Chapter 3: The Scientific Project and the Diagrammatic Aesthetic

Diagrammatic modes of presentation rapidly co-evolved along with scientific developments of the sixteenth and seventeenth centuries, in such an intimate way that their use in fine art has come to visually and conceptually incorporate many of the most important philosophical ideals and techniques of the scientific project.

Science influences the world-view of an age, to which art responds. Chapter three considers the basis of this connection in order to provide a scientific and philosophical basis from which to examine the various qualities of diagrammatic art. Examples are thus provided of important diagrammatic artworks from both the twentieth century and the contemporary period, which best capture the nature of this relationship, its development and current manifestations.

Idealisation, essentialism, reductionism, objectivity and the division of primary and secondary qualities have a complex and controversial philosophical interdependence within the philosophy of science. Diagrammatic art in particular embodies these concepts and works with them creatively to present the viewer with, and involve the viewer in, a complex web of these interrelated qualities.

1 Marcel Duchamp, Glider Containing a Water Mill in Neighbouring Metals, 1913-1915, Oil and lead wire on glass
Figure 20: Some of the fundamental philosophical aspects of scientific investigation and their relationship to the diagrammatic format

Figure 20 presents a summary of these scientific-philosophical concepts (shown in red) and provides examples of the effects they have had upon the production of the scientific diagrams and thus, this thesis argues, the development of a diagrammatic aesthetic in fine art. Examples are provided of artists who have made important diagrammatic art works that embody the ideas being discussed, or whose practice is based upon principles that directly connect their work to the philosophy of science and the scientific diagram.

In their book *The Culture of the Diagram*, John Bender and Michael Marrinan outline the philosophical and visual processes at work in the encyclopedic plates of the 18th century, a period that marked the re-emergence of the diagrammatic format. Contrasting selected plates from Diderot and d'Alembert's encyclopedia, such as the entry entitled *Agriculture, Labourage* (Figures 21 a,b) with Dutch landscape painting.
Bender and Marrinan describe how the farming equipment loses its context of use and is disintegrated into component parts and revealed in multiple points of view upon the whiteness of a page conceptually resized by scales of reference. Here, the physicality of objects and their use is leached away and natural light struggles to cast token instances of shadow. We, however, are allowed to see with a clarity and precision not part of everyday life. Whiteness, the catalyst that binds tableau to visual catalogue, enables a trenchant knowledge that is the descriptive gain of the graphic economy of the diagram.  

Figure 21a, b: Agriculture Labourage Plates I and II, Illustration in: Encyclopédie ou, Dictionnaire raisonné des sciences, des arts et des métiers, par une société de gens de lettres. 1751-72

The diagrammatic plates of the encyclopedia provide not only an important visual illustration but a historical documentation of how the key concepts shown in figure 20 began to come together to synthesise a visual format that was in-line with the underlying philosophy of the scientific process itself.
3.1 Idealism: Adding simplicity and removing complexity

“Reduce, reduce, reduce was my thought...”  
Marcel Duchamp

Figure 22: Mark Manders, *Kitchen (Reduced to 88%)* and detail, 2002, Painted wood, canvas, stainless steel, water, 165 x 187 x 81 cm, Image courtesy of Mark Manders

In science and mathematics, the process of idealisation is the deliberate simplification of a phenomenon in order to make it more tractable in terms of conception and computation. The crudity of ordinary objects has the potential to obscure their mathematical essence, and idealisation is used to combat this tendency.

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Idealisation allows the manipulation of impossible objects with impossible qualities under impossible conditions, and yet enables one to come to very real conclusions about the fundamental nature of reality. According to the philosopher of science Michael Weisberg,

the practice of theoretical science seems just absolutely run through with idealization in all parts. Perhaps some of the most fundamental physics might avoid this, but just about all the science that makes contact with everyday things involves all kinds of approximations, distortions, leaving things out and so forth.69

Idealisations are generally divided in two categories: adding simplicity (Galilean/Platonic), and removing complexity (Aristotelian/minimalist), although these are not mutually exclusive approaches and are often used in conjunction with one another. Platonic and Galilean idealisations both compare reality to ideal states and structures which don’t or can’t exist, but towards which approximations can be made. Concepts such as frictionless surfaces, ideal gases, and perfect platonic spheres are all forms of Platonic or Galilean idealisations (See figure 15, Galileo Galilei, Folio sheet 121r).

If Galilean idealisations are the deliberate addition of distortion to a model of reality, Aristotelian or “minimalist” idealisation aims at excluding as many negligible variables as possible, maintaining only the core causal factors of the phenomenon. The goal is to understand the essential nature of the phenomenon being studied in order to retain the fundamental aspects and to decide which inconsequential elements can be removed.

As the artist Mark Manders writes of his work *Kitchen* (Reduced to 88%) (figure 22):

This work brings together a number of ideas I have been working on over the years. Actually, it can be seen as a three-dimensional painting. At the back of the piece is a large, empty, unprepared canvas. Around it I have made a giant frame in the form of a kitchen. In the end, the kitchen became the front of the work. I have stripped the word “kitchen” to the point that only the naked essence of the concept of a kitchen remains. 70

Returning to the analysis of the plates shown in figure 21 a and b, it becomes apparent that both Platonic and Minimalist subtypes of idealisation are at work. Extraneous details such as the landscape, flora and fauna, including the human users themselves, are systematically removed to highlight the objects being examined. Deliberate distortions are added to the images, such as the scale of human figures, the removal of gravity so that objects float in white space, and the use of an omniscient viewpoint (discussed in section 3.4).
Avant-garde art of the twentieth century is pervaded by an idealistic and reductive sensibility that was further refined with the evolution of abstraction. Many such works have strongly diagrammatic characteristics. Piet Mondrian’s utopian, geometric paintings of the 1920s attempted spiritual transcendence by purity of form and the omission of all extraneous details. In Russia, at approximately the same time, the politically motivated Constructivists rejected bourgeois taste and Romantic notions of artistic subjectivity, to develop an alternative aesthetics of formal, objective clarity.

