Picturing the Molecular Body in Art and Science

Section One
To See

Chapter 1

The Image

Seeing and doing thought in terms of imitation has a long history. The origins of this thinking can be traced right back to Aristotle. The efficacy of this idea, the different ways in which it has been interpreted, adopted, and practiced can be seen in the many different ways of seeing, doing and making things that forms the basis of distinct cultures and civilisations. In this century, also described as the digital age, I propose that it is momentous once again to look back at the different interpretations of the idea of imitation as the Greek philosophers used the word *technê* to describe all forms of doing and making by human beings, encompassing every creative endeavour.

Technê/arts represent all manner of human industry. And art is an image of that industry. Image is a drawing, it is a painting, it can be sculpture, it is a chart, a graph, a photograph, map, a portrait of a living being, or a thing, and or even text. It may represent pre-existing objects; it may represent what has never existed in nature or otherwise.

The image is attractive because of the force of its appeal. The power of this appeal rests in its ability to show what could potentially be. Hence, it is thinkable to see in the image a boundary object between the worlds of the imaginal and sensible. In this formulation, the image can be conceived as an active object that it is able to function as the link between seeing and doing and knowing. It is precisely because of the position of in-between-ness that the form of the image is able to encompass, and join all existing, and non-existent things. Finally, it is from its position in the middle that the image is able to operate as an intermediate entity picturing lives lived in the worlds inhabited by the Gods and the mortals.

This is not the problem.

This was the solution to the problem, singled out as the problem of the creation of the world. The subject is not new. Humans have looked up to the stars for centuries to try and find an answer to this question. In religious contexts this question is framed as the problem of the relationship between God the Maker and the world. For philosophy, it is the relationship between mankind and the universe, and to ask why and how it was made. The persistence of these questions was the problem that confronted early Arabic philosophy, and philosophers in Abbasid Baghdad. The urgency

of the matter as Dimitri Gutas sums it is that philosophy had *died* for two hundred years, and if it was to survive its ninth century re-birth, then it had to find a means to think about these questions.[1] The philosopher, and polymath Abu Yusuf Ya'qub ibn Ishaq al-Kindi (d.870), proposed the use of mathematical sciences for this purpose.[2] Foremost a scientist, al-Kindi hoped he might be able save both religion and science by presenting a geometrically sound, mathematically conceptualized solution to the theological debates on creation. Except, as historians will tell us, while al-Kindi did not quite settle the different ideas on creation of the world, he did however inaugurate philosophy.[3] Key features of his view on creation of the world are: A) He rejected Aristotle's thesis that the world is eternal by arguing that the created world cannot be infinite. B) He developed the concept of unity in multiplicity, based on the concept of one, claiming nothing can be known about God, he is pure oneness, and C) Al-Kindi

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[1] Dimitri Gutas, "Geometry and the Rebirth of Philosophy in Arabic with Al-Kindi," in *Islamic Medical and Scientific Tradition : Critical Concepts in Islamic Studies*, ed. Peter E. Pormann (London, UK: Routledge, 2011).

[2] Al-Kindi has the honor of being known as the first philosopher

[2] Al-Kindi has the honor of being known as the first philosopher as he squarely broke with all former traditons by asserting that mathematics was the prerequisite for the study of philosophy, to even Aristotle. Ibid., 7.

[3] Ibid., 13.

adopted the Neoplatonic idea that "God's act is creation" which he defined as "bringing being to be from non-being".[4] Philosophy did survive, and his work and eclectic method set the precedent for many future debates in Arabic philosophy.

Conversely, al-Kindi's theses also mark one of the first points of fissure between the different schools of Islamic philosophy. The rationalist Mu'tazilite especially rejected his position, which was the creation of the world as bringing being to be from non-being, what in Latin is known as *creatio ex-nihilo*, as absurd.[5] Mu'tazilite philosophers argued that the idea of bringing being to be from non-being is incomprehensible from the Aristotelian perspective. Not only was the premise viewed as a challenge to human rationality, it was further claimed that the idea was untenable, especially because verses in the Qur'an do not conclusively support a view that the world was created

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[4] See Chapter 3 "Al-Kindi and the reception of Greek Philosophy" Peter Adamson and Richard C. Taylor, ed. *The Cambridge Companion to Arabic Philosophy* (Cambridge, UK: Cambridge University Press, 2004), 32-51. A distinct feature of Al-Kindi's philosophical works is that they represent an attempt to bring into a compatible framework philosophical ideas of Aristotelian, Neoplatonic and Platonic schools of thought. The influence of these ideas and method had a lasting effect on all future Arabic philosophy.

[5] There is vast literature on the dispute of creation of the world in Arabic philosophy. For a more recent historical analysis, see Salman H. Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World* (Albany, New York: State University of New York Press, 2004), 34.

from nothing.[6] In this way, as Salman H. Bashier sums it, "whether the non-existent is something or nothing was a major dividing line between the Mu'tazilite and the Ash'arite philosophers on the issue of limits to rational thought."[7]

Thirteenth century philosophers inherited these philosophical differences. As a response to the disputes, mystic and philosopher Ibn 'Arabi (d.1240) re-conceptualized the term *barzakh* used in the Qur'an to describe a "barrier between two things" for example, the intermediary world between death and resurrection.[8] He developed it as a philosophical solution to address the issue of limits of rational modes of thinking, such as the enigma of existence from non-existence.

Ibn 'Arabi's *barzakh* is philosophical construct that makes it possible for to differences interact, and yet, retain a framework that does not compromise the distinctive

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[6] Ibid., 30.
[7] As Bashier points out, al-Ghazali's polemic against philosophers was on the issue of uncritical acceptance of creation out of nothing. A defense of the philosophical method was given by Ibn Rushd. Ibid., 33. See also Oliver Leaman, *Averroes and His Philosophy* (New York, USA: Oxford University Press, 1988).
[8] Claude Addas, *The Quest for Red Sulphur : The Life of Ibn 'Arabi*, trans. Peter Kingsley, 1993 ed., Golden Palm Series (Cambridge, UK: Islamic Texts Society, 1989), 342; Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 75-76.

integrity of either positions, for example, the known with the unknown. *Barzakh* takes its inspiration from the analogy given in the Qur'an, where it is described as a form that is able to join two types of water, one sweet, one salty and yet keep them distinct.[9] The potency of Ibn 'Arabi's philosophical ideas are that they are aimed to reconcile the reason of philosophy with reason of Islamic revelation, or rational and mathematical science with metaphysics. (I shall return to the making versus creating debate in Section Two)

Bashier in his detailed study titled *Ibn al-'Arabi's Barzakh* says that Ibn 'Arabi devised *barzakh* as a concept to address fundamental points of disagreement on the nature of creation of the world between the two schools of Arabic philosophy of his time. Equally matched, conversant in the exegesis of the Qur'an, Islamic law, and the philosophy of the ancient Greeks, albeit imbued in Aristotelian philosophy, the differences between the two schools were over the conceptual framework for understanding the division between the creation of the world out of existent or non-existent matter. That is, was the world formed out of pre-

[9] *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 10 & 102.

existent eternal being or non-existent being?[10] To give a comprehensive background to Ibn 'Arabi's philosophy, Bashier tells us that the idea of *barzakh* is rooted in Plato's theory of Forms. According to the theory of forms, objects of the world can be divided into either sensible or intelligible objects. Although contingent upon the other, the sensible and the intelligible are independent of the other, however the sensible *participates* in the intelligible. This distinction is key. Plato used Forms as an exercise to overcome limits to rational thinking by mentally tracing the paths of the sensible to arrive at the intelligible; that is of reason.[11] The difficulty as pointed out by Aristotle, Bashier explains is that "in order to establish a relation of causality between a Form and a sensible thing that participates in it, we must place intermediate objects between them."[12] Further summarizing the Aristotelian argument as explained by Ibn Rushd in his commentary on *Metaphysics*, he says that the formal basis for the existence of an intermediate thing collapses because analysis will tell us that the intermediate must necessarily be dual, and be an abstract form (formal + sensible) in

[10] Ibid., 33.
[11] Ibid., 83.
[12] Ibid., 84.

nature. Therefore, the intermediate thing can neither be Form nor indivisible objects. Moreover, in this formulation, the intermediate can only be made up of more intermediate forms, and, this process Aristotle had argued could continue to infinity, therefore limitless, and, therefore not rational. (Aristotle's philosophical framework does not accommodate the concept of actual infinity.)[13]

As a reversal to the philosophical impasse between the intermediate form, the Form and sensible, (existence and non-existence of Islamic philosophy) Ibn 'Arabi's methodological framework *barzakh* allows a possibility for cognitive re-signification and a transference of the abstract in-between, the intermediate form into a space for reflection and self-realization. In apprehending *participation* as an active principle, Ibn 'Arabi gives the intermediate the status of imaginal in the form of an image.[14] Presented this way, the intermediate becomes imaginal form, what he refers to as *a'yan thabitha* (fixed entities).[15] Thus, as a concept, the image is conceived as a

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[13] Ibid., 84-85.
[14] Ibid., 89.
[15] The imaginal in the philosophy of Ibn 'Arabi is "that which is a synthesis between the spiritual and the corporeal, which is more real than the imaginative impressions fashioned by the human mind." See note 21, Chapter 5 in ibid., 173.

bridge that enables entry into a creative sphere, and is able to reflect upon the sensible, to get to the intelligible.[16] According to this system, the *barzakh* overturns the dogmatic notion of *bringing being to be from non-being* quoted above, which was at the core of the controversy between the Ash'arite and Mu'tazilite over the creation of the world from absolute nothingness or pre-existent matter. Since participation is active according to this formula, and is defended by the analogy of a mirror, Ibn 'Arabi says *barzakh* allows,

> If you possess the power of reasoning and you perceive the image you realize that you have perceived an affair of being (*wujud*) on which your sight has fallen, but you will immediately know, with manifest certainty, that there was nothing there to be witnessed.[17]

Bashier further explains that the ontological status of images as conceptualized by Ibn 'Arabi is both existent and non-existent.[18] He uses the example of mirror images to both critique rational modes of thinking that rely heavily on the input from the senses, and, at the same time, offers the imaginal as a mode for seeking, searching, finding out.

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[16] Samer Akkach, "The World of Imagination in Ibn 'Arabi's Ontology," *British Journal of Middle Eastern Studies* 24, no. 1 (May 1997): 102.
[17] Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 89.
[18] Ibid.

It is precisely because Ibn ‘Arabi’s philosophy is characterized by his ability to exploit the lexical breadth of Arabic language, he is able to encompass in the word *wujud* manners of knowing, searching, finding out, and hence being.[19] Formalized between the many facets of *wujud* that include knowing and finding out, creation cannot stem from or come into being out of nothing, without active participation. As Bashir elucidates, it is quite because images are both existent and non-existent, that it is not possible to uphold or negate their existence.[20] That is, the imaginal is a process for knowing, and *barzakh* is the divide between the visible and invisible, *zahir* and *batin*, manifest and non-manifest. Moreover, creation is thought of as a productive process that enables bringing into being.

Samer Akkach in his article further elaborates on the *barzakh* in the philosophy of Ibn ‘Arabi as the creative link between the ontological categories of Absolute Being and Absolute non-being.[21] He resolves the distinction between types of creative activities (God and man) for the *barzakh*

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[19] For the significance of the word *wujud* in Ibn 'Arabi's writings see William C. Chittick, "Presence with God," *Journal of the Muhyiddin Ibn 'Arabi Society* XX(1996).
[20] Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 89.
[21] Akkach, "The World of Imagination in Ibn 'Arabi's Ontology."

also operates as the conceptual limit between entities. Akkach writes, Ibn ‘Arabi formulates *barzakh* as a model to maintain the essential difference between “creative mechanism of human and Divine imagination”, i.e., one that is joined; yet coextensively maintained apart.[22] This arrangement then allows Ibn ‘Arabi to logically conceptualize *barzakh* “as the activity of defining the possible.”[23] As Akkach and Bashier explain, the element of *difference* is key, difference is necessary, and underscores much of Ibn ‘Arabi’s philosophical framework. The concept of difference not only defines the limits but also by assigning the concept of creativity parameters, the two domains of creativity, the ideal and the sensible, although they interact, they are harmonized by difference and by division. From the Islamic perspective, this resolution becomes acceptable, as the human and divine are joined by the imaginal, and the image can disclose forms of being and knowing. It is a mirror of creation but not Creator, whose form is unknowable.[24]

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[22] Ibid.
[23] Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 87.
[24] 112:4 "Surat Al-Ikhlas" *The Quran*, trans. Yusaf Ali.

This account of image differs from the classically ascribed, preeminent objections against the forms and arts of representation that are traditionally the subject of Platonic polemic against *mimesis*. For instance, in an early essay, first published in 1957, Hans Blumenberg outlines the break that European humanists had to make from ancient metaphysics, for Man to establish his modernity and to think of himself as a "creative being."[25] Moreover, as Blumenberg describes it, the break entailed violence. He explains, the force of the violence comes to be known in,

> Vehement passion with which the attribute of creativity was gained for the subject was marshalled in the face of the overwhelming importance of the axiom of the "imitation of nature."[26]

This was the case especially as this understanding of creation is founded upon the Greek idea *technê*, or art, that in Aristotelian terms, imitates nature. Since human industry is endowed with a creative force, to create is to behave like nature. It is by virtue of creation that the human is able to complete what is deficient in nature. This makes,

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[25] Hans Blumenberg, "'Imitation of Nature' : Toward a Prehistory of the Idea of the Creative Being," *Qui Parle* 12, no. 1, The End of Nature (2000).
[26] Ibid., 19.

"Nature and "art" structurally identical" as Blumenberg explains.[27]

Locating further points of rupture, Blumenberg suggests that the violence with which technology and science asserts itself against nature can be ascribed to an original reaction to Plato's polemic against representative arts stated in the tenth book of his *Republic*. Bulumenberg in this essay pointedly argues that Plato's critique is "an argument that does not so much protest against its negative consequences as against its *origins* by focusing on its ontological underpinnings."[28] Presenting a more nuanced reading, he says that Plato further elaborates his objection to representation by analogy of a craftsman. The craftsman is able to see Forms "permitted to his mental gaze."[29] Whereas, a painter simply reproduces what already exists. Here I would like to remind the reader, the concept of mental gaze of Plato discussed resembles Ibn 'Arabi's domain of the imaginal.

Nonetheless, this still leaves unanswered what is it that connects the idea of creation to Being, intelligible to

[27] Ibid., 18.
[28] Ibid., 25.
[29] Ibid.

God or divine in the different interpretations of Greek philosophy. A tentative answer can be gleaned from well-known analogy that Plato uses and Blumenberg incorporates in his paper. Platonic position is that the craftsman "makes something *new* only from the perspective of the phenomenal world, but not from the perspective of the world of Forms."[30] That is, according to the Aristotelian system nature and creation are structurally identical. Except, this also means all possible existences are permanently pre-given.[31] Hence, to free creation and creativity from ideological and religious bonds, a complete break had to be enacted, to make room for "*authentic* human creations."[32] Methodologically, in the act of severing all metaphysical ties, emerges the secular subject capable of genuine creativity.[33] Additionally, in breaking the idea of completeness of pre-given Form or Being, Blumenberg diagnoses an essential break with nature itself. In this analysis, nature is perceived as an endless supply of raw material for human productivity. As a contrast, due to a

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[30] Ibid., 27.
[31] Ibid.
[32] Ibid., 22.
[33] In this essay Blumenberg specifically traces the philosophical roots of a break with metaphysical tradition, and hence nature, grounded in the Christian appropriation of philosophical literature on creation. Ibid.

difference in interpretation, this particular metaphysical break did not take place in the Islamic philosophical and intellectual tradition where there is no perceived discord attributed to human industry or creativity and between rational thought and religion.[34]

Looking back at the philosophies of the ancient Greeks, Blumenberg points out, Greeks encompassed within the idea of *technik*, a synthesis of all "actual operative abilities of man within reality."[35] For the ancients, *technik* was a concept that included "artistic" and the "artificial."[36] In the passive form, the *technik* takes on a reflective state. All the same, the arts differentiated from *technik* retained effectiveness because the ancients also believed that especially artistic images such as paintings are embedded with a facility that is able to link a conception of the divine with the mortal. In the thousands of years of evolution, perhaps, fixed deep within human psyche is the knowledge that the creative impulse, our creative capacity, inventive imagination, enables all making. Of all the abilities, it is believed, in the ability

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[34] George Saliba, *Islamic Science and the Making of the European Renaissance* (Cambridge, MA, London, UK: The MIT Press, 2007).
[35] Blumenberg, "'Imitation of Nature' : Toward a Prehistory of the Idea of the Creative Being," 17.
[36] Ibid.

to create, humans are akin to the supernatural as they too are able command all manner of being by making.[37]

The problem is, Plato used the word "to imitate" and "to participate" arbitrarily, but perhaps not interchangeably.[38] Advancing this thesis, Blumenberg further explains, misperception stems from Plato's use of the terms *mimesis* and *methexis*, without categorical distinction. The difference in interpretation becomes more glaring as *methexis* entails participation, and is not tinged with the same negative assessment as *mimesis*.[39] This is the very exercise of participation with the Forms of Plato. As a first protest in the process of overturning the Platonic invective against *mimesis*, Aristotle reversed the formula through which the relationship of making was made more compatible with nature.

Although liberated from the constraints of *mimesis*, Aristotelian inventions retain metaphysical roots according to Blumenberg's thesis. The technical, mechanical, and artistic that altogether form human creativity, is still

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[37] Blumenberg claims that as making involves touch, it "acquires metaphysical value because it is discussed as a theological concept, as an attribute of the divine." Ibid., 26-27.
[38] Ibid., 25.
[39] Ibid.

understood in the terms and vocabulary of Platonic Forms, whereby, all human industry is simply a means to complete nature. In the principle attached to eternity of Platonic Forms, forms and nature get transformed into "eternity of the real world itself."[40] Thereafter it becomes possible to reimagine and construct new worlds, new forms by technological means, ad-infinitum.

In the twenty-fist century we know, *technik* separated from art has evolved into technology and continues to be aligned with the artificial and is the opposite of natural. Except, there is a difference. The difference is what confronts the arts today as Christopher Wood explains, "The ultimate aim of *technê* - the challenge – is the generation of life out of non-life."[41] This marks a regeneration of the philosophical pursuit of the ideas symbolized by *creatio ex-nihilo* debates, however, this time backed by technology without consequences and, confirming Blumenberg's thesis as seen in the images of the twenty-first century scientific self.

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[40] Ibid., 29.
[41] Christopher S. Wood, "Art History Reviewed Vi: E. H. Gombrich's 'Art and Illusion: A Study in the Psychology of Pictorial Representation', 1960," *The Burlington Magazine* CLI, no. December (2009).

This is the problem.

This is the problem I intend to take up in the following chapters of this thesis.

Chapter 2

Trusting the Image

> 25 The painter Zeuxis began to give his works away, because, as he said, they could not be bought for money. He did not believe any price could be found to recompense the man who, in modelling or painting living things, behaved like a god among mortals.
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> 27 The ancient writer Trismegistus believes that sculpture and painting originated together with religion. *He addresses Asclepius with these words: "Man, mindful of his nature and origin, represented the gods in his own likeness'.*
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> 46 I do not know how it is that paintings that are without fault look beautiful in a mirror; and it is remarkable how every defect in a picture appears more unsightly in a mirror. So the things that are taken from Nature should be emended with the advice of the mirror. ("Book Two" *On Painting*, Leon Battista Alberti, 1435-36.)[42]

It can be said that in Quattrocento Florence the underlying basis of Platonic distrust of representation, known as visual errors in ancient terms, was fixed by a mathematical technique of representation that later came to be known as perspective. *Perspectiva*, as it is called in Latin belongs to a theory of optics. Perspective, as the word is commonly used until today, is a way of drawing and painting by means of faithful rendition of what can be seen according to geometric construction of perception based on the theory of visual rays. Alberti's claim is, in the ability to portray as accurately as possible what the perceiving eye sees brings the viewer closer to the truth.

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[42] "Book II" Leon Battista Alberti, *On Painting*, trans. Cecil Grayson, 1991 ed. (London, England: Penguin Books, 1436), 61-83.

In this way mathematically grounded Greek optics reinvented by artisans, became in their hands a technique for drafting. This method was later promoted in academies as the principal way of drawing what the viewing eye could and would see. At least symbolically, the space of the *image* drawn in accordance with fidelity to mechanical geometric construction of pictorial space replaced the subject of distrust from the search for the objective.

Martin Kemp describes the perspective as the "science of art."[43] Before perspective was used to interpolate divine attributes, or was even considered a science, Erwin Panofsky in his well-known essay *Perspective as a Symbolic Form* (1927) writes that perspective is *scenographia,* which was a technique used by architects of antiquity for representing buildings on a flat surface.[44] Panofsky states, "In this way the Renaissance succeeded in mathematically fully rationalizing an image of space…."[45]

However, it is important to note that scenography is the technique for drawing buildings not as they might

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[43] Martin Kemp, *The Science of Art : Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, USA and London, UK: Yale University Press, 1990).
[44] Attributed to Vitruvius, see note 18 in Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher Wood, 1997 ed. (New York, USA: Zone Books, 1927), 97.
[45] Ibid., 63.

appear, but "how they will appear when constructed."[46] Unlike subsequent writing on the subject of vision and painting, the weight of Panofsky's essay is not based on a forensic analysis of the development of painting on the basis of the mathematical rationalizing of vision, but of *space*, the surface of painting. For example, drawing is a means to show how a particular space might look in the future; such is common practice in architecture till today. In 25 B.C, Vitruvius described scenography as a branch of optics in his *Ten Books on Architecture* according to the text cited in Panofsky (1927) it states:

> "Scenography" is (1) the method of the painter who wishes to represent buildings and must reproduce not their true but their apparent dimensions; (2) the method of the architect who may not apply proportions considered beautiful from the point of view of abstract mathematics, but rather, striving for "*pros opsin euruthmia*" ("proportion according to visual impression"), that is, fine form as subjective impression, must work against the deceptions of the eyes -[47]

In this formulation, problematic over the philosophical disdain concerning *mimesis* does not go away, and the difficulty of representing how things are seen on to a two-dimensional surface does not get resolved. Summed up best by the Platonic protest that is referenced by Panofsky

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[46] See in notes "What Is Scenography?" in ibid., 98-100.
[47] Ibid., 99.

later in the notes, he writes, "Plato protests precisely against this replacement of the "*ousai summetriai*" ["actual symmetries"] by the "*doxousai einai kalai*" ["those appearing to be beautiful"])."[48]

Then, quite dramatically as historians tells us, in fifteenth century Florence, a new technique was invented that had the potential to suspended all manner of doubt over the shortcomings of appearance in representation. This event took place in year 1425 when a Florentine architect rediscovered perspectival drafting. Italian architect and biographer, Antonio Manetti (d.1497) reports that in a public display, the architect of Santa Maria del Fiore, Filippo Brunelleschi (d.1446) ostended the art of perspectival painting as a technique for transferring intangible apprehension on to a two-dimensional plane.[49] It was not merely that Brunelleschi was the first to demonstrate the use of the laws of optics as a tool for making paintings, Brunelleschi thereafter is known as the inventor of perspective.[50] That is, Brunelleschi invented a

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[48] Sophist 235E-236A. Source quoted from ibid.
[49] Hans Belting, *Florence and Baghdad*, trans. Deborah Lucas Schneider (Cambridge, Massachusetts and London, England: The Belknap Press of Havard University Press, 2011), 164-69.
[50] See "Chronological Outline of the History of Linear Perspective" in Samuel Y. Edgerton Jr., *The Renaissance Rediscovery of Linear Perspective* (New York, USA: Basic Books,

technique for drafting, which is the ability to draw what is seen in terms of visual rays that can be mapped, measured, and drawn, very much the way light is studied using mirrors.

Building on the work of Brunelleschi, Leon Battista Alberti (d.1472) wrote the treatise *Della Pittura*, *On Painting* as a handbook for the artist. This treatise is notable for it stresses that artists must paint according to principles of 'nature'. That is, he emphasized that painting must depict technical know-how of representation based on the laws of optics. Alberti's contribution is momentous, for he advanced and popularized a technique for measuring space for compositional painting. A remarkable characteristic of *On Painting* is not simply that it was the first of its kind. It is remarkable because it is the first handbook for the artist that directly addresses Aristotle's critique of Plato's distrust of vision. Aimed at the artist, Alberti explicitly instructs the reader to use perspective to correct distortions of visual perception.[51] In this way,

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1975), xv-xvii. See also Kemp who proposes based on the evidence of a letter that mentions Brunelleschi's association with perspective, that perspective may have been invented as early as 1413 or just a bit before that. Kemp, *The Science of Art : Optical Themes in Western Art from Brunelleschi to Seurat*.

[51] In a more recent study Sinisgalli proposes the thesis that Alberti's *On Painting* was written in two separate languages, 1435 in vernacular Tuscan Italian and improved and corrected version in Latin later. See Leon Battista Alberti and Rocco Sinisgalli, *Leon Battista Alberti: On Painting : A New Translation and Critical*

Alberti certainly did address the philosophical distrust of *mimesis* allied with Platonic model of vision. Quite tellingly, he begins the treatise with a statement of intention at the outset to speak not as a mathematician. He says, "Mathematicians measure with their minds alone the forms of things separated from all matter. Since we wish the object to be seen, we will use a more sensate wisdom."[52] The elegance of Alberti's solution was precisely that as a mathematician, he was able to recognise that *Perspectiva* was founded upon the synthesis of the mathematical (Euclidean-Ptolemaic) formulation of vision, with Aristotelian theory of intromission linked with the idea that knowledge is fundamentally graspable by perceptive methods. Thus, it is quite probable that Alberti's training as a mathematician enabled him to see the potential in the metamorphoses of the science of optics into the art of representation. This idea becomes more credible when thought together with quite a well-known and succinct description of the most basic account of linear perspective given by Kemp, who defines it as "a system for recording the configuration of light rays

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Edition, trans. Rocco Sinisgalli (Cambridge, England: Cambridge University Press, 2011).

[52] See Book I Leon Battista Alberti, *On Painting (1435-36)*, trans. John R. Spencer, 1970 ed. (New Haven, USA: Yale University Press, 1956).

on a plane as they proceed from an object to the eye in a pyramidal pattern."[53]

The result is, perspective transformed the visual. Perspectival art could make firm claims to empiricism that were grounded upon mathematical rules of seeing. Alternatively, it can be said, perspective is a way of visualization that can be thought as a comprehensible form of mathematics. In the guise of perspective, mathematical thinking not only transformed parameters of the visual; the rational and the empirical in turn also became mathematical.[54]

Magical in its appeal, in the early stages of its discovery, the strength of perspectival painting was very quickly grasped by the Church elite, and integrated within the moral authority of Scholasticism.[55] In its appropriated form, the art of perspective was used as a tool for interpellation, and to evidence logic of divine providence, divine light that is ascribed to Jesus Christ in the Bible,

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[53] Kemp, *The Science of Art : Optical Themes in Western Art from Brunelleschi to Seurat*, 342.
[54] Belting, *Florence and Baghdad*, 168-69.
[55] Belting references Rotman's analysis of the vanishing point in connection with "projective geometry." The idea that it is possible to see and map what can be seen it then taken up by the Churchman to symbolize the divine eye. See Brian Rotman, *Signifying Nothing : The Semiotics of Zero* (New York, USA: St Martin's Press, 1987), 21-22.

and the omnipresent all present, all seeing heavenly eye.[56] Unsurprisingly, medieval scholars known as Perspectivist were amongst the first proponents to engage with the Latin translations of Greek and Arab literature on optics. The writings of Scholastic personalities, such as Roger Bacon, (d.1292-94) John Pecham, (d.1292) and Witelo, (d. after 1278), mark the revival of interest in the science of optics in Europe. Importantly, all together, their work proved no resistance to the idea of applying theories of light to painting.[57] Combined with scholastic appeal, as the convention of visual language changed, the universally acknowledged abstract language of mathematics was subsequently able to close in the fallibility of subjective sensory evaluation with the infallibility of divine light.

