the existences of material things and instead focuses on the study of human experience (or, the contents of human consciousness)\(^\text{14}\). It is not technically an ontological position in this respect, as it is concerned with \textit{what is knowable}, rather than \textit{what there is}. Its deferral of questions about the existence of the external world carries with it an implied dualism\(^\text{15}\). One aspect of phenomenology that is particularly relevant to architecture is that things such as aesthetic beauty and meaning are in fact the result of cognitive processes, rather than properties of the objects in themselves.

Heidegger
Martin Heidegger (1889-1971) rejected all notions of dualism, and proposed a phenomenological position that understands the individual being as a phenomenon of consciousness. Instead he argued for a monist existence in which the notion of \textit{being}, which he referred to as \textit{Dasein}, becomes a phenomenal aspect of matter. In this view

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there are no objects or subjects but rather a single system, within which *Dasein* is able to dwell through devices such as language and building.

His thoughts about language and building as the mechanisms which enable *Dasein* to “dwell” in the world led him to devote a degree of attention towards architectural theory, with his essay “*Building, Dwelling, Thinking*” exerting strong influence on architectural theory in the following decades.

**Summary**

We have seen that there is no consensus among philosophers as to the exact ontological nature of the universe as we perceive it. This lack of consensus is in fact an apparently perpetual and *generative* condition, which stimulates each further development within the debate. The primary focus has been on dualist and monist positions, as this dichotomy within philosophy resonates with the apparently individual human being.

The associations made by philosophers between mathematics and logic, and the apparent order in nature provide the most fundamental area of agreement between these conflicting ontological positions.

Perception appears to inform the human mind that it is profoundly separate from its surroundings. This latent dualism often provokes a sense of discomfort within the mind, when confronted by particular aspects of the scientific understanding of “*what there is*”. It is with this in mind that our attention now turns to the current scientific position regarding nature at its most fundamental level.
1.2 QUANTUM MECHANICS

It is important to note that there is no single, unified philosophy of science. This seems ironic, for a discipline primarily engaged in furthering our understanding of the unassailable truths of nature. Under one philosophy of science promoted by Karl Popper (1902-1994), any such unanimous philosophy would in fact be unscientific, and therefore of no interest or use to science. Popper’s position was that, for any argument to be considered scientific, it must be falsifiable. That is to say, any scientific hypothesis must be open to experimental testing, and potential must exist for that testing to disprove the hypothesis (should it in fact be wrong).

The scientific method favours philosophical positions anchored in logic and observation, and employs methodologies which demand an exclusion of emotion and faith, though not necessarily of intuition. Where the outcome of empirical observation contradicts intuition-based belief, the scientific method insists that the conclusions derived logically from the evidence, no matter how counter-intuitive, form the most accurate and objective depiction of “reality”.

Perhaps the most surprising ontological model arising from the discoveries of science is that arising from the theory of Quantum Mechanics (QM). The behaviour of matter becomes remarkably different at immensely small scales; a Quantum Mechanical universe seems so at odds with human experience that the reality proposed by its observations may only be grasped at an abstract, intellectual level rather than a familiar, intuitive level.

Regardless how strange ontological frameworks associated with QM, it is an
immensely powerful scientific tool which has provided humanity with its most deeply-rendered depiction of how the universe behaves at the smallest sub-atomic scales. Perhaps more importantly, Quantum Mechanics is the scientific theory underpinning all of humanity’s electrical inventions, from the electric light bulb to the Apple iPad. As a tool, it is known to produce results.

A Brief History

In order to understand a mechanism as abstract and technical as quantum decoherence it is necessary to first consider the theoretical context within which it operates, which is the scientific discipline of Quantum Mechanics (Q.M.). Simply put, Q.M. is a branch of physics which analyses and makes predictions about the behaviour of matter at sub-atomic scales. Through careful experimentation, observation and extremely complicated mathematics Q.M. has developed a remarkably reliable description of nature’s behaviour at the smallest of scales. It has also become one of the human species’ most useful tools, giving rise to the entire electronics and computer industry.

Although it is highly technical in nature, and expressed in a nearly impenetrable mathematical language, Q.M. attracts much attention from interested laypersons worldwide. This is not due to its role in modern technology, but rather for the fact that its description of nature’s behaviour at tiny scales is particularly bizarre, and poses profound and revolutionary ontological implications.

Although Q.M. as a whole is contributed to by numerous individual pieces of work and experiments, there are three particular pieces of work which must be
considered in order to understand any ontology derived from the quantum mechanical
description of reality. These are black body radiation, the Uncertainty Principle, and the
Double-Slit Experiment.

Until the beginning of the twentieth century the discipline of physics was
dominated ‘classical’ mechanics. Based on the laws of motion Sir Isaac Newton
published in his 1687 *Philosophiae Naturalis Principia Mathematica*, classical mechanics
accurately describes the motion of macroscopic objects. Newton’s laws were incredibly
accurate, and still form the basis of our understanding of the motions of large objects
such as galaxies, planets, communications satellites, and artillery shells. However,
Newton’s laws break down when they are applied to the behaviour of objects at very
small scales.

One of the issues faced by physicists was whether light exists as a wave or as a
particle. Newton proposed a theory in which light is comprised of individual particles
which he called *corpuscles*, and this view dominated until James Clerk Maxwell (1831-
1879) produced equations in 1861-1862 which apparently proved the wave nature of
light. Now known as the Maxwell Equations, these also showed electricity and
magnetism (previously thought to be individual forces) were actually one force,
electromagnetism.
Black-Body Radiation

At the end of the nineteenth century physicists were attempting to resolve one of classical physics’ problems, known as black-body radiation. All matter which has a temperature above ‘absolute zero emits electromagnetic radiation. According to the laws believed at the time, calculations suggested that a hypothetical physical body capable of absorbing all electromagnetic radiation falling upon it, which is in thermal equilibrium with its surroundings, should emit an infinite amount of radiation at the shortest wavelengths (the ultraviolet end of the spectrum). In mathematics any equation which yields an infinite result must be incorrect, and this prediction was therefore referred to as the ‘ultraviolet catastrophe’ for it indicated a failure of classical theory’s power to fully describe physics16.

Working to resolve this problem, German physicist Max Planck (1858-1947) proposed that the energy radiated by the black-body was not continuous but rather was emitted and absorbed in individual pieces which he termed quanta17. Planck showed that each quantum contains a certain amount of energy which is proportional to the frequency of its wave; the higher the frequency, the higher the energy. This means that at high enough frequencies the energy required to emit a quantum would be greater than is available, and the quantum cannot therefore be emitted. With this work, now known as Planck’s Law, Planck had not only resolved the problem of the ultraviolet catastrophe, but had made the discovery which initiated the era of Quantum Mechanics.