Naum Gabo studied science and medicine at the University of Munich from 1910 to 1912, and later moved on to study philosophy and art history until 1914. Simultaneously, he studied engineering at the Technische Hochschule in Munich, which housed a large collection of mathematical models, real-world objects designed to represent highly abstract idealised concepts.

![Figure 23: Naum Gabo, Linear Construction No. 2, 1970 - 71, Plastic and nylon threads, 113 x 50 x 69 cm, Image courtesy of Tate Gallery](image)

Gabo often worked from templates to produce serial replicas of his work. *Linear Construction No.2* was one of Gabo’s favourite works, and exists in twenty six versions (some virtually identical, others at different scales; hanging and with bases; with and without black insets). \(^3\) (figure 22)

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3 Gabo’s ongoing search for ideal, skeletonized forms connects his practice to C.S. Peirce’s theory of sign systems, as discussed in Chapter 4.
Rejecting conventional notions of mass, volume and line, Gabo replaced them with the concepts of time and space and interpreted time as movement. His ideas were strongly influenced by Albert Einstein’s theory of relativity, and the clarity of the then newly created modern plastics allowed for a clarity of concept and form that held great appeal to Gabo. In discussing the influence of mathematical diagrams upon his Crystal series, he stated how his aim had been to “take this complicated formula and change its realisation to prove that what was basically a fantasy (the intuition of the mathematician) could be seen through the intuition of an artist” 72

Figure 23: Alberto Giacometti, The Palace at 4am, 1932, wood, glass, wire, string, 63.5 x 71.8 x 40 cm, Image courtesy of Museum of Modern Art, New York

In art as in science, idealisation often involves aspects of both essentialism (section 3.2) and reductionism (section 3.3), and figure 23 provides a key example. Giacometti’s The Palace at 4 a.m. appears to be a delicate maquette constructed for a theatre performance.
The three overlapping, open plan constructions that create the architecture of the work have been compared to Giotto’s depiction of houses. Giotto, however, simultaneously depicts two spaces but only one event, whereas Giacometti presents several spaces simultaneously alongside events that occur at different times in a way that is similar to the medieval conception and rendition of the stage. 73

The Palace at 4 a.m. can be read as a Romantic-Objective, self-directed psychoanalysis. The little that Giacometti did reveal about the symbolism of the work highlights its deeply personal nature: the three panels representing the three windows of his childhood bedroom, the chess piece-like female figure as his mother, and the central structure cradling the small round ball as Giacometti himself. The caged spine and skeletal bird, which appears to be flying through an open window, are connected to aspects of a failed love affair. 74 Giacometti is said to have commented that the sculpture was the result of

...a period of six months passed in the presence of a woman who, concentrating all life in herself, transported my every moment into a state of enchantment. We constructed a fantastical palace in the night - a very fragile palace of matches. At the least false movement a whole section would collapse. We always began it again. 75

The unusual appeal of the work is perhaps the result of Giacometti’s use of an austere, skeletonised visual language to capture the subjective extremes of his self-psychoanalysis. In this way, the sculpture can be read as a didactic, theatrical model resulting from a process of emotional idealisation; an object used by the artist to examine and replay his oedipal relationship with his parents and the difficulties he faced in forming lasting relationships with women. Revealingly, in the same year, Giacometti published a book detailing the events of his childhood - *Hier, sable mouvants* (Yesterday, Shifting Sands) - in which it is suggested that he had finally learned to live with himself. 76

Finally, in terms of reductive, diagrammatic idealism being applied in a way that is Romantically-Objective, it is worth considering the artistic education and practice of Marcel Duchamp. Duchamp was born at a time when the French education system was undergoing a series of national reforms to its curriculum, including the introduction of new programs for drawing instruction to its public schools. 4 Rather than focusing upon the imitation of nature and the human body through the study of the old masters, classical sculpture and art of the renaissance, the new curriculum focused instead upon laying a foundation for fluency in measured, mechanical drawings, a skeletal, diagrammatic style which Molly Nesbit terms ‘the language of industry’.

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4 The ‘Ferry reforms’ of the French national school system were made in the 1870’s and 80’s, Duchamp was born in 1887.
By and large this was a language meant for work, not for leisure, and certainly not for raptures or poetic, high cultural sighs. This language was “preaesthetic”, a public culture based upon mechanical drawings, “sans colour, sans nature, sans body, sans the classics, some would have said sans everything.”