It can thus be said, the success of the enterprise of the art of perspective is twofold. First, the art of

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[56] A . Mark Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, vol. 91, Transactions of the American Philosophical Society, New Series (Philadelphia, USA: American Philosophical Society, 2001), cvi-cix.

[57] Renaissance historians confirm that outside of scholastic circles especially artists, including leading figures such as Brunelleschi, Lorenzo Ghiberti (d.1455), Piero della Francesca (d.1492) and Leonardo da Vinci (d.1519), read, or were familiar with technical writing on optics. See for example Kemp, *The Science of Art : Optical Themes in Western Art from Brunelleschi to Seurat*.

perspective drew its authority from the ancient philosophers on optics, which is the study of light. Second, additional intellectual backing came from the theologian scholars who had proclaimed the belief nearly two hundred years before *Della Pittura* was written, they had said that the study of light was essential for understanding physical vision, which in turn was "instrumental to understanding spiritual vision."[58] In this way, not only did perspective survive, it thrived.

Optics, *Manazir*, and Perspective

According to the classic art historical narrative scientific modernity in art is grounded in the genealogy of linear perspective. Described as a process of radical transformation in how things are perceived, perspective in the European tradition symbolizes an end to all illusionism associated with the medieval Dark Ages, including theocratic world-view. The Renaissance is precisely when it is claimed that the irrational, the subjective, the fantastical, are

[58] Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, 91, xciv.

put to rest, brought into order. In the arts, this idea is interpreted by means of perspective. As Panofsky puts it, "Perspective mathematizes this visual space, and yet it is very much the *visual* space that it mathematizes."[59] To write it in another way, although, Panofsky was unable to conclusively tie the foundations of perspective with surviving ancient artefacts, his notion of perspective as a symbolic form functions well with the narrative that vision is culturally constructed, and modern vision is allied with modes of perspectival seeing. In this way it can be claimed that camera photography is the continuation of the evolution of perspective, and most importantly, perspective is a way of seeing that joins up the art of the Renaissance with the culture, art, and philosophy of the ancients.[60] In this arrangement of reading historical events, rationalized space is foremost a means of legitimizing the way by which things in the world are observed and get seen. Over time, the identities of the legitimizing authorities may have changed, all the same, mathematical mapping of visual space, retains unwavering authority, as presently asserted by the sciences.

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[59] Panofsky, *Perspective as Symbolic Form*, 71.
[60] The thesis developed by Panofsky seems to be supportive of the continuation arguement. Ibid. See also Martin Kemp, *Behind the Picture : Art and Evidence in the Italian Renaissance* (New Haven, USA and London, UK: Yale University Press, 1997).

Within the discipline of history of art, literature on the contextual analysis of the making of Western art occupied with the topic of vision, or gaze, or perspective, or the science of art, or picture science or picture theory or visual culture is vast.[61] Much ink has been spilt in trying to answer how and why artists in Europe did not adopt modes of perspectival representation prior to the early part of the fifteenth-century. For example, art lacking in perspectival appreciation is often deemed primitive or naïve. This claim retains not only its polemic barb. Counter claims to this position within the domain of the visual remain both contemporary and as well as topical.[62]

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[61] For key texts on Renaissance perspective please see, Panofsky, *Perspective as Symbolic Form*. John White, *The Birth and Rebirth of Pictorial Space* (London, UK: Faber and Faber, 1957). Samuel Y. Edgerton Jr., *The Renaissance Rediscovery of Linear Perspective*. Kemp, *Behind the Picture : Art and Evidence in the Italian Renaissance*; Norman Bryson, *Vision and Painting : The Logic of the Gaze* (London, UK: Macmillan, 1983). Martin Kemp, *Behind the Picture : Art and Evidence in the Italian Renaissance* (New Haven, USA and London, UK: Yale University Press, 1997); Kemp, *The Science of Art : Optical Themes in Western Art from Brunelleschi to Seurat*. James Elkins, *The Poetics of Perspective* (Ithaca, USA and London, UK: Cornell University Press, 1994).

[62] The making or undoing of a particularly European brand of cultural ascendency, one that is allied with the identity and heritage of classical Greece, and looks up to the time of European Renaissance as a model, at least in part has something to do with the sustained interest in the period. For a more recent example of comparative scholarship on vision and perspectival space in art, see Belting, *Florence and Baghdad*. See; Saliba, *Islamic Science and the Making of the European Renaissance*. See also Laura U. Marks, *Enfoldment and Infinity : An Islamic Genealogy of New Media Art*, ed. Roger F. Malina and Sean Cubitt, Leonardo (Massachusetts Institue of Technology, 2010).

A central assertion of standard art history textbook is that Renaissance painting is the culmination of an uninterrupted relationship of the arts with the discourses on light and vision of the ancient Greeks. If, the competence of the painters is to be looked upon as a solution to the problem of vision, then there is an asymmetry in this account. On the basis of what can be verified from the study of medieval manuscripts, historians of science tell us that there existed no unified theory to explain the relationship of the property of light and the relationship of light to visual perception around the Mediterranean and its environs until the eleventh century.[63] This makes untenable the acceptance of the straightforward, integrated art historical narrative of the development and transmission of perspective, from the Greeks to the Italians.[64]

The diversity of theories on vision that may have been available ranged from the Atomists who believed in

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[63] A. I. Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, ed. J. B. Trapp, trans. A. I. Sabra, II vols., vol. II: Introduction, Commentary, Glossaries, Concordance, Indices, Studies of the Warburg Institute (London, UK: Warburg Institute, University of London, 1989).

[64] Hans Belting, "Perspective: Arab Mathematics and Renaissance Western Art," *European Review* 16, no. 02 (2008). Belting's thesis is the most detailed analysis to date of the link between Arab studies on optics, and Renaissance art.

intromission theory, as did Aristotle much later. Euclid and Ptolemy held an opposite view and postulated that visual rays of light emanated from the viewers eye, which was the view that light proceeded from the look, much like a projector, known as extramission theory.[65] Concurrently, Plato and Galen promoted a combined theory of intromission-emission. More to the point, these were some of the choices confronted by the early Arab scientist, the so-called Arab intermediary studying optics. The challenge lay in the fact that they found that there existed no consensus between the mathematician, the philosopher, the astronomer, and the physician.[66]

It was not until Ibn al-Haytham, born in Basra, Iraq in AD. 965, that as David C. Lindberg puts it, the "first comprehensive and systematic alternative to Greek optical theories was formulated."[67] Invited to Egypt at the behest of Fatimid Caliph al-Hakim, Ibn al-Haytham was expected to work on a project for controlling the Nile river floods. As a historical account has been recorded and recounted, Ibn al-Haytham soon realised that the project brief to control

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[65] David C. Lindberg, *Theories of Vision from Al-Kindi to Kepler*, 1996 ed. (Chicago, USA: University of Chicago, 1976).
[66] Ibid.
[67] "Alhazen's Theory of Vision and Its Reception in the West," *Isis* 58, no. 3 (Autumn 1967).

the waters of the Nile was unworkable. Subsequently fearing the displeasure of the Caliph, he went into hiding. And according to the sources referenced by A. I. Sabra, during the time Ibn al-Haytham was in hiding, he earned his living by charging the "non-negotiable sum of one hundred and fifty Egyptian dinars" for a copy of *Elements* of Euclid, a textbook on astronomy sometimes referred to as *Intermediate Books* and Ptolemy's *Almagest*.[68] It is said, after the death of Caliph al-Hakim (1021), Ibn al-Haytham set up residence outside the al-Azhar mosque in Cairo where it is believed he devoted himself solely to writing up until his death, estimated to be in either 1040, or 1041.[69] Ibn al-Haytham, famous for his work in the field of optics, astronomy, and mathematics, later came to be known as Alhazen in the Latin West for being the individual responsible for introducing the most sophisticated theory of optics to Europe at that time.

Ibn Haytham was a prolific scholar, who in keeping with the intellectual milieu of the age, wrote on a wide range of subjects that included poetry. Sabra traces the biography and provenance of Ibn al-Haytham's manuscripts on

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[68] Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, xxi.
[69] Ibid.

mathematics and astrology based on the Ibn Abi Usaybi'a (d.1270) catalogue of manuscripts known as *Tabaqat*.[70] According to Usaybi'a, Ibn al-Haytham completed twenty-five titles on mathematics and forty-four titles on physics and metaphysics.[71] It says in the *Tabagat*, Ibn al-Haytham completed his monumental synthesis of the then existing scholarship on optics, *Kitab al- Manazir*, *Book of Optics* between 1028 and 1038.[72]

For reasons not known, historian Sabra tells us *Kitab al-Manazir* slipped into obscurity and did not receive any serious consideration until more than 250 years after its completion. Out of the Islamic mathematicians and philosophers hereto, Kamal al-Din Abu al-Hasan al-Farisi (d.1320) is credited with resurrecting the *Kitab al-Manazir* in his *Tanqih al-Manazir* (1302-1311).[73] At the behest of his teacher, Farisi summarized as well as provided a commentary on *Kitab al-Manazir.*[74] Historians believe sixty works survive Ibn al-Haytham, and out of these, just three have been translated into Latin according to historian of science

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[70] The full title of Ibn Abi Usaybi'a list of manuscripts "Uyun al-anba fi Tabaqat al-atibba". Ibid.
[71] Ibid., xxii.
[72] Ibid.
[73] Ibid., 1xiv.
[74] See ibid., 1xvii-1xix. Kamal Din al-Farisi, Persian mathematician & physicist (1267-1320) was the pupil of Qutb al-Din al-Shirazi (1236-1311).

A. Mark Smith.[75] Of the works known in Latin, *Kitab al-Manazir* is notably the most significant. Nevertheless, the identity of the person who completed the first Latin translation in late twelfth or early thirteenth-century remains unknown.

According to some references, the school of Gerard of Cremona (d.1187) remains an unproven possible source for partial translation of the text.[76] The title by which *Kitab al-Manazir* of Ibn al-Haytham was identified in the early part of thirteenth century as either *Perspectiva* or *De aspectibus*.[77] The earliest Latin citation from *De Aspectibus* is from the subsequent part of 1240s.[78] As noted by A. Mark

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[75] The Arabic text of Ibn al-Haytham's Optics, Kitab al-Manazir survives in five copies, all in libraries in Istanbul, the Sulemaniye Library, Ahmet III Library (now New Library) and Topkapi Sarayi Museum. The oldest copy dates back to 1083. See "Introduction" ibid., 1xxx.

[76] Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, 91, xix-xx. Other titles translated into Latin include "Treatise of Parabolic Burning Mirrors, and "On the Configuration of the World".

[77] Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 1xxiii. Smith's research shows that it is likely that the Latin *De aspectibus* was based the combined works of Ibn al-Haytham and the treatise on optics known in Latin as *De crepusculis* by late eleventh-century scholar Ibn Mu'adh of Ja'en Spain.

[78] Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, 91, xx.

Smith, it is not much later that *De Aspectibus* is referenced by Bacon in his *Perspectiva* (1265), Witelo cites it in his *Perspectiva* (1275), and Pecham uses it in his *Perspectiva communis* (1280). Given the interest, including artistic interest in optics by mid-fourteenth century, *De aspectibus* was translated into Italian.[79] For example, the Italian source dated 1341, is quoted by Florentine sculptor Lorenzo Ghiberti (d.1455,) who references Alhazen as the authority from the Italian *Optics* manuscript by Guerruccio di Cione Federighi in his *Commentarii*.[80] Conservative analyses by experts on Ghiberti's biography further support the idea that there is a link between knowledge of mathematics of optics and artistic success (Ghiberti won the competition for casting the doors of the Baptistery cathedral in Florence 1401).[81] Together with the successes of Brunelleschi and his contemporaries, perhaps it is not unexpected that the demand for any kind of manual, or textbook on the study of vision and representation would be well prized by artists and architects. In recent scholarship, Hans Belting has re-introduced the work on

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[79] Ibid.
[80] See Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 1xxv. Note 122.
[81] Belting, *Florence and Baghdad*, 150-55.

perspective by mathematician Biagio Pelacani of Parma (d.1416).[82] Belting further stresses that Pelacani was very well versed in Alhazen's work.[83] Furthermore, Belting's thesis is that Pelacani's reading of optics represented a different interpretive voice, as he looked to mathematical optics as a system of measuring "physical objects" in very much the same way "as the space they occupied."[84]

Successive scholarship on the arts of the Renaissance conclusively shows that works on optics were being sought after and read outside of university curriculum for students of mathematics. Indicative of demand, in the second half of the sixteenth century, 1572, Friedrich Risner published printed copies of *De aspectibus* in Basel in a volume by the title *Opticae thesaurus*. As the title suggests, *De aspectibus* marketed in the form of a thesaurus was a significantly truncated or abridged version of the original Arabic. However, Risner's text was much easier to understand

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[82] Frangenberg also notes Pelacani work of perspective was well known in his time. Moreover he was familiar with Latin version of Alhazen's Optics. Thomas Frangenberg, "Perspectivist Aristotelianism: Three Case-Studies of Cinquecento Visual Theory," *Journal of the Warburg and Courtauld Institutes* 54(1991): 142.

[83] For the description of Ibn al-Haytham's theories on vision and distance, see Book II, Chapter 3 "Perception of Distance" and "Perception of Position" in A. I. Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, ed. J. B. Trapp, trans. A. I. Sabra, II vols., vol. I: Translation, Studies of the Warburg Institute (London, UK: The Warburg Institute, University of London, 1989), 149-68.

[84] Belting, *Florence and Baghdad*, 150.

for the non-expert. Its popularity included the fact that it was set in a more readable type, abbreviations were kept to the minimum, and text included citations and cross-references, Risner had rendered the technical language easier to understand, which altogether made the *Opticae* "accessible as a research tool."[85] Furthermore, apart from the difficulties in translation, in Risner's version the first three of the eight chapters of Book One in the original Arabic are missing in the *Opticae*/*De aspectibus*. The unfortunate consequences of this are that it is on a somewhat abridged version of *De aspectibus* that most modern scholarship is based, as confirmed by Arab and Latin experts on history of science, Sabra and A. Mark Smith.[86]

The interruptive distance between the original Arabic and Latin certainly has symbolic significance. As Smith rightly points out, translation is never a straightforward conversion process "Ibn al-Haytham, and his Latin incarnation, Alhacen, represent two distinct and even conflicting, interpretive voices."[87] As a result, we come to

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[85] Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, 91, xxii.
[86] Ibid., xxii-xxiv.
[87] For a structural comparison of the texts see ibid., xxiii-iv.

know that the medieval philosophers and artists in Europe read a particularly Latinised version of Ibn-Haytham's *Kitab al-Manazir.* For example, the study of optics did not progress into a style of painting in Farisi's Persia, as evidenced in art, and thus proven by scholars.[88]

That said, despite the problematic associated with translation from Arabic into Latin, and this has been stressed by historians, the fact is that the absent chapters from all surviving Latin manuscripts exacerbates and misses the most remarkable aspect of Ibn al- Haytham's scholarship.

The key difference between the Latin and Arabic manuscripts is in the opening chapter of Book I, which is the introductory chapter, preface, or *sadr.* To mark the beginning of his research, Ibn al-Haytham "summarizes views of ancient mathematicians and natural philosophers on the subject of vision, states his own view of the nature of optical inquiry, and explains the aim and method of his book."[89] And thus he is able to bring forth a synthesis of

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[88] For a historical overview of of Alhazan's optics on art of the Renaissance see "Alhacen and Renaissance Art" in ibid., civ-cxii. See also Hans Belting, "The Double Perspective: Arab Mathematics and Renaissance Art," *Third Text* 24, no. 5 (2010).

[89] Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, 91, ix.

close to nine hundred years of literature on the nature of vision and light. Additionally as Sabra states, Ibn al-Haytham was driven by the conviction that there must be a viable theory of optical phenomena that is able to satisfy the requirements of both physics and mathematics. In addition, for the first time in recorded history, he presented the field of vision within the scope strictly governed by experiments alone.

The word *i'tibar*, experiment emerged as the identifiable methodological tool involving the "manipulation" of devices constructed for experiment.[90] The strength of the project is the investigative orientation; the object of the study is to do with proof rather than discovery. In this way, he introduced a new methodology for studying visual perception. Ibn al-Haytham's *Optics or Kitab al-Manazir* is not a philosophical dissertation on the nature of light but an experimental and mathematical investigation of the properties of light, an exposition that links light to vision. In spirit, it owes much to the philosophical

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[90] See "The Astronomical origin of Ibn al-Haytham's Concept of Experiment" and part VIII "The Physical and the Mathematical" in A I Sabra, *Optics, Astronomy and Logic : Studies in Arabic Science and Philosophy* (Aldershot, UK, Brookfield, USA: Variorum, 1994), 133-36 and 11. See also Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 7.

discourse in the manner of Aristotle, and in process to experimental and mathematical investigation of the properties of light and colour as they relate to the problems of vision for Ptolemy. He ascribed to the view of the physicists or natural philosophers *al-tabiyyun*, not because it was not sufficient on its own, but because it "constituted an element of truth which had to be combined with other elements derived from "mathematicians" *ta'limiyyun* e.g. Euclid, and Ptolemy."[91] In the resulting synthesis *tarkib* of this method, Ibn al-Haytham retained the logic of mathematical modes of inquiry that had dominated the field of optics, except, as Sabra explains, in Ibn al-Haytham's formulation the methods remained, while their principles were inverted in line with the doctrines of natural philosophers. Furthermore, Sabra finds, that all arguments in the book are either "inductive, experimental, or mathematical, and it cites no authorities."[92] Ibn al-Haytham's inquiry is mathematical proof as it looks not into the essence of the nature of light, but a study of how light behaves.[93] His *Optics* conclusively disproves the possibility

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[91] Part VI in Sabra, *Optics, Astronomy and Logic : Studies in Arabic Science and Philosophy*, 133-36.
[92] See, II ibid., 190.
[93] For an early study of Ibn al-Haytham's experimental method, see Saleh Beshara Omar, *Ibn Al-Haytham's Optics : A Study of the*

of visual rays as physical extensions emanating from the eye.

Ibn al-Haytham's work marks amongst the first separation of the practical sciences from philosophical inquirers. His work is recognised as bringing into the tradition of empiricism a culture of experimental investigation.[94] What Ibn al-Haytham did was to refuse qualitative analyses on the nature of vision in Aristotelian terms and adopted a geometrical and mathematical system for interpreting phenomena in terms of a very different framework. His was the first attempt whereby theological, philosophical issues are no longer entertained as relevant to scientific inquiry.

In sum, this synthesis of Aristotelian emphasis on empiricism with Ptolemaic study of light, Galen's anatomical study of the eye, aided by Platonic mathematics, represents a syncretic attitude to methodology in the sense that Ibn al-Haytham was able to merge the ideal with the empirical.[95]

Origins of Experimental Science (Minneapolis, USA: Bibliotheca Islamica, 1977).

[94] Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 1xxvi.

[95] Plato held the view that rays of light emitted from the eye toward the objects of the world.

To conclude this chapter as Belting writes, Ibn al-Haytham was able to demonstrate that "what governed the world was neither the gravitational force of matter nor chance but light, and by studying light one could uncover the mathematical structure of creation."[96] If indeed the process of translation produced two quite distinct personalities, Alhazen's *De aspectibus* forever changed the *look* of painting in Western Europe. In this setting of history, the study of optics can alternatively be viewed as a set of unfolding events whereby the art of perspectival painting in the depiction phase becomes the intermediary *science of art*.

From the scientific point of view, Ibn al-Haytham's mathematical study of light retains its potency. Microscopes, telescopes, crystallography, x-ray, all apply the understanding of physical nature of light and use it as the basis for understanding the mathematical structure of *creation.* His thesis on light links with twenty-fist century optics. The trajectory of his understanding of geometry of light also has far reaching significances for all imaging

[96] Belting, *Florence and Baghdad*, 99.

technologies in the digital, atomic, and molecular age.[97] This sets the stage for the conception of the scientific image. As Sabra's translation and commentary tell us, Ibn al-Haytham Book I, chapters 1, 2, and 3 are missing from Risner's 1572 Latin edition. In the third chapter of Book I, he uses the term al-*bayt al-muzlim*, *camera obscura* in the process of examining and setting up a place for his experiments.[98] All the same, as Sabra emphasizes, as the translator he has used the word "'image'" to speak about what Ibn al-Haytham called the "'form of the sun's [or moon's] light'", "it is worth observing that what he designated by that expression is simply a patch of light having a certain shape" not picture.[99]

The significance of the nuances that are missed in translation cannot be emphasized enough. What does emerge from Sabra's scholarship underscores the capital differences in the understanding of scientific literature between cultures, and also marks a point in history that anticipates

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[97] Charles M. Falco, "Ibn Al-Haytham and the Origins of Computerzied Image Analysis," *2007 International Conference on Computer Engineering & Systems* (2007).
[98] Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 1xxvi.
[99] Ibid., 1i.

in the eleventh century photographic and imaging techniques to come.

Chapter 3

Culture of Image

The Arab text *Kitab al-Manazir* and its Latin version *Optics*, represented by Ibn al-Haytham and Alhazen, historians claim, characterize two different histories, make two distinct cultures. As discussed in the previous chapter, the discrepancies in text, interpretation, reception, and appreciation of Ibn al-Haytham's scholarship make the difference argument a possibility.[100] In this chapter, I shall take on board the differences in the two personalities of Ibn al-Haytham not from the perspective of historians of science, or history of art, but think of Ibn al-Haytham's *Optics* as a text that bridges the two ends of image making practices represented by the disciplines of art and science respectively. Given that artists were familiar with the subject matter of *Optics* during the Renaissance, it is

[100] A. Mark Smith's thesis in part makes the point that the differences in the reception of the Arabic and Latin versions of *Kitab al-Manazir* could just as well be said to represent two distinct personalities, Ibn al-Haytham and Alhacen. See Smith, *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*, 91.

reasonable to say that perspectival drawing techniques subsequently did have an impact on the feasibility of the scientific image. Anatomy drawings of Andreas Vesalius (d.1564) or Leonardo da Vinci (d.1519) for instance, make great examples of drawings that demonstrate the study of the human body. These drawings also show off the virtuosi skilled in the art of mapping and measurement techniques as per the rules of perspective drawing.

As examined in the last chapter, writings on optics drove changes in painting and drawing. Similarly, renewed humanism in the twentieth century represented by philosophers like Ernst Cassirer (d.1945) had a profound impact on the discipline of history of art. This particular link has been analysed by Michael Ann Holly in her study of the foundations of art history. Especially noteworthy is her discussion of the influence of Cassirer on Ernst Panofsky, whose method of analysis gave art history epistemological moorings going all the way back to the arts of the Renaissance.[101] Thereafter *Western* art practices not only became established as a science in art historical dictum,

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[101] For a historical analysis of Panofsky's essay on perspective and its subsequent influence on the discipline of art histroy, see Michael Ann Holly, *Panofsky and the Foundations of Art History*, 1987 ed. (Ithaca, USA and London, UK: Cornell University Press, 1984).

but also any shift away is at times viewed as a loss of the symbiosis between the arts and sciences. Unsurprisingly, this loss is articulated, perceived, and even lamented along the lines expressed by C. P. Snow (d.1980) in his famous 1959 essay entitled "Two Cultures."[102]

As a contrast, in the twenty-first century fallout of political and military action post 9/11 attacks on the World Trade Centre buildings in New York has resulted in the polarization of Muslim culture in opposition to the so-called civilised world. At the same time, the two personae of Ibn al-Haytham in the arts has become a symbol that links two cultures, science and art and Islamic and European. Represented concurrently, Ibn al-Haytham is known for the pioneering work on the geometry of light and vision, and for his influence on the art of perspectival representation as a drawing technique. In the arts, for example, the *Optics* of Ibn al-Haytham is marked by a renewed interest in tracing historical differences in the assimilation of scholarship on the science of optics and its appreciation by the artists belonging to Muslim and European cultures. Hans Belting has taken up this point and maps out the different artistic trajectories of Ibn al-Haytham's *Optics* in his book *Florence*

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[102] C. P. Snow, *The Two Cultures*, 1998 ed. (Cambridge, UK: Cambridge University Press, 1959).

and Baghdad.[103] However, besides the arts of the Renaissance, the different ways of evaluating how vision works and how things get seen also come together in making of new media art forms and scientific visualization techniques because both systems share mathematics as the fundamental ground for mapping and measurement. For example, pictures from the Hubble telescope would be unreadable if they could not be rendered through the norms of perspectival art.[104] Conversely, much new media art explores the inner workings and interaction of material structures such as graphs, and maps and all forms of data gathering, and as such is much less so about the exterior image per se. Yet, historically modernity in the arts has been symbolized by the differences in the forms of visual art and artefacts that then get aligned either with the scientific or the traditional. The differences in appearance therefore have not only come to distinguish the non-scientific and scientific as in the two cultures, but also have come to distinguish the European from the rest of the world, and have augmented the politicization of Muslim culture as the other.

Laura U. Marks challenges some of conventional ideas

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[103] Belting, *Florence and Baghdad*.
[104] See Martin Kemp, *Seen/Unseen : Art, Science, and Intution from Leonardo to the Hubble Telescope* (Oxford, UK and New York, USA: Oxford University Press, 2006).

of representation in her book *Enfoldment and Infinity*. She traces the historical connection of ideas between Islamic civilisation and Europe in new media art.[105] On the basis of her study, Marks finds there has been a flow of ideas that she terms as a "genealogical link" between new media art and Islamic philosophy, its art forms, and history of mathematics.[106] Her thesis rests on the overall conceptual affinity between electronic and new media arts and 'Islamic' arts that is based on geometric and mathematical principles. The strength of Marks's analysis is provoking and becomes apparent in often cited art such as the "Cupola of the Salon de los Ambajadors" fourteenth century Alhambra (see Figure 1) when compared with more contemporary art for example, "The Bay Lights" 2013 (see Figure 2) and "Multiverse" 2008 (see Figure 3) by artist Leo Villareal. All these examples of art have a mathematical origin and involve viewer participation strategies based on the perceptual. This analysis becomes viable especially as the new media arts have less emphasis on the pictorial in the sense of European figurative and perspectival arts. The emphasis on the non-figurative, the hidden, and the attention to the non-

[105] Marks, *Enfoldment and Infinity : An Islamic Genealogy of New Media Art*.
[106] Ibid., 25.

apparent Marks sees as the "aniconic turn" of new media arts.[107]

All the same, even as Marks diagnoses a growing tendency within new media art towards the mathematical, coded, geometric, and the algorithmic forms, art and science also come together in the work of artists who work with scientists to produce novel biological, and even live works of art, referred to by Jens Hauser as "organic media art."[108] Except, unlike many examples of new media art works that Marks details in her book, organic media problematize the aniconic architecture of new media art forms. What makes organic media art exceptional is that it is on the very basis of the alpha numeric, geometric, programmatic, and algorithmic, a variety of biological substances when they are made visible as disembodied living forms or entities start to challenge the traditional abstract purview of what life or living matter is. Although artists who work with biological materials aim to challenge bio-political incursions into the personal and bodily, yet the ability to politicize and complicate the technological capabilities to

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[107] "Infinity and Accident: Strategies of Enfoldment in Islamic Art and Computer Art," *Leonardo* 39, no. 1 (February 2006).
[108] Jens Hauser, "Biotechnology as Mediality: Strategies of Organic Media Art," *Performance Research: A Journal of the Performing Arts* 11, no. 4 (2006).

alter or reconfigure organic substances at this discrete level can only be articulated in what are recognisably figurative forms of representation. The process of visibility makes resistance to the politicization and control of life challenging, and for example, once cellular life at molecular scale is represented in the form of an image, as an image it does not only depict life, but also becomes iconic of the processual apparatus of seeing living. In the shapes of living bodies, the abstract, algorithmic and perceptual become recognizable as the eye view of scientific machinery and the clinical eye, which is fundamentally a controlled way of seeing. Therefore, contrary to the aniconic turn in new media arts, organic media arts, and particularly the biological sciences ostensibly expose all media to stem from canonically structured domains. Moreover, I think organic media are more iconically structured as shifts in focus towards the biological show desires that are fundamentally embodied and anthropomorphic in conception. For example, the desire to create a dialogue, interact, and communicate, not be determined by fixed structures, to think of life as free are in sum unthinkable outside the human. These ideas as they are contained within art making are somewhat reminiscent of the search for extra-terrestrial life as themed in great works of science fiction for instance. This is perhaps due

to the fact that visualization processes make biological materials accessible to control, to alteration, and even *re-programming* starting molecular scale up. Since the difference in proximity, biology is on earth and cosmology belongs to the universe, smart drugs, and designer babies become more possible. As a contrast, the extra-terrestrial remain illusory, and speculative.