17 Ibid.
The Uncertainty Principle

Following Max Planck’s discovery of the quanta, physicists quickly took it up as the most exciting area of theoretical physics. German physicist Werner Heisenberg (1901-1976) produced a mathematical argument that became one of the defining tools within Q.M.

Heisenberg discovered that the more detail one knows about the position in space of a particle, the less one can know about its momentum. This discovery was at first considered to relate solely to the mechanics of observing the particle (as any physical measuring apparatus must interact with it, thereby changing its position or momentum). But further consideration of this aspect of nature revealed that, instead of us being unable to measure the exact state of the particle, it actually has no exact state. Instead the particle exists in what is referred to as a superposition of states, which is to say its state appears to be smeared out within its environment. This superposition of states is of particular interest when considering the “double-slit experiment” discussed in the next paragraphs.

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The Double Slit Experiment

The so-called “double slit experiment” is a physics experiment that is simple in nature, but reveals some of the most intriguing aspects of nature. Most importantly, it demonstrates what is known as the *wave/particle duality* of matter and energy.

Originally devised in 1803 by British physicist Thomas Young (1773-1829), the experiment involves directing a light source towards a card in which is punctured by two parallel slits. Behind the screen, a photographic medium records the light that passes through the slits, which may be either-or-both open.

Using a constant beam of light with a single slit open, a predictable single band of light is recorded by the photographic plate behind. However with both slits open, rather than showing two individual bands, the photographic plate records what is termed an *interference pattern* of alternating dark and light bands, a structure understood to be typical to *waves*. This phenomenon can be seen in the ripples in a pond, when two or more disturbances in the water cause series of waves which *interfere* with each other. Where wave crests overlap, they amplify, where crest overlaps trough, they cancel. The resulting interference pattern recorded by the apparatus shows that light is wavelike in nature.\(^{19}\)

However, this is seemingly at odds with the ‘photoelectric effect’ (for which Albert Einstein earned the 1921 Nobel Prize in Physics) which shows that light comes in discrete particles. 19th century experiments had shown that light of particular frequencies, when shone on particular metal surfaces, would cause the metals to emit electrons. Einstein’s insight was to connect this phenomenon with Max Planck’s theory

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of quanta, which showed that for energy to interact with an environment it must be in discrete quantities.

Conducting the experiment again, this time with the apparatus set to fire individual photons at discrete intervals, the results expose a particularly intriguing and counter-intuitive aspect of nature. With a single slit open, the apparatus predictably records a single band of light behind the slit. With both slits open, firing individual photons (with no other photons with which to interfere) one would expect the apparatus to record two single bands of light, corresponding to the slits. However, the apparatus records the familiar interference pattern! Proper consideration of this results in the understanding that each individual photon has passed through both slits and interfered with itself en route to the photographic medium.

A particle in this smeared out, dual state of existence is said to be in a superposition of states. The photon can only be in this superposition of states after it leaves the source, until it is measured by the apparatus. Upon its arrival at the photographic plate this superposition of states disappears as the photon interacts with the particles in the photographic medium, and the photon is known to have arrived at a single particular position. Described in the language of waves, this is described as the collapse of the particle’s probabilistic wave function.

Our perceptions suggest that this imprecise quality in the behaviour of nature must somehow be an illusion. Experience suggests to our intuition that an individual entity cannot be in two (or more) discrete locations simultaneously. By placing a measuring device on each slit, it is fair to presume that the actual, single slit the photon

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passed through can be known. And indeed it can. However, when the experiment is conducted in this manner, the recording device never records the photon passing through both slits, always through one or the other. It appears as if the act of observing which slit the particle passed through has caused its wave function to collapse at the slit, rather than at the photographic plate.

This simple experiment thus disproves the common-sense belief that the particle (as a demonstrably individual, single entity) must have a single knowable history, that tells the objective truth about the path it took from the light source, through a single knowable slit, to its final knowable position on the photographic medium. Instead, this picture of nature shows that the particle has actually travelled in a manner best described by a mathematical probability wave. The expression of this state in mathematical terms is known as the particle’s wave function. Therefore the photon’s trajectory through the apparatus can only be known in terms of the likelihood of it having taken a particular path through the apparatus. The probability that the photon passed through either slot is obviously extremely close to 50%, but prior to the event of passing through either slot, a photon’s wave function must include all other possibilities.

Regarding the nature of events that could be considered ‘observation’, it is perhaps more helpful to consider the process as being transaction of energy/information between particles, rather than something necessarily requiring a conscious observation. For example, in this experiment the interaction between the photons and the atoms of the photographic medium can be understood as an observation.

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**Decoherence**

The mechanism by which environmental factors result in the collapse of a particle’s wave function is termed *quantum decoherence*. The interactions between the environment and the particle effectively nudge it into a single predictable state. Quantum decoherence in effect shields the conscious observer (and also the macroscopic world) from the fuzzy, probabilistic nature of the quantum world. Regarding this aspect physicist Brian Green writes:

> Although photons and air molecules are too small to have any significant effect on the motion of a big object like this book ... they continually ‘nudge’ the big object’s wave function, or, in physics-speak, they disturb its coherence: they blur its orderly sequence of crest followed by trough followed by crest. This is critical, because a wave function’s orderliness is central to generating interference effects. And so, as much as adding tagging devices to the double-slit experiment blurs the resulting wave function and thereby washes out interference effects, the constant bombardment of objects by constituents of their environment also washes out the possibility of interference phenomena. In turn, once quantum interference is no longer possible, the probabilities inherent to quantum mechanics are, for all practical purposes, just like the probabilities inherent to coin tosses and roulette wheels. Once environmental decoherence blurs a wave function, the exotic nature of quantum probabilities melts into the more familiar probabilities of day-to-day life.\(^2\)

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In encountering this mechanism we have finally come to our analogy. The notion of decoherence will be deployed within the production of the architectural design component of this research. This analogy will be developed further within the context of that architectural research, but for now it is important to acknowledge that decoherence is a threshold mechanism, channelling smeared-out and incomprehensible superpositional systems into definite states, comprehensible to common sense.

**Ontological Interpretations**

The contemporary Zeitgeist, as it will be understood by future philosophers and historians, will be one profoundly infused with the discoveries of science. Science’s power to explain phenomena and inform technological invention has come to be one of contemporary civilisation’s most notable characteristics. Having now acquainted ourselves with a variety of philosophical positions (which are variously complimentary, contradictory, or mutually exclusive) and the key points of quantum theory, we may take on the ontological positions raised in association with the theory.