Nesbit is here describing the reductive nature of diagrammatic idealism and its relationship to the scientific division of qualities as discussed in chapter 3.4. and elaborated upon in terms of C.S. Peirce’s semiotics in Chapter 4. The drawing course was divided into objects depicted in perspective (i.e. reproduced the way they appear to the eye), and in projection (i.e. ideal forms as they ‘really are’, independent of a human observers).
Then director of the Beaux-Arts School in Paris, the sculptor and critic Eugène Guillame, elaborated upon the program:

Drawing is by its very nature exact, scientific, authoritative. It images with undeniable precision (to which one must submit) things such as they are or as they appear. Not one of its configurations could not be analyzed, verified, transmitted, understood, realized. In its geometrical sense, as in perspective, drawing is written and is read: it has the character of a universal language. 79

In such a way a distinction was made for French students between apparent and true representation, a distinction Duchamp would later refer to as retinal and non-retinal art. (See chapter 3.3, Quote reference: 88)

Figures 25 and 26 present Nesbit’s contrast of the diagrammatic presentation of a coffee mill both in perspective and projection (from the French preparatory book of drawing practice of 1887) with Duchamp’s 1911 painting *Moulin à café*. This early painting by Duchamp precedes his *Nude descending a staircase* by one year, and was made as a wedding gift for his brother the artist Raymond Duchamp-Villon. Duchamp described how the work was “based on the idea of ‘dismantling’ the grinder” and already show the influences of cubism such as fractured line and multiple projected view points. 80

However even at this early stage, it appears that Duchamp was already incorporating ideas of physicality and sexuality in contrast against to the stark, idealised qualities of the ‘pure’ diagrammatic form. *Moulin à café* is a symbolic and functional forerunner of the element identified as a chocolate grinder in Duchamp’s *The Bride Stripped Bare by her Bachelors, Even*. In a series of notes written to accompany The Large Glass, Duchamp explained that, “The bachelor grinds his chocolate himself”, suggesting that the Coffee Mill is a metaphor for masturbation. 81 Duchamp later commented that: “Always there has been a necessity for circles in my life, for, how do you say, rotation. It is a kind of onanism.” 82

Duchamp further developed his non-retinal use of the reductive, idealising properties of the diagrammatic line in his work in a number of important ways, from his use of one dimensional plumb lines, which he dropped to make 3 standard stoppages to redefine the meter; to the two dimensional preliminary sketches for his Large Glass with their archetypal Goethean ur-lines suggesting platonic skeletons. Once completed, the large glass contained complex idealised representations depicting various machine parts, apparatus and virtual projections from the forth dimension. (See also chapter 3.3) His various projects embody a more general shift in science and culture, from drawing as representation of natural world, to drawing as a means of depicting the technical nature of the structural and functional systems which underlie reality, by means of the diagram.
3.2 Essentialism: Where to draw the line

“I don’t paint things, I only paint the differences between things.” \(^83\)

Henri Matisse

Figure 27: Erick Beltran, *The personal-social order,* (from the Calculum series) 2008, printed poster, Image courtesy of Erick Beltran
scientific essentialism is the philosophical position that things, and especially ‘kinds of things’, can be grouped according to certain essential properties they have in common. These key features allow them to be distinguished from other things or other kinds of things. The origins of this idea in Western thought can be traced back to the philosophy of Ancient Greece, particularly to an argument over whether or not the ‘essence of a thing’ lies without or within the thing in question. Plato’s idealism proposed the existence of pure essences, ideal forms that lie behind reality and make things what they are. Aristotle’s counterproposal posited the existence of ‘categories’, an essential ‘substance’ within things themselves as the source of their characteristics.

One of the key aspects of essentialism is the concept of ‘natural kinds’, in which phenomenon are believed to fall naturally into distinct, classifiable sets and orders, independent of humans. In the dialogue Phaedrus, Plato proposes that successful theories should “carve nature at its joints”; 84 Harry Binswanger updates this ancient metaphor to suggest that:

objectivism holds that Nature is like a roast chicken. It’s true that the roast chicken isn’t already cut up and it doesn’t already have dotted lines on it saying ‘cut here’... On the other hand, it doesn’t mean we can’t take the knife and just cut anywhere. 85

The elements of chemistry and the fundamental particles and forces of physics provide examples of natural kinds. At the other extremes of scale, astronomy classifies distinct forms of galaxies, stars and black holes according to certain criteria.

Systems of classification based upon natural kinds has proven to be a great success in science, and yet there is still considerable philosophical debate as to whether they are scientific discoveries or inventions - that is, whether they are a feature of the architecture of reality or constitute the architecture of science itself. One fascinating and somewhat ironic example demonstrating the issues of essentialism is Newton’s description of the rainbow as seven distinct colours, rather than six as one might expect. His division of indigo and violet was motivated by his own interest in Pythagorean musical harmonics, a set of beliefs held by Ancient Greek sophists who argued that there exists a connection between colors, musical notes, known objects in the solar system and the days of the week. Seven is an important harmonic number in this system, and hundreds of years after it had been surpassed by a superior understanding of the universe a single number influenced one of the titans of Western science to make a subjective,

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artificial division that would exist for centuries to come.\textsuperscript{86}

Natural kinds in biology also reveal that distinctions become blurred and subject to change when applied to the complexities of organic life. The taxonomic division of Darwinian species has an arbitrary nature, complicated by the fact that they are evolving, dynamic populations (as discussed in terms of Goethe’s work on the metamorphosis of plants in chapter two).

Kinds, or ‘sets’, which are subject to ambiguity such as species, race and gender are often referred to in semiotic terms as \textit{floating signifiers} - the words are more concrete that the concepts to which they refer. Floating signifiers have a “vague, highly variable, unspecifiable or non-existent signified, [and may] mean different things to different people: they may stand for many or even any signifieds; they may mean whatever their interpreters want them to mean.”\textsuperscript{87}

This grey area of suspended certainty has proven to be a source of fascination to artists, who have developed numerous ways to subversively introduce uncertainty into empirical systems of classification. Such artists often choose the authoritative language of the diagram to do so.