The influence of the science of optics has been discussed in light of the art of painting, astronomy, and cosmology. In the following parts of this Section, I shall discuss further the arts' engagement with specifically the biological sciences in order to open up the discussion on what happens when the science of optics shines its light on the biological. This shift in focus from the cosmological to the biological, I shall first analyse in terms of the philosophical unease with the image, and include the classical Arab and Islamic perspective to tease out the problematics associated with the image making and its effects upon the subsequent development of the techniques of scientific image making. In this way I shall think through the conception that images inhere the world of the possible, as in the *barzakh* and also think of images along side the Platonic polemic against *mimesis*, as discussed in Chapter 1. In Chapter 4, I shall discuss the possibility and limit of the molecular image as a way to think of limit to rationally

grounded modes of knowledge.

To advance the idea of transformative powers ascribed with the image in different cultures, I think it is important to understand the differences in the understanding and absorption of the philosophical particularities that get embedded in the analytical framework of particular disciplines, values, and beliefs. For example, based on purely the visual, it can be said that the figural plays a nominal role in Islamic art.[109] However, to think that Islamic arts are aniconic is also mono-dimensional. As the Oxford English Dictionary definition has it, aniconic is "deity or deities of idol not shaped into human form."[110] Archaeological historians will tell us that there was an ancient Meccan deity called *Allat*.[111] Nevertheless, just as circumstantial as it would be to claim that the life like form of an old Meccan deity has been replaced by the

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[109] For a history of the status of painting in Islam see K. A. C. Creswell, "The Lawfulness of Painting in Early Islam," *Ars Islamica* 11/12(1946). See also A. A. Vasiliev, "The Iconoclastic Edict of the Caliph Yazid Ii, A. D. 721," *Dumbarton Oaks* 9/10(1956). And Ahmad Muhammad Isa, "Muslims and Taswir," *The Muslim World* 45, no. 3 (1955).

[110] Oxford English Dictionary, "Anicoic," (Oxford, UK: Oxford University Press, 2013).

[111] For a history of early Arabian religious icons see Hashim Mohammed Al-Tawil, "Early Arab Icons: Literary and Archaeological Evidence for the Cult of Religious Images in Pre-Islamic Arabia" (PhD dissertation, University of Iowa, 1993), 102-69. See especially chapter III, "Major Female Deities of pre-Islamic Arabia" where Al-Tawil discusses the three most famous goddesses Allat, Al-'uzza and Manat.

formless monotheistic *Allah*, would be to presume that imagery is replaced by geometry. Additionally, distrust of the senses, and the image as it is seen as the embodiment of the senses has a philosophical history longer than Islam, just as is Plato's polemic against *mimesis.*

Fundamentally, the root of distrust of the senses rests not as much on what can be known through the senses, but rather alludes to the limits of all that can be known rationally. For example, in medieval Arab philosophy these ideas were debated in terms of the unknowability of God or Divine via the senses, hence ultimately these debates also became questions to do with faith. During Ibn al-Haytham's lifetime, the early Islamic theologian philosophers debated on the issue of knowability of reality via the senses. These debates were part of the *Kalam* tradition that was not only committed to the "possibility of knowledge", but also committed to overturn philosophical postulates on the unreliability of the senses, and unknowability of reality or true knowledge through the senses.[112] The group of Muslim philosophers known as the Mu'tazilite proclaimed that *ilm* knowledge distinguished faith in Islam, not "mere adherence

[112] The practioners of Kalam usually referred to the sceptics as the sophists, al sufista'iyya in Arabic. See Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 107.

to traditional belief", and they represent the earliest and most influential philosophical tradition in Islam.[113]

It is from within this philosophical background that Ibn al-Haytham was working on the science of optics. This is why his work is an investigation into the properties of light to solve the problem of vision, and directly addressed the problem of true knowledge through the senses. As clarified by Sabra, Ibn al-Haytham used the word *sura* as in reflection, or patch of light. He also used, *sura* as in form. Unsurprisingly, meanings that are more contemporary include picture, and photograph.

The residual difficulty is not to do with the scientific study of light. The difficulty is in the potency of translation of the many philosophical words and terms that get used interchangeably and in time acquire quite specific meanings. For example, perspective for the artist is a technique for drawing based upon geometric principles. Alternatively, as Thomas Frangenberg notes, as late as the sixteenth century, Italians held on to a variety of views on theories of vision and optics, what he calls "Perspectivist Aristotelianism".[114] Frangenberg's article particularly draws

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[113] "Book III", ibid.
[114] Frangenberg, "Perspectivist Aristotelianism: Three Case-Studies of Cinquecento Visual Theory."

attention to the fact Italians continued to hold on to very different views even when at times the theoretical literature on vision was an amalgam and included terms that were inherently contradictory. To give an example of self-contradictory formulations of theories on vision Frangenberg points to a particularly noteworthy manuscript owned by Dante scholar Benedetto Varchi to exemplify his point.[115] In the words of the unknown scholar,

> The visual ray is nothing other than what the philosophers call *species* or *forms* that is the *simulacrum* and image of an object, which, leaving the object and multiplying itself in the medium, arrive at our eye.[116]

Visual ray, species, and forms represent Euclid, Aristotle, Ptolemy, and Plato effectively. Each of them represents and holds a particular position in the science of optics. Moreover, irrespective of whether the pyramidal patterned visual rays or visual cones literally embody rays from the eyes, or are simply imaginary lines that represent the look or the gaze of the viewing subject, drawing convention as per rules of linear perspective would remain unaffected. In the same way, it is not paradoxical to

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[115] Perhaps it is not surprising for a Dante scholar to own a muddled manuscript on optics. According to historian Vasco Ronchi Dante Alighieri failed to grasp Alhazen's theory. Lindberg, "Alhazen's Theory of Vision and Its Reception in the West," 333.
[116] Frangenberg, "Perspectivist Aristotelianism: Three Case-Studies of Cinquecento Visual Theory," 140.

entertain the idea that perhaps at the conceptual level the differences in the geometrical and philosophical analysis of vision were also recognised. The question then is, what is the problem?

To list some discrepancies as cited by scholars who are experts on vision as Sabra note that early translators used *sura* for many Greek words "including: *edios*, *idea*, *eidolon*, *morphe*, *eikon*, *typos*." *Sura* from Arabic into Latin is *forma*, and English ""form" includes "form, shape, figure, outward appearance, effigy, image, picture, semblance, illustration."[117] Belting cites Plato in *Timaeus* who speaks of images that form in mirrors, and he used the word *eidolon* that could mean "idol" as well as "image".[118] Cited in David C. Lindberg, "Epicurus describes *eidola* in his *Letter to Herodotus*: "particles are continually streaming off from the surface of bodies." "Sight occurs as these *eidola* enter the observer's eye."[119] As Lindberg states, the most problematic part of Epicurean theory is the "problem of the shrinking *eidola*", so as to enable *eidola* of large objects to fit into

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[117] Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 68.
[118] Belting, *Florence and Baghdad*, 101.
[119] Lindberg, "Alhazen's Theory of Vision and Its Reception in the West," 334.

the observers eye.[120] Neoplatonist introduced the species into optics. Plotinus (d.270 AD) in *The Enneads* claimed all existences emanate outward essences, just as fire heat, snow cold, or fragrant substances scent.[121]

Alhazen's critics claimed that Alhazen himself was indecisive about the existence of visual ray theory. Based on the study of Risner's Latin 1572 translation, Lindberg defends Alhazen. He finds that it was not irresolution, but more to do with the fact that Alhazen did think visual rays, also called radial lines, were effective for the demonstration of "properties of sight", good for constructing "mathematical hypothesis" but he did not believe in the existence or possibility of visual rays that emit outward from the eye. He held the mathematical radial lines to be imaginary.[122] Sabra concurs this position in his commentary on *Kitab al-Manazir.* Ibn al-Haytham did differentiate and accepted the differences between the philosophers and mathematicians. What is significant is that it is precisely because he did not set out to refute the mathematically based geometric optics, that he was able to formulate optics as a composite science. His exposition is

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[120] Ibid., 335.
[121] Ibid., 336.
[122] Ibid., 326-27.

methodologically clear in setting the parameters of the investigation in the way he makes it explicit from the outset that his study was aimed to demonstrate, show how vision worked. Moreover, in order to explain his working rationale, he says his methodology had to be synthetic because the subject matter of vision is not only bodily and entails physical activity, but also as the eye is able to ascertain shape, form, size, and distance, which is a form of measurement that therefore makes vision within traditional ambit of mathematical enquiry.[123] That said his approach had to be both physical and mathematical.

Ibn al-Haytham consistently used the term *daw* for light. In a direct translation from a passage on the description of ray in *Discourse on Light* by Ibn al-Haytham, Sabra translates:

> Light in any self-luminous body is one of the properties that constitute the essence of that body, and, therefore, the light that exists in any self-luminous body is a substantial form in that body.[124]

In order to distinguish direct light or essential light *dhati*, Ibn al-Haytham made contrasts with accidental light

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[123] Sabra, *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*, II: Introduction, Commentary, Glossaries, Concordance, Indices, 5.
[124] Ibid., 9.

aardi, which he calls *al-daw al-aradi* "that shows on the opaque bodies on which it radiates from other bodies is an accidental form."[125] Moreover, in a way that was more customary of Arabic scholarship of his time, he endorsed his own conclusions with further supporting statements such as "This is the opinion of those among philosophers who have verified the matter."[126]

> 'Ray' *al-shu'a* is the name of the light that extends along straight lines in transparent bodies…Now the straight lines on which the light extends are imaginary and not sensible lines, and the totality of the imaginary lines together with the light that extends on them is what is called 'ray'. The ray, therefore, is a substantial form *sura jawhariyya* that extends on straight lines. Mathematicians have applied 'ray' to the ray of sight *shu'a al basar* only in analogy with the ray of sun or of fire.[127]

As per Ibn al-Haytham's thesis, light is form, *sura*.[128] Form is the total appearance of an object, and form is also "*the image or likeness of the object as a pattern of light and colour.*"[129] Furthermore, as Sabra points out Ibn al-Haytham's books on optics did not require the associative link to Plato's forms, although having said that, forms do signal "new orientation" a "reversal in the direction of rays", in line with established opinion of the natural philosophers.[130] To put it in a philosophical context what

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[125] Ibid.
[126] Ibid.
[127] Ibid.
[128] Ibid., 21.
[129] Ibid., 69.
[130] Ibid., 1v.

Ibn al-Haytham's set to do was to settle the philosophical distrust of the senses that can be traced right back to the Presocratics. Senses were believed to be an unreliable source of knowledge. As summed up by Sabra,

> Plato excluded objects of sense from class of true objects of knowledge. And, for Aristotle, scientific knowledge was possible only in so far as it concerned the universal and intelligible as opposed to particular and sensible.[131]

Translators will tell us, translation is like a sedimentary process where each version of translation is able to contribute at the same time creates ambiguities as discussed in the previous chapter. The difference in the appreciation of Plato's use of terms *methexis* and *mimesis* interchangeably set the precedent for the unproblematic acceptance of a distrust of the sensible. The result is a loss of acuity in the interpretation of the cognate verbs attached with the terms that make the task of translation even more complicated, and make a return to original meaning or undoing impossible. *Sura*, form, patch of light as an image, is form likeness, idol, shape, and appearance. The patch of light as an image in the form of art also becomes a way to imitate nature, the opposition to imitation becomes subjective expression, and opposition to subjective

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[131] "Book III", ibid., 106.

expression is over come by empirically grounded objective.

In this process, art becomes science and science more visual like art, and with new media art and *technê*, art and technology become one as in new media, organic or inorganic. And all along, just as the ancients took their inspiration from the sun as a means to examine and map how objects are perceived, light is still used as a means of measurement. The length of a meter is set on the basis of speed of light is 299 792 458 m/s in a vacuum, making light the universally accepted and agreed physical constant. Given its status as the physical constant, the behaviour of light and its relationship to vision continues to unfold the unseen as used by telescopes and microscopes, for instance. Furthermore, it is on the foundations of geometry of light, for example, that the technique of x-ray crystallography on the basis of diffraction patterns is able to determine three-dimensional atomic structure of matter. This includes matter that is biological in origin. Dorothy Crowfoot Hodgkin (d.1994) is credited with having advanced not only the technique of x-ray crystallography, but also she used crystallography to understand the atomic structure of protein molecules. Rosalind Franklin (d.1958) was also a crystallographer like Hodgkin, and worked on understanding the structure of the DNA molecule, instrumental in Francis Crick and James Watson's 'discovery' of the structure of the

DNA molecule in 1953.[132] The developments that took place in the following years were bought to a conclusion and new beginning at the start of the twenty-first century, which was marked by the completion of the Human Genome Project in 2003.

The completion of the mapping or counting of the nearly three billion base pairs of the human genome has become an axis point of coincidence with the coming of the new century. The double helix of the DNA molecule also distinguishes this century, as the century of the biological.[133] The DNA molecule is seen as the code that allows for the mixing of distinctions between the literal and notional philosophical constructions. Thereafter, in the decade that has followed, debates surrounding the meaning and beginning of life have gained new currency in public media. Particularly, the strands of news making which are to do with the proliferation of new diseases, novel cures also become the basis to reopen origins debate, including if or not God exists and even if we exist, as we believe we know

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[132] J D. Watson and F.H. Crick, "Molecular Structure of Nucleic Acids; a Structure for Deoxyribose Nucleic Acid.," *Nature* April 25, 1953.
[133] Declan Butler, "Publication of Human Genomes Sparks Fresh Sequence Debate," ibid., 15 February 2001. See also Viewpoint, "The Human Genome : Science Genome Map," *Science* 291, no. 5507 (2001).

ourselves to be. If we can say that the past century was the century of the science of physics, what we see presently is a blurring of traditional disciplinary boundaries not only between the sciences but also in forms of art that are made up of biological substances. Thus, increasingly, an eye on biology predominates scientific discourse with regards to the application of biology to all other technology ranging from genetics to artificial intelligence. In the arts, this shift in focus towards biology saw to the birth of a new art form, "organic media art" as per Jens Hauser or "Bio Art" as coined by Brazilian artist Eduardo Kac in 1997. (I shall return to the art of Kac in detail in Chapter 4.)

In estimating the forces of forms of visibility, W. J. T. Mitchell coined the phrase "pictorial turn" to address the renewed usages of visibility attained as a result of the proliferation of information technologies.[134] Yet, the critique or the problematics associated with the pictorial are not solely a symptom of the age of post-modern technological advances, they are as well located within the continuation of the fundamental differences in the absorption of Form, species, *sura*, *eidolon*, idea, and

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[134] W. J. T. Mitchell, *Picture Theory : Essays of Verbal and Visual Representation* (University of Chicago Press, 1994). See also *What Do Pictures Want? The Live and Loves of Images* (Chicago and London: University of Chicago Press, 2005).

appearance in a patch of light. Whether or not the enterprise of philosophy is grounded in language or images, it is precisely in the reorientation of the visual ray that what gets exposed also embodies fears, hopes or desires.[135] And perhaps these appearances as images would have remained mere shadows without the mathematization of the visual plane. As Alain Badiou explains, in the "Aristotelian orientation", "mathematics is a grammar of possible existence."[136]

Making Mathematics Real

Artists do not make images; they manipulate how things get seen and sensed. The artistic interface between the imaginal worlds takes the shape of drawings, paintings, prints, etchings, sculptures, photographs, and theatre or art performances to list but a few. The imaginal is written in a variety of prose, including song, poetry, drama, the novel and even as in the code. Artists make films, videos,

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[135] Richard Rorty is popularly associated with the phrase linguistic turn that he used to critique an emphasis on language in analytic philosophical tradition.
[136] Alain Badiou, *Briefings on Existence*, ed. Rodolphe Gasche, trans. Norman Madarasz, 2006 ed., Intersections: Philosophy and Critical Theory (Albany, New York: State University of New York Press, 1998), 102.

multi-media installations, multi-media, material and dimensional works of art, analogue, digital, and electronic art. Even more, art forms do not have to be restricted to what is perceptible by vision alone.

An exception is when artists choose to make work out of biologically sourced materials, for example, tissue samples. In order for the work to even exist, materials need to survive outside the confines of the test-tube or petri dish. This whole enterprise also needs the full backing and support of lab infrastructure. Either the artists require training or they need specialist help and assistance. To make something out of animal tissue cells, artists and the lab may need permission to handle these substances. With the network of arrangements in place, tissue can be used as an artist material. Theoretically formless tissue specimens can be moulded into any shape as long as the graft is supported by an armature made up of a biopolymer, it can take up many types of shapes and forms. As seen in the shape of artworks, this material can morph and take the form of a jacket, pair of wings, meat, ear, hymen, and even boots. For example, work by artists Oron Catts and Ionat Zurrr of Tissue Culture & Art is pioneering in the way the artists make use of the cells and tissues of dead animals to sculpt works. Their best known examples include “Victimless Leather” 2006 (see Figure 4) and “Disembodied Cuisine” 2003 (see Figure 5).

The interdisciplinary coordinated effort is however not the only aspect that makes biological art works complex. Works of organic media can never fall in line within the neat categories of activities such as photo real painting, or perspectival drawing. More than the aesthetic value, these works demonstrate the power and skill to do and make things in the world, including taking up natures' characteristic of growth to fashion objects not found growing unaided, such as a jacket or a transgenic orchid.

Even though technically organic media works do complicate divisions between the natural and the artificial, these differences are not directly perceptible to the senses. As Boris Groys points out, due to technological advancements "we are no longer able by visual means alone to make a firm distinction between the natural or organic and the artificial or technologically produced."[137] Groys gives the example of genetically modified food as a case of when it is not possible to tell if the fruit or grain concerned has been genetically modified. In instances of art where material concerns are key to the formal aspect of the work, then, the credibility of the artwork rests on what we are

[137] Boris Groys, "Art in the Age of Biopolitics: From Artwork to Art Documentation," ed. Documenta 11 (Ostfildern, Ruit: Hatje Cantz, 2002).

told about the work, and not what is possible to judge with the naked eye. American artist Andrew Krasnow works with human tissue to critique aspects of American nationalism, US Army's historically belligerent relationship with indigenous American people, and its continued aggressive military led foreign policy. An example of his work that addresses all his artistic concerns is "Shitkickers" 2005 (see Figure 6). Shitkickers in the first instance appear as an innocuous pair of cowboy boots, except, one finds that they are made up of a patchwork of human tissue that the artist says he uses as a means to convey the pain and suffering caused by military action. The problem is that although the strength of the work rests on formal material appreciation, this material sensitivity is not available to direct or unaided perception. In most cases of organic media art, what does circulate is forms of documentation of the inside turned outside, body and lab, as iconic images demonstrating the power of what art and science can do. And although Krasnow's ideas are potent, military might and scientific might are the two faces of biotechnology, especially given that military action has been fundamental to the development of modern medical science.[138]

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[138] To further critique and address the links between the personal,

Even in instances when artists and scientists come together, art making is fundamentally indifferent to scientific activities. Scientific work needs to be reproducible as data or as experiments. Reproducibility in the arts is not a matter of proof building on the basis of repetition. The pre-digital problematics pertaining to the effects and prospects of reproducibility of a work of art were first written about by Walter Benjamin in his influential 1936 essay "The Work of Art in the Age of Mechanical Reproduction."[139] The loss in every reproduction of the original Benjamin calls "aura" is a potential loss of affect of the original in the moment of reproduction. That said and as is well known of Benjamin's thesis, as Gorys explains, the loss of aura is not merely an aspect of reproduction; rather it is one of dislocation of the original in reproduction, and therefore the concern with reproduction is "topological."[140] And it is in response to the notion of the threat of dislocation of life from its roots or origin that in 2002 Mitchell introduced the term

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military and medicine see my works titled "Molecular Warfare" 2009-13 (see Figure 7), "Flies the Night Sky" 2012-13 (see Figure 8), and "Dol Bel" 2011-13(see Figure 9).

[139] Walter Benjamin, *The Work of Art in the Age of Mechanical Reproduction*, trans. J. A. Underwood, 2008 ed., Great Ideas (Penguin, 1936).

[140] Groys, "Art in the Age of Biopolitics: From Artwork to Art Documentation."

"biocybernetic reproduction."[141] Coined after Benjamin, biocybernetic reproduction Mitchell proposed is a way to look into art practices that were critically engaged in questioning the processes involved in genetic engineering and computer technology. He introduced the concept infused with a twenty-first century spirit and urgency to address the impact and speed at which a biotechnologically defined model for thinking is absorbed into all systems of technology. Benjamin anticipated in mechanical reproducibility a prospect that ultimately saw to the unprecedented mass destruction of life caused by military machinery at the end of World War II. Reproduction by biocybernetic means, Mitchell fears based on his assessment is built on a model of replication where all life, at least in theory is reproducible, and hence expendable. Therefore, given the long shadow of war in the present century, in Mitchell's calculation it becomes even more significant to think about the impact of science for ethics and politics in the age where it is difficult to keep up with the speed at which knowledge is transforming the living conditions for all life on the planet.[142] This danger of the unbridled

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[141] W. J. T. Mitchell, "The Work of Art in the Age of Biocybernetic Reproduction," *Modernism/modernity* 10, no. 3 (2003): 483.
[142] *What Do Pictures Want? The Live and Loves of Images*, 309-34.

advance of technology into all modes of life, including the biological Mitchell, defines as the mode of technically determined biocybernetic reproduction.[143] The expectation is: art can help shatter utopian fantasies of the intermingling of technology with life.

Another encounter with visualization of biological substances at the molecular level was witnessed in the run up to the completion of the Human Genome Project. Orchestrated by the media, policy makers, and politicians alike, at the start of the new millennium, the governments of the United States and Great Britain unanimously declared the moment was yet another giant leap for mankind like its astronomical counterpart. Paradigmatic of a world historical moment, the "epistemologies of the eye", as coined by Lorraine Daston and Peter Galison come into full force when the three billion base pairs of the human genome become a symbol for understanding life.[144] Synthesized by the most sophisticated technological apparatus of the time, the announcement that the human genome was composed of billions base pairs, the image of the DNA molecule was collectively perceived as the de-coupling of complexity of life. The

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[143] "The Work of Art in the Age of Biocybernetic Reproduction."
[144] Lorraine Daston and Peter Galison, *Objectivity*, 2010 ed. (New York, USA: Zone Books, 2007; repr., First).

technological advances become more poignant if we compare the first attempts at unveiling of the shape of the DNA molecule in 1953, which were a pencil sketches that are now in the Wellcome Trust Archive (see Figure 10).[145] In the following fifty years, synced with advances in computer based modelling software, the shape of the DNA molecule at the start of the twenty-first century looked smooth, slick and smart specimen of nature's marvel, attributed to the technical progress of man (see Figure 11).

The significance of the DNA molecule remains unchanged for molecular biologists but the hubris surrounding the image is new. The image of the DNA molecule contains the first instance it became possible to theorize what life could be or become with adjustments starting at the molecular scale. At the same time, the acknowledged count of three billion base pairs supported the belief that complexity of large numbers had occluded comprehension in the past. Concurrently, the image of DNA molecule has especially came to be perceived as a harbinger for the scientific progress to come in the twenty-first century. This development is identified as an epistemological shift, and this visible code for life comes to rest in a particular

[145] Francis Crick, "DNA," in *Wellcome Archives and Manuscripts* (London, UK: Wellcome Library, 1953).

shape: the form of the double helix. Thus, the asymmetrical spiral character of the sugar bonds that form the backbone of the DNA molecule is recognized as a marker that foregrounds the advance of molecular technology.

The human centred bodily displacement caused by molecular biology today is comparable to Galileo's heliocentric theories based on telescopic observation that displaced Earth as the centre of the Universe. Viewed from the vantage of a kind of techno-biological unfolding of scientific developments that include the unveiling of the structure of the DNA molecule, organic media art or Bio Art emerge as speciality art that is able to critically engage with what is predominantly perceived as a part of the biological turn in the sciences. The emphasis toward the biological materializes out of the biopolitics that Michel Foucault formulated during the lectures at the College De France, albeit, in the twenty-first century with a pedagogical shift in emphasis on the cellular.[146] In the present this also means that control is possible at ever

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[146] On biopolitics see Michel Foucault, *The Birth of Biopolitics : Lectures at the College De France 1978-79*, ed. Arnold I. Davidson, trans. Graham Burchell, 2008 ed. (Basingstoke, UK: Palgrave Macmillan, 1978-79). More recently Nicolas Rose builds on Foucault's biopolitics project in Nikolas Rose, *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*, ed. Paul Rabinow, Information (Princeton and Oxford: Princeton University Press, 2007).

more discrete levels, as a result, modifications at the molecular level are seamless.

The biological turn is a specific way to think about the changing relationships between types of knowledge produced by the convergence of technological advances- i.e., advances that have come about in the fields of computer technology, molecular biology, and genetic engineering. More significantly, the architecture of structural biology has been completely transformed as a result of combining more traditional research methods with sophisticated visualization techniques. The emphasis on the visual, supported by computational machinery then makes it possible to successfully join diverse research outputs and subject them to the logics of mapping, computing, and communication, fundamentally determined by information technology, or forms of wet technology that Eugene Thacker calls "biomedia" to ask "what a body can do."[147]

The *turn* is trope to analyse shifts in ways of seeing and doing. The molecular scale signifies a shift away from what can be perceived by the unaided human eye to the lens that structures perception. I see the shift towards lens not

[147] Eugene Thacker, *Biomedia*, ed. Mark Poster Katherine Hayles, and Samuel Weber, vol. 11, Electronic Mediations (Minnesota, USA: University of Minnesota Press, 2004), 14-15.

only as a biological turn, but also a scale shift that detracts the more traditional move away from telescopic to the microscopic. The scale shift is also a change in orientation, i.e., shift in seeing on a molecular scale reorients and brings about a form of transformation in the conditions of how life matter is perceived and governed. Like the telescopic lens, the inward turning of the microscopic lens not only has the potential to expose the human body as the ground for the materially possible, but also the molecular scale makes it plausible to think of life processes in the language of atomic physics.[148] Detached from the messiness of biological processes, molecular biology, as Evelyn Fox Keller points out makes it structurally possible to attempt the deep philosophical problem of understanding life, albeit in the same manner as asked by physicist Erwin Schrodinger in his 1944 book *What is Life?*[149] As Keller explains, the result is a pedagogical shift in the way science is done, and all matter, whether organic or biological, is then onwards studied from the logics of

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[148] Evelyn Fox Keller, "Physics and the Emergence of Molecular Biology: A History of Cognitive and Political Synergy," *Journal of the History of Biology* 23, no. 3 Autumn (1990). See also *Refiguring Life : Metaphors of Twentieth-Century Biology*, The Wellek Library Lectures at the University of California, Irwine (New York, USA: Columbia University Press, 1993).
[149] Erwin Schrodinger, *What Is Life? : The Physical Aspect of the Living Cell* (Cambridge, UK: Cambridge University Press, 1944).

physical matter. The same tools are used to look at biological specimens as in the material sciences. Biological specimens are similarly subjected to the judgment on the basis of the same scrutiny as applied to inorganic material under observation. This transformation brings about a categorical change in the perception of organic life of cells, which in the vocabulary of information science, physics and mathematics are understood through the metaphor of building blocks of life principle, molecular scale up. In this way, in the twenty-first century, the human body becomes in principle a sum of its mechanic parts, an idea formulated by Rene Descartes (d.1650).[150] In the process of molecularization, units of bodily sourced materials can be modified, distributed, and tuned as pathological by-products. As Bas van Fraassen explains, as many systems of representation that there may be known to exist, the Cartesian coordinates representing "shapes in motion" together with numeric equations is fundamental to all modes of scientific representation.[151] Therefore, advances in

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[150] See "Treatise on Man" in Rene Descartes, *The World and Other Writings*, ed. Karl Ameriks and Desmond M. Clarke, trans. Stephen Gaukroger, Cambridge Texts in the History of Philosophy (Great Britain: Cambridge University Press, 1998), 99-169.
[151] Bas C. van Fraassen, *Scientific Representation: Paradoxes of Perspective* (Clarendon Press, Oxford: Oxford University Press, 2008), 22. See also Brian Rotman, *Mathematics as a Sign : Writing,*

technology in a way simply advance a mechanized system of representation. Thus, in this mechanistic purview, biologically sourced specimens get known not only structurally, but also get known in relation to the cells structural environment. Therefore, once the system of biology enters the topological domain, biological substances can be discussed in terms of abstract entities that can be defined by numeric equations. Furthermore, measurements that result in fractional numbers are rounded off to smoothen the count in favour of rationalized numbers. In the digitized form, the body becomes malleable or mouldable, and infinitely reproducible, as we enter the age of biocybernetic reproduction. In this way not only does it become possible to ask, what a body can do, aided by visualizing technologies the image of the digitized body becomes the surface that can be manipulated, both by artists and scientists to show not only all that can be seen, but also done. Conceptually mechanical forms of reproduction and visualization can happen as one in the abstract language of mathematics. To bring the complexity and messiness of life back into biology therefore must also include a critique of the very system that makes mechanized reproduction possible.