Known as the Copenhagen Interpretation, the earliest consensus ontological position relating to Q.M. was developed between 1924 and 1927 by a group of prominent physicists, including Heisenberg. At its core this picture of nature is one in which reality is physically smeared out, and only assumes an actual position when we attempt to interact with it. This occurs through the mechanisms of decoherence and wave function collapse. The apparent wave/particle duality is an illusion, and light is neither particle nor wave, and assumes those apparent states when we perform measurements: the act of observation collapses the wave function. An important point in
this view is that the wave function collapse is a real phenomenon that occurs within a single universe\textsuperscript{23}.

Another ontological interpretation of the discoveries of Q.M. pushes the already startling picture of nature into a realm which would appear impossible, were it not perfectly aligned with physicists’ observations. Known as the Many Worlds interpretation, this position suggests that the superposition of states actually requires the existence of multiple parallel realities for the particle to smear out into. This position was developed in 1957 by American physicist Hugh Everett (1930-1982), and effectively proposes an infinite complex of branching realities. Every time a superposition of states is faced with potential wave function collapse, each possible branch is taken to actually exist, with our phenomenal perceptions relating to the branch into which it has been observed to collapse. David Deutsch, a physicist who has studied the Many World interpretation in great depth, proposes that the interference pattern arising in the double-slit experiment does so not as the interaction of a single particle with itself, but as the interference with itself in other nearby realities\textsuperscript{24}.


\textsuperscript{24} Ibid., pg166.
1.3 ARCHITECTURE

Ontology in Architecture

Throughout the history of architecture theorists have devoted a great deal of effort to analysing the ontological characteristics of architecture. While this interest has often been clearly evident in architectural theory, ontological ideas and concerns are not often so easily detected within the actual practice of architecture. While issues relating to ontology may not be of urgent concern to architectural practice in general, it is nevertheless possible to gauge the prevailing ontological positions of the period in which a work of architecture is produced.

Architectural theorists and historians have typically referred to this ontological undercurrent with the German term zeitgeist (which roughly translates to “the spirit of the times”). Coined by German philosopher Johann Gottfried von Herder (1744-1803), the term refers to the most generalised cultural, political, and intellectual climate of any given period.

Earlier discussion illustrates that philosophers themselves lack consensus with regards to monism and dualism, with pluralist arguments confusing matters even further. Common to all positions however, are theories relating to form and the experience of aesthetic pleasure. Any work of architecture which results in the creation of an architectural artifact must be seen to align with one of these positions, either by authorial intent or by mere fact of having phenomenal presence in space and time.

By extension, no single theory of form can therefore be determined in architecture as practiced today. Similarly, no single ontology can therefore be attached to all of
architectural theory or practice. However an approximate understanding of current positions can be gained from an aggregate view of the discipline. It is this aggregate that will inform future readings of the contemporary Zeitgeist.

**Ontology of Architecture**

The ontological nature of the work of architecture can be thought of in terms of “what there is” in such a work. Beginning as a thought compiled from fragments of memory, the work of architecture begins a process of instantiation from the moment the architect produces a representation of it, either a drawing or a model. But it is obvious to say that although the work of architecture now exists, there is not yet an object in space and time which might be called a *building*. The object that produces the phenomena associated with buildings has not yet been instantiated.

Should an actual building come to be built, materials will be gathered in one place and assembled in sequence until it is finished. This presents us with the first application of our *decoherence* analogy. At some point during this construction process, the assortment of materials can now be said to produce the phenomena associated with objects known as “buildings”. But it is ambiguous at what point this threshold occurs, as if a superposition of states occurs in which the object exists as both not-yet-building and building. Particular factors such as enclosure, weathertightness, and compositional repose may serve as mechanisms of decoherence, nudging phenomenal experiences of the object into place: *now* it’s a building.
And yet, consider the Barcelona Pavilion: its physical enclosure is incomplete, and yet it is finished. Its material elements slide past each other, seemingly not yet in-place, and yet its composition is generally accepted to be in a state of complete repose. For its particular qualities of uncertainty, both phenomenal and metaphorical, the Barcelona Pavilion will become central to the investigations towards the elements of the work of architecture to follow.

Considering again the generic work of architecture, now as a completed building, we are still presented with ontological matters. The case of the church, as discussed by Polish phenomenologist philosopher Roman Ingarden (1893-1970), provides another interesting precedent. At some point during its instantiation, the assemblage of building materials comes to produce the phenomena associated with experiencing objects known as “churches”. But when a tradesman works to repair the effects of time upon the church, he performs this work on a phenomenon known as a building, which is incidentally also known as a church. At what point then, does such a building come to satisfy the criteria associated with churchness? Ingarden positions this threshold in relation to the act of consecration, effectively the ceremonial act of agreement that the building is now to be considered also a church. As such, it may now be considered to produce phenomena which cannot be produced by its constituent parts. The phenomenon of churchness is within the cognitive processes of the subject rather than within the object.

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Monism and Dualism in Architecture

A dualist position in architecture must insist that the instantiated building is a mere approximation of its ideal form. The less approximate the instantiation, the more pleasing it will be. Any architect whose body of work seeks to develop some kind of ideal prototypical building through a process of repetition may be argued to be practicing in the area of platonic dualism. The position that the classical orders of architecture can be expressed through idealised rules of proportion might be understood to also be aligned with dualism. The very adherence to these rules implies a position that in some way the rules of their form exist as separate ideals.

Architectural historian and theorist Branko Mitrović argues that the work of Venetian architect Andrea Palladio can be understood to align with the dualist position of Plato. In the first case, the process of repetition and refinement seen in Palladio’s prolonged interest in perfecting the design of the villa. In the second case, Mitrović sees the absence of optical correction in Palladio’s work as an inference that the object itself should exist in the closest approximation of its ideal, regardless of how a human observer might perceive it26.

Mitrović also makes the case for an implicitly monist position within the architecture of Leon Battista Alberti. Alberti’s theories consider beauty, for example, to be a property of objects in themselves, rather than a non-physical ideal form. He also argued that a work of architecture’s shape can be understood as the combination of matter and lineaments. Both these arguments align with the Aristotelian position that form and beauty are properties of objects, which are themselves part of a single objective reality27. Alberti’s formulation of lineament is influential today, within CAD and BIM

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27 Ibid., pg51.
software, which describes the shapes of three-dimensional objects as sets of vectors (which are analogous with lineament).