The Mexican artist Erick Beltrán’s practice is an ongoing, accumulative investigation into the current structural mechanisms of division, connection and control that regulate the flow of information, and thus power, within the information age. Beltran provides a re-evaluation of the role played in society by the editor, and presents visitors to his projects with walk-through installations of information graphics and charts covering the walls, floor and ceilings that combine fact, fiction and ambiguity with an air of diagrammatic authority.

Notions of diagramming, archiving, and cataloging are central to his work, especially in terms of how images are “defined, valued, ordered, classified, selected, reproduced, and distributed in order to create political, economical and cultural discourses in contemporary society.”\textsuperscript{88} Alexander Gerner describes Beltrán’s conceptual map \textit{The Personal Social Order} (figure 27) as a:

\begin{center}
meta-diagrammatic machinic map experimenting with orders of thinking, representations, and operations in different orders of knowledge, the sub-concepts and lines of which can be related, folded/unfolded in multiple representative and non-representational “clandestine” ways.\textsuperscript{89}
\end{center}

The Japanese Artist Shusaku Arakawa’s entire career was a diagrammatic investigation into construction and deconstruction of shared experience and meaning. After deciding to leave his studies in art at Musashino Art University, Arakawa moved to New York
where he became friends with Marcel Duchamp, and established a personal and artistic partnership with writer and artist Madeline Gins which would span more than four decades. Together their interest in architecture and philosophy produced a body of work spanning a vast range of media, and almost entirely diagrammatic in nature, and which Jean-Francois Lyotard said “makes us think through the eyes.”

Arakawa developed a diagrammatic form of visual ‘fuzzy logic’, exploring the limits of image, text and understanding which incorporated the philosophical ideas of Ludwig Wittgenstein. Systems of classification are fundamental to Arakawa’s approach to art, and his process mimics the methodical scientific dissection and analysis of phenomenon into their individual elements in order to understand the mechanisms of their meaning.

However Arakawa’s humorous attempts to reassemble and reconnect the dismantled parts into new structures, only helps to reveals the fragility of our techniques of classification and nomenclature, as well as the dissonance between subjective mind and objective reality (figure 28). As Italo Calvino writes:

"An Arakawa painting seems precisely cut out to contain the mind, or to be contained in it... After studying one of Arakawa’s paintings it is I who begin to feel that my mind is 'like' the picture."

Over time Arakawa and Gins’s interest in using the diagram to probe the relations between linguistic, semantic and perceptual expression shifted to incorporate the body in architectural environments and a syncretic questioning of human life and death. In a statement that architecturally and hodologically connects the practices of Arakawa and Gins to Erik Beltrán’s, and the way in which these artists question kinds, sets and signification, Gins writes that “Jottings and memos having to do with what anything in the world consists of should be made large, even enterable.”

Gins and Arakawa produces a rich new vocabulary to map out the poetic-conceptual terrain their work explored, in some cases suggestive of new fields of study, such as biotopology and coordinology. However, the organising, de-organising and re-organising principle which remaining of central importance to their exploration of the human condition in all its manifestations was the diagram:
A biotopologist produces ongoingly organized and redistributing gatherings of all that pertains to that organism that persons who happens to be the biotopologist herself, including the slightest of slight urges and what only faintly indicates itself as being operative as an organizing principle; she calls these ongoingly and redistributing gatherings of her making “diagrams.” 93
3.3 Reductionism: A componential analysis of the world

“Math is really logic. Logic is really philosophy. Philosophy is really psychology. Psychology is really biology. Biology is really Chemistry. Chemistry is really physics. Physics is really math.” 94

Ben Mordecai

Figure 29: Damian Ortega, Cosmic Thing, 2002, Suspended automobile components, cable, Dimensions variable, Installation view: The Institute of Contemporary Art, Boston

Reductionism is the collapse or ‘reduction’ of higher levels of meaning and being to lower levels of elemental parts, a cascade of continual fragmentation and analysis that is underpinned by the concepts of essentialism and idealism. This attitude or manner of thinking, has dominated the modern period, and forms a theoretical and methodological framework which is the basis of many of the well-developed areas of modern science.
Reductionism and reductivism are terms which suffer from a lack of clear cross-disciplinary definition. What is often referred to as reductive in art theory (most often used to describe minimalist art) refers to essentialism, that is the addition of simplicity or removal of complexity in an art work, and to idealism, when art works make reference to the ideal forms of geometry, rather than the scientific understanding of the term as the fragmentation of a phenomenon in to its component parts for careful analysis.

Often placed in opposition to a synthetic and hierarchical approach that consolidates and integrates systematic components in to higher level systems, the analytic reductionist approach seeks the essential nature of an object in terms of its constituent parts and the relationships between those parts. In this sense reductionism assumes that understanding a given phenomenon requires first, the discovery of a new, more fundamental level of reality that lies beneath or behind the familiar level of understanding, and second, that this new basic level can be analysed or broken down into subsystems, elements, relationships, processes, and so on, which account for and explain the observations at the familiar level.95

Hierarchical reductionism posits that rather than trying to explain complicated phenomenon in terms of their smallest component parts, scientific explanations must take in to account which level within the hierarchy of reductive knowledge is appropriate, so that we are “explaining cars in terms of carburettors rather than quarks”.96