Imaging, Counting (Stanford, California: Stanford University Press, 2000), 100.

Similarly, the concept of mechanical reproduction entails idealised conception of mathematical infinite, the reiterable, which I believe is part of the concept of mechanical forms of reproducibility and reproduction.

To problematize idealised forms of mathematics, Brian Rotman sets up a dialogue between Kronos and his mathematical protégé Simplicius on the future of mathematics. The future of mathematics, he argues, must rest non-Euclidean mathematics, which is a system of mathematics that challenges:

> The idea that certain ideal objects (in this case mathematical ones) are "out there" somewhere, existing prior to human beings and their culture, untouched by change, independent of energy and matter, beyond the confines and necessities of space and time, and yet somehow accessible to the minds of mathematicians.[152]

In the same way, the non-Euclidean also challenges classical geometry where points and lines can exist without change, infinitely in space and introduce into mathematics "real-world" limits as Rotman argues.[153] That is, to do away with the principle of ad infinitum that can be traced back to Aristotle. According to Aristotle, infinity is the potential ability to "do what you've just done again, and again and

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[152] *Mathematics as a Sign : Writing, Imaging, Counting*, 127.
[153] Ibid., 130.

again, and so on."[154] As Rotman explains, the realm of application and reach of mathematics is being redefined with the advent of computer technology, which is introducing actual limits, and in combination with technology, mathematics is directly linked with shaping the contours of concrete reality. This change is greatly impacted by the proliferation of imaging software with the result biologists studying mutation are able to hypothesize outcomes on the basis of mathematical modelling. Moreover, these models can be visualized and hence even "manoeuvred."[155] The mathematical basis of molecular biology is modelling life and what it can be. Mathematicians can, with the aid of computer technology, as Rotman explains,

> Produce previously undrawable diagrams such as fractals and chaos maps; they can visualize topological surfaces whose existence was unsuspected before they were seen on a screen; they can discover features that precomputational mathematicians never could have imagined.[156]

In very much the same way, mathematically modelled systems of biology can hope to offer solutions to biological problems, previously unthinkable. Due to the mathematization of the material understanding of biological substances, the

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[154] Ibid., 131.
[155] Ibid., 67-68.
[156] Ibid., 128.

character of molecular biology has also come to represent counting systems, and geometry, that is visualized by molecular imaging graphic programmes such as Jmol or iSee, that are supported by complex mathematical code writing. In the mathematics of biology, molecular biology gets a new visibility, and in the new visibility rest new problems but also new realities, new possibilities. Yet, biology is life and by its nature of living cannot be without effects. Real life is unlike what Rotman calls the life of the mathematical Agent who lives in a "frictionless, airless, timeless, Platonic world where it can count as long as it pleases without cost or effort."[157] In very much the same way, the detachment of the lab from life is the problem, and therefore organic media and Bio Art are just one of the ways by which the muddiness, the messiness, and the bloodiness of biology can make the way back to the bench. This I shall explore in the next chapter.

[157] Ibid., 132.

Chapter 4

The Possible Image

Building on past three chapters, in the final part of this section, I shall try and bring back the messiness of life to the discussion of technologism of biology. To do so, I shall re-examine the generative capacity of images that depict biological matter at the molecular scale. For instance, the artists, as do the scientists, see in the microscopic images of the DNA molecule potential sites for things that can be materially feasible. Scientific outputs have included target medical treatments and biocomputing or design systems that use molecular biology as model. And artists have used biological waste and specimen as raw material to sculpt original objects as discussed previously. To further analyse the impact of visualization of biology, in this chapter I shall address the changes that come about as organic media artists create art out of materials and techniques sourced from the biology lab, and argue that these artworks are more than just social markers indicating changes in perception. Michel Foucault in his study of the

changes in perception of the body in eighteenth century France formulated the term "medical gaze" to describe the process of rationalizing the nature of disease.[158] Correspondingly, visualization apparatus continue to shape perception as our biological understanding of the body is hooked up to diagnostic devices that in the twenty-first century are connected to a myriad of imaging and magnification apparatus. Organic media art is but one result of the increased ability to see, as visualization processes extend the perceptual parameters and continue to change what is believed to be biologically controllable as the minutiae of cell circuitry appears within grasp.

To delve into the potency of the idea of biological transformation, in this chapter I shall focus on single artwork by Eduardo Kac entitled, Alba.[159] This work is widely known. My aim is not to discuss how this work of art makes awareness of the cellular similarities between mammal and fish visible, or how it does complicate human and animal body parameters. Alba does all of this as do lab animals. Historians, new media theorists, and ethicists have also

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[158] Michel Foucault, *The Birth of the Clinic : An Archaeology of Medical Perception*, trans. A. M. Sheridan Smith, 1994 ed. (New York, USA: Vintage Books, 1973).
[159] I am borrowing the word transformation in the sense experts examining links of molecular biology and technology use it.

extensively discussed Alba.[160] I shall argue that although Alba could be seen as a measure of technological success, and it is an object that displays the frontier of what can be done and made biologically feasible, Alba presently marks an ethical limit to what can be done with these new and emerging technologies. I shall start by detailing the making of the bunny, and then subsequently problematize "aesthetics" conceived by Kac in his claim about transgenic art that he states, "must be understood to mean that creation, socialization, and domestic integration are a single process."[161]

Useless Marker

Fluorescent Green rabbit, Alba is unique. It is unique as an albino rabbit that is host to Green Fluorescent Protein GFP from a jellyfish *aequorea Victoria* (see Figure

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[160] For more recent evaluations of transgenic art and Kac's rabbit see Robert Mitchell, *Bioart and the Vitality of Media* (Seattle, USA: University of Washington Press, 2010). "Green Bunnies and Speaking Ears: The Ethics of Bioart Joanna Zylinska, *Bioethics in the Age of New Media* (Cambridge, Massachusetts and London, England: The MIT Press, 2009), 149-74. See also Eugene Thacker, *The Global Genome: Biotechnology, Politics, and Culture* (Cambridge, Massachusetts and London, England: The MIT Press, 2005), 307. Mitchell, "The Work of Art in the Age of Biocybernetic Reproduction."

[161] Eduardo Kac, *Telepresence and Bio Art : Networking Humans, Rabbits and Robots* (The University of Michigan Press, 2005), 271.

12). It is unique because it was custom created to include in its genome genetic material sourced from a jellyfish, not to perform or live as a lab specimen but as a work of art. Born in February 2000, artist Kac says, rabbit Alba was genetically modified to emit fluorescence twice as bright as the wild jellyfish type.[162] On the basis of this particular cosmetic aspect, what the audience see is a picture of the green *glowing* rabbit set against a white background (see Figure 13). Made thirteen years ago, due to the pace of technological change and time, Alba already appears as a vintage project that symbolized particular changes in cultural, political, intellectual, artistic, philosophical, and medical attitudes towards molecular biology that were to lead human health and bodily aspirations into the new millennium. In the past decade, although the and fears and promises of a new biologically determined era have dissipated, the political significance for the biological matters even more as the "art of government" is able to regulate the (human) biological at ever more discrete levels.[163] For instance, Claire Pentecost discusses Kac's

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[162] Ibid., 266.
[163] Foucault sums up the art of government as "rationalization of governmental practice in the exercise of political soverignity." Foucault, *The Birth of Biopolitics : Lectures at the College De France 1978-79*, 2.

work Alba to bring attention to the link between politics associated with neoliberal values to the explosion of funding for specializations within the life sciences such as genetics, bioinformatics, bioengineering, and biotechnology. In summing up the problem, Pentecost writes, "I conceived the problem this way: science in the service of neoliberalism alienates the non-specialist whose life is profoundly affected by its commercial application."[164] Especially noteworthy is her critique of the pedagogical role of artists who use biological materials in generating discussions about the new developments in technology.

Another unique feature regarding Alba is that the unveiling of Alba was more in the manner of scientific announcement on 14 May 2000 at the Planet Work conference.[165] Furthermore, Alba has not been experienced in flesh in the public domain, as is the case of most works of art and is only known through images. Alba instantly became news as the idea of transgenic gained traction across disciplines, especially molecular biology and bioethics as the first

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[164] Claire Pentecost "Outfitting the Laboratory of the Symbolic Toward a Critical Inventory of Bioart in Beatriz da Costa and Kavita Philip, ed. *Tactical Biopolitics : Art, Activism, and Technoscience*, Leonardo (Cambridge, MA, London, UK: The MIT Press, 2008), 112.

[165] Kac, *Telepresence and Bio Art : Networking Humans, Rabbits and Robots*, 266.

live, non-human animal transgenic work of art situated within contemporary practice.[166] Importantly, Alba is not the first transgenic animal. As it is possible to glean from Pentecost's analysis, the significance of project Alba is that through the arts, the idea of transgenic is naturalised as a topic for discussion within the humanities. Due to its unique biological character, this rabbit certainly did catch up with the attention of critical theorists, writers on new media arts spanning across disciplines; not restricted to art history, critical theory, or visual culture. The journey of this Green Fluorescent Protein GFP enhanced rabbit as I see it, unfolds like a map that shows the reception of the molecular biology and technology paradigm as it gains acceptance across disciplines represented by the arts and humanities. Thirteen years into the new millennium, all the same, Alba the transgenic rabbit can still represent the unresolved problems of engineering biology that continue to be relevant across a range of concerning disciplines from art, philosophy, ethics, law, and even notices for the weekly gatherings of post-human futurologists.

Alba is artist Eduardo Kac's second transgenic artwork. Alba is also a transgenic animal, and though this

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[166] Ibid.

point is obvious, I think it is important to state that Alba is a multicellular animal, not, bacterium that has been genetically modified to host the incorporation of deliberate human inserted foreign gene into its genome. The technique of achieving this insertion is the controlled joining of DNA from different organisms called gene splicing. Quite literally, the term means trimming, cutting, and pasting of genetic material, which is part of the routine procedure for cloning and creating transgenic laboratory creatures. The lab specimen can range from unicellular organisms to complex multicellular organisms such as mice or rabbit, Alba in this instance.

In the life sciences, the practice of research based on combining genes is called Recombinant DNA technology (rDNA). This process additionally involves the insertion of other gene sequences so that the host body does not reject the foreign gene, and ensures that the cells of the host body express the foreign gene correctly.[167] The significance of this type of research is that it includes experiments that combine human genetic material with animal for therapeutic purposes. In particular the implications for

[167] John W. Kimball, "Transgenic Animals," William. C. Brown, http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/W/Welcome.html. Accessed, 13 December 2013.

creating human/animal chimeras continues to pose legislative difficulties, some of these concerns I shall address in the writing to follow.[168]

On the artistic front, to create an art project of scientific complexity such as Alba, Eduardo Kac teamed up with scientists Louis-Marie Houdebine, Patrick Prunet, and Louis Bec (noted for coining the term zoosystematican to describe the concept of digital modelling of living systems) who Kac met at *Ars Electronica* in September 1999.[169] Alba is materially complex, however. A project like Alba is even more complex since it is configured as a work of art, and therefore becomes socially intriguing and intellectually challenging. Particularly, as transgenic art, Alba cannot be neatly explained in the manner of scientific experiments that are aimed at problem-solving, transgenic art forces a rethinking about a new kind of materialism that emerges with abilities to engineer cellular life molecular scale-up. It adds to the persistence of questions that involve thinking about political aspects of life such as freedom, alterity, otherness, resistance etc. that are not the type of

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[168] See Shane Burke, "Justifications for Patents as Applied to Human-Animal Chimeras," *European Intellectual Property Review* 34, no. 4 (2012).
[169] Kac, *Telepresence and Bio Art : Networking Humans, Rabbits and Robots*, 266.

questions that life sciences try to solve in the lab. Together with the emotional force of the seen, the visible, seeable, the imagined and knowable, the seamless appearance of transgenic creature becomes more troubling as genetically modified farm animals are also routinely GFP tagged for identification purposes.

After Kac announced the realization of his transgenic project, he wrote a paper titled "GFP Bunny" describing his new work by the label "transgenic" as the creation of "unique living beings."[170] However, this is not the problem. The problem is that at the same time as Kac exploits the potential for artistic creation to its limits, he also highlights the desire to "respect, nurture, and love the life thus created."[171] These sentiments are contradictory as they carry the implication of potential violence and cruelty that is not only simultaneously present in any creation or birth in the wild or lab for example, but also must equally be present in the creation of living works of art. How necessary was Alba's creation, remains questionable.

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[170] Kac introduced the term "transgenic art" to art lexicon in 1998 in his proposal for the creation of a albino dog of the hairless variety that would express GFP. See Eduardo Kac "Life Transformation-Art Mutation" *Signs of Life : Bio Art and Beyond*, Leonardo (Cambridge, Massachusetts and London, England: The MIT Press, 2007), 164.
[171] Ibid.

Furthermore, the paradoxical sentiments are a part of the relational inter-dependency between a created thing and its creator. This relation exists whether it is between the gods or mankind or artist and artwork. Meaningful creation entails giving life or life-likeness to something, and this transference of life potential is in principle the assertion of will. Therefore, it is inherent to the nature of creation that the created things have the possibility to develop an independent life. For instance, even inert artistic creations such as a play, a painting, a building can take on a *life* independent of the makers. If creation as art is a marker of human life, then, when art is made out of flesh as in the case of transgenic creature, we find that not only do Alba the GFP Bunny and Kac have distinct fates, but also Alba the GFP enhanced rabbit faced separate outcomes. Rabbit Alba was never released from the lab, and Kac has kept his art project alive as he continues to make artworks themed around Alba the GFP Bunny.

In this same paper, Kac also outlined a complicated list of what he expects from his artistic creation.[172] In particular as a response to his critics, Kac has consistently maintained that Alba is an artwork, and not a

[172] For the nine point list please see *Telepresence and Bio Art : Networking Humans, Rabbits and Robots*, 266.

breeding project.[173] In his defence Kac states that transgenic art must be accepted as an aesthetic gesture, or as James Elkins points out, Kac's emphasis is on communication, and not aesthetics discussed in terms of beauty, taste, or judgement.[174] Since Kac does use the term aesthetics, and there is a lack of correspondence between the visible and discrete, (Alba will not appear to glow except under especially lit conditions) I must concur aesthetics must be something other than the cosmetic feature of fluorescence. The question then is what else could aesthetics be in the context of transgenic art?

The borrowing of term "aesthetics" to describe the process of creating and domesticating a living creature does not make disappear the latent violence or cruelty experimental genetic engineering entails. It exhibits a somewhat mindless and casual attitude towards the cruel aspect of living creature as art. Lab transgenic animals routinely die however Kac makes every effort to keep the idea of transgenic Alba alive in his art veiled under the hubris of aesthetics. For example, following the episode of being denied release of his art, Kac led a campaign comprised of a range of Alba related *objet d'art* including

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[173] Ibid., 270.
[174] See James Elkins "Foreword" in ibid., viii-x.

"The Flag Alba" 2001, "Free Alba" 2001-02, "Featherless" 2006, "Lagoglyphs (2007-11)"(see Figure 14, 15, 16 & 17).[175] The phrases that Kac uses to relate his experience and talk about transgenic art include discussion of the project, and artworks such as "The Flag Alba" that he conceptualized as a "social marker" to indicate Alba's absence, and aesthetics as "social gesture." He writes about his public campaign to have Alba released from the lab in Jouy-en-Josas France as an "intercontinental custody battle" that entailed giving prominence to "Alba's plight", and although Kac was able to get his message across to many, he claims he was being silenced and censored by authority.[176] If aesthetics is a process, and particularly if it includes dialogue and communication as Kac claims, then artwork and the media campaign dedicated to Alba do create the aesthetic distance to contemplate connectivity of all life, yet. If these aesthetic gestures can be likened to Aristotle's over turning of Plato's charge against poetry for producing deceptive affects, then, the problem is not that Kac's transgenic art on the material level mirrors technological alternative to reproductive process of nature. Especially given that the strength of Kac's work rests on both

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[175] "Kac," http://www.ekac.org. Accessed, 13 December 2013.
[176] *Signs of Life : Bio Art and Beyond*, 168-70.

technical mastery and scientific accuracy, and that Alba as art and life become one. The problem is that art and life become one. The bloodiness and messiness of life is unaccounted for. And, Kac appeals to trauma on an emotional and psychological level in the aesthetic affects that are created. As Alba the transgenic bunny is made known to the public in a series of events and art objects, the dramatic can be noted in the both the language that Kac deploys to describe the events as identified earlier and title of the actual artworks. Particularly, "Featherless" for instance, which is a 25cm painted resin figurine portraying Kac cradling an albino rabbit Alba could very easily be misread by a more visually attuned reader as myself "Fatherless" especially as Kac does describe "The Free Alba" campaign as a custody battle. If the context of the work is transgenic, or cross-species creature, then what is seen is a rather pathetic display of human-animal co-existence. The critique I offer is that by appealing to the emotional, Kac, like the pressure groups that lobby against therapeutic uses of transgenic or cloned animals limits the scope of the terms of dialogue, and this is the real loss.

Similarly, "Flag Alba" and all events related to campaign Alba appear to parody a sense of outrage as an aesthetic form that Kac enacts in the production of Alba inspired art. Moreover, the problem is that transgenic art

can only come about under liberal democratic regimes. For instance, if Plato's polemic against *mimesis* in the tenth book of *Republic* is to be understood in the context of Platonic doubt over the benefits of poetic catharsis, as Elliot Bartky claims.[177] Plato's distrust of poetic forms is then in particular directed towards the affects of the genre, which include tragedy, as "tragedy, the most democratic of poetic forms, is least able to overcome the human propensity for desire after desire."[178] On account of Bartky's analysis, under liberal forms of democracy, similarly the danger is that if there are any lessons to be learnt from the unchecked freedom to pursue social, economic, intellectual, or creative drives, then these lessons are mostly realizable and meaningful as in Aristotelian account of collective forms catharsis including cinema and even art gallery. If the lesson is that the freedom to include life invention as an artistic process is either a disaster or unproblematic then the 'tragedy' is in the degeneration of the terms of debate. Plato identified that genre of tragedy takes preference either under tyranny or democracy, which can be taken as a sign of degeneration

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[177] Elliot Bartky, "Plato and the Politics of Aristotle's "Poetics"," *The Review of Politics, Special Sesquicentennial Issue* 54, no. 4 (Autumn 1992).
[178] Ibid., 595.

of the state.[179] Alain Badiou thinks of global capitalism as an amalgamation of the two, and terms it "totalitarian-democracy."[180] This way the even more real loss is masked by the aesthetic affects of art, whereby status quo is maintained. Alba is never released from the lab, the fate of transgenic creatures remains uncertain, and Kac has the complete freedom to continue making art about Alba that circulates within the gallery system. Furthermore, as Kac insists, Alba is not a chimera in the scientific sense, and instead must be viewed as an artistic or cultural chimera.[181] Therefore, I think Alba abodes equally well with the poetic accounts of chimeric creatures that in the classical tradition, more often than not, like Alba, are fated to end in grief or misfortune.

Prior to the patenting and sale of transgenic animals for example, GloFish (2003), in 1980 the U.S. Supreme Court ruled in the case of *Diamond v. Chakrabarty* that living microorganisms (genetically modified bacterium capable of breaking down multiple components of crude oil) are

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[179] Ibid., 596.
[180] Badiou calls USA style regimes of government "totalitarian-democracy." See Alain Badiou, *Ethics : An Understanding of Evil*, trans. Peter Hallward, 2002 ed. (London, UK: Verso, 2001), iv.
[181] Kac, *Telepresence and Bio Art : Networking Humans, Rabbits and Robots*, 264.

patentable.[182] On the basis of reinterpretation of 35 U.S.C. section 101 it became possible to issue the ruling that live human-made microorganisms are patentable subject matter, thereafter understood in exactly the same terms as "manufacture" or "composition of matter."[183] As of then it has been established that plants and nonhuman animals can be patented. In conclusion, the Congress extended patent protection to include "anything under the sun made by man."[184] Due to the materially ambivalent language entailing both "matter" and "anything" the first animal patent was issued in 1988 to Harvard University for a mouse genetically engineered to contain cancer-causing gene. The Onco-Mouse, as it is known, was licensed to DuPont Co., in exchange for providing the principle funding for transgenic research to study cancer.

American artist Bryan Crockett responded to the lab-manufactured mutant with a seven-foot marble sculpture "Ecce Homo" in 2000 (see Figure 18), probing questions about the effects of the growing authority of science in Western societies. In the same year, transgenic rabbit Alba was included within the ambit of intellectual property law.

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[182] See K W O'Connor, "Patents for Genetically Modified Animals," *Journal of Animal Science*, no. 71(Suppl. 3) (1993).
[183] Ibid., 36.
[184] Ibid.

Legally any work of art under the copy and creative commons act is subject to the artist. In practical terms, Kac has patent rights to Alba. In this context as Kac is pushing for the invention of life as artistic process, the problem that appears is also a show of force of what the partnership of artistic will and scientific (state and corporation) might are able to do under the aegis of late capitalism. Just as live works of art symbolize disjunctive partnership between entities that are recognizably unequal, for example between human and animal. Kac as the artist designer of life in partnership with the scientific establishment although was able to realise his project, yet, what becomes apparent is that corporatized scientific establishment emerges as a form of sovereignty. It alone seemingly has the operating authority to take and give life in a similar way to the concept of sovereignty theorized by Carl Schmitt. Schmitt's conception of the sovereignty can be imagined in terms of a dialogue between citizen artist, life inventor facing the questions "who is supposed to have exceptional powers", "who is entitled to decide those actions for which the constitution makes no provision."[185] In this instance,

[185] Carl Schmitt, *Political Theology: Four Chapters on the Concept of Sovereignty*, ed. Thomas McCarthy, Studies in Contemporary

because the constitutional status of chimeric creatures is undecided, due to a gap in law, the director of the lab in France was able to exercise his authority to prevent the release of Alba. The problem however is that the perceived freedom to attach the artistic signature to life manipulation forces the recognition of sovereign status as represented by biotech labs as "the highest, legally independent, underived power" in operation, and Kac has subsequently returned to growing plants and conventional mediums for making art.[186] And, the problem of creating transgenic creatures remains unresolved. (I shall take up the ethical problem in detail in Section Two)

The Impossible Image

The dramatically opposite of the social and dialogical purposes for exploring green fluorescence protein is the lab for cancer research where GFP tagging is routinely used to observe how cancer spreads. The techniques that were used to create Alba likewise are normally reserved for breeding lab animals to test pharmacological effectiveness, tumour cell

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German Social Thought (Cambridge, Massachusetts, and London, England: The MIT Press, 1985), 10-11.
[186] Ibid., 17.

behaviour, or the complex interaction between tumour cells, and the extracellular matrix of relations to adjacent healthy tissue, and or blood and lymphatic vessels. Transgenosis include crossing species barriers as part of the experimental process. Most frequently, transgenic creatures are mice with copies of a variety of human oncogenes spliced into the DNA that express GFP. This method of visualization belongs to the array of constructs that makes it possible to analyse the progression of cancer tumour "metastases *in vivo* at the single cell level of resolution" in-situ.[187]

By shifting disciplinary sites, the aesthetic or philosophical appreciation of what life is moves ground from its aesthetic and metaphysical moorings, to a material field, as answers become ever more urgent. The problems in the lab are not oriented to critiquing the instrumentalizing effects of molecular biology that renders the human/animal body in the language of bioinformatics or unchecked growing influence of science.

Co-joined with the cancer research lab is the ward for

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[187] For a description of the preparation process for the analysis of GFP enhanced transgenic mammary tumours see Jeffery Wyckoff Fayyaz Ahmed, Elaine Y. Lin, et al., "Gfp Expression in Mammary Gland for Imaging of Mammary Tumor Cells in Transgenic Mice," *Cancer Research* 62(2002): 7166.

cancer patients. This is the place it is hoped that all claims to biotechnological prowess are true. This is the place where life-and-death matters, matter. Here is perhaps as great a place as any to join up with W. J T. Mitchell who draws from early media and communication theories of Marshal McLuhan to think about the changes in understanding the body as he does by the phrase "biocybernetic reproduction."[188] As the term suggests, perhaps the single most lasting effect of early twentieth century epistemic constructions is the no limits approach that inheres within discipline of molecular biology. As time leaps into the twenty-first century, the idea of the body networked with technology has not only made the body ever more precarious, but also within the field of philosophy of biology, technology, anthropology, and forms of critical theory, consensus seems to be as Stefan Helmreich finds "life is in transformation."[189]

Molecular biology, and cancer genomics analogously study cellular transformation. These disciplines however challenge the body as media and network of communication paradigm. Scaled down, for instance, both viruses and mutant cells function within of circuits of 'communication' the

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[188] Mitchell, "The Work of Art in the Age of Biocybernetic Reproduction."
[189] Stefan Helmreich, "What Was Life? Answers from Three Limit Biologies," *Critical Inquiry* 37, no. 4 (2011).

common catch phrase to describe intercellular signalling processes and as it turns out, at the molecular level, intercellular matrix are far more complex. A virus communicates by deception for example. It propagates laterally, and is able to cause mutation. Contrarily, cancer is a mutation that proliferates by the logic of a self-system. Just as there is no cure for the cold caused by the flu virus, and cancer happens, the question why? The answer remains hermetically sealed.

A result of the paradigm shift brought about by advances made in computational technology is not that the body has become distributed, divided, digitized; we are simply able to count faster and visualize better. Big numbers dominate the biological sciences, for instance, the rate of red blood cell production in a human body is estimated in the range of 300 billion cells a day; an endless list can follow. As Helmreich describes it, information technology causes a kind of "epistemological dizziness" by details further augmented by visualization, simulation, and computational techniques that both produce and unveil.[190]

For the biological sciences, duplication, and

[190] Ibid., 695.

multiplication is a continuous process of how life evolves at the cellular level. A balance of cellular lifecycle is living, and when not, it is a show of excess, as a kind of failure of life from within forces of vitality and can cause diseases such as cancer. For example, when mitosis goes out of kilter, it forms tumours, essentially triggered by the unrestrained growth of a single cell. Thus, malignant tumours make a perfect model to study cellular growth at the molecular level as cancer becomes a part of our understanding the fine balance in nature that makes life, the formation of unique multicellular organism happen. Besides, the study of cancer includes all cell types as this disorder is not restricted to any specific organ, blood, muscle, bone, or tissue, and, the complexity involved makes it well suited for applied advances in computer technology. Just as technology is driving cancer research, cancer research drives technology.