Le Corbusier (1887-1965) echoed Herder’s notion of the zeitgeist (forcefully, rhetorically and arbitrarily, in appropriate architectural manifesto style) with proclamations of a machine age new spirit, seeing within it the heroic evidence of humanity’s progress and potential. He also professed his belief in a causal relationship between mathematical ratios of proportion and aesthetic beauty. His conception of regulating lines, which he claims “have served to make very beautiful things” 28, also aligns with Aristotle’s notions of lineament.

Humanism in Architecture

Humanism, within architecture, has ever been an inherent aspect of its character. As an activity performed by human beings in the service of human beings, architecture may possibly never fully break away from its humanist roots. However, attempts to create a humanist formulation of architecture have typically failed to have an enduring impact on the discipline at either theory or practical level 29. These attempts have also generally centred on the formulation of a system of measurement derived from commonalities found within human bodies, rather than in the sense that philosophers intend the term humanism.

In book three of his Ten Books on Architecture, Marcus Pollio Vitruvius (c.80-c.15 B.C.E.) identified the human form as the fundamental unit of measure for the work of

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architecture, especially the proportions found within the Classical orders. This position was famously illustrated c.1487 by Leonardo da Vinci, showing the relationship between the human form and geometry.

British architectural historian Geoffrey Scott (1884-1929) argued that the pleasure (or otherwise) of experiencing a work of architecture is directly related to a subconscious anthropomorphic relationship to its form, proportions, and elements. In seeming contradiction to this, Scott also held the Kantian position in relation to the judgement of beauty, emphasising that it must be a disinterested and non-conceptual judgement.

In recent times, Christopher Alexander has attempted to develop a scientific taxonomy of architectural “patterns” which may serve as the set of characters within a defined architectural language. Although this is an attempt to cast a language of architecture within the methodologies of science, Scott maintains that it is developed with humanist intent.

Materialism in Architecture

The recent public focus on the immediate need for action in relation to anthropogenic climate change and environmental sustainability has had an immediate and profound impact on architecture in both practice and theory. Theorists and practicing architects have quickly come to understand that the creation of works of architecture can no longer

ignore the economies of material and energy consumption. While this new thread in the profession’s fundamental concerns originated in a worried and reactionary manner, it has quickly come to be an area of the discipline with which architects are increasingly engaged.

In architecture, a shift of focus from aesthetic or linguistic matters to the physical performance and material properties of buildings may also be understood as a sudden swing towards a materialist position within the discipline. This is not to say that matters of aesthetics and content are diminished, but rather that they become an aspect of the architecture that develops in response to forecasts of its physical performance; they are no longer generative concerns. For instance the practice of shading expanses of glazed exterior wall with louvers or brise-soleil is no longer done with aesthetics or human-comfort as the primary concern, but rather to moderate the material performance of the building itself, thereby reducing its energy consumption.

Contemporary philosopher and architecture theorist Manuel DeLanda promotes a materialist view of architecture, and makes the case for what he calls a New Materialism. DeLanda offers a reading of the history of urban development and growth within a framework relating to material performance of the elements which comprise the urban fabric:

*From this point of view cities arise from the flow of matter-energy, but once a town’s mineral infrastructure has emerged it reacts to those flows, creating a new set of constraints that either intensifies or inhibits them*\(^{32}\).

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DeLanda has also written extensively for influential Italian architecture magazine *Domus*, on the potential to be explored in modern material innovations such as biomimetics, intelligent materials, and other advances within material engineering\(^\text{33}\).

Another increasingly attended strand of thought within architectural materialism is that of parametric and algorithmic architecture. Factors such as spatial characteristics, structural and environmental performance, or material properties inform initial parameters by which works of architecture are generated, using advanced computer-modelling software.

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**Post-Modernism**

Any medium through which meaning may be communicated must be considered to in some way conform to the structural rules of language, with architecture being no exception. During the Post-Modern period of the 1950’s and 1960’s linguistic theorists and philosophers turned their focus on these structures, analysing the mechanisms through which language operates. This area of study, called semiology, was deeply influential on theories of architecture during the decades which followed.

A particular aspect of Post-Modern semiology is the position that for any work created as a vehicle for a language, the author’s intended interpretation of the work is but one of a multitude of equally valid interpretations. *Meaning* as such, is not a singular narrative characteristic that can be fixed into an exact state within a text and extracted intact by every audience. Instead, it is a property of the individual reading, which arises as the synthesis of various factors including authorial intent, audience’s state of mind or worldview, and their cultural background.

Another characteristic of Post-modern architecture is its cross-pollination between architectural representation and architectural form. Use of established representational gestures can often be determined within the built forms of its architecture. For instance the presentation of historical architectural elements as a type of flattened representation upon the facade is seen in the Portland Authority building by Post-Modern architect Michael Graves.

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Phenomenology

Phenomenology in architecture, while derived from its parent within philosophy, has come to be a discrete area of theory in its own right. Architects and theorists within this area of interest have concentrated on the relationship between the physical senses and the phenomenal apprehension of works of architecture. Where Post-modern architecture was primarily concerned with language-based cognitive systems, phenomenologist architecture seeks rather to engage the systems of perception, relating to the intuition and physiological responses to encounters with works of architecture.

The communication of an architectural experience, while prone to the uncertainties discovered by the post-modern movement, may be reliably anchored by those aspects of physical reality which elicit predictable physiological responses in human beings. Coldness will always cause a human body to shiver, heat will always cause it to sweat, height will induce vertigo in certain people, tight spaces induce a sense of confinement in others, and sloping surfaces will cause most stationary people a degree of discomfort. Not to mention textures, colours, light and shade and so on, all of which are phenomena by which the work of architecture is experienced.

The use of these phenomena for poetic purposes may be understood as the core aim of phenomenology in architecture; phenomena are to be considered the linguistic medium by which architectural experience is communicated. Phenomenologist architect Juhani Palasmaa argues for the erosion of the preference afforded to vision in the architectural experience, in favour of architecture with more subtle phenomenal qualities. He argues that the fixation on the visual elements of architecture, through media like photographs and iconic images, leaves it open to accusations of being a
strategy closer to psychological marketing of form, undertaken by force of visual persuasion\textsuperscript{35}

\textbf{Deconstruction}

Drawing from the philosophical work of linguistic theorist Jacques Derrida (1930-2004), Deconstruction in architecture is typically discussed in terms of its close succession to the ideas of Modernism. Rather than attempting to trigger architectural experience through the acknowledged meanings of the constituent elements of a language of architecture, it seeks to subvert the mechanisms of language. The experiences evoked by such architecture are achieved through the architect’s embrace of the uncertainty of communication within its semiological systems. It has been described as “a discourse about the impossibility of discourse”\textsuperscript{36}.