Mexican artist Damian Ortega often dismantles objects and ideas in to their component parts, displaying the results in the format of exploded diagrammatic installations, such as the dismantled Volkswagen Beetle in Cosmic Thing (figure 29). The sculpture executes in three dimensions what the standard exploded diagram does in two, and is poetically reminiscent of the fact that in physics, the more matter is reduced in to component parts of ever decreasing dimensions, it had been revealed as being composed mostly of what appears to be empty space. In describing the process of dismantling the car, Ortega states that his:

...desire was to offer the expanded vision of an object. [...] In the process I started to understand the conceptual importance of technique, and how it is related to form: the whole working process is what composes the piece. 97

In a more absurd and ephemeral work that deals with order in disorder, Elote Clasificado (Classified Cob, 1998 - 2005), the artist has numbered each individual kernel of corn on its cob in his own pseudo-scientific project and left the object to dry for a period of seven years, so that its slow fragmentation over time has left it now scattered with gaps.
Marcel Duchamp applied the objective, idealist, essentialist and, importantly, reductive approach of science to that which is most human, namely sexual attraction and the complex, somewhat farcical rules of bourgeoisie courtship and mating. Duchamp used the diagram as his visual medium of choice, and in doing so created one of the most important and enigmatic art works of the twentieth century: *The Bride Stripped Bare by Her Bachelors, Even*, otherwise known as *The Large Glass*.

*The Large Glass* metophysically diagrams the fragmented psychology and mechanics underlying human desire and sexual relations, broken down to their various component parts. The work presents its subjects mechanomorphically, as if under the unrelentingly austere, reductive and analytical gaze of modern science. However, Duchamp’s keen sense of irony and subtle humor led him to incorporate an array of hidden puns within the work. This, in combination with the absurdly applied faux-scientific, diagrammatic seriousness ensures that the work retains an element of the subjective (as discussed in terms of C.S Peirce’s concept of *tone* in chapter 5).

*The Large Glass* is the result of a combination of chance procedures, carefully plotted perspective studies, and laborious craftsmanship, and is accompanied by copious notes made during the planning of the work’s structure. Many of these notes were published both during his own lifetime, by Duchamp himself, and posthumously to accompany an exhibition of his work at the Pompidou centre in Paris in 1980. Some 478 documents have been released for publication at the time of writing, consisting of: *Box of 1914* (16 notes), *The Green box* of 1934 (94 documents), *A l’infinitif*, 1966 (79 notes), and finally *Marcel Duchamp notes*, 1980 (289 notes).

*Figure 30: Marcel Duchamp, The Bride Stripped Bare by Her Bachelors, Even (The Green Box),* (1934), *Box containing collotype reproductions on various papers, 33 x 28.3 x 2.5 cm*
Rather than the reduction of an object to its physical component parts, as in Ortega's *Cosmic Thing*, the notes represent Duchamp's thought process itself fragmented into elemental notions, gathered as a mobile collection of sketches, diagrams and texts, a mobile, rhyzomatic archive of ideas. Duchamp regarded his reference notes as essential to experiencing and understanding *The Large Glass*, in order to avoid it being considered merely on aesthetic grounds. He chose to publish a selection from them as his alter ego Rrose Sélavy as *The Green Box*, stating in interview that:

> I wanted that album to go with the Glass, and to be consulted when seeing the Glass because, as I see it, it must not be “looked at” in the aesthetic sense of the word. One must consult the book, and see the two together. The conjunction of the two things entirely removed the retinal aspect that I don’t like.  

Duchamp took a great deal of care when deciding upon a printing technique (collotype) and appropriate papers, in order to ensure the reproductions would match the original notes as closely as possible. *The Green Box* was eventually published in French as an edition of 300 with twenty deluxe versions in 1934. (figure 30)

By 1956, the British artist Richard Hamilton has compiled a diagram of Duchamp's *Large Glass* carefully detailing which notes from the Green Box corresponded to which parts of the glass, which he then sent to Duchamp. Duchamp, would later refer Hamilton as *mon grand déchiffreur* (my great decipherer), and was so pleased with Hamilton’s fastidiousness that he proposed that he work on an English language translation of the entire contents of *The Green Box*. Duchamp suggesting that Hamilton work together with George Heard Hamilton, a professor of art history at Yale who had already translated a limited number of notes in 1957. The result of the collaboration was the 1960 English publication of *The Green Book*, described on its title page as *The Bride Stripped Bare by Her Bachelors Even, A Typographical Version by Richard Hamilton of Marcel Duchamp’s Green Box, translated by George Heard Hamilton*.

Over forty years of research later, in 2000, Hamilton once again selected notes from Duchamp's *Green Box*, this time assembling them in a direct visual relationship with *The Large Glass*. Hamilton chose to create the work as a print titled *Typo/Typography of Marcel Duchamp's Large Glass*, juxtaposing ninety three textual and diagrammatic notes with a carefully designed, digital vector image of *The Large Glass*, thus finally uniting both the visual and literary elements of Duchamp's project. (figure 31). The texts occupy the empty space of the unmarked glass in original *Large Glass*, Duchamp having chosen glass as a medium in order to avoid having to paint a background so that the images floated in a space comparable to the white ground of the plates of Diderot and d'Alembert’s encyclopedia, as discussed at the start of this chapter.

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7 Several versions of the print were produced, the definitive version being that of 2003.
Commenting upon the nature of the Duchamp’s notes, Hamilton points out the elaborate, interconnected nature and creative potential arising from Duchamp’s reductive, diagrammatic project (diagrammatic in multiple aspects), explaining how the notes are packed with clues but these clues must be patched together with those from other papers in the box to build the overall concept. There are often restatements, modifications and developments of the same idea on different sheets ... One continually senses, when handling the documents of the box, a desire to be perfectly explicit simultaneously with an indifference as to the result. The expression of the urge, rather than its conclusions, is important – one variant is as valuable as another and the idea gets a bonus from this multiplicity of expression – the system is synergetic.