More to the point, cancer is not a new disease. The oldest known medical record to discuss cancer dates back to 1600 BC. And yet, in its known 3600 year history, the single line that holds true for both the prospective physician and patient alike translates, “no treatment” which continues to

haunt and challenge.[191] Susan Sontag in 1978 claimed, "nobody conceives of cancer the way TB was thought of - as a decorative, often lyrical death. Cancer is rare, and still scandalous subject for poetry; and it seems unimaginable to aestheticize the disease."[192] Today cancer is not so rare, and is chiefly given the identity of a hairless emaciated baldhead. To aestheticize it, is it any more imaginable? How does one aestheticize the prolonged consciousness of certain death? We all have the knowledge that death is certain. The configuration of memory is such that it suppresses the traumatic as a survival mechanism. This is one reason why we don't remember our own birth, and we have to remind ourselves that life is short and impermanent. This is perhaps why the aestheticisation of cancer is difficult. For a start, time changes for a cancer patient and marks the

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[191] The oldest surviving papyrus containing the teachings of the great Egyptian physician, Imhotep who lived around 2625 B.C., exists in the form of a 17century B.C. copy. Translated in 1930, this medical treatise is written in detached scientific vocabulary as if "he were writing a modern surgical textbook". In case 45 we have the most explicit description of a tumor in the breast, where the therapy offered by the great physician is offered in a single sentence, "There is none." See Siddhartha Mukherjee, *The Emperor of All Maladies : A Biography of Cancer* (London: Fourth Estate, 2011), 40.

[192] Susan Sontag, *Illness as Metaphor* (Toronto: McGraw-Hill Ryerson Ltd., 1978), 20. See also Jackie Stacey, *Teratologies : A Cultural Study of Cancer* (London, UK: Routledge, 1997). For an artistic attempt at picturing cancer see Damien Hirst, *Cancer,* 2004. Flies and resin on canvas, 3658 x 3658 mm. And *Biopsy Paintings,* 2006.

first demarcation from the rest of the healthy world. She becomes an entity that is no longer bound to time related growth and aging. Out of time, she is given a new identity. In addition, as the persona given by the new identity takes shape, time accelerates. Not only does cancer testify to the power of a single cell, but also the speed at which cell proliferation is able to take control of the body results in loss of control. Additionally, the processes involved in the treatment forces the patient to literally relinquish all control. For instance, to get to the target of malignancy, the first assault is like indiscriminate carpet-bombing. The effects are devastating, irrespective. The patient is expected to fight. In series titled "Picture of Health?" 1982-86 Jo Spence (d.1992) is wearing a crash helmet and through it looks straight at the camera, and stares out at us, challenging the viewer to look, really look and meet her eyes (see Figure 19).[193] Another artist who really dares the viewer to look is Hannah Wilke (d.1993). Her series titled "Intra-Venus" 1992-93(see Figure 20) documents her battle against lymphoma. Wilke, like Spence recorded the effects of

[193] London SPACE, and Studio Voltaire, London., "Jo Spence: Work (Part I & Ii)," in *Jo Spence Memorial Archive, London*, ed. SPACE and Studio Voltaire (London, UK: Camden Press, London, 2012), 20. See also Amy Sherlock, "Jo Spence: Space & Studio Voltaire," *Frieze* September 2012.

the treatment for cancer over a 5-year period until her death. What is left behind for the viewers of the artist's oeuvre includes sets of photographs that show her cancer-ravaged body that challenge and continue to shock. The photographs are uncompromising; they are unflinching. They are direct in the way they deal with the subject matter of the body and provoke active participation by assaulting everything that is posed in the manner of "esthetic defenses."[194]

A critic once asked Wilke, "What would you have done if you weren't so gorgeous?" Her reply at the time was, "What difference does it make?... Gorgeous people die, as do the stereotypical 'ugly'. Everybody dies."[195] Wilke died and has left behind her legacy in the form of her artwork.

Oncologist Siddhartha Mukherjee writes that cancer is thought to be a "modern" disease because it attracts modern metaphors that tend to get associated with concepts denoting overproduction, insatiable desires, and overwhelming growth for instance. He writes, "Cancer is a machine unable to quench its initial command (to grow) and thus transformed

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[194] Richard Vine, "Review of Exhibition Hannah Wilke at Ronald Feldman," *Art in America* May 1994.
[195] Source quoted from Andrew Perchuk, "Hannah Wilke Ronald Feldman Fine Arts," *Art Forum* April 1994.

into an indestructible, self-propelled automaton."[196] This description likewise does not suffer from a lack of visual metaphors that belong to the digital age, military age, and Mitchell's biocybernetic age. Since Spence and Wilke, cancer treatments have certainly entered the biocybernetic age and even the smart age. For instance, a patient could be offered immune therapy, which is a treatment involving intravenously administered infusions made up of a concoction of what are described as monoclonal antibodies, (i.e., an army of cloned fighter cells) that are introduced into the bloodstream to specifically target cancer cells. Perhaps due to the fact that the birth of modern of treatments for cancer were a by-product of a World War II chemical weapons mishap, war metaphors are never far from all matters cancer. The patient fights cancer, she is a cancer survivor, and her body is the battleground. The strategy is of containment and surveillance. The body is watched. The body has to be monitored, looked at, no longer at the human, more familiar perspectival scale, but at the molecular, cellular, and the atomic. The visualization techniques range from modern ultrasonography initially used for detecting enemy submarines, to imaging technologies such as CT scans, MRI

[196] Mukherjee, *The Emperor of All Maladies : A Biography of Cancer*, 14.

scans, (f)MRI scans, and even more militaristic procedures where a person is injected with half-life nuclear isotopes that radiate what could just as easily be described as subterranean topographical signals, from the body back to scanning devices.

Alternatively, cancer is a condition where cells forget to die according to Jean Baudrillard's description of apoptosis.[197] The term apoptosis was first proposed in 1974 by A. H. Wyllie et.al, as a then less recognised mechanism of "controlled cell deletion."[198] This principle is more precisely defined as programmed cell death. Cancer cells, on the contrary, exploit the fundamental logic of evolution unlike any other cell type Mukherjee explains. These cells fight the hardest for survival. The evolutionary terminology used to speak about cancer cells is not unlike the idea of survival of the fittest paradigm. Ironically, writes Mukherjee, "If we seek immortality, perversely so do cancer cells."[199]

More than the technological metaphors that inscribe

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[197] Jean Baudrillard, *Impossible Exchange*, trans. Chris Turner (London, UK: Verso, 2011).
[198] A. H. Wyllie J. F. R. Kerr, and A. R. Currie, "Apoptosis: A Basic Biological Phenomenon with Wide-Ranging Implications in Tissue Kinetics," *British Journal of Cancer* 26, no. 4 (August 1972).
[199] Mukherjee, *The Emperor of All Maladies : A Biography of Cancer*, 6.

cancer as a modern disease, cancer is modern, because both the research and treatment for cancer fundamentally depends on visibility. This is one reason why GFP performs well as the new retina for the scientists. Starting at the molecular scale, scientists are able to mark cellular functions in DNA molecules, where the protein molecules inside certain types of cell, carry the additional trait of fluorescence. This allows cellular activity to be tracked in-situ, live in the body of a grown animal. This technique has the ability to pick up fluorescence read as signals for changes in the molecular activity within cells. In this way GFP becomes a new scalpel. An additional tool in the hands of the surgeon who is able to peel away skins, formerly represented by the logic of a particularly stable perspectival frame as seen in the dissection drawings of Vesalius. This technology enables seeing past the density of the body, at the same time, understanding molecularization and the mathematical complexity involved in modelling biological systems bring with it anew the realisation of the difficulty in picturing biological functions as they correspond to the living. The symptomatic excesses associated with cancer as a modern disease has as much to do with its complexity, as it has to do with the visual frame. Seen in terms of an image of life and death imbalance, cancer is a condition that distorts the seeing, knowing aspect ratios. For instance in many cases

cancer has no notable effects till the disease is well advanced. Similarly, transgenic art and the GFP Bunny, words that originate from cancer genomics used in popular parlance or new media theory are also just another sign of the challenge to understand what this disease is in connection to life, how it happens, how it fails and what it could be.

After her first fight with cancer, Spence was diagnosed with blood cancer thought to be triggered by the cytotoxic treatments for her earlier breast cancer. Titled "The Final Project" 1991-92, Spence maintained her thoughts in notes for example:

I thought cancer was lonely, but it was nothing to having leukaemia. Leukaemia is a killer disease. There is no cure for it. If you deviate one iota from the path of chemotherapy, everybody, literally everybody, thinks you're stark raving mad. This time my witness, my advocate's eye, is a hundred times keener than it was before, and I'm using my camera as a note book. I keep a diary. I'm watching, and I know there is no easy answer. How do you make leukaemia visible? Well, how do you? It's an impossibility.[200]

Sontag's suggestive provocation (who like Spence was first a breast cancer survivor and then later died of leukaemia) that cancer is impossible to aestheticize is additionally to do with the fact that the treatment for cancer leaves the body of the patient devastated. It leaves a mark; it impinges upon the notion of a person's selfhood.

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[200] SPACE, "Jo Spence: Work (Part I & Ii)," 30.

The brutality of the treatment is the nearest thing that matches the brutality of war on its victims. Brutality perhaps presents representational impossibility or limits.

At the brink of representational impossibility, Lala Rukh recorded the final minutes of her mother's life as a cancer patient. Composed against the grid of graph paper, "Heartscape" 1997 (see Figure 20) offers a set of windows cut in pitch photographic paper. Framed alongside the graphic notes of the electrocardiogram, what is seen mark the final performance, as a lasting gesture to register the beat, rhythm that is life of a living person. The darkness of the paper, juxtaposed with the trembling heartbeat invites the viewer to look, however. This time, because there is 'nothing' to see, the darkness presents itself as the space for the comprehension of loss, love, pain, and mourning. Imagination can have the power over the impossible.

Richard Rorty, shortly before he was diagnosed with cancer, in summing up Shelly's defence of poetry for the ability to make language richer, wrote, "Reason can only follow paths that the imagination has first broken. No word, no reasoning. No imagination, no new words. No such words,

no moral or intellectual progress."[201] Plato's dream, Rorty argued at the time, to seek abstract real, in itself could be thought of as a great poetic accomplishment. As a postscript, when he found out that his cancer was terminal, upon reflection he wrote that philosophy had little influence on his predicament. Poetry, however, found a kindred spirit.[202] This account perhaps sums up best the dance of life configured between limits of seeing and knowing, reason and imagination. At the limits of reason, imagination returns, to aid what it is to know. All there is to know cannot simply be understood in terms of rational accounts, and just the same, broken bones cannot be fixed by poetry. Yet, "cultures with richer vocabularies are more fully human when their memories are amply stocked with verses" are Rorty's words in parting.[203] This is what art can bring to the culture of science.

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[201] Richard Rorty, "The Fire of Life," *Poetry Magazine* November 2007.
[202] Ibid.
[203] Ibid.

Section Two
To Do

Chapter 5

Section One discussed the relationship of the history of optics and organic media arts as a way to think about the dissimilarities in approaches to creation and knowledge making. Chapter 1 introduced the distinctive ways Plato's polemic against *mimesis* has been absorbed due to the differences in translation between cultures and discussed these differences as they distinguish attitudes towards modernity and creativity. Chapters 2 and 3 traced the history of vision and looked at the influence of Ibn al-Haytham's optics in the making of the scientific method and Chapter 4 examined transgenic Alba as a work of art that connects scientific visualization with creative powers of art and science. Section One altogether examined molecular biology as a condition of modernity, particularly as technologically augmented notions of controlling the limits, and possibilities of the body in the digital age are connected to the visualization and rationalization of biology on a mathematically ordered visual plane (the computer screen). The idea of mathematical visualization of biology was studied in relation to the contemporary outlook on designing biological materials as organic media artists

investigate this phenomenon. The writing was a way to explore how exposure to the inner workings of a body can alter familiar perception models and to ask with increased visualization, what more is it that we find?[204]

Section Two aims to problematize visualization as it makes more complex the general conception of a living body as seeing enabled by imaging techniques reveals the mechanism of the body as one being assembled out of parts that are composed of mechanical cells. In particular, I shall discuss the innovative scientific processes for observing microscopic details as they cause a scale-shift in perception, thereby making the whole of the body appear as if composed out of a host of malleable cells for production. As examined in Chapter 3, this aspect shift is particularly notable as molecular vision processed by computational software takes on a digitally mediated characteristic and cells in the body get seen as unit bits that can be defragmented and reconfigured. In what follows cellular substances such as the DNA are looked at as a complex set of

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[204] In line with exploring the idea of cellular processes of multiplication, I worked on drawings using stencils to register shift in the perceptual plane to the micro. These were also made to register the invasive character of medical techniques that can mete out violence upon the body at the cellular scale. For example, see drawings titled, "Portrait of the Inside" 2009-13, and "Molecular Warfare" 2009-13 (see Figure 22 & 7).

operations that function as an indifferent yet determining vital force. This form of conditioning registers the nature of a cell as one that is imbued with self-directing forces conceptualized literally with regards to the organising principles of organic chemistry. That said, the ethical problem of building or manufacturing living systems as objects of art or as biological machines remains under-explored apart from strands of debate that in the context of biotechnology operates within the value systems of certain interest groups, for example, the much cited American Presidential Commission for the Study of Bioethical Issues.[205] The paradox is that on one hand we are finding out how a small change at the molecular level can have significant consequences for the health of the body. On the other hand, a part of the nature of the difficulty in imagining the implications of actions taken at the molecular scale is due to the naturalization of the idea that the body is split between the whole and remote abstract cellular fragments conditioned by the digital age. Unlike past research and experimentation on the fecundity of cells, what is exceptional about the twenty-first century is that

[205] Joanna Zylinska presents an alternative model based on Levinasian ethics in her book. See Zylinska, *Bioethics in the Age of New Media*.

perception is purely formulated in the imagery of cellular mechanics. As a result, the body is conceptualized as pure matter, aided and explicated in terms of programming language of command and code, which makes it feasible to engineer genes, tissue, organs, and transgenic creatures.

In Chapter 5, I shall deliberate upon the implications of body written as mathematical text and biology as data that gets concatenated into processes for making sentient artefacts. I shall use the writing to consider the effects of computer technology that has made it possible to render the biological make-up of the body into a form that can be written and disclosed in the arithmetic language as described by Brian Rotman, particularly, as the outcomes include transgenic art.[206] In the process of making transgenic creatures for instance, the physics, chemistry, and biology of the body come together as a unified system of thinking because all these different ways of understanding rationalize the body using complex mathematical formulations. Owing to the numeric complexity of the material under analysis and since mathematics makes it possible to communicate biological information across disciplinary precincts, for example, visualized data enables

[206] Rotman, *Mathematics as a Sign : Writing, Imaging, Counting*.

communication. The problem is that the abstract language of mathematics that supports both communication and visualization also masks the inherent ordered disorderliness of biology as it differs from other types of physical matter. Once the body is seen as though a composition of material units, the materiality of inter-cellular activity opens itself to thinking in the vocabulary of control and production. As discussed, the desire to control can be evidenced in examples of pharmaceutical products as scientists working on regenerative medicine see cells as a site for potential research and artists have been exploring the generative capacity of molecular biology as they transform the expertise to mould and handle biological substances into art forms. The challenge however lies in the complexity to understand the desire to harness, direct, and alter by human intervention.

To discuss the productive aspect of molecular biology, Chapter 5 will connect with ideas elaborated in Chapter 4 though the focus will be on the innovative and creative character of biotechnology as it entails creating living art. In order to do this, at the outset, I shall revisit Eduardo Kac's paper titled "GFP Bunny" specifically to focus on the section where Kac presents his readers with a set of points detailing potential outcomes of transgenic art Alba.

I shall concentrate on point number nine to consider what necessitates "expansion of practical and conceptual boundaries of art making to incorporate life invention."[207] My aim is to try and tease out how art making includes life invention. This is mainly as transgenic art makes a concrete example of human intervention towards the creation of a unique body and this art form can open up the debate to address the social and ethical underpinnings, which determine the uneasiness with biotechnical developments.[208] To extend the scope of debate, I shall analyse the idea of creation mostly through issues I have raised via the writings of Ibn 'Arabi. And use his parallel understanding of creation, imagination coupled with *wujud* being as interlinked concepts to unpick some of the ethical anxieties that have been expressively summed up by Leon Kass in his well known paper from 1974 titled, "New beginnings in life", published in *The new genetics and the future of man.*[209] In his paper, Kass argues against all forms of reproductive

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[207] Kac, *Telepresence and Bio Art : Networking Humans, Rabbits and Robots*, 266.

[208] In many instances, the fundamental moral unease is rooted in the idea that biotechnology is able to tamper with the pre-given sanctity of life.

[209] Biologist Leon Kass argues that both in vitro fertilization and cloning are ethically wrong. See Leon Kass, "New Beginnings in Life," in *The New Genetics and the Future of Man*, ed. M P Hamilton (Grand Rapids, Michigan: W B Eerdmans, 1971), 15-63.

technologies. He fears that medical scientific progress could make it feasible to generate new human life detached from,

> Human sexuality and ultimately from the confines of the human body, a separation which began with artificial insemination and which will finish with ectogenesis, the full laboratory growth of a baby from sperm to term.[210]

The content of this paper has appeared in many articles over the years, which makes it over forty years since Kass first envisaged what was for him the worse possible entanglement of power with control of human reproductive capacity. Notwithstanding evidence to the contrary, Kass's objections based on the analogy of what transpires in a world such as one delineated in Aldous Huxley's *Brave New World*, remain relatively unchanged.[211] In Huxley's novel, a work of imaginative and satirical fiction, the world has become a somewhat promiscuous place inhabited by asexually produced

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[210] Ibid., 21.

[211] It is ironic that Kass bases his objections on totalitarian regimes and yet, he has continued to conflate fact with fiction in elucidating concern over novel uses of biotechnology in the guise of modern science. See Leon Kass, "Preventing a brave new world". *Technology and Values*: *Essential Readings* (2001): 311-322. Kass's objections, as W. J. T. Mitchell rightly points out, are limited. For example, despite (and in reality) serving as the Chairman of the United States President's Council on Bioethics, from 2001-2005, his ethics do not go far enough to oppose an equally utopian project, Operation Enduring Freedom, commonly known as the war against terror.

human beings who are managed and disciplined by a totalitarian order of Alphas and Epsilons.[212] Somewhat strategically, Kass borrows his ideas from C. S. Lewis's *The Abolition of Man* reasoning that assisted means of reproduction are a form of market driven eugenics.[213] The overall tone is not only moralizing, it cautions that the utopian purview of eugenic processes will lead to disaster, in particular, he warns that the latent potential inherent in in-vitro fertilization will end with the "transfer of procreation from home to laboratory and its coincident transformation into manufacture."[214] To his credit, Kass had predicted the first cloned animal within a few years of his writing the paper, to be followed by a "rush to develop cloning for other animals, especially livestock, thereby to champion meat or milk producers."[215]

The decade since inclusion of life invention has entered contemporary art making could also be thought of as a significant shift away from debates that are centred upon the moral and ethical uses of genetic engineering for therapeutic purposes. The artistic advance however makes it

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[212] Aldous Huxley, *Brave New World*, 2007 ed. (London, UK: Vintage, 1932).
[213] Kass, "New Beginnings in Life," 50.
[214] Ibid., 53.
[215] Ibid., 44.

all the more pressing to address the philosophical, the social, the political, the real, fictive, and the imaginable conditions that can change as a result of scientific developments in seeing that enhance measuring, mapping, and making as exemplified by transgenic artworks. The artistic involvement in conjunction with moral and ethical problematic has been written about at length with the viewpoint that assisted means of reproduction or biotechnological advancements despite medical benefits, ethically lead to conditions that could ultimately debase life.[216] That said, I concur with the need to examine the technological incursions into the biological domains that in many instances threaten to make the living substitutable. However, there is a problem. Advancement is aligned with artifice and perceived to transgress limits set by nature. This argument thus sums up the tension between nature and technology that I shall examine in this chapter to rethink the ethical dilemma over the responsibility for engineering novel creatures.

In order to contemplate if it is actually possible to think outside of binary terms such as artifice or nature and to consider if imitation can be anything outside of nature,

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[216] See Philip, *Tactical Biopolitics : Art, Activism, and Technoscience*.

Chapter 6 will reintroduce in detail Ibn 'Arabi's concept of "*ayn thabitah* permanent archetype" (in Bashier's translation fixed entities) as it is linked with *barzakh.* My aim is to incorporate Ibn 'Arabi's ideas and use them as thinking aids to blur the theoretical dichotomy between natural and artificial as it relates to the creativity and industry of Man. In this chapter, I shall extend my analysis of Ibn 'Arabi's exploration of creation from existent non-existent by drawing on Toshihiko Izutsu's analysis of Ibn 'Arabi's writing in *Sufism and Taoism* as these ideas are interconnected to the concept of *barzakh.*[217] In this way, I intend to problematize Kac's use of the word life invention, which is fittingly allied with the idea of human agency as a contrast to how animals are born in the wild for example, that he uses to describe transgenic art projects. I expect to highlight the complexity implicit in the idea of invention that has come to symbolize a break from nature. The perceived human prowess over nature not only belongs to a binary model of thinking, but as I shall argue, thinking apart from the standard binary model, for example, Ibn 'Arabi's tripartite model can limit conceit scientific or

[217] Toshihiko Izutsu, *Sufism and Taoism : A Comparative Study of Key Philosophical Concepts*, 1984 ed. (Berkley, Los Angeles, London: University of California Press, 1983).

otherwise and advance the possibility to reflect on an ethical position that is inclusive of all life molecular scale up.

Molecular Biology and the problem of knowledge

The base clause of both alliance and division between reason founded on rational thought and conviction based on faith rests upon suspicion. In modern terms theorized as Cartesian doubt, scientific scepticism has been a useful marker for centuries in maintaining differences over legitimacy and the control of knowledge. Fundamental issues at the heart of the matter are related to what there is to know, how do we know, the status of proof in the building of kinds of knowledge systems that can be considered lawful, useful, good, ethical, right, and just. Unlike nineteenth century epistemic constructions, twenty-first century molecular biology backed by the full force and knowledge of scientific experimental techniques and methods in revealing the plasticity of the animal body, is making certainties of the past, the unique and distinct human subject to turn in on itself. The maker, seer, and doer not only become one in the image of the scientific self, but also it is the self which gets dispersed into forms of cellular components. This

scattering is the nebulas new frontier where seeable, sayable, speakable, knowable threaten to return as shimmering entities that can be grasped, but only just. Therefore, the fight for dominance by reason is no longer restricted to the superlunary stratosphere; the quest for control today rests with the body as the site to signify what life is and its meaning.

To get past the division between invention and creation and to get past the effects of technology written on the basis of change and innovation in the language of control and command that ultimately ends with objectifying meaning. A recourse to forms of thinking based on imagination and dialectical reasoning makes it essential to part company, and, join a master of subverting dualisms. The philosopher Muhyi-l-Din Muhammad ibn Ail ibn Muhammad al-Tai al-Hatimi, introduced previously by his better known abbreviated name Ibn ‘Arabi. Exemplified as a Sufi, and characterized as a gnostic; the hermeneutics of Ibn ‘Arabi represent originality in thinking strategies that are able to undo paradoxes, especially when different systems of thinking, for example scientific reasoning and religious

values form bases of conflict.[218] He was born in Murcia, Spain in 1165 AD and spent the last thirty years of his life in Damascus, where died in 1240. Well-known as a legendary teacher, prolific writer-philosopher and poet, Ibn ‘Arabi lived in a milieu enriched by the previous three hundred years of scholarship based on the revival, transmission, and assimilation of classical literature of the ancient Greeks into the Arabic language. A remarkable feature of this time was the patronage for all kinds of scientific activity. This was also a time when the philosophical works of Plato and Aristotle, Indian arithmetic and Persian philosophy were studied alongside theological and spiritual teachings of the three principal Abrahamic religions; Judaism, Christianity and Islam.

Ibn ‘Arabi is also known as the *Shaykh al-Akbar*, the Greatest Master, whose writings are described as a heterogeneous blend that “synthesized Islamic law, theology, philosophy, mysticism, cosmology, psychology, and other

[218] In this article Franz Rosenthal argues that Ibn 'Arabi's corpus is fundamentally philosophical. See Franz Rosenthal, "Ibn 'Arabi between "Philosophy" and "Mysticism" : "Sufism and Philosophy Are Neighbors and Visit Each Other". Fa-Inna at-Tasawwuf Wa-T-Tafalsuf Yatajawarani Wa-Yatazawarani," *Oriens* 31(1988).

sciences."[219] By a conservative estimate Ibn 'Arabi is said to have authored 350 works. The most well known in English translation are *al-Fusus al Hikam* (*The Bezels of Wisdom*) and *al-Futuhat al-makkiyya* (*Meccan Revelations*) written between 1202-1231 and then revised between 1234-38.[220] In the context of this writing, because this teacher, poet, philosopher, and mystic's scholarship represents a synthesis approach to knowledge, the knotty and trans-disciplinary nature of twenty-first century science and technology, and moral and ethical quandaries can be subjected to scrutiny on the basis of his ontological framework that I shall be exploring in this section. The methodological technique of juxtaposing logic with imagination as conceptualized by the model of *barzakh* makes it possible to reflect on the subject of artistic boundaries and to test how they theoretically expand artistic limits to include as Kac asserts, life invention. To borrow from Michael Sells adaptation of Ibn 'Arabi writing at the beginning of the *Fusus al-Hikam*,

> While looking at a smudged mirror what the viewer sees is the mirror. If in the act of looking the mirror is simultaneously

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[219] William C. Chittick, *Imaginal Worlds : Ibn Al-'Arabi and the Problems of Religious Diversity* (Albany, New York: State University of New York Press, Albany, 1994), 1.
[220] Addas, *The Quest for Red Sulphur : The Life of Ibn 'Arabi*, 206.

polished, a perspective shift occurs. The mirror is no longer noticed at all, only the image of the viewer reflected in it.[221]

As Sells explains, Ibn ‘Arabi uses the metaphor of the mirror image “as a symbol of mystical perspective shift.”[222] He uses perspective shift as a point of departure to present a theory of what it means to be a “complete human being” as in the “mystical experience of passing from duality to non-duality”, or as a way towards the realization of being one with divine manifestation.[223] The thesis that Ibn ‘Arabi advances in all his writing is based on the principle of non-duality. Arabic scholars describe Ibn ‘Arabi’s writing in terms of poetic prose that incorporates visual imagery and forms a distinct branch of philosophic scholarship in pursuit of “proving the non-duality of everything concerning God and His universe.”[224] For example, verses in the Qur’an repeatedly say, “There is but one God”, in Ibn ‘Arabi’s conception, “there is nothing but God.”[225] William C. Chittick explains, even though Ibn ‘Arabi never himself uses the term in any of his writing, he is considered to be “the

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[221] Michael Sells, "Ibn 'Arabi's Polished Mirror: Perspective Shift and Meaning Event," *Studia Islamica* 67(1988): 121.
[222] Ibid.
[223] Ibid.
[224] Ibid., 121-22.
[225] Rom Landau, *The Philosophy of Ibn 'Arabi*, vol. 22, Ethical and Religious Classics of East and West (London, UK: George Allen & Unwin Ltd., 1959), 23.

originator of the Sufi doctrine of *wahda al-wujud* "Oneness of Being" or "Unity of Being"."[226] In the writing to follow, I shall attend and make use of the word *wujud* being (in greater detail in Section Three) that Ibn 'Arabi puts to test against a wide range of philosophical and theoretical concepts. He advances the concept of *wujud* being together with the oneness thesis to address manifold philosophical ideas that include rational limits to knowledge, the relationship of the world to all creation, which he proposes can only be fully realised once the subject versus object predicate is eliminated. Ibn 'Arabi's subject of knowledge is the self that must overcome seeing in terms of dualities, which are constructed to identify the self from other in order to recognise the *true* reality, i.e., unity with all of creation. Whilst I acknowledge that Ibn 'Arabi's texts are aimed at mystical unity of creation, my intentions although do not share the same orientation, I share with Ibn 'Arabi the quest to understand the dynamical nature of knowledge. The process of my research project is like the act of polishing the mirror, seeking to understand the self as exposed by the scientific lens. Is the rational self the goal of being human, and how does it come to be? It is the

[226] Chittick, *Imaginal Worlds : Ibn Al-'Arabi and the Problems of Religious Diversity*.

act of looking at the self that I shall continue to problematize in order to explore the relationship of knowledge to the values of selfhood. The perspective shift that is of interest is to understand how to recognise the united body as singular and multiple, distinct and yet dispersed once it has been disclosed by molecular biology in its relationship to the rest of living organisms. The mirror subject to this writing are the mirrors, the lenses used in a variety of microscopic techniques. Microscopic vision shows the inter-connectedness of all life forms and matter. This complicates not only what was thought to be and categorized as different species of the animal kingdom, once seen as cells and molecules, the different and same have become different in even more similar ways. The body is seen not only as body; human, animal, and plant, under visually oriented digitization processes, it also becomes, text, language, code, and therefore open to reading, translation, and interpretation.