In a way this may be understood as a phenomenological approach to Post-modernism, where experiential phenomena are triggered as much by the work of architecture’s textural and poetic qualities as by its perceived semiotic content (which is often deconstructed to the point of illegibility).

Consider the widespread critical attention directed towards the Jewish Museum, Berlin (1989-1996), by Daniel Liebeskind. This building is often appraised in relation to its semiological content, as promoted by the architect himself\textsuperscript{37}. But a 2011 tour of the building by this author found such content obscured to the threshold of absence, even with pre-existing awareness of this narrative. Instead, the building’s most profound impact on the author arose through its phenomenological characteristics.


\textsuperscript{37} Ibid., pg667.
1.4 SUMMARY

We have seen that, with the multitude of ontological positions, no single worldview can be expected to be expressed through the medium of architecture. Particular practitioners’ work might carry implicit or explicit allegiances to ontological positions of form or content, but it will be the domain of future historians of architecture to determine which of them could be said to dominate our Zeitgeist.

What can be considered the meaning of an architectural idea, form, or space is a relatively controversial aspect of architecture which has received much attention by theorists. If architecture can considered a medium through which meaning may be communicated at all, analysis of the mechanisms by which this communication occurs may better enable the practicing architect to impart the intended experience or narrative content.

The architectural idea is communicated through language and graphic representation, able to convey narrative and meaning in an explicit and direct manner. The building as an object in space and time however, is apprehended via the senses and by cognitive processes, in a phenomenal manner. The observer apprehends the built work of architecture primarily visually, but entirely via the senses, and forms a direct internal response. Therefore, in order to effectively convey anything at all the architect must aim to produce built forms which communicate with the observer’s senses directly, and in a language they actually comprehend. The architect’s desired message is also subject to the fact that “meaning” consists of not only the purposeful expression of the producer, but also of the interpretive reading of the observer.
Kit of Parts

The Analogy

In order to construct the metaphor effectively it is necessary to first identify what is being compared, and in what sense it is being compared, and if it is indeed relevant to make the comparison at all.

The apprehension of a work of architecture can be seen to involve processes which find suitable analogy in quantum decoherence. In quantum mechanics the smeared-out wave function of a particle’s position and velocity is a description of its coherent state, which renders any knowledge of the particle’s actual state uncertain (in fact, unknowable). When the particle interacts with another particle (or is in some way measured by an observer) decoherence causes the wave function to collapse into just one known state.

Taking this mechanism as our analogy, it is possible to imagine a wave function of all possible interpretations of the meaningful content of any given work of architecture, this may be considered a description of the coherent state of the work’s meaning. When an observer interacts with the work and commits to any particular ‘reading’ of its content, they trigger decoherence of these multiple possible meanings into just the one which accords with their individual perception and cognition.

Any conceivable varying interpretation of the content of an architectural work is possible. Indeed, varied interpretations of any work of language appear to be inevitable. Our analogy would suggest that the wave function of content can be made to collapse around close approximations of how the author intended, through the decoherence initiated with the use of particular symbols and physical conditions. These serve to confine uncertain and plural readings into approximations of stable, predictable ones.
Effects of time

Consideration of a timeline depicting the existence of a work of architecture would make it seem that architecture, as a result of the processes by which it is produced, is best aligned with Dualist philosophies. Along this timeline a work of architecture evolves through a spectrum of various states, and may be considered to exist in a non-physical mental state at one end, and as a physical object in time and space at the other. Along this timeline, a work of architecture will variously exist as idea, drawing, virtual model, physical model, building materials, structure, envelope, building, useful building, adaptive reuse, decay, ruin, memory. At certain phases of this journey the work may exist in a variety of plural or individual states, but the directionality of time imposes inevitable limitations on particular aspects of its existence. This physical/non-physical nature of the work of architecture, when taken with the association between architecture and beauty gives architecture a set of characteristics which align well with the Dualist position.

At two distinct but indefinable thresholds along this timeline, the work of architecture transitions from its non-physical state into a physical one; it is instantiated. Then, after its usefulness has been exhausted and it is derelict or ruined, it crosses a symmetrical threshold back into a non-physical state memory. It is difficult to determine an exact point during the architectural production process where a building can now be said to exist in space and time, just as it is difficult to determine when a building has become entirely a memory.

Of course, once the architect produces drawings above a certain level of detail the work of architecture now has physical presence in space and time, even if that presence
Ceci n'est pas une maison.
is limited to two dimensions. But it cannot yet be considered a building as it may only be occupied by an act of imagination. Should the architect produce a physical scale model of the work it now becomes a three dimensional object in the physical world. But it is still not yet a building, as models are typically too small to be occupied and also lack the spatial, tectonic, and functional aspects of that which they represent. Although the work of architecture can now be considered to exist, it does so in a representational mode only.

The passage of time, as it relates to the work of architecture, also plays a causative role in the inevitable material behaviour of the building. This may take the form of the daily passage of the sun illuminating and heating the building’s materials and spaces, or the inexorable development and decay of its physical building materials. Patina is seen as a phenomenal expression of the building’s duration.

Also, the duration of a building typically exceeds that of human beings. In this way, previously agreed upon meanings, embodied within the architectural works particular language, may come to be forgotten as those to whom the language is legible themselves pass into history and memory.
Effects of Scale

As discussed in relation to Q.M., the scale at which a scientific experiment focuses determines the nature of any metaphysical models which may be derived from its observations. A humanist worldview is irrelevant at sub-atomic scales; at human scales, commonsense laws of cause and effect reign; and humanism is again irrelevant at the scale of the galactic super-cluster. We are denied experience of the furthest extremes of scale. Vitruvius, Le Corbusier and others have suggested that the fundamental unit of scale in architecture should be the human being, the human measure. A similar alienation occurs between this human measure and the extremes of architectural scale.

In his 1995 essay ‘Bigness’ Dutch architect Rem Koolhaas makes the case for a theory relating to extremely large buildings. He argues that beyond a certain critical size a large building operates by a set of criteria different from those of smaller constructions, most importantly in its relationship to the urban environment. For Koolhaas a big building should be a microcosm, effectively turning away from the world outside. It owes no sensitivity to its immediate physical or social context; it is separate. In addition to this he argues that the sheer size of such buildings prevents them being controllable by any single legible architectural gesture, instead being composed of autonomous parts which contribute to the whole.


Koolhaas’ argument identifies the pivotal role played by scale in the experience of a work of architecture. In Koolhaas’ position, buildings of such enormity exist in a state where their relationship to human beings is effectively irrelevant. In addition to this, the separation of facade from interior allows such buildings to assume an inscrutable quality, where a reading of the exterior is of little or no use in determining the conditions of the interior. The facade becomes a gesture of concealment and deception to the city, offering it what Koolhaas calls “the apparent stability of an object”.