Figure 31: Richard Hamilton, *Typo/Topography of Marcel Duchamp’s Large Glass*, 2003, Graphic material, Printed ink on paper, 42 x 29.6 cm
3.4: Primary and Secondary Qualities

“The observer, when he seems to himself to be observing a stone, is really, if physics is to be believed, observing the effects of the stone upon himself.”

Bertrand Russell

Figure 32: Olafur Eliason and Ma Yangson, *Feelings are facts*, Fluorescent lights (red, green, blue), aluminium, steel, wood, ballasts, haze machine, Dimensions variable

8 Reality is divided by science into primary and secondary qualities. Primary qualities such as number, magnitude, position, and solidity, are measurable aspects of physical reality - characteristics said to convey facts. These measurements are intended to consider only qualities that exist in the things themselves, qualities that can be determined with certainty and do not rely on subjective judgments.

Knowledge arising from secondary qualities, however: sight, sound, smell, taste and touch - cannot be expressed mathematically in any direct way, and thus do not provide objective facts about things in the world. Human senses are not to be relied upon to make objective observations about the world, and are therefore relegated to a secondary position suitable only for reading the scales, charts, dials and numerical data from measuring equipment and scientific apparatus.

This distinction forms the basis for a basic dualism: only the primary qualities are considered to be real, while secondary qualities are supposed to be the result of the effect on the senses of the primary qualities. In other words, our perception of reality is the illusory result of our human, sensory interpretations of primary qualities. A major aim of positivist science is to replace experiential phenomenon with a mathematical model incorporating only their primary qualities. This quantitative result is intended to be more real than the phenomenon observed by the senses, and the task of science becomes a kind of “metaphysical archaeology” striving to reveal an underlying mathematical reality.

The primary–secondary quality distinction has its roots in the ideas of the Ancient Greek philosophers Leucippus and his student Democritus (c. 5th century BCE), and is also found in Plato’s dialogues and medieval scholastic thought. It is not until the work of Galileo Galilei in the scientific early modern period, however, that we see a definitive formulation of this distinction, and in terms corresponding to their contemporary usage.

Galileo developed the ancient ideas of atomism to describe reality as the manifestation of an infinitesimal number of geometric points, thus legitimizing atomism with mathematics and paving the way for a reductive mathematical process in science. This mechanistic view proposed that all aspects of everyday reality were ultimately reducible to the shape, position and relations of invisible atomic building blocks. In his 1623 treatise Il Saggiatore (The Assayer), Galileo writes:

…I think that tastes, odors, colors, and so on are no more than mere names so far as the object in which we locate them are concerned, and that they reside in consciousness. Hence if the living creature were removed, all these qualities would be wiped away and annihilated.

The primary-secondary quality distinction lies at the intersection of key issues in metaphysics, epistemology, and the philosophy of perception, and remains an ongoing debate in the philosophy of science.

The lasting effect this debate has had on diagrams (and thus diagrammatic art) is an intellectual distrust of colour as a secondary quality, so that whiteness came to be promoted to the “highest expression of the indifference that lies beyond all that is relative and partial...” and that truth embodied in the idea was “like a visible form bleached of its colour.” 104, 105

Alongside line, colour was employed by Sol LeWitt as an elemental component within the logical system of his artistic production, rather than being used for its aesthetic appeal: “It might seem to some that color is synonymous with decoration, but I try to use color objectively... I do not use color for effect, although I see no evil in that.” 106

LeWitt’s early practice was drawn towards purist, colour limiting ideals (see figures 39 a,b), but took on an increasingly personal tone over time, whilst still maintaining its strict, formulaic basis. 10 One major transition for LeWitt’s was from a use of pencil and crayon for his wall drawings to multiple layers of vibrant ink washes. The artist credits this shift to his encounter with the frescoes of Giotto, Masaccio, and other early Florentine painters, after moving to Spoleto, Italy, in the late 1970s. 107 Quattrocento art played a motivating factor in LeWitt’s escape from what he called the creative prison of the ideological pronouncements and inhibitory rules he had established for himself in his early works, looking instead for “something more universal, more important”, than an avant-gardist stance alone could provide. 108 LeWitt was also quoted at the time as saying how he aspired “to produce something [that he] would not be ashamed to show Giotto.” 109

Olafur Eliasson is a contemporary artist whose practice both embraces and investigates the subjective nature colour, and who is actively engaged with the cognitive aspects of vision. Proposing that “the analysis of colours is, in fact, about the ability to analyse ourselves”, Eliasson’s installation works Your Rainbow Panorama and Feelings Are Facts (figures 32, 33) create hodological spaces that present the viewer with formulated structures of immersive colour experience. 110 The very title Feelings Are Facts places itself in opposition to the scientific duality of primary and secondary qualities, and also to Sol LeWitt’s proposition that “Perception is Subjective”. 111 It also aligns Eliasson’s work on colour with Goethe’s theory of colours and the various physical and psycho-biological contexts in which humans perceive colour, rather than the detached mathematisation of the visual spectrum established by Newton.