Perspective Shift one: Scale, being micro

As Sells explains, Ibn ‘Arabi deploys metaphoric language, and dialectic logic in his writing to open up the

possibilities within words to generate new meanings. He says, "In Ibn 'Arabi, being is continually transformed from the "object" to the dynamic."[227] It is in its dynamic form that perspective shift becomes an event. Perspective shift occurs each time new sets of meanings are generated in reading texts. In a similar manner, translation comes to be of central concern once the biology of the body has been written in molecular language. With the transcription process, the body is both a unit cell and billions of cells written in the language of molecular biology. As molecular biology is written in a numeric form of writing, it can allow configurations of the kind that can be combined with other codes and be transformed.[228] In the form of codified language of biological matter, the body can be looked at, reinterpreted, and worked upon. Furthermore, the integration of the processes of seeing, counting and measurement enable comparison across a variety of biological specimen. As biological data is analysed on the basis of chemical

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[227] Sells, "Ibn 'Arabi's Polished Mirror: Perspective Shift and Meaning Event," 140.

[228] Wendy Chun uses software as a metaphor to explore the appeal of computer technology as it enables users to combine the visible with invisible to create new forms of visible objects and bodies. See Wendy Hui Kyong Chun, *Programmed Visions*, ed. Lev Manovich Matthew Fuller, and Noah Wardrip-Fruin, Software Studies (Cambridge, Massachusetts and London, England: The MIT Press, 2011).

composition, shape, size, and location, these processes involve a synthesis of the laws of physics, chemistry, arithmetic, and geometry. Consequently, precision and accuracy is demanded on the microscopic scale, which involves a *handling* of figures that in shear counting terms are aggregates of millions and billions of bits, shared traits across the animal kingdom in the form of cells, genes, chromosomes, and protein molecules for a start. Yet, when the numeric clarity is a result of computations involving large numbers, counting additionally brings with it a mix of wonder coupled with opacity and incoherence. It is like the 'wow' one feels looking at the sky on a moonless starry night, and then to wonder does life only exist on planet Earth?

Figures can be impressive, especially as kinds of data can show and bring into consciousness parameters of the body in terms of intercellular connectivity of billions of cells. For example, data tells us that the average number of neurons in the human brain is estimated to be a hundred billion and can demonstrate by cross analysis that genetic human brain activity differs from chimpanzees by 10%. A comparison of the draft of the human genome with a draft of the chimpanzee genome has shown for example,

> Genetic differences that have accumulated since the human/ chimpanzee species diverged from our common ancestor, constituting

approximately thirty-five million single-nucleotide changes, five million insertion/deletion events, and various chromosomal changes.[229]

The authors further claim that "modern molecular studies have spectacularly confirmed" the propositions made by Charles Darwin and T. H. Huxley that humans share common ancestry with the African great apes.[230] Given the richness of information, it makes it plausible to imagine, as many possibilities as there are perhaps zeros in all the counting. Notwithstanding the range of possibilities, the problem is in the closing-in of meaning, even as the scientific lens opens up many paths for seeing human and animal in indistinct and interconnected terms. Knowledge by numbers is the only acceptable mode for an epistemic understanding of the body, epitomized by science. Above all, what gets confirmed is a faith in the singularity of the scientific method to arrive at the meaning of life, as symbolized by biology. Rationality reigns, and the human and the animal hierarchical orders remain intact. As Martin Heidegger (d.1976) writes, "Sciences know the way to knowledge by the term "method." Method, especially in

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[229] The Chimpanzee Sequencing and Analysis Consortium, "Initial Sequence of the Chimpanzee Genome and Comparison with Human Genome," *Nature* 1 September 2005.
[230] Ibid.

today's modern scientific thought, is not a mere instrument serving the sciences; rather, it has pressed the sciences into its own service."[231] Heidegger further goes on to explain that Friedrich Nietzsche (d. 1900) was the first to identify this phenomenon in his *The Will to Power*. Citing notes numbers 466 and 469 respectively: "It is not the victory of *science* that distinguishes our nineteenth century, but the victory of scientific *method* over science."[232] And, "The most valuable insights are gained last of all; but the most valuable insights are *methods.*"[233] To conclude I quote his analysis, "Method holds all the coercive power of knowledge."[234]

Perspective Shift two: Seeing, touch extended

Molecular biology is convincing. It is able to show, based on empirically gathered data what science can do when its optical gaze extends touch at the microcellular levels.

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[231] Martin Heidegger, *On the Way to Language*, trans. Peter D. Hertz, 1982 ed. (USA: Harper San Francisco, 1971), 74.
[232] Ibid.
[233] Ibid.
[234] Ibid., 74.

The molecular biologist is able to dissolve the haptic and optic distance by treating cells as little machines with nanoscale circuitry. In this way scientists can influence all that can potentially be held and touched in the future. The techniques of molecular biology, for both seeing and experimenting upon can be grouped as ex-vivo, in-vitro, and in-vivo. Ex-vivo is when a specimen, such as a tissue sample is maintained and studied live outside of the body with the aid of Two-photon microscopes, for example. Applications include tissue engineering. In-vitro is any process that involves manipulating cells outside the body and then reintroducing them back into the body. This technique is widely used to fertilize an egg by a sperm outside the body for instance. In-vivo is the structural capacity to combine all techniques of visualization that include scanning and x-ray with processes of genetic engineering, thus making it possible to visualize life in-situ. An early example is ultra sound imaging which is used to see mass inside the body. Sophisticated versions used today can show additional detail and in colour. More advanced techniques such as Positron emission tomography (PET) or magnetic resonance imaging (MRI) or *f*(MRI) make it possible to visualize the anatomy at molecular scale. Furthermore, fluorescent tagging and imaging involves all scientific processes of seeing and making. Visualization techniques, including multiphoton

microscopic imaging, make it possible to see the generation of new forms of cell and tissue type that can be a combination of human, animal or marine sources, either as transgenic cells or in the form of a full animal body, i.e., complex organism. Therefore, the problems involving the differences in how we know what there is to know and see is weighted towards methods that can be defined in epistemological terms. Primacy is given to the scientific method, which entails a shift in emphasis from word based writing to a language written and made up of numbers.

The body, once it is written in the language of cellular biology can operate just as text does. In the form of the molecular code, it continues to unravel, reveal itself as a potential site for possibilities that are inherent within doing and making.[235] In essence the thing that all the revealing and showing, combined with mixing does is that it demonstratively changes and unmoors many signs traditional to the norms of identity. It changed language and it has changed speech. It has altered the straightforward relationship between the signifier and the signified. And yet, even as a form of meta sign writing, the

[235] A cloned animal is an example of translating and rewriting the molecular script. Similarly, genes can be tested to predict future onset of hereditary disease for example.

very same computational processes make syntactical coherence to reach breaking points as the numeric can become rational once again only as an image. Computational and measuring processes at the molecular level render speech into pattern and everything that there is to see, hear or feel, can be mapped and presented, except, this information can only be grasped once it is translated into a form of digitally rendered image. Likewise, representation of the body in the optical mirror of science not merely codifies the body. It also shows that presentation and representation is the culture of scientific reasoning. In addition, with every presentation, the dynamics of the possible, real, and imagined is open to re-configuration. Forms of representation then become sites for reconfiguration with the combination of digital imagining and mathematics. When mathematicians use digital imagining, the casualty is metaphysics, explains Brian Rotman. He writes,

> The image confronts the mathematician with the juxtaposition of two opposed understandings of the objects they study. The classical, orthodox viewpoint: mathematical objects are transcendental, invisible, and imagined versus the digital, understanding them as materializable, variously idealizable, and imagable. The difference is fundamental: the first describes, for example, a Euclidean point, contentless, infinitistic, and zero

dimensional; the second, a material pixel with real, specifiable dimensions and variable information content.[236]

Moreover, when the body is studied as a digitized and mathematically mapped visualized site, the biological can also be redrawn, and in this process rests the possibility for every thing imagined to become realizable.

To take the discussion further, science progresses by consensus to the mean. New forms of consensus building additionally include collective witnessing. A recent example of en-mass witnessing at the time of this writing happened, as millions across the cyber and media space were able to access pictures of neurons firing in the brain at the launch of the Human Brain Project. It is important to note that at events like this, multiple levels of 'proof' are brought on display. The prowess of science can be seen in the inaugural video as a show of solidarity amongst the scientifically united. The Human Brain Project represents the 'shared' core ideals and values that have come to mark the ultimate goals

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[236] See Notes to chapter Four, no. 10 Brian Rotman, *Becoming Besides Ourselves : The Alphabet, Ghosts, and Distributed Human Being* (Durham and London: Duke University Press, 2008), 144.

of human civilisation.[237] In the somewhat glossy promotional video, the participating scientists at the launch of this project can be seen speaking candidly in a filmed interview where they highlight the direct link of technology with medical research. In particular, the message that comes across speaks in naturalised terms of the symbiotic interest of medical research on degenerative human brain diseases linked with the present limits of computational technology. The mission statement of the Human Brain Project is to make supercomputers modelled on the human brain.[238] To succeed however, it is in the form of visually structured data gathering that any making will take place. Particularly, as the organic and the synthetic represented by forms of mathematical modelling can only be synthesized in terms of hardware that rests on the visual, except. Molecular imaging disrupts the logic of linear forms of representation itself.

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[237] The HumanBrainProject, "Human Brain Project: Overview," The Human Brain Project, http://www.youtube.com/watch?v=JqMpGrM5ECo&list=UUd5sWIVavCp4hzp2mFWI2qg. Accessed, 13 December 2013.

[238] For example, in order to overcome present processual limits, The Human Project aims to build new computing technologies patterned on the understanding of the brain. See "Sp7: High Performance Computing," The Human Brain Project, http://www.youtube.com/watch?v=In8Qhy7_4TA&feature=c4-overview&list=UUd5sWIVavCp4hzp2mFWI2qg. Accessed, 13 December 2013; Rotman discusses the idea of simultaneous view points that collapse the structure of linear thinking in terms of parallelism. See chapter 4, "Parallel Selves" in Rotman, *Becoming Besides Ourselves : The Alphabet, Ghosts, and Distributed Human Being*, 81-88.

Once the body is formalized by the scientific method of representation, the enfolding of the body into forms that although operate within languages of rational thought and reason, personalization by an arrangement of numbers leaves both numbers and language in abeyance. For instance, the molecular code of AGTC's as structural data or the connections between neurons and synapses can only be comprehended in the form of an image on a computer screen. That said, the distrust of vision, which mapping and measurement techniques, and all forms of rational ordering of the world as the perspectival picture plane traditionally set to correct, also gets disintegrated.

The molecular image is even more complex, as it is designed to encourage unexpected connections. It therefore does not follow the logic of central perspective. A quick browse of the Research Collaboratory for Structural Bioinformatics (RCSB) Protein Data Bank (PDB) or Structural Genomics Consortium (SGC) will show that molecular imaging is not static.[239] The viewer at the touch of the computer

[239] Browse for example, A. P. Truong S. Bowers, R. Jeffery Neitz et al., "Design and Synthesis of Brain Penetrant Selective Jnk Inhibitors with Improved Pharmacokinetic Properties for the Prevention of Neurodegeneration," *The RSCB Protein Data Bank*(2011),

screen or keypad can rotate, zoom in, and navigate the structure of the macromolecule to allow for a number of connections and multiple viewpoints instantly become apparent. The stochastic modelling of the cellular world challenges linear representations. This kind of data visualization hovers between moving image as in the cinematic and a still. The language of the software is alphanumeric and the ordering is visual. Molecularization therefore makes formalized linear thinking based on image perspective and coherent speech impossible. This is a shift in perspective, as an event, molecular biology challenges the notion of objective stock taking of the world.

Perspective Shift three: Making Things

In the mix of philosophical traditions set after Aristotle's *De Anima* is the philosophical idea that the facility for imagination and thought sets humans apart from other creatures in the animal kingdom. With imagination comes language and rational processes, however, once limits

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http://www.rcsb.org/pdb/explore/jmol.do?structureId=3RTP&bionumber=1. Accessed, 12 March 2013.

to rational means of reasoning are reached, then, imagination again becomes useful. As theorized by Ibn ‘Arabi’s ontology of the imaginal sphere, the imaginal as a method enables a mix of creative ingenuity with will, allowing for the processes of creativity in the most expansive way. Doing and making in this way become essential to really understand what it is that can be seen when words and numbers become inadequate. Sophisticated forms of genetic engineering exemplify a case where unsorted forms of information such as raw data is not necessarily underpinned or supported by adequate processual expression. To put this differently, scrupulous data gathering can impede interpretation. Creativity however can resolve difficulties caused by procedural demands as it thrives on counter-intuitive lateral modes of thinking. This additionally solves the problem of ‘what to do?’ with all the exponential data that gets generated outside the remit of the specific research project. As a result, genetics the sub discipline of molecular biology has made tremendous progress in the past twenty years. It has further still opened up the field to interdisciplinary subfields that use biology with engineering such as synthetic biology. What is even more intriguing is that this field is not strictly limited to the scientific domain and includes groups of artists, designers, and scientists. Arts Catalyst in the United Kingdom is an

arts organisation and commissioning body that works to "enable people to have distinctive, thought-provoking experiences that transcend traditional boundaries of art and science."[240] A loose group of artists, activists, and academics collectively described as biotech hobbyists have been working together for more than a decade to action debates surrounding bio futures or bio-securities issues.[241] Moreover, their work is not restricted to out of lab activism; this group literally gets their hands wet on a lab bench. Past projects have included design proposals for ecological systems, reverse engineering genetically modified seed types, and redesigning living systems using tissue culture. Even as the making of whole organisms such as cloned animals exemplified by transgenic creatures does problematize the ethical dimension of animal testing for medical research, the moral objections made by Kass, the ethical concerns over medical manipulations of mammalian embryology, and reproductive systems gets more complicated

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[240] The Arts Catalyst, http://www.artscatalyst.org/about/. Accessed, 13 December 2013.

[241] da Costa writes about artist groups who work under the umbrella of "Biotech Hobbyist", emulating tactics that have been inspired by a mix of computer hacking culture with DIY computer technology of the 1970's. See, Beatriz da Costa, "Reaching the Limit : When Art Becomes Science", in Philip, *Tactical Biopolitics : Art, Activism, and Technoscience*, 373-76. See also; Eugene Thacker, *The Global Genome : Biotechnology, Politics, and Culture*, ed. Sean Cubitt and Roger F. Malina, Leonardo (Cambridge, MA, and London, UK: The MIT Press, 2006).

when artists join in the project of life invention. There is an important change that has taken place in the thirteen years since Kac made Alba and is presently breeding petunias coded with DNA segments from his haemoglobin.[242] The difference is, that the others who have joined up with Kac's aspirations, are not more "biotech hobbyists", but hobby scientists who, like Kac the artist, are setting to "inspire others to create new living things."[243] This affiliation of hobby scientists based in the United States is currently working on projects primarily aimed at creating a tree type that they expect will glow in the dark. They believe if they are successful, the glow in the dark trees could provide an alternative to street lighting in the cities of the future.[244]

To think about the future impacts of science and technology today and to provoke debate, Peter Galison has listed a set of ten key questions in the article titled,

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[242] See Eduardo Kac, "Natural History of the Enigma," http://www.ekac.org/nat.hist.enig.html. Accessed, 13 December 2013.
[243] Andrew Pollack, "A Dream of Trees Aglow at Night," *The New York Times* May 8, 2013.
[244] For a survey of domestication and hybridization of plants type in art practice, see George Gessert, *Green Light : Toward and Art of Evolution*, ed. and Roger F. Malina Sean Cubitt, Leonardo (Cambridge, Massachuesetts and London, England: The MIT Press, 2010).

"Ten Problems in History and Philosophy of Science."[245] At the start of the article he asks, "What kind of account are we after historically and philosophically when we attempt to address science not as a vacuous generality but in its specific local formation?"[246] The problems that Galison enumerates include the problem of contextualizing argument from within or outside of textual content, technology and politics, interdisciplinary sciences, the role of the scientific doubt, and the problem of what he calls "Making Things."[247]

To get to a contextualized and much more nuanced understanding of art that intersects with routine lab work, in the remaining part of this chapter, in I shall use Galison's framework to deliberate on the problem of making things out of biological materials. All the same, before starting to address the problem of Making Things, I consider it is important to identify the key generalities in operation to pinpoint the specific condition on the basis of which it becomes possible to make living things and the problems with such generalities and the importance as

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[245] Peter Galison, "Ten Problems in History and Philosophy of Science," *Isis* 99, no. 1 (March 2008).
[246] Ibid., 111.
[247] Ibid.

Galison has it, of "specific local formation."[248] The fundamentals of generalization can perhaps be traced back to the first taxonomic classification projects in Europe. As Michel Foucault points out, before the eighteenth century, the taxonomic model of biological classification did not exist. He writes,

> That, if biology was unknown, there was a very simple reason for it: that life itself did not exist. All that existed was living beings, which were viewed through the grid of knowledge constituted by *natural history.*[249]

Over time as natural history developed into the various specialisms. The project of classification that in the early stages was conceived on the basis of visual differentiation, habitat, character, and physiology, later developed into zoology, botany, and human sciences that then came to be distinguished from the material sciences by the unifying trait of life itself. Karin Knorr Cetina calls this categorical difference "central dogma."[250] She further develops Foucault's concept of classification of life into twenty-first century molecular biology. Knorr Cetina writes,

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[248] Ibid.
[249] Michel Foucault, *The Order of Things : An Archaeology of the Human Sciences*, 2009 ed., Routledge Classics (London, UK and New York, USA: Routledge, 1970), 139.
[250] Karin Knorr Cetina, *Epistemic Cultures : How the Sicences Make Knowledge* (Cambridge Massachusetts and London, England: Harvard University Press, 1999).

> Molecular biology today is based on a central dogma, which retains the focus of life but at the same time breaks away again from earlier conceptions. The central dogma is that DNA contains building blocks of life; all information needed to create an organism….[251]

Examined in this way, the principle of generality that prevails and underlines Bio Art projects is founded upon the idea that all organisms are a composition of molecular matter. As a result, constituents of molecular biology become available to the artistic palette as yet another type of material, and even more so, an open-source medium that can be used as a moulding material to elicit the creative process. It is by a reference to the ideas pertaining to pure materialist readings of organic matter that bring with it the artistic licence to colour, mark, and tag creations. Consequently, it becomes possible to imagine living beings with fluorescence coded in their DNA. As a result, transgenic creatures are then able to glow in hues of blue to green and the veins in the petunia petals can come to symbolize the human arterial system.

Transgenic art or designed living things cross all manner of disciplinary boundaries. In essence what the problem of Making highlights, is the structural difficulty

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[251] Ibid., 139.

of scientific language to address the social impacts of the new technological developments. Recourse to epistemological frameworks alone however is not sufficient to attend to the paradigm shift from 'natural' to the 'fabricated'. Given that the historians and philosophers of science are traditionally conditioned to thinking in binary terms i.e. rational and irrational, therefore to facilitate lateral thinking Galison proposes a more creative use of language-based compositions that he describes as "oxymoronic constructions" such as "fabricated fundamentals."[252] To untangle and better grasp how we might understand these new things, assuming that it cannot be a coincidence that the field defined as synthetic biology, perfectly sums up the criteria for an "Oxymoronic construction."[253] In other words, the words synthetic and the biological gesture thinking about an arrangement of words in terms of opposites, i.e., synthetic with artificial and biology with natural. Can biology be synthetic? The Oxford English dictionary definition lists the historical and etymological roots of the word synthetic and its uses in the formation of everyday understanding of the word. According to the dictionary, synthetic as it is used in logic: "proceeding from causes or

[252] Galison, "Ten Problems in History and Philosophy of Science."
[253] Ibid., 118.

general principles to consequences or particular instances", or as per its 1697 definition, "The Sciences Theoretical, such as Physicks, Metaphysicks, Mathematicks, &c. are disposed in Synthetick Method." In chemistry synthetic is that: "pertaining to or involving synthesis; of organic compounds, produced by artificial synthesis" and as description of a substance: "made by chemical synthesis in imitation of a natural product." In the form of a figure, synthetic is defined as that which is "artificial, imitation or invented."[254] The transgenic it can be said thus embody a synthesis of all disciplines of scientific know how. Yet, even as an autonomous whole, in the form of a living-breathing body, the transgenic remains within the domain of something that imitates a natural product and therefore can never is autonomous enough. The difficulty is exacerbated especially when there are no 'natural' examples of glowing bunnies, cats, fish or mice, and flowers knowingly configured with segments of human DNA and trees above ground are not known to emit light visible to the human eye. As Galison states, "From philosophy, we have inherited the distinction between methods of gaining and securing knowledge (epistemology) and methods of establishing the set

[254] Oxford English Dictionary, "Synthetic," (Oxford, UK: Oxford University Press, 2013).

of what there is in the world (ontology)."[255] The methodological problem is not in the ability to engineer cellular matter, but how to understand the objects in a social and historical context when identity and normative rights are all classified on the basis of ontological certainties pertaining to a notion of origin?[256] The source of moral unease that is identified by Kass and symbolized by products of synthetic biology concerns the impact on the meaning of life, the question is, is it possible to be 'unnatural'? What is it about the unnatural that makes some of us uneasy?[257] The answer I propose for explaining this ethical unease is that molecular biology that has its origins in the classification project of natural history, as Foucault writes in *The Order of Things*, is disrupted. The logic by which a variety of living things were put on a grid folds up with the prospect of the dissolution of the very basis of classification itself. To elaborate; given that the classification project was centred on mankind, then, just as molecular biology can show that there is more in common between species of the animal kingdom, it can be argued that

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[255] Galison, "Ten Problems in History and Philosophy of Science."
[256] Ibid.
[257] For a detailed historical account of making people, and the moral dilemma for ethics from Frankenstein to Dolly and beyond, see, Philip Ball, *Unnatural : The Heretical Idea of Making People* (London: The Bodley Head, 2011).

it is biotechnology that enables designing living systems molecular scale up, and it shows that there is more in common between the creative nature of god and man. In this analysis, transgenic art as Alba not only make traditional boundaries uncertain, but also the processes of technology are able to displace the status of natural *creation* and even replace it by artistic *invention*. Just as the fears that Kass raises are underpinned by the unease with the mixing of theological with scientific reasoning, tampering with reproductive technologies is seen as meddlesome in matters of sanctity of life. The fear is as Knorr Cetina puts it, "life is no longer a vitalistic force or the breath bestowed by god upon every single creature. It is suddenly at the disposal of the molecular biologist…."[258] It is precisely because it was religion in the past that was instrumental in dispelling the mythical creatures that symbolized the belief system of the ancients. In the combined forces of the two, the artistic with the scientific, in the form of the transgenic it becomes possible to imagine once again a space

[258] Cetina, *Epistemic Cultures : How the Sicences Make Knowledge*, 140.

where the menagerie of *Imaginary Beings* can threaten to come back to life itself.[259]

[259] Jorge Luis Borges, *The Book of Imaginary Beings*, trans. Norman Thomas di Giovani, 2002 ed. (London, UK: Vintage, 1967).

Chapter 6

Creation, creatio ex-nihilo

In this chapter I shall further problematize the making of biological artefacts by referring to the philosophical debates in the Arabic tradition over creation of the world that were at the heart of its early philosophical deliberations from the late ninth century up to thirteenth century. I shall look to synthesize some of these examinations in order to think again the contemporary problem of Making Things. I shall argue that as the new frontiers of science have shifted to biology, the value of philosophically driven analysis of theology is worth a revisit especially as the problem of making, which entails creating something, gets linked with creation and creature that in philosophy has a long history. That said, although Kac's transgenic art Alba problematizes all three aspects of making, I intend to focus on the disquiet over novel living forms as it connects both the act of creating and the biological creature that is art. For instance, ancient writer Trismegistus quoted in Leon Battista Alberti's *On*

Painting expressed the belief that sculpture and painting originated alongside with religion, and "the virtues of painting, therefore, are that its masters see their works admired and feel themselves to be almost like the Creator."[260] As cited in Chapter 1, outlining the intellectual history of antagonism between mechanical and organic, or creation and invention in early Christian thought Hans Blumenberg writes, "Making first acquires metaphysical value because it is discussed as a theological concept, as an attribute of the divine."[261]

In a similar vein, early practitioners of Arabic philosophy vigorously debated the nature of creation of the world, the relationship of creation to God, and the limits to rational knowledge. These discussions mirror some of the contemporary challenges presented by Making Things out of organic media, including unique creatures. For instance, Arab philosophers were debating if creation of the world came into being out of nothing, whereas in the present context, molecular biology and biotechnology has taken up the challenge to create life from 'scratch', that is, out of non-living synthetic matter. In the Muslim tradition,

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[260] "No. 26 and 27. Book II" Alberti, *On Painting*, 61-62.
[261] Blumenberg, "'Imitation of Nature' : Toward a Prehistory of the Idea of the Creative Being," 26.

creation *ex-nihilo* was perceived as a "serious challenge to human rationality."[262] In the twenty-first century creation of life from nothing in order to understand the origins of life posits one of the greatest scientific challenges. Moreover, the ensuing literature on the impact of the developments in biology and technology is not restricted to the scientific domain. And neither is it limited to a discussion of how the configuration of novel living things affects social, market, or environmental conditions. The processes involved in making unique living beings impacts classification order as discussed. Therefore, if ontological categories are a part of the classification project, and, if these are defined on the basis of the idea that the world is created, then, the world that is created has been created in a specific order. If categories are made on the basis of evolution, then the standard model rests on the idea that man evolved from apes, and not frogs for example. In both cases, advances in molecular biology can render past categories untenable. A synthesis of the scientific

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[262] The inquiry into the creation of the world was taken up my many Arab philosophers including Ibn 'Arabi. The most well known discussion is between al-Ghazali and Ibn Rushd. Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 32. See Leaman, *Averroes and His Philosophy*, 15-41. See also Harry A. Wolfson, "The Twice-Revealed Averroes," *Speculum* 36, no. 3 (July 1961).

processes show that at the molecular level, all that is living is connected. For instance in the context of molecular biology, Ibn 'Arabi's oneness model can conceptually be used as a means to reflect upon the connectedness of all life and the technical aspects of this model can applied to explicate multiplicity and differences in the animal kingdom. The connectedness of all living exemplifies Ibn 'Arabi's concept, which theoretically is a type oneness of being that as Salman H. Bashier defines it is unification as symbolized by the *barzakh* that is "not exclusive to differentiation."[263] The challenge that remains is that the disciplines of sciences put together as yet cannot tell us how living organisms were formed and came to be distinguished from other matter, what this being as form of existence *wujud* is, and, this is exactly at the core of the problem of Making Things that I shall reconnect with in Section Three.