Koolhaas restores the human measure to his theory through the relationship between humans and the autonomous constituent components of big buildings. In other words, the observer’s cognitive and visual relationship with such a building occurs at the human scale; their relationship to the whole is unstable.

At particular thresholds along the continuum of architectural scale the human being is faced with cognitive, perceptual and physical barriers which limit the potential of the architectural experience. At some point the scale gradient between enormous buildings and the human measure crosses an ambiguous threshold, beyond which the building can no longer be concerned with the individual human being. A corresponding threshold exists along the scale between the human measure and small buildings. Beyond a certain limit, we may only occupy a space in an approximate way, through the imagination.

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Palimpsest

The palimpsest is a sheet of parchment from which the previous text has been erased, or “scraped clean”, and upon which new text has been written. Traces of the original text remain legible behind the new, although effort has been made for its erasure.

Pritzker Prize winning Italian architect Aldo Rossi (1931-1997 B.C.E.) viewed the urban fabric as a form of palimpsest, where the traces of a city’s former state remain as artifacts within its contemporary state. These artifacts serve to inform what he calls the collective memory, which informs a citizenry’s connection to its place. Also serving this collective memory is the city’s monuments, which provide an element of permanence opposing the fluid temporality of the palimpsest. This view seems analogous to that of contemporary theorist Manuel deLanda, discussed in an earlier chapter.

The requirements of the campus amount to the construction of a monument to scientific endeavour, with a marking of the place where the typically insular world of scientific discovery proudly opens itself up to the community. The combined effects of the constructions within the scheme serve to establish the campus as such a monument.

Contrasting with this monument is the palimpsest of the site, scraped clean in the minor urban holocaust enacted by the necessary expansion of the campus. Traces of the old neighbourhood remain, private land now rewritten as public space. Public markets at the weekend further encourage the mixing of scientists and citizens.

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43 Ibid., pg59.
Trace and Layer

Analysis of the various layers of information and patterning built up within the local urban fabric provides interesting insights regarding the inter-layer relationships. A classic duality exists in the layer categories:

A) Physical
   2. Roads.
   3. Trees.

B) Non-Physical
   4. Property boundaries.
   5. Contours
      (which represent something non-physical, but describe something physical).

Particular relationships between layers leave traces within others, and even in their absence they remain legible. In some cases this seems banal; that buildings tend to form approximate rows in the spaces between roads is obvious. Less immediately obvious is that non-physical property boundaries have a relationship with the locations of mature trees, or that roads remain legible in contour-line maps.

Both layer and trace offer elements to the design process. The layering of material, through processes like collage and stencilling, allows for the construction of images in which the entire image cannot be determined within any of the individual layers. Layering of space and form provide potential to programmatic or compositional issues. Traces of the language of architectural production (that is, drawings or techniques) might linger in the built work, fused with its forms and structures.
Symbols

Certain shapes, images and textures carry the ability to trigger particular mental and physical responses in the observer. Through cultural conditioning particular shapes such as letters can act to shuttle complex thoughts from author to audience. They convey language but are not visual representations of the things they relate to. The pictogram or graphic icon may convey content equivalent to many words, and visually describes the thing to which it refers. Being a visual representation of its subject, this type of picture seemingly offers an informational shortcut between author and audience.

Through its simplicity the graphic icon reduces the scope for miscommunication. Due to processes of cultural cross-pollination, largely associated with the proliferation of personal computers, a graphic icon depicting the gable-end wall of a particular type of domestic building has come to be the globally accepted pictogram for “home”, within western cultures at least.

Analysing the role of the iconic building, Charles Jencks advocates the use of the “enigmatic signifier”, an obviously intentional sign but one which carries a quality of indecipherability. Such a sign may evoke a response within an observer without necessarily being readily interpretable, permitting multiple readings⁴⁴. The familiar graphic icon may be rewritten as enigmatic signifier; retaining the traces of its familiar meaning, yet somehow now evading reading. Perhaps it invites reading, but refuses to offer any clue as to the language in which the familiar icon is rephrased.

⁴⁴ Charles Jencks, The Iconic Building, New York: Rizzoli, 2005
Barcelona

Built as the German Pavilion for the 1929 International Exhibition, this building by Ludwig Mies van der Rohe is widely acknowledged as one of Modernist architecture’s defining works. It was intended as a temporary building to house various diplomatic receptions including a royal function with King Alfonso XIII of Spain. It would also serve to present an image of German modernity to the international community. Construction began in 1928, and the pavilion was inaugurated on May 27th 1929. In February 1930, less than a year later, it was dismantled following the end of the exhibition45.

Due to the brief nature of its existence, relatively few people were actually able to visit the pavilion in person. In the years following its demolition it came to be widely known through a series of carefully composed black and white photographs, which heroically portrayed its serene spatial qualities and austere geometry. Therefore it was more through the medium of photography than personal experience that the building came to assume its place in the canon of Modernism46.

In 1986, guided by these photographs and various available drawings, a group of dedicated Spanish architects reconstructed the building. This reconstruction was

produced as faithfully to the original as possible, and is considered a remarkable work of architecture in its own right.

In a variety of ways then, the Barcelona Pavilion provides an intriguing precedent for this research. The building’s design gives it a particular quality of ambiguity and incompleteness, providing uncertain spatial threshold conditions relevant to this research project’s architectural parti. It is also of interest for its unusual chronology, which has seen it exist in multiple consecutive and concurrent states. At different times the architectural work of the pavilion has existed as idea, representation, physical building, and memory. More than this, it has existed and continues to exist in various permutations of these states. The manner of its widespread publication and recognisability also raises interesting issues relating to the consumption of architecture as both product and cultural icon. And finally the Barcelona Pavilion is of interest for Mies’ own self-professed project of representing the Zeitgeist through architectural means or, as he put it “the will of the epoch into space”\textsuperscript{47}.

The rear courtyard of the Barcelona Pavilion, in which Georg Kolbe’s statue ‘Alba’
(dawn, or sunrise) poses in a small pool of water, is arguably one of Modernist
architecture’s most recognisable (and therefore memorable) spaces. But consider this: it
does not exist, and except for a few months in 1929 and 1930 it has never existed. Our
memory and recognition of the space shown comes almost entirely from that famous
photograph. In fact, it is likely that almost no person alive today could have a genuine
memory of having experienced the space depicted in the photograph.

Of course, many people alive today have had an approximate experience of the
space, having visited the reconstruction of the original pavilion. But this reconstruction
is itself a memory of sorts. A 1:1 scale model: a representation derived from various
simulacra and fragmentary memories of the original.