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10 An example of this is LeWitt’s Wall Drawing 46 in 1970, created two days after hearing of the death of his friend the artist Eva Hesse. Rather than the usual straight lines used to construct his wall drawings, the draughtsman is instructed to use a hand drawn ‘not straight’ line, a motif that appears in this work for the first time, and was created in tribute to the organic nature of Hesse’s work.
The importance of physical motion, spatial orientation and the fluid, subjective experience of colour become very apparent in Eliasson’s own description of his installation Your Rainbow Panorama, constructed on top of the ARoS Aarhus Kunstmuseum, in Denmark in 2010:

Imagine Your rainbow panorama as an instrument that tunes you – its user – so that your body is transformed into a colour resonator. Enveloped in the rainbow environment, you produce afterimages in hues complementary to the colours in the glass panes around you. If you look at the city through red glass, your eyes develop a green afterimage. If you maintain a quick pace, the colours remain vibrant. But if you pause in one colour zone, the hue around you grows pale while the colours in your peripheral vision, where the walkway curves, intensify. Colour intensities depend on your speed.  

Also of note in terms of creating a diagrammatic understanding of the romantic-objective nature of colour is Eliasson’s ongoing project with a colour chemist to mix paint in the exact colour of each nanometre of the visible light spectrum (approximately 390 to 700 nm). Starting in 2009, Eliasson refers to the project as his Colour experiment paintings. Taking an objective, scientific stance to explore an art-historical and ephemeral use of colour, Eliasson applied his project to Turner’s watercolour paintings in the 2014 Tate Britain exhibition Turner Colour Experiments. By examining how much colour, which colour, how much light and how much darkness turner used in selected paintings, Eliasson created a set of seven circular colour wheels based upon each painting. “The schematic arrays of colours on round canvases generate a feeling of endlessness and allow the viewer to take in the artwork in a decentralised, meandering way.”

(For an image of Turner Colour Experiments, see Appendix G)
3.5: Detached Objectivity: The absent artist and omnipresent observer

“Essentially, perspective is a form of abstraction. It simplifies the relationship between eye, brain and object. It is an ideal view, imagined as being seen by a one-eyed, motionless person who is clearly detached from what he sees. It makes a God of the spectator, who becomes the person on whom the whole world converges, the Unmoved Onlooker.”

Robert Hughes

Uniting all of the art works within the category of diagrammatic art considered within this thesis, is an aura of detached, objective indifference, a form of artistic ‘un-expressionism’. Objectivity is a deeply integral, idealistic goal of scientific enquiry that aims to keep the claims, methods and results of science free of personal opinions, interests and prejudice, as well as societal and community biases.

The goal of objectivity is therefore a representation of the world as it is, unmediated by human minds and other distortions. Scientific realists believe in the effectiveness of the models and theories of science to successfully describe both the observable and unobservable aspects of the world with a perspective-free objectivity. Thomas Nagel calls this the “view from nowhere”, and Bernard Williams describes it as the “absolute conception”.

Just as pure objectivity in science is an ideal concept however, it also remains an ideal in art, with artists choosing to affect objectivity rather than attempt the scientific ideal of complete detachment in their work. (This points is covered in more detail in chapter four in relation to C.S.Peirce’s concept of the *tuone*, and how even the most objective artworks retain notions of subjectivity and aesthetic decision making).

The ambition to escape from the singular human perspective remains a source of fascination, either by imagining reality through multiple perspectives or by taking the position of an invisible, detached or omnipresent observer. For the catalogue accompanying his exhibition *The Absence of Mark Manders*, the titular artist writes that “(u)nder a table you have the possibility to test your own absence. The realization that life is taking its course, even without you, is an intense human experience; it shows the finiteness of personality.”

Physicist John Wheeler’s diagram of the Universe as a self excited circuit: starting small (thin part of ‘U’ at upper right), the Universe grows (loop of ‘U’) and in time gives rise to observer participancy (upper left) which in turn imparts “tangible reality” to even the earliest moments of the Universe.
Figure 34 shows Picasso's *Standing Female Nude*, an example of what has come to be referred to as analytic cubism (the predominant style of the early stages of cubism as opposed to the later synthetic cubism). This approach to image-making structurally dissects subjects using multiple viewpoints and overlapping planes. Structural forms in analytical cubism are emphasized using a highly simplified colour palette, and density of image tends to be at the centre of the canvas. By combining an air of objective indifference with multiple detached viewpoints, the art works of analytic cubism keep the viewer at a distance whilst appealing to their intellectual curiosity to decipher the meaning of the work and become engagement as a “component in a dynamic system of meaning”.

The Romantic-Objective nature of such work relies upon its diagrammatic qualities, and this kind of art implicitly acknowledges and poetically benefits from its impersonal, objective stance and austere, hermetic symbolism. The critic David Sylvester proposes that the works of *late analytic cubism* are the result of the artists working on a deeply instinctual level, beyond reason or theoretical rationalization.
Sabine Rewald refers to this period as *high analytic cubism* (1910-1912), and describes how Picasso and Georges Braque were appealed to by their friend and dealer Daniel Henry Kahnweiler to give their pictures realistic titles in order to provide a conceptual reference point for their increasingly abstract images. It was during this period that the artists began to add letters and numbers to their work, often creating puns and referring to the contents of the painting as a way to re-introduce a subjective element. (The title as conceptual key to diagrammatic art is also discussed in chapters 5 and 6.)

The features of analytic cubism, and especially late analytic cubism, relate in style to the diagrammatic visual arrays developed during the production of encyclopedias during the European Enlightenment by placing emphasis upon:

- their strict frontality,
- their discontinuity with the fictive spaces of tableaux,
- their pervasive whiteness that joins visual parts to the network of numbers and letters keyed to a text - [which] fail to converge in a single vantage point or entity that might be called a viewer.