In the context of classical Arabic philosophy, the relationship between God and the world continued to be debated in parallel with scientific progress of the time. The differences in methodological approaches subsequently

[263] Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 5.

came to represent different schools of philosophy. As a result, it is difficult to position the practice of Arabic philosophy (particularly during the ninth till the thirteenth century) with any fixed system under which it can be classified apart from the fact that the practitioners wrote in Arabic. For instance, they were Aristotelian, they were Neoplatonists, they read *Metaphysics* by Aristotle, they read *Enneads* by Plotinus, and they read Hippocrates, Galen, Ptolemy, Dioscorides, and Euclid. They trained as physicians, astronomers, surgeons, calligraphers, cartographers, geometers, artists, jurists, and mathematicians. They represented a cosmopolitan blend from Damascus, Baghdad, Basra, Cairo, Shiraz, Cordoba, Tabriz, Aleppo, Andalusia, to list a few places, and although predominantly Muslim, many prominent scholars were not Muslim. Together the scholars are credited with preserving ancient philosophy. They read the Qur'an alongside philosophical texts and used it foremost as a guide to clarify legal, and ethical issues. Side-by-side, they made use of the philosophical methods of reasoning, logic, and grammar to stretch lexical limits of language itself. And if there is a language that allows this advantage, it is Arabic.

As scientific knowledge advanced, parallel to the debates in the demonstrative sciences, metaphysical debates over the nature of creation and the relationship of creation to the attributes of Allah, God (including all ninety nine names) described in the Qur'an became central themes for defining both religion of Islam and science. Furthermore, notable scientists in classical Arab age were also involved in greater philosophical debates about the nature of existence and of being in the world. Moreover, a distinguishing feature of this scholarship is that it represented manifold viewpoints. For example, Al-Kindi who is recognised as the first philosopher was also the first to sympathize with the desire to neutralise the tension between religion and philosophy. He expressively believed that there was no conflict between the fundamentals of the faith of Islam with the teachings of ancient philosophical sciences. Al-Kindi interpreted the verses of the Qur'an according to the principles of Neoplatonic reasoning. His position on creation was that the world was created from nothing pre-existent and was finite. He differed in this from the rest of the well-known Arab philosophers who identified with the Aristotelian tradition. The source of conflict that al-Kindi logically set to undermine were central Aristotelian concepts from *Physics* and *Metaphysics*, as Kevin Staley explains, are "directly contrary to the Moslem creed,

namely, the eternity of matter, motion, and time."[264] However, as historians of Arabic philosophy point out, although the Qur'an does state that man was created from clay, it does not categorically state how the world was made.[265] This view is supported by the subsequent scholarship, for example, taking up from al-Kindi, Ibn Sina (d.1037) proposed that indeed it is God who is the final and efficient cause for all that exists in the world therefore creation is *ex-nihilo*. At the same time, he argued that the being of the world is an ontological event and since God is outside of the causation of this event, is eternal. In line with the Aristotelian view, he reasoned that the world therefore must be eternal. The scholars that followed continued to discuss the limits to all that can be known through philosophy in concurrence with reasoning based on an understanding of Qur'anic verses and these reflections were passionately debated. Those who favoured a more traditionalist view opposed dialectal methods of reasoning. These philosophical debates came to a critical peak in Abu

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[264] Kevin Staley, "Al-Kindi on Creation : Aristotle's Challenge to Islam," *Journal of the History of Ideas* 50, no. 3 (Jul.-Sep., 1989): 356.

[265] 23:12 "Surat Al-Mu'minun" states, "Man We did create from a quintessence (of clay)" *The Quran*. See also "Creation ex-nihilo in the Qur'an" Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 29-31.

Hamid al-Ghazali's (d. 1111) critique of Greek-Arabic philosophy in *Tahafut al-Falasifah* (The Incoherence of the Philosophers). Al-Ghazali's chief contention was that the idea of an eternal world proposed by the Neoplatonist school chiefly represented by Ibn-Sina and al-Farabi compromised the nature of God. Al-Ghazali argued that both creation and time could be thought of as essences of God. And essences of God are not identical to God. Therefore, the world exists by the will of God and can cease to exist by the will of God. He argued that as God is both outside of time and matter, there is no need for the concept of pre-eternity or post-eternity. According to al-Ghazali, the world was created *ex-nihilo*, "at a finite moment in time in the past from the present."[266] Majid Fakhry discusses and contextualizes al-Ghazali's scholarship by the fact that al-Ghazali started out as an Ash'arite theologian and later in life turned to Sufism, although he was critical of philosophy of his time, his critique did not include a dismissal of mathematics, logic, or ethics.[267] Furthermore, as scholars like Bashier point out, al-Ghazali was motivated by the idea that

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[266] Michael E. Marmura, "Al Ghazali," in *The Cambridge Companion to Arabic Philosophy*, ed. Peter Adamson and Richard C. Taylor (Cambridge, UK: Cambridge University Press, 2004), 142.
[267] Majid Fakhry, *Averroes (Ibn Rushd) His Life, Works and Influence* (Oxford, England: Oneworld Pulications, 2001), 13.

scepticism brings clarity and reason and this idea influenced later philosophers like Ibn 'Arabi for instance. To support his point and to situate al-Ghazali's scholarship, Bashier references Ibn Tufayl (d.1185) in Lenn Evan Goodman's translation of *Hayy ibn Yaqzan*, which quotes al-Ghazali, "For he who does not doubt does not look; and he who does not look will not see, but must remain in blindness and confusion."[268]

Contrary to historical facts, these differences have been politicized as splitting sets of events that drew the religion of Islam apart from the sciences. Consequently, these events have been analysed in terms of what George Saliba refers to as the classical narrative. According to this recounting of historical events, the enterprise of science came to a decisive end after al-Ghazali's critique of the philosophers' method Saliba explains.[269] What is misunderstood is that the divisions between the early philosophical schools, the Mu'tazilite and Ash'arite, were based on the differences over philosophical methods. Besides, the relationship of knowledge of God to objects of

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[268] See note 8. Source cited from Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 44 and 161.
[269] See Saliba, *Islamic Science and the Making of the European Renaissance*.

thought, and the nature of all things in the sensible world remained consistent preoccupations past al-Ghazali's lifetime.[270] The central disagreements were: did God create the world out of nothing and was creation *ex-nihilo*? Was time created or not? And if time was created, was it finite or infinite, and what was its relationship to the total existence of the universe? These questions have remained persistent. In the twenty-first century, the philosophical persistence of these very questions about the "beginning of time" forms the rationale for expensive research projects such as the Large Hadron Collider setup to investigate why the Universe developed the way it did.[271] The effort to understand life is matched by projects such as the Human Genome Project and Human Brain Project that in the process of studying brain disease also raise moral and ethical questions about the dignity of what it means to be *of* life itself.

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[270] For example see Dimitri Gutas's outline of Arabic philosophy from 9th till the 18th century in Dimitri Gutas, "The Study of Arabic Philosophy in the Twentieth Century: An Essay on the Historiography of Arabic Philosophy," *British Society for Middle Eastern Studies* 29, no. 1 (May 2002): 7.

[271] Science & Technology Facilities Council, "Large Hadron Collider," Science & Technology Facilities Council, http://www.lhc.ac.uk. Accessed, 13 December 2013.

In the thirteenth century, condemnations against philosophers' use of rational logic supportive of Neoplatonism initiated by al- Farabi and Ibn Sina to understand the basis of creation continued to be a cause of friction between Muslim philosophers debating the merits of reason of science and reason of (Aristotelian) philosophy. As a part of the ongoing dialog aimed to harmonize and moderate philosophical and religious contestations of knowledge of things in the world and the world's relationship to God, Ibn 'Arabi used the concept of *barzakh* based on his foundational theory of non-duality to neutralise the philosophical dispute of *creatio ex-nihilo* Bashier argues. Similarly, Samer Akkach maintains that Ibn 'Arabi used the oneness model to solve the differing views on the creation of the world by making methodological use of the imaginal frame, where the existent and non-existent are conjoined by the imaginal plane that connects Divine Imagination with human imagination out of which emerge all possible existences.[272] The problem is as Bashier explains, "whether the nonexistent is something or nothing"

[272] Akkach, "The World of Imagination in Ibn 'Arabi's Ontology," 102-05.

distinguished the Mu'tazilite from the Ash'arite position.[273] The philosophical unease at the time was the awareness of the fact that the Aristotelian principle of eternity of the world conceptually nullifies the idea of creation *ex-nihilo*, however, the drive to reconcile the philosophical divisions between the schools continued to be generative for philosophy, barring the political implications, as the different philosophers presented their solutions. Ibn 'Arabi's solution with the imaginal, in addition introduced a concept of limit to reason, that is also enfolded in the ontological framework of *barzakh*. Thus, it is through this limit that the creative capacity of Man participates in the process of "Divine Knowledge of Immutable Essences" (Bashier translates *ayn thabitha* as fixed entities and Izutsu as permanent archetype which I shall develop below).[274] He used the imaginal as an intermediary space to accommodate by enjoining the division between opposites such as existent

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[273] Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 33.

[274] Samer Akkach sums Ibn 'Arabi's position on creation by citing from the opening lines of the text of his al-Futuhat, "'Praise be to God who brought the world into existence from non-existence and the non-existence of non-existence of non-existence.'" Akkach, "The World of Imagination in Ibn 'Arabi's Ontology," 113.

and non-existent making creation an ongoing generative process.[275]

With this formulation at hand, in the following writing to address the contemporary problem of Making Things, I shall explore if the oneness formula can re-conceptualize the objections to designing unique organisms or living forms on the basis that biotechnological innovations are neither artificial nor invented. I shall build upon the intermediary domain of the *barzakh* that links and separates divine creation and imagination by introducing Ibn 'Arabi's term *ayn thabitah* permanent archetype in the complementary way that Ibn 'Arabi uses it to solve the problem of thinking in dichotomies of existent and non-existent. I will use these concepts to blur the distinction between creation and invention, natural and artificial. In this way, I hope to further the terms of debate, expand on the scope of philosophical negotiations with the idea of imitation, given that the idea of artistic creation gets even more complicated when the ability to manoeuvre biological entities results in living creatures. This problem is the ethical problem of Making Things.

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[275] Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*.

Making Life from Scratch

As discussed, classical Arabic philosophical debates retained a kind of potency and dynamism because the practice of philosophy included interpretation of the Qur'an as a means to uncover absolute truths together with developments spurred on by the advances in the demonstrative sciences. It was fundamental at the time that as these ideas were tested and argued, they stimulated philosophy. However, in some instances, debates were challenged and dynamism became problematic when it came to the formulation of moral and ethical regulations. In these situations, solutions were resolved by recourse to what was stated in the verses of the Qur'an and if the issue was not stated or mentioned in the Qur'an, then issues were resolved on the basis of interpretative tradition. What is lost today is that learned men of the Islam's past believed that religion and science belonged to the same continuum of knowledge. In keeping with past traditions, I propose that the twenty-first century moral dilemma over the nature of responsibility that is unsettled by the phenomena of Making Things can be thought differently aided by the analytical tools of Ibn 'Arabi's philosophy. To do so, I shall test with this writing if the philosophy of Ibn 'Arabi can cause a shift in perspective.

My intention is to examine if an alternative philosophical view can broaden the fundamental ethical objections to the making of biological artefacts. Especially as the inclusion of life into the paradigm of invention by Kac, both as part of artistic practice and in parallel with the ethical questions posed and highlighted by Kass in the problematic symbolized by in-vitro fertilization, at the core are questions about life. The problem is that advances in the life sciences are viewed as a symbol of Man's control over nature or as the break with metaphysical tradition. This program of analysis leads to no resolve because it is inherently dualist in thinking structure. That is, all propositions and contentions are formed out of binary distinctions, such as man or animal, man or God, natural or artificial, subject or object, creator or maker, and self or other, for example. To get out of philosophical quandary brought about by thinking in binary terms, Ibn 'Arabi in his time stretched lexical parameters of language to resolve the conflict over methodological disputes in understanding nature and creation as debated in the courts of the Almohad, Abbasid, Ayyubid, and Fatimid sultans. Although given that what makes a good faith based argument grounded in non-concrete reasoning, may not hold for reason based on empirical reasoning. I tentatively propose that Ibn 'Arabi's formulation of the concept of *ayn thabitha* permanent

archetype can bring about a more nuanced understanding of the moral dilemma over the nature of responsibility that is unsettled by the phenomena of Making Things and posed by the technical potentials of molecular biology as it deals with life.

In order to think of *wujud*, being, existence, and life, Ibn ‘Arabi conceptualizes existence in terms of three ontological categories, and not two, i.e. being and not being. First of these categories belongs to the Divine, the second ontological entity is what he calls *ayn thabitah* and the third ontological category is all things that appear in the sensible world. The Divine is God, and in essence unknowable. The *ayn thabitah* are entities that function as principle determinants of the inherent possibility that pre-exists in all matter that is created. This third group of ontological entities is all things that can be perceived by the senses. Diagrammatically ‘Arabi’s ontological framework can be visualized as a circle divided into three parts. At the top position is “Absolute in its absoluteness”, the middle position is occupied by what are described as “archetypes” proceeded by the “world of sensible things.”[276]

[276] Izutsu, *Sufism and Taoism : A Comparative Study of Key Philosophical Concepts*, 159-60.

As Izutsu elaborates, because archetypes occupy the middle position, "archetypes have the double nature of being active and passive, that is, passive in relation to what is higher and active in relation to things that stand lower than themselves."[277] Denoted by the word *qabil*, which in Arabic expression is the word used to describe the nature of a thing that symbolizes potential.[278] As an adjective, the word *qabil* can be used as a prefix to describe something that is adaptable, adjustable, has aptitude, and is capable, divisible, incorruptible, indestructible, malleable, curable, and immutable. Izutsu continues to explain, in the ontological structure of Ibn 'Arabi, the archetype has the potential to be and become precisely because it is in itself endowed with potentialities that define the very existent character. Nature is what is given, which defines the inner structure of the possible potentialities of what things could become. At the same time, "considered in themselves, they are of a self-determining nature and exercise a determining power over the possible things of the world."[279] Furthermore, to extend the lexical parameters of the idea of the permanent archetype, contained within the words *ayn*

[277] Ibid., 159.
[278] Ibid.
[279] Ibid.

thabitha, Izutsu explains, according to Ibn 'Arabi archetypes have in them the essences of all possible states of being. Additionally, he goes on to elaborate that Ibn 'Arabi uses the term *a "yan al-mumkinat* essences of possible things" when he refers to the permanent archetypes.[280] In one sense, this alludes to concrete possible existing things in the world. And concurrently, for Ibn 'Arabi, archetypes "remain in themselves 'intelligible' without being individualized."[281] They are non-existent, and yet "permanently subsistent."[282] As he says in a passage translated from *Fusus al Hikam*, which can be summarized thus: although archetypes are defined by a state of non-existence, they are necessary to all existence and yet, materially they "have not even smelt the fragrance of existence."[283]

As a thought experiment, I am going to give the concept of permanent archetype, (as noted by Bashier, resemble Plato's Form) the identity of a single biological cell. I will take it as an ontological category denoted existent in an ontologically intermediary state of non-

[280] Ibid., 166.
[281] Ibid.
[282] Ibid., 161.
[283] Ibid.

existent existents of Ibn ‘Arabi’s *ayn thabitah*. Like the archetype, a single biological cell is endowed with life force, which is self-organising. Cells multiply and divide modulated by biological processes. At the same time, a cancer cell as discussed in the previous section, makes a type of cell that exemplifies the extreme end of self-organising rule. Relatedly, under the direction of a molecular biologist, a cell is adaptable, adjustable, it has aptitude, it is capable, it does divide, and it can be incorruptible, indestructible, malleable, curable, and immutable. In it’s (positive) potential capacity, the archetype directs life. It signals life. As a sign of life, a cell embodies the blue print for life. All forms of life are made up of cells. It is singular and universal. It is divided and spread across species, however, the issue is, is a cell that is living, same as existence, and philosophical being?

Ibn ‘Arabi was certainly not looking at cells under a microscope. All the same, in this thought experiment as a cell has been given the identity of permanent archetype, then, logically given its ontological status in the intermediary state, a cell therefore cannot not have an external existence. Such is the nature of a mammalian cell that it cannot exist unaided outside the body. All the same,

trillions of cells make the body as one. Cells like the concept of permanent archetypes are non-existent in external sense. At the same time, Ibn ‘Arabi also assigns the archetype a permanent reality, and that is connected with consciousness. At the top end, archetypes are connected with Divine Consciousness and at the lower end, archetypes are connected with all that can be realised and appears in the sensible world, the world of sense. In the intermediary state, a cell, an archetype, is then everything and nothing, potential consciousness and no consciousness, all life and no life at the same time.

As molecular biology turns the scientific lens inwards, twenty-first century biology radically brings into focus once more the complexity of matters pertaining to genetic engineering and the relationship of the creation of new living forms to life itself. The medieval Arab philosophers were debating religious and metaphysical aspects of creation with equal measures of attention to Aristotelian philosophy and the idea of eternity of the world that was further problematized by the concept of *creatio ex-nihilo*. Rotman traces the unease assigned to the idea of nothing with the idea of the void, and the number zero in his study of semiotics of the numeric value zero, to study and compare the link between zero and nothing from the

Greek philosophical and Christian religious perspective. For the Greeks as Rotman writes,

> For Aristotle, engaged in classifying, ordering and analyzing the world into its irreducible and final categories… the prospect of an unclassifiable emptiness an attributeless hole in the natural fabric of being, isolated from cause and effect and detached from what is palpable to the senses, must have presented itself as a dangerous sickness, a God denying madness that left him with an ineradicable *horror vacui*.[284]

Paradoxically, in the case of medieval Europe, he explains, the inclusion of the number zero became acceptable not because the number zero could accommodate the empty space value assigned to it in counting. The number zero became acceptable as a means to signify nothing in accordance with Christian belief. That is, God created the world out of nothing, creation *ex-nihilo*.[285] In this way as Rotman writes, "Christian theology was forced to recognise 'nothing' as something."[286] According to Rotman's study, as theological analysis of creation of the world out of nothing came to be absorbed, nothing came to be not synonymous with void or mathematical infinity but symbolized God as the originator of the world.[287] Ironically, in the twenty-first century, the same number zero enables computer code writing and with it

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[284] Rotman, *Signifying Nothing : The Semiotics of Zero*, 63.
[285] Ibid., 58-72.
[286] Ibid., 63.
[287] Ibid., 64.

the possibility to think again the idea if indeed it is possible to make "life from scratch."

Outside the realm of mathematical abstraction, the physical relationship of nothing to something, God to man and life to creation, molecular biology, and biotechnology can challenge the source of religiously held beliefs about creation. For example, scientific research projects that are investigating origins of life presently see and understand life in material terms as stated in the article titled "Life-Changing Experiments" that represents standard scientific understanding of biology formulated in terms of "…standard model of life." That is, "It's the model of DNA and amino acids and proteins and a genetic code."[288] Quoted in the same article in the words of an astrobiologist; "It's the common feature of all biology and the framework through which everything we know about life is based."[289] All the same, even as the genetic code is set to replace the authority of creation *ex-nihilo*, the very same philosophical foundations underwrite rhetorical claims exemplified by these statements. For example, science magazines such as *New*

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[288] Heidi Ledford, "Life-Changing Experiments: The Biological Higgs " *Nature* 29 March 2012.
[289] Astrobiologist Chris McKay of the NASA Ames Research Centre in Moffett Field, California, quoted in ibid.

Scientist or *Nature* are abound with articles that use familiar tag lines that include making life from scratch, nature's tool box, artificial life, and so on. The most recent at the time of this writing, which validates my point, is best summed up in the opening sentence of an article published in *New Scientist* entitled, "Craig Venter close to creating synthetic life."[290] It says, "For the first time we are close to creating artificial life from scratch."[291] With characteristic irreverence Venter is quoted in an other article stating that he intends to call the genome of the bacteria "Hail Mary Genome" claiming that this might be the first "rationally designed genome."[292]

Outside the binary of rational and irrational, two distinct modes of reasoning, one governed by rational logic, and the other intellectual reflection become one in Ibn 'Arabi's philosophy. To continue with the thought experiment for attending to the problem of Making Things using Ibn 'Arabi's tripartite system of ontological categories, the archetypes as cells can be subjected to any matrix for understanding creation. The cell, as permanent archetype can

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[290] Andy Coghlan, "Craig Venter Close to Creating Synthetic Life," *New Scientist* 16 March, 2013.
[291] Ibid.
[292] Wil S. Hylton, "God of Small Things " *The New York Times Sunday Magazine* June 03, 2012.

be used in the material understanding of human and other living animals or inanimate entities. Irrespective of genera, given the cellular identity in this instance, archetypes contain in them all essences of possible things, prior to their coming into existence in the sensible world. From the intermediary position, the biological cell as an archetype has in it the capacity to be configured and to be and become a multitude of living forms. Therefore artists who work alongside molecular biologists are not producing a third category of object, as in transgenic or synthetic life forms, they are not creating or inventing from "scratch" or any idea of a pre-existing beginning, they are possibly only unravelling what is already given to the power of a single cell. Moreover, the permanent archetypes operate in the same imaginal space as conceptualized by the term *barzakh*. What molecular biology dissolves is the nineteenth century categories of things, living things, and manufactured things in terms of natural and artificial.

Even if I were to assign a more deterministic ontologically functioning state to the archetypical cells, Ibn 'Arabi's principle of unity of all existence brings with it the possibility to think of the unity of all forms of life. For example, genetics studies the hereditary function of human disease. Processes of gene sequencing combined with

visualization techniques permit comparison between different species. Recent studies as a result of advances in the sequencing of the protein coding genes in the zebrafish tell us that the zebrafish "comparison to human reference genome shows approximately at least 70% of the human genes have at least one obvious zebrafish orthologue."[293]

Orthologues are shared genetic traits with a common ancestral gene. This is why zebrafish make a viable model to study human disease. That is, if zebrafish and humans did not have a share in some greater gene pool, studies of this nature would be quite futile. What is shared and is common to all scales of life forms is life, but not existence. And existence as in *wujud* encompasses life, being, and finding out, which is ultimately a way to affirm the reality of all creatures that exist via the connective feature of living.

To return to the act of polishing the mirror, to see the body revealed via the scientific lens, artists and scientists are both working in the intermediary space, of existent non-existents, that is a productive and creative space from which all things can come into being. As per Ibn

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[293] Matthew D. Clark Kerstin Howe, Carlos F. Torroja, James Torrance, Camille Berthelot, Matthieu Muffato, et al. , "The Zebrafish Reference Genome Sequence and Its Relationship to the Human Genome," *Nature* 17 April 2013

'Arabi's thesis, "*nihil* is not unconditional 'non-existence', but 'non-existence' in the particular sense of something being as yet non-existent as an empirical or phenomenal thing."[294]

With this formulation in place, at the end of this chapter, I will conclude the section by responding to the objections to in-vitro fertilization based on the view that it impinges sanctity of life. Before that, as Basim Musallam points out, it must be noted that in Islam, as is the case in Judaism and Christianity, taking of life is not prohibited. All the three predominant monotheistic religions permit the slaughter of animals, specifically non-human animal life. All the same, because killing is only considered a crime against another human being, it is essential to decide at which moment the foetus becomes a person: "the moment of conception, of birth, or some point between?"[295] Based on the exegesis of the Qur'an, Muslim jurists believed that the foetus develops into a human being after a cycle of transformations that is completed in hundred and twenty days. That is, a foetus becomes a human

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[294] Izutsu, *Sufism and Taoism : A Comparative Study of Key Philosophical Concepts*, 201.
[295] Basim Musallam, "The Human Embryo in Arabic Scientific and Religious Thought," in *Islamic Medical and Scientific Tradition : Critical Concepts in Islamic Studies*, ed. Peter E. Pormann (London, UK and New York, USA: Routledge, 2011), 323.

being only after 120 days.[296] This then became law. Muslim women in accordance with these guidelines have the right to induce abortion and most importantly, they are accorded complete decision-making control over their bodies without the need for any further recourse to the authority of law. This law is based on the analysis of the description in the Qur'an, as the Qur'an makes no direct mention of this.[297] In conclusion, ethicist and jurist Ibn Qayyim (d.1350) by drawing on the logics of *sabab batin* hidden reason, with *sabab dhahir* apparent reason, identified an area where only religion can have answers.[298] As he explains in this case, according to hadith's timing of embryonic development, the foetus becomes a human "in the fourth of the forty-day periods, after 120 days."[299] In conclusion, he adds, "This can only be known through revelation, *for there is nothing in nature as such which requires it.*"[300] That is, the process of ensoulment is God's way of creating human beings and this "understanding is not open to methods of science. Ensoulment

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[296] Ibid.
[297] Musallam cites references from the Qur'an from chapters XXII, 4 and XXIII, 12-14. Ibid.
[298] It is important to bring to the readers attention the fact that although Musallam's essay is based on the work of Hanbali jurist from Damascus, the Shafi'i, Hanafi and the most conservative, the Maliki school of Islamic law (that although did not agree on abortion), held the Hanbali position on abortion legitimate. Ibid., 324.
[299] Ibid., 323.
[300] Ibid., 327.

belongs to a different realm of meaning, outside science but at the centre of religion."[301]

Unattached to the sphere of monotheistic religions, the concept of the soul philosophically shares its origins with the Greek classical tradition and particularly to Aristotle's *De Anima* that in English translation is referred to as *On the Soul*. In this text Aristotle places all forms of living organisms in a hierarchal order based on degrees of distribution of *soul* or as an ontological category of living types classified according to the ability to grow, multiply, and die, sense perception, movement, and intellect. Aristotle's concept of the soul is a formal concept and the religious concept of the soul depends on the specificities of faith. In the intermingling of the two concepts are perhaps to be found the many ways it is possible to be, to know, and become, and these ideas I shall take up in the following section.

[301] Ibid.

Section Three
To Be

Chapter 7

Section Two addressed the ethical challenges that emerge as a result of developments in molecular biology that Peter Galison identifies in terms of the problem of Making Things. I used Galison's ideas to problematize genetic engineering as an artistic process that includes life invention outlined by Eduardo Kac. I ended the preceding chapter with an exploration of Ibn 'Arabi's oneness philosophy and the term *wujud* being to temper the mechanistic vocabularies in which molecular biology is discussed. It was my aim to test if this term could further expand the philosophical parameters of the ethical concerns that surface alongside technological advances for understanding biology. The ethical problem is not simply that molecular biology has exposed possibilities within biology for making novel forms or processes out of living organisms. The moral complexity is specific to the fact that it is possible to alter the outcome of what is perceived as a potentially living body past technical inception at molecular or cellular stage. These matters are especially pertinent for setting legal and ethical standards to limit kinds of experimentation. Similarly, the dispute over the

best methods for understanding life, or creation of the world based on the philosophical debates amongst early Arab philosophers is, a greater epistemological and political problem, and even an ideological problem, or perhaps a greater historical-cultural problem but not essential to the problems of science. The violence that is caused by artistic, scientific, philosophical, and political adventurism however is theoretically an intellectual problem to understand the nature of violence that permeates human creative pursuits.