This image, along with the Barcelona Pavilion’s floor plan will be a central theme in the
‘kit of parts’ investigations to follow.
Photographs

The photograph has long been acknowledged as a powerful medium for communicating architecture to wider audiences. Its value as a supporting device for education, publicity, and criticism is unquestionable. While the architectural photograph may communicate some of the aspects of the visual architectural experience, being constrained by the very nature of its own medium it must also act as a filtering mechanism. The composition chosen by the photographer deliberately arranges and narrows the content of the architecture, selecting which elements contribute to the content intended by the photographer, while excluding elements which dilute or disagree with it. A skilfully composed photograph, which frames and *distils* the content of a work of architecture, may indeed come to be more widely recognised than the building it portrays. However, it would be absurd to consider the experience of viewing a photograph as substitute for personal experience of the work of architecture.

Juhani Palasmaa argues that these aspects of architectural photography contribute to an undesirable situation in which architecture’s authentic phenomenal properties are overridden by the allure of the well-framed photograph. 48

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Stencils

Any account of contemporary art as it stands today must surely closely consider the medium of graffiti, less pejoratively referred to as street art. Dismissed by many as the work of vandals (as is quite often the case) it cannot be denied that, to some extent, it embodies the Zeitgeist.

Although the method of execution of street art varies widely, the technique of stencilling resonates strongly with this project’s design processes. The image produced by the stencilling process does so by the admission of spray-paint through a screen, and may be either singly or multiply layered. The very mechanisms of its production contain an interplay between admission and exclusion in the formation of memory.

Our interest is in multi-layered stencilling for the fact that no single layer contains the full content of the image, yet each layer leaves traces of its presence within the others. This may be understood as a type of figure-and-ground relationship, but also as a relationship similar to that discussed in relation to trace.
Extrusion

Developing the investigations of stencilling, extrusion may be understood as a process of three-dimensional stencilling, using plastic materials as the medium rather than paint or light.

Continuing the cannibalistic analysis of the Barcelona Pavilion, another of its iconic architectural images (the floor plan), is re-phrased as generative cross-section. This process results in new spatial characteristics derived from the original imagery. Intentionally, this represents a dualist position in which an ideal is employed in the architectural production process.

The maquette represents an ambiguous work, which could be either be intended for domestic scale or larger.

Embedment

Similar approaches to embedment may be employed as with extrusion. In this maquette, a sliced Barcelona Pavilion is embedded within a contemporary take on Le Corbusier’s Maison Dom-ino.

Implied by this approach, is the monist position that the ideal acts not in a generative capacity, but as a property of that within which it subsides.
Lineament

Considering Alberti’s arguments relating to lineament as a defining property of shape, this investigation seeks to employ the line as a built element.

The lineaments defining the shape of the internal mass are exaggerated by the use of canted structural columns and beams. Employing an architectural draughting technique known as line-overstretch, these lineaments extend beyond the surface they describe and serve as defining points in the shape of the exterior mass.

Through acknowledging the role of lineament, and again employing a strategy of embedment, this maquette may be understood to align with a monist position.
Unfolding

This section of research is parametric in nature, and attempts to demonstrate how form can be generated from abstract rules. This approach is informed by the apparent causal relationship between the laws of physics and the physical world. Shape and spatial quality seemingly unfolds further with each successive increase number of dimensions occupied. Each increase in scale correlates to an increase in complexity, with simple mathematical equations representing one end of the process, and complex shapes in space and time at the other.

The fold, as theorised by philosopher Gilles Deleuze (1925-1995), represents a powerful device within architectural theory and design. Of Deleuze’s argument’s relevance for architecture, Peter Eisenman writes: “Folded space articulates a new relationship between vertical and horizontal, figure and ground, inside and out...”49.

This study shows the unfolding of a work of architecture from a single point in a Cartesian space. Through undisclosed parametric guiding rules the work sweeps out from its point of origin until it meets an unseen boundary condition, which results in a folding back in on itself, creating closed surface loops. These folding loops interact with each other to create spatial phenomena, which are sometimes a property of the loops themselves and sometimes a property arising from the relationships between individual loops.

This maquette may be understood to represent a pluralist position, where the work has arisen through non-physical generative parameters. However, there are only the folded loops: the shapes and spaces generated arise due to their self-interaction.

MOUNT ALBERT SCIENCE CENTER

Project Brief

The Existing Campus

Gate 01: 120 Mt. Albert Road, Sandringham, Auckland.
Gate 02: Hampstead Road, Sandringham, Auckland.

Located on the eastern slope of a dormant volcano in Auckland, New Zealand is the Mount Albert Science Center, a scientific research campus operated by both commercial and governmental agencies. Chief among the organisations on the campus are Plant and Food Research, and the Institute of Environmental Science and Research.

Plant and Food Research:

Plant and Food Research are a government-owned research company with over 900 employees throughout New Zealand, Australia, and the U.S.A. The company’s head office is based at the Mount Albert site, and occupies the majority of the buildings on the campus. They are engaged in various areas of research, with a focus on marine and plant-based food industries. The buildings within the facility vary widely in function, form and material condition; included are a multi-storey Brutalist concrete laboratory block, large and anonymous industrial sheds, decaying greenhouses, and a recent 2,000m² greenhouse by Auckland architects Jasmax, which houses transgenic plant research.
Institute of Environmental Science and Research (E.S.R.):

E.S.R. are science advisors to various government departments such as the Ministry of Health, the Ministry for Primary Industries, New Zealand Customs, and the Department of Corrections. The E.S.R. facility at the Mt. Albert campus is focused on forensic biology and forensic science, including the analysis of crime scenes for the New Zealand Police. Due to the sensitive nature of their research, the E.S.R. building on campus has high security protocols.

In addition to the existing science campus on the site is a large area of contoured landscape, variously planted and grassed, from which Meola Creek originates. Following the abandonment of research into a virus damaging New Zealand's cabbage trees in the 1990's, this space is host to several densely-planted rectangular blocks of cabbage trees. The density and geometric regularity of these blocks gives them a noticeably architectural quality; an unintentional organic folly built from eccentric trees.

This landscaped area on the campus connects to a larger body of green space, which continues northward down the hill and is bordered by residential dwellings, a community swimming pool complex, and the Mount Albert Grammar School (whose students maintain a small farm in the site’s paddocks). The furthest eastern edge of this green space is fringed by the high density Morningstar apartment development, and the Westfield St. Luke’s shopping mall.
Objectives of the Scheme

In an aggregate sense, the New Zealand public exhibits an apparent wariness of science, which may stem from factors such as outright ignorance, a lack of exposure to the scientific worldview, or science’s insularity and difficult technical methodologies. With the strategy outlined below, this scheme proposes to develop the existing campus into a multi-disciplinary, commercial and academic institute of science. This campus will provide not only a venue for the pursuit of scientific knowledge, but will allow for the strengthening of the relationship between scientific endeavour and the public realm.