The contemporary practice of artist Richard Talbot employs the machinery of perspective and technical drawing usually associated with perspective studies, geometry and construction plans. However Talbot puts these systems to work creating spontaneous poetic forms, intricately rendered in two dimensions. Central to Talbot's practice are issues of point of view, perspective, materiality (the creation of ideal forms as real world objects), and the interplay of prescriptive and intuitive mark making systems.

Combining his own practice with research in to the construction of early Renaissance paintings, Talbot has argued convincingly against the prevailing view of linear perspective as a tool or pseudo-mathematical device for creating the illusion of three dimensions. Instead he proposes that the geometry of linear perspective serves as a remarkably flexible, creative tool within Renaissance painting, giving rise to a spatial ambiguity between surface and depth. In this way, Talbot is also able to work intuitively in his own practice, and to think, structure and speculate within an apparently rational system.

Talbot also references Leonardo daVinci's suggestion of using accidental images as a means to allow forms and ideas to emerge which would have otherwise been entirely unpredictable, and how he himself incorporates intuition and chance in his work:

I make some marks and lines that are purely diagrammatic and some which describe forms. I have become very aware of the interplay between them and the spatial effects that they produce. These lines and other marks, which do not initially have any visual purpose, become just as much part of the drawing as anything else. In addition I am not defining objects absolutely and they remain transparent. The overall sense of transparency it creates is an essential part of the process, allowing forms and ideas to emerge.
This connects Talbot’s approach to Deleuze’s use of the term diagram in his analysis of the paintings of Francis Bacon. As discussed in section 1.2, Bacon introduced involuntary, spontaneous marks to his canvases to disrupt his own painting process and force himself to deal with and incorporate the marks in to the work. Bacon described these marks as suggestive of “much deeper ways by which you can trap the fact you are obsessed with”, a means to arrive at an image unachievable by a more considered, illustrative approach alone. 123

Talbot’s working process gives rise to drawings as open-ended systems which retain the complex matrices of their own working-out. They also contain aspects of stereotomy 12, orientation, reorientation and the juxtaposition of multiple view points (both rotated about an arbitrary axis in three dimensions and as a mirror image). Talbot has suggested that such an approach promotes the idea that it is the process of drawing itself that can be considered the medium of his work, rather than the materials chosen to make the work manifest. 124

Figure 35: Richard Talbot, Missing the Target, 1989, pencil on paper, 140 x 80 cm,

Talbot refers to the matrix of marks from which his images arise as a kind of scaffolding holding the three dimensional forms. 125 Drawings such as Random Moves (figure 35) highlight a connection between Talbot’s technique and Goethe’s concept of the urphomenon, the essential underlying pattern or process of a thing from which specific individual forms arise (See chapter 2.5).

12 The art or science of cutting and arranging solid bodies (i.e. stone) into desired shapes and arrangements.
Such an image as figure 35 and the processes involved in its making embodies all of the traits of diagrammatic art’s relationship to the philosophy of science, as listed at the start of this chapter: idealisation, essentialism, reductionism, objectivity and the monochrome tendencies resulting from the division qualities (see figure 20).

Talbot has written of how his objects defy gravity, how they show no signs of the ware and tear of the real world environment, such as chipped corners or edges. Instead they exist as skeletal, idealised forms, readable as representations of objects at any scale, from the intimate to the infinite, aligning them conceptually with the idealised diagrams of geometry and digital, scalable vector graphic, as opposed to the pixelated jpeg image. The pictorial space occupied by the drawings appears immediate and shallow rather than the continuum of a horizon-less white space, allowing Talbot to relate his drawing process to more physical ideas of sculpting space and of cutting, slicing and revealing hidden component parts.
When asked in interview about his approach to using colour, Talbot admits to “having always avoided it, as I’ve never understood it. It’s a complete mystery. If I was making a drawing, I can’t see any reason to use colour. But then equally I probably can’t see any reason not to use it. But then I would probably be thinking well, why do I?”

(For the full transcript of the interview, see Appendix H)

Richard Talbot’s practice is one of several that are positioned on Chart 1 (One Hundred Diagrammatic Artworks from the Last Century) in the immediate vicinity of a circular Heideggarian clearing. This void represents an ideal, metaphorical and unreachable position that numerous artists working with diagrammatic imagery have both approached and retreated from (a subject that will be dealt with in depth in the following chapter).

In discussing his idealised avoidance of colour Talbot recounts a tutorial with the British - Romanian Artist Paul Neagu whilst he was a student in London:

I distinctly remember that when I did my MA at Chelsea, the external assessor we had was Paul Neagu... the work I’d made at Chelsea had become really quite austere, and extremely minimal, and he said... ‘don’t forget the other side of yourself’, and I realized exactly what it was he meant. That we can easily kind of forget. But then I think that also we need those extremes sometimes, to realize something. We need to go beyond in order to know where the edge was. It’s only when you fall over the edge that your realize there was one.

This chapter has focused upon the underlying philosophic and aesthetic connections between the use of the diagram in science and its use in fine art. Chapter four explores the semiotics of the diagrammatic art, and considers the subtle but fundamental differences between the way that the diagram is used in science and its use and subversion in the field of fine art.

Chapter four also presents selected works by Sol LeWitt, Benar Venet and Marcel Duchamp as important examples of artists who, like Richard Talbot, have employed the diagram in art in order to approached the ‘event horizon’ of perfect objective austerity, in order to see just how little subjectivity is required to produce a work of art.