Development of the institution:

1) Establish a Department of Physics.
This department will engage in both academic and applied physics, and will provide a facility for theorists and practitioners to cross-pollinate each other’s fields.

2) Provide new spatial and functional resources for the campus’ existing organisations.
New scientific facilities will include laboratories, offices, archives, and a several lecture spaces (both enclosed and outdoor).

3) Provide for the daily routine of the public to overlap with that of the institute’s staff.
New social facilities will be open to the public and will include a park, a restaurant, a cafe, and a bar. A community outreach center will provide a venue for the public and external educational organisations to access scientific information.

Development of the campus:

1) Expansion of the site.
The site will expand to include several neighbouring properties. Dwellings from these
properties will be relocated to new sites. This expansion provides scope for the development of the institution, and also for the development of landscaped public green space within the campus.

2) **Intensify local urban node.**

Developments to the east and west of the site carry implications for the volumes of traffic moving past the site, which currently favour the north-south route past the site (Mt. Albert Road). With the intended major expansion of St. Luke’s mall to the east, and the continuing extension of the South-Western Motorway to the west, an increase in traffic along the east-west route is foreseeable (Owairaka Road, Euston Road). This east-west route is currently bisected by an awkwardly zigzagging junction, leaving the north-south route uninterrupted. The restructuring of this junction provides an opportunity to intensify the existing urban node.

3) **Restore spatial and visual linkages between the campus and its urban context.**

Redrawing the spatial and visual links with the neighbourhood around it allows the campus to present an invitation to the city. This moves away from the existing situation in which the campus is effectively cloistered within a perimeter of residential dwellings, which presents no such invitation to the public.
The Site

The site lies at the intersection of several busy roads, being Mt Albert Rd running North-South, Owairaka Rd running west from the intersection towards New Lynn, and Fowlds Avenue, running East from the intersection and towards St Luke’s shopping Mall. The strategy regarding the site is conceived with a dual purpose.

Firstly, the campus should be permitted to break free of its existing boxed-in suburban cellular condition, which currently renders it all but invisible to the neighbouring urban environment. Being bounded on all sides by dwellings on imposes an internalised nature on the site, with the only announcement of its existence being the Brutalist laboratory tower visible behind the houses in the foreground. Exposing the site to the major traffic paths provides a strong visual connection between the site and the community, acting as the invitation to passersby to join in the discourse that the campus seeks to inspire and encourage.

Secondly, the site should retain the traces of its history, allowing it to carry the trace of a time before the minor urban holocaust enacted when the campus penetrated the walls of its residential shell.
Design Schemes

Preliminary scheme
The preliminary scheme proposes a building in which the phenomenal experience carries an element of illusion. The icon of the abstracted “house” form is presented to the observer, ironically in built form. A building derived from an abstracted representation of a building.

But the apparent stability of the object proves to be an illusion, as once the observer is dislocated from the original viewpoint, they find themselves confronted with an object unlike that which they originally perceived. Instead they discover a composition of distributed and unrelated elements, only apparently composed into a single cohesive shape by virtue of the observer’s position in space and time. Motion destroys the illusion, and while the original figure may still be understood, a new layer of understanding exists in which the building becomes a less instinctively understood object.

Taking the situation in reverse, the station point (to borrow from the terminology of perspective drawing) is indicated through visual and spatial cues, with the intention of decoherence. The building which offers no stable meaning when taken as a whole, becomes clearly legible from the station point’s privileged location. The wave function of the superposition of “all possible pluralistic readings” has effectively collapsed on a powerful symbol: home.

But only in one location.
Developed scheme

Retaining the core elements of the preliminary scheme, this iteration incorporates architectural elements of *lineament* and *unfolding* as discussed regarding our “kit of parts”.

Consideration is also now given to the treatment of the site, proposing the removal of a number of dwellings adjacent to the site, in order to allow the campus to break free of its cellular confines. The views presented also begin to clarify the spatial relationships between the proposed intervention and its surroundings, both on campus and with neighbouring properties.

Preliminary renderings begin to explore materiality and the characteristics of interior spaces. A digitally fabricated topographical wall system is also investigated which acts as a stencil for light, projecting images through the enclosure of the inner mass, onto the translucent shell of the outer mass. Development of this system was undertaken as a separate study, with its results intended for application within this research. Documentation of the development of this system is included in the appendix.
Final scheme
The final stage of design development for the scheme (as presented here) continues to refine the elements introduced in earlier iterations.

Additionally this version sees another station point developed. From this position of privilege, the building’s form resolves itself as a representation of the north elevation of LeCorbusier’s Villa Stein-de Monzie (1929) in Garches, France. This side of the actual building in itself is highly sophisticated in its overlaid forms and spaces. In representing it in its elevational view, these sophistications are compressed, resulting in a view that is actually built to phenomenally express the two-dimensional drawing more accurately than the three-dimensional Villa Stein does itself. Again, as with the struturealisation of the lineament, the scheme seeks to retain some qualities of drawing within the built form.

Having now achieved two points at which the wave function for pluralistic reading of the building’s form has effectively collapsed, the apparent dichotomy between monist and dualist positions finally finds a voice within the scheme. The surety of the iconic symbol for home can be understood as representing the dualist position, as a sign it is naturally understandable in an immediate way. The notion of an ideal form of domestic building endows this apparently stable elevation with its dualist character. In contrast, the elevation of Villa Stein-de Monzie offers no such certainty of understanding. Even if one is guided to the correct station point, comprehension of the representation before them requires a familiarity with that particular work of architecture. This knowledge-contingent situation can be taken as symbolic of the monist position, which requires deeper understanding than the immediate phenomena of the senses (which inform one that the mind is separate from the world).

The spatial organisation of the proposed interventions is developed, This iteration also approaches full resolution of the exterior and interior masses,
01. secure atrium
02. open lecture space
03. cafe dining
04. cafe
05. carpark
06. entrance ramp
07. reception
08. bar
09. counter
10. restaurant dining
11. kitchen
12. private lecture hall
13. laboratory
14. offices
15. bathrooms
16. meeting room
17. void
18. tutorial room
19. break-out room
20. ramp to roofscape
Bibliography

Print Resources

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• Rattenbury, Kester (ed.), *This is Not Architecture*, London: Routledge, 2002.


**Internet resources**