In order to examine the role of violence and creativity especially, in the use of biological matter for artistic purposes, in this section I will focus on the problem that I see is a result of thinking in dichotomies. I shall argue that the binary model for thinking about life in terms of either/or such as natural or artificial and creation or invention exacerbates cruelty inherent within the creative impulse. For instance, as discussed, the unease associated with the idea of taking away embryonic life is attached to the faith in the concept of ensoulment or the existence of soul at the cellular stage. The difficulty surfaces when the terms of debate that are grounded in expressions of either rational or mechanistic existence or metaphysical being, and, not in terms of violence that is

not divorced from experience and the relationship of power to violence.[302] By arguing that the hardline differences in opinions are a part of the binary thinking structure, I will connect the ideas discussed in Sections One and Two that in sum are an exploration of the notion life as mirrored in the arts that is both complex and dynamic. And, to get out of the dualist model I will bring to a conclusion the concepts developed during the course of this thesis around Ibn 'Arabi's term *wujud*. I will make the case that an alternative framework for the examination of the nature of life in non-binary terms is possible without compromising the scientific, as Ibn 'Arabi's ontological ideas are not simply founded on the word *wujud* being in metaphysical or esoteric terms as Franz Rosenthal explains.[303] It is my understanding that *wujud*, as a model would be incomplete without a bias towards the empirical. This assessment is based on the analysis that if all of Ibn 'Arabi's ideas are connected to the idea of *wujud*, then, *wujud* as it is linked with the terms *barzakh* limit and *ayn thabitah* permanent archetype that specifically addresses the concept of limit

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[302] I contemplate the link of violence to power, and violence in representation in series titled "Full Colour" 2011-13. For example, see "Full Colour 11" (see Figure 23).
[303] Rosenthal, "Ibn 'Arabi between "Philosophy" and "Mysticism" : "Sufism and Philosophy Are Neighbors and Visit Each Other". Fa-Inna at-Tasawwuf Wa-T-Tafalsuf Yatajawarani Wa-Yatazawarani."

to rational modes of knowing, must theoretically necessitate all that can be known through experience.

In the past chapters, I elaborated on the link of *wujud* to knowledge gained through reason that can be identified by the symbol of the surface of the mirror that features in Ibn ‘Arabi’s writings. It is vital to recall that he describes the process of polishing the surface of the mirror as analogous to the actions of one who is seeking clarity in the pursuit of knowledge, divine or not. In practical terms, *wujud* thus neatly ties up with the one who is seeking knowledge. In particular, this pursuit of knowledge is not a form of detached contemplation, as logically any idea of thinking about life; nature or being would be rendered obsolete without the active participation of the enquirer. Keeping to this approach, *wujud* is a way of being human by searching and finding. In this way, drawing from Ibn ‘Arabi’s methodological framework, I propose that Ibn ‘Arabi’s mirror is a kind of lens. At the same time, this mirror does not simply replace the scientific lens; the mirror is the archetypal lens. And this idea of the lens joins up with the histories of specular devices, starting with the mirror as the foremost surface for reason and reflection. In time, the use of mirrors and lenses evolved driven by activities for understanding the nature of

reflection and refraction of light. The results include forms of images that as they are fixed or firmed up make a photograph, for example. For instance, photography as a genre has become the most acceptable medium for proof making that is associated with scientific means for acquiring knowledge. The problem is, in the instances when the scientific lens turns inward towards the body, the microscopic image making processes for example, are unable to determine exactly what thought or life is, especially as it is possible to be preserved in perfect bodily state and be 'brain dead' as the case may be. An illustration of the problem can be seen in the images of the brain produced by scientists at Harvard University Center for Brain Science (CBS). In the tradition of Santiago Ramon Cajal, CBS lab have developed a method to tag individual nerve cells in different shades of fluorescent proteins to isolate and trail axons and dendrites in different parts of brain region in transgenic mice.[304] Mice brain can be imaged with light microscopy, as Brainbow maps (see Figure 24, 25 & 26) show beautiful arrangements of colour and composition orchestrating the delights of thought in action for the non-

[304] Peter Reuell, "Brainbow Version 2.0," *The Harvard Gazette*(May 15, 2013), http://news.harvard.edu/gazette/story/2013/05/brainbow-version-2-0/. Accessed, 13 December 2013.

specialist viewer. And yet, even as this technique can tell us a lot more about how the brain is wired, colours are visual aids, and the technological reach is restricted to the mechanical. A peculiar aspect of these images is that they evoke questions such as, is there more to life and intelligence than the mechanical sum of its parts, and if yes, what is it, and how can it be verified by scientific measures of assessment. This issue remains central to the advances made in the field of molecular biology, and, it is this problem, which I left unaddressed in Chapter 6 that I shall try and unpick in this section. The preceding sections, "To see" and "To do" were a way to reconnoitre the possibility inherent in the arts to explore the connection between seeing and doing. In the following and concluding part of this writing, I shall propose that just as *wujud* is linked with the search for knowledge; it is linked with art, *technê*, image making, and creativity that are co-extensive to the senses, and foremost to imagination. These are all ways of knowing. They are ways of making meaning, and of making sense of the sensible, which is to know how to *be*.

The Soul

For the ancient Greek philosophers, understanding the connection of what accounts as human thinking, or rational knowledge and how it occurs in the body, and what it is persisted as a complex philosophical issue. In the twenty-first century just as organic media art problematize the paradoxical relationship between the molecularization of the mortal body, and technical (corporeal) abilities to push the limits of biologically possible. Or bioethics studies the advances made in molecular biology with the object to adjudicate a legal framework incorporating philosophical, moral, material, and ethical truths to determine what life is, and to set limits to all that can be done with biological processes at the molecular level; for the ancients, some of these intuitions were also enquiries into what they termed the soul.

Platonic views on the concept of the soul are well known. They include pre-existing abstract entities that make-up the soul as a form of intellect that can, for example, be appealed to when what is perceived via the senses is liable to confusion. According to the Platonic view, there are two types of thinking: one that is sensible and second through reason, that is, the soul is responsible

for the latter. In Platonic formulation, the soul is responsible for the faculty of judgement as discussed in the dialogues of Plato's *Timaeus*.[305] For example, Sarah Broadie in a more recent evaluation of *Timaeus* elaborates on the difference in the making of the cosmic soul by Demiurge from the mortal kind in which case each soul is individuated, and primed to assume responsibility. As she puts it, "It is simply a fundamental fact that reason in mortals is reason individualised."[306] Moreover she continues, "So if the world is to be complete, there will necessarily occur in it actions (and consequences of actions) of which neither the Demiurge nor any god is the agent-cause."[307] Articulated in these terms, *nous* intellect is the essence of the human soul, and not accessible through the direct particularities of the senses alone. In Platonic thought, mathematics is a thinking system that enables "decisions" or "intuitions" in instances when the sensible yield no answers.[308]

If we accept intelligence is the essence of human life, then Aristotle in *Perì Psuchê* first identified the

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[305] Plato, *Timaeus*, trans. Benjamin Jowett, 1949 ed. (Indianapolis, USA: Bobbs-Merrill, 360 B.C.E).
[306] Chapter 4 "Immortal intellect under mortal conditions" Sarah Broadie, *Nature and Divinity in Plato's Timaeus* (Cambridge, UK: Cambridge University Press, 2012), 102.
[307] Ibid.
[308] Badiou, *Briefings on Existence*, 95.

problem of scientifically and materially elaborating what this intelligence might be made of. Well-known by its Latin translation *De Anima*, in this text Aristotle sets to find what Eugene Thacker articulates in contemporary terms as "how to think a concept of life that is, on one hand, irreducible to the living, and, on the other hand, which does not immediately evoke the mystical or is compromised by the scientific?"[309] Today the disciplines within the life sciences preserve much of the terms of this challenge to think about what life is. Furthermore, the expressions of the debate are modelled in scientific vocabularies set to argue against intelligibility by abstract or esoteric means of knowledge. That is, scientific language sets itself apart from language rooted in the idealisation of Platonic Forms, (i.e., absolute truth or what Real is inaccessible and cannot be verified by the senses) since this idealised language was adopted and synthesized to elaborate religious doctrines. Nonetheless, uncritical mechanistic purview of molecular biology faces conceptual difficulties in answering the link of life to living, and thought in very much the same tradition as addressed by Aristotle in *De Anima*. This is important, especially because new knowledge pertaining to

[309] Eugene Thacker, *After Life* (Chicago, USA and London, UK: The University of Chicago Press, 2010), 101.

the biological body also brings new ethical dilemmas for understanding if life is anymore than what its materially determined attributes as discussed in the last chapter.

Aristotle begins *De Anima* in praise of knowledge, he states at the outset, translated below.

"Cognition is in our eyes a thing of beauty and worth, and this is true of one cognition more than another, either because it is exact or because it relates to more important and remarkable objects."[310] Aristotle goes on to add, "On both these grounds we may with good reason claim a high place for the enquiry concerning the soul."[311]

The crux of the investigation in *De Anima* develops in a manner much like Aristotle's study of the differences in plant and animal types for example in *Historia Animalium*, History of Animals. What makes *De Anima* significant is that it marks a shift within Aristotelian philosophy from the purely physical and material domains to metaphysical concerns of the relationship between *anima* soul and the body. It is in *De Anima* that Aristotle introduces the idea of the *anima* as a distinct body capable of existing

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[310] "Book I, i", Aristotle, *De Anima*, trans. R. D. Hicks (Cambridge, UK: Cambridge University Press, 1907), 3.
[311] Ibid.

independently of the perishable body.[312] In conclusion not only is *anima* aligned with *nous* or intellect, together with sense perception, intellectual capacity in humans to contemplate the nature of existence or thought itself gets understood as the distinguishing feature between mankind and other organic living beings. There is however a difference. Unlike other ancient poets and philosophers cited in *De Anima*, Aristotle builds up his reasoning with an emphasis on the empirical. For example, the sets of questions he asks are: What category of substance does the *anima* fall into? Is it divisible, or indivisible? Is it homogenous, one or many? Is it a quality, quantity, or potentiality?

In his time, Aristotle was searching to define attributes that would lead to a better understanding of the Platonic conception of Idea, thought, intellect. An often-cited example of Aristotelian formulation is that movement in organic matter is unlike any movement that can be seen in the elements. He claimed that this particular facet, the ability and potential to self generate is what characterizes all living beings and called it *psuchê anima*.[313] *Psuchê* he

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[312] CH.2 413b 22-414 a 13 ibid., 57.
[313] "For the soul is the cause of animate bodies as being in itself the origin of motion, as final cause and as substance." See CH. 4 415 b 6-416 a 4 ibid., 65.

believed was the one distinguishing feature that doubtless differentiated the animate from the inanimate. That said, *anima* in scholastic reception was inferred not only as extra-corporeal causation of organic movement, but also linked with the divine. This assimilation of Aristotelian ideas made *anima* difficult to explain in corporeal terms and hence *psuchê* understood in terms of the Latin *anima* soul became a great matter of significance for the pursuit of scholastic studies, especially in the idea of immortality of the soul in connection with the body. Not in the least, what *anima* soul might be continues to be of interest to both science and religion.

The historical context in which Aristotle wrote *De Anima* addressed the then existing views on the idea of soul derived from an admixture of the Greek mythology, poetry, and philosophical assessments and opinions between different schools of thought in ancient Greece.[314] R. D. Hicks in the introduction to his translation to the text states that the earliest conception of the opposition of the body from soul are rooted in ascetic ideas developed in part under the aegis of the state. Followers of Orphic and Pythagorean philosophies regardless of political affiliations, commonly

[314] See Hicks "Introduction I", ibid., xx-Ixxii.

accepted the doctrine of transmigration including the notion that somehow the soul was better than the body.[315] As a result, it was widely accepted that the best way to maintain harmony of the soul was by observing strictures on bodily desires, however as Hicks points out, the early enquirers where less concerned with the mysteries of the underworld, and were more scientifically inclined in their orientation. They were "men sought to explain to themselves of what things were constituted and how they had come into their present condition."[316] Quite specifically, their problem was the "constitution of matter."[317] More to the point as Hicks tells us, all together the ancient thinkers believed the soul to be "not immaterial, but of an extremely refined and mobile materiality."[318]

The earliest thinkers who engaged with, and investigated, and elaborated upon the questions posed in *De Anima* on the nature and essence of *psuchê, anima*, or soul include the writings of many notable philosophers. Oliver Leaman in his study of philosophy of Ibn Rushd includes to

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[315] Hick explains that in the Greek tradition doctrine of transmigration of the soul was developed by the Orphic and Pythagorean brotherhoods. Ibid., xx-xxi.
[316] Ibid., xxi.
[317] Ibid.
[318] Ibid.

the list Alexander of Aphrodisias, Themistius, Ibn Sina, Ibn Bajja, al-Ghazali, and Ibn Rushd (*Short*, *Middle* and *Long Commentaries*) followed by Maimonides, Thomas Aquinas, and Gersonides.[319] What we do know from history is that all these eminent thinkers contributed to not only philosophy, but also in many instances either put theological scholarship at ease or at complete odds with investigative methods of rational science. However, unlike the Schoolmen compatriots, the philosophical disagreement between al-Ghazali and Ibn Rushd is somewhat mistakenly cited as an example of a dispute between religion and science as discussed in the last chapter. Historians of Arabic philosophy and science point out, more than a matter of religious dispute, the debate between the philosophers was methodological discord between rational and religious reasoning.[320] I would like to stress this point especially because in his time Aristotle was also trying to find the best method for embarking on an enquiry into the nature of thought *psuchê*, *anima*, or soul. For instance, just as he asks if the souls of different

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[319] Leaman details the different analysis and understanding of Aristotle's view on the nature of the soul in "The Soul and Essence" in Leaman, *Averroes and His Philosophy*, 82-116. More recently Eugene Thacker follows the path of the reception of Aristotle's ideas in *De Anima* in Western philosophical tradition in Thacker, *After Life*.

[320] See "The Incoherence of the Incoherence" in Leaman, *Averroes and His Philosophy*, 15-41.

species have a different genus, that is, is there a difference between the soul of a horse, dog, man, and god?[321] He also progresses the analysis by analogy of mathematical objects that get known in terms of their attributes such as straight or curved. This information Aristotle says, aids considerably to the knowledge of a thing.[322] I will return to this point in the concluding subsection Number Sense.

Alfred L. Ivry in his article verifies through the examination of extant Latin, Arabic, and Hebrew manuscripts that Ishaq ibn Hunayn's (d.910) translation of Aristotle's *De Amina* was the Arabic source *Kitab al-Nafs.*[323] Ivry traces the genealogical link of the many versions, revisions of Ishaq's translation that were in circulation including his Arabic translation of Themistius' *Paraphrase* of *De Anima* that were available to Ibn Sina and Ibn Rushd for example. Commentaries by Ibn Sina and Ibn Rushd vary in interpretation, and each thinker represents his own epistemological framework, at the same time the primary sources remain the same Ivry argues. The differences in interpretation are significant especially as both Ibn Sina

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[321] CH. i 402 a 21 402 b 22 Aristotle, *De Anima*, 5.
[322] CH. i 402 a 21 402 b 22 ibid.
[323] Alfred L. Ivry, "The Arabic Text of Aristotle's "De Anima" and Its Translator," *Oriens* 36(2001).

and Ibn Rushd were physician philosophers, and hence perhaps doubly interested in this text. Moreover, as Ivry has made the point, both philosophers acknowledged that the relevance of this text was in the application of the study of the soul across disciplines outside of biology. For instance, Ivry cites a reference from *Long Commentary* where Ibn Rushd identifies with the study of the soul for the purposes of "political science."[324] Some of the interesting distinctions that emerge in this article between the explanations of Ibn Sina and Ibn Rushd are for example, Ibn Sina distinguished the aptitude for "discrimination" between "imaginative intellect in humans" he called it *al-tamyiz* and contrasted it with "estimative faculty" that animals are endowed with *wahm* in Arabic.[325] Ibn Rushd curiously interpreted this simply as "intellection."[326] Another rather notable distinction that Ivry finds as a result of comparison, even though they both were reading the same translation, Ibn Sina purported the idea that origination of the "intellect is in us "after not being,"(*ba'da ma lam yakun*), i.e., *ex-*

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[324] Ibid., 67.
[325] Ibid., 70.
[326] These differences also make an example of the way Ibn Rushd was moving to refine his ideas in keeping with absolute fidelity to the Arabic translations of Aristotle. Especially as al-Gahzali's polemic was against the philosophical methods that Ibn Rushd set out to defend. Ibid.

nihilo."[327] Contraverse assessment is given by Ibn Rushd in his *Long Commentary* explains Ivry, where Ibn Rushd is much more faithful to the translation in his analysis and presents the "intellect in question as material intellect."[328] The span of the years between the deaths of Ibn Sina in 1037 and Ibn Rushd 1198 represents not merely an intellectually rich period in Arab philosophical tradition. Philosophical ideas were also founded quite early on the basis of promotion of the conviction by the Abbasid caliph-al-Ma'mun (d.833) that revelation and exegesis of the Qur'an must be in continuum with all ancient knowledge. Conservative positions were however not quite tolerated, and these problems were both cultural and political problems, and outside the scope of this writing. The positive attitude towards Hellenistic philosophy is exemplified A. I. Sabra notes by a well-known story from tenth century Baghdad. As the story goes, Aristotle appeared in a dream to the Abbasid caliph al-Ma'mun. In this dream, the philosopher and king had a learned debate over the worth and nature of good. The conclusion that is widely known stated that primacy must be

[327] Ibid., 71.
[328] Ibid.

given to *aql* reason over religious law.[329] The above example, it could be said typifies what Arab scholars at the time believed, which is that the way to absolute knowledge, and the ultimate goal of knowledge existed coextensively in the methods prescribed by rational science. This evaluation is still incomplete Sabra points out, especially as the reasoning stated above does not fully explain the importance of the pursuit of science in the early history of Islam. As he makes the point, the geographical span of the Islamic lands had reached as far as Kashmir in the east before the end of ninth century.[330] He further continues, based on Islam's claim to an all enduring message for all people at all times, during the years of conquests, Islamic religious ideology also came in contact with other religious beliefs, including other monotheistic faiths such as the Judaism and Manichaeism for example.[331] Therefore, in the endeavour for Islam to define itself in the face of diversity of intellectual attitudes, in the words of Sabra, "The result was a huge intellectual ferment, centred especially in multicultural Iraq, to which the movement of Islamic

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[329] A. I. Sabra, "Situating Arabic Science: Locality Versus Essence," *Isis* 87, no. 4 (December 1996): 660.
[330] Ibid., 657.
[331] Ibid., 658.

theology, philosophy, and science owed their birth."[332] As a result, Arab sciences represent a rich and complex blend of cultural and religious exchange of ideas that happened together with the enterprise of translation of ancient scientific sources into Arabic language.[333] This history is as complex as the variety of tiling patterns found in Islamic architecture, particularly due to the intertwining of different approaches to religion and science in Islam. Intellectual histories concerned with the scientific revolution in the middle ages however contextualize the formation and progress of scientific knowledge predominantly in terms of a clearly identifiable periodization process defined in terms of a neat origins and decline narrative. George Saliba has challenged this idea. His study shows that the classical idea of a beginnings narrative is unable to explain the sophistication of commentaries and the interpretation process itself that is evidenced in the manuscripts. He argues on the basis of his observations that the development of scientific instruments could not have

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[332] Ibid., 657-58.

[333] For a history of the making and influence of Islamic science on the Renaissance see, Saliba, *Islamic Science and the Making of the European Renaissance*. For a critical overview of why scientific modernity could not take root in the Islamic lands see, Toby Huff, *The Rise of Early Modern Science: Islam, China and the West* (Cambridge, UK: Cambridge University Press, 1993).

been possible if scholarship was based on translation of pre-existing ancient texts alone.[334] Therefore, as an alternative theory he proposes that the revival of the Greek scientific tradition by the Arab scientists was not simply propelled by the translation enterprise. Historical studies based on surviving manuscripts find in the manuscripts not just past scientific knowledge, but also see them as a record of a critically attuned culture that is well preserved in the pages of text containing commentaries, notes, and textbooks, many of which are encyclopaedic in length. As Saliba explains, contrary to the premises of what he calls the "classical narrative", in the case of early Muslim scientists, the key actors had a different role to play in the development and subsequent decline of Arab dominance in the scientific disciplines. According to the classical narrative, the sciences in the Islamic lands succumbed to negative pressure exerted by the theologian elite. This paradigm somewhat uncritically mirrors the particularly troubled position that was pitched up by the Catholic Church authorities in quattrocento up to the seventeenth century as is often exemplified by the case of Galileo. Saliba argues that the classical narrative uses the

[334] Saliba, *Islamic Science and the Making of the European Renaissance*.

European model as a basis for understanding the decline of science in the Islamic world. He continues to explain, assessment by comparison to European middle ages is not tenable as in Islam there was no central church like authority that could identifiably be held responsible for the staunch adherence to the idea of inherent incompatibility of rational thought with religion.[335] Moreover, Saliba views the comparative evaluation tinged with orientalism. As he finds in his study of the development of the discipline of astronomy: religious critique of Greek cosmology in fact led to the discipline of cosmology to separate from astrology. Hence, the philosophers to distance themselves from the polytheistic structure of the beliefs of their ancient predecessors "cast a new name for their discipline, the discipline of *ilm al-haya*."[336] That is, science of astronomy. In describing the spirit of the time, Saliba states,

> The serious astronomers had to answer more complex questions regarding the suitability of the proposed Ptolemaic astronomical configurations in accounting for the observations…. For them, it was no longer sufficient to find the positions of the planets at

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[335] George Saliba questions the premise of the decline narrative on the basis that Islamic science continued to flouish post publication of al-Gahzali (d.1111) critique of philosophy, and after the sacking of Baghdad in 1258. See, Chapter 7, "Age of Decline", in ibid., 233-55.

[336] Ibid., 132 and 75. "'ilm hay'a" is science of configuration of the world.

any time for purposes of casting a horoscope or some such thing, but they had to know how the planets moved, what caused their motion…[337]

Even before the astrologers set to differentiate themselves, the earliest example of distinct contribution to scholarship is attributed to Al-Razi (d.925-935) the physician who wrote a critique on the work of Galen. His intention though was not to dismiss the worth of Galen's scholarship, and, to explain the motivation behind his critique in *Kitab Shukuk a'la Jalinus*, (*The Book of Doubts about Galen*) he has stated in quite explicit terms in the following manner. In this text he states:

Asked why modern scholars should attach [such critiques] to [the works of] the ancients, I cite several reasons. Among these is that error is inherent in human beings…. Another reason I cite for such critiques is that the sciences continually grow and are refined as time passes. […] If then be said that this is tantamount to claiming that modern scholars are better than the ancients, I reply that I do not see that this statement is valid except on condition that the moderns improve on that which has been laid down by the ancients.[338]

Other examples of critique literature that belong to what Saliba calls the *shukuk* tradition include Ibn al-Haytham's *al-Shukuk ala Batlamyus* (*Doubts of Ptolemy*) and *Kitab Sharh*

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[337] See, "The Critical Innovations" in, ibid., 132.
[338] As quoted in Compier from Muhammad ibn Zakariya Razi's "Kitab al-Shukuk ala Jalinus", Mehdi Mohaghegh ed. and trans, in Abdul Haq Compier, "Rhazes in the Renaissance of Andreas Vesalius," *Medical History* 56, no. 01 (January 2012): 7.

Tashrih al-Qanun (*Commentary on the Anatomy of Ibn Sina's Qanun)* by Ibn Nafis (d.1288).[339]

Historians agree that medieval Arab scientists were indebted to the philosophical writings and scholarship of the ancient Greeks. It is from them they inherited many things, including, the tradition of debate. As a part of the tradition of debate, they also inherited from the Greek Peripatetic School a range of categorical differences in the philosophical views regarding the nature of God from Plato and Aristotle, making philosophical examination for a new religion above all a necessity.[340] This particular mix of teleological reasoning based on the Qur'an combined with

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[339] Saliba discusses the phenomenon of shukuk tradition in the discipline of astronomy. See, "Encounter with the Greek Scientific Tradition", in Saliba, *Islamic Science and the Making of the European Renaissance*, 94-117. Moreover, it is important to note that the tradition of critique was key to innovation and development of all scientific activity in the Islamic world.

[340] For example see Jim Al-Khalili, *Pathfinders : The Golden Age of Arabic Science*, 2012 ed. (London, UK: Penguin, 2010). Historical documents show that logical thinking based on mathematics was promoted by mathematicians like Al-Khawarizmi (d.847). Moreover, to deal with complex mathematical sciences, Khawarizmi coined the term algebra as distinct from arithmetic, which has no classical precedent. Other mathematical sciences such as geometry and optics, also flourished in this time supported by royal and bureaucratic patronage. Scientists of the time studied philosophy. For example, Al-Kindi was a mathematician and he is considered to be the first Muslim philosopher. Al-Farabi (d.950) was a distinguished polymath, also known in his time as the second master after Aristotle. He was followed by Ibn Sina (d.1037) renowned for the medical encyclopaedia al-Qanun fi al-Tibb (Canon of Medicine) altogether represent the variety of backgrounds and professional training engaged in scientific scholarship and philosophy.

theories of knowledge based on logic and demonstrable proof tradition continued to be a driving force for both, metaphysical debates over knowledge of the nature of God and creation, and scientific debates based on logic and empirical observation. All together, the community of scientists writing in Arabic symbolizes the importance and the need of the time to resolve contradictions, not merely between reason and religious law. Most importantly, the commentaries sort to resolve practical inconsistences in the Greek scientific texts, especially when they either contradicted or were inadequate to explain phenomena in the physical world based on empirical observations as the sciences advanced.

Side-by-side, there existed another kind of contradiction between the philosophical methods, not restricted to the methodological differences between religion and science. For example as Saliba notes, Ibn Rushd also objected to the study of astronomy. Saliba quotes Ibn Rushd from his commentary entitled *Tafsir* p.1661, where he is to have protested:

> The science of astronomy of our time contains nothing existent (*lays minh sha maujud*), rather the astronomy of our time conforms

only to computation, and not to existence (*hay'at muwafiqat li-l-husbab la li-l-wujud*).[341]

This is how there is a paradox. On the one hand, Ibn Rushd took up the position of rational way to theology, and on the other hand condemned astronomy of his time stating it only conformed to "computation and not existence."[342] The classical understanding of mathematics is abstract, invisible, and imagined. Ibn Rushd however, who also belonged to the Andalusian milieu, had to negotiate with a bias favouring what Sabra and Leaman term as the literalist tradition.[343] As in the instance of the commentaries of *De Anima* cited by Ivry, Ibn Rushd as the Aristotelian by remaining faithful to its tradition claimed that computation belonged to the realm of pure ideas (as per definition of classical mathematics). It therefore could not speak for "existence" *wujud*, as means of "computation" were unacceptable forms of proof for the demonstrative sciences. The context of this statement was given in reference to the

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[341] Saliba, *Islamic Science and the Making of the European Renaissance*, 179.
[342] Ibid.
[343] A. I. Sabra, "The Andalusian Revolt against Ptolemaic Astronomy: Averroes and Al-Bitruji," in *Transformation and Tradition in the Sciences : Essay in Honor of I. Bernard Cohen*, ed. Evertt Mendelsohn (Cambridge, UK: Cambridge University Press, 1984). Oliver Leaman also references Sabra. See Leaman, *Averroes and His Philosophy*, 5.

study of the movement of the stars that was raising doubts on Ptolemaic cosmology. All the same, given that Ibn Rushd uses the word *wujud*, it is possible to read the statement another way. On the hypothesis that the Greek science of astronomy was predominantly concerned with the study of the movement of the stars to predict the effects of the superlunary on the sublunary, and that this idea was intolerable from the perspective Muslim *ulama* specialising in religious scholarship. Then, the use of the word *wujud* to critique the thirteenth century astronomy by Ibn Rushd, who was also a Maliki judge, could also be understood to encompass the unknowability of "being", "existence", and literally "finding" or predicting the future.[344] As an example of the lexical breadth of the term, *wujud*, in the Sufi or mystical tradition is finding, or searching for the meaning of existence, and although is to ultimately find God or truth.[345] It does not preclude all manner of searching, and seeking knowledge, for Ibn 'Arabi uses this very term to extend the terms of *wujud* being to encompass all manner of existences, as per principle of unity of all existence, i.e.

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[344] See Sabra who contextualizes the particularities of Ibn Rushd's position on the basis of hardline politics particular to Islamic Spain. Sabra, "The Andalusian Revolt against Ptolemaic Astronomy: Averroes and Al-Bitruji."
[345] Chittick, "Presence with God."

life, and matter, including unity in all forms. Thereby neutralising the tension between methods of reason, be they religious, empirical (Aristotelian) or mathematical (Platonic).

In the instances where philosophical methods were at odds with religious values or beliefs, or if what was stated in the Qur'an was not explicit, then there was friction as exemplified by the discussion over the creation of the world *ex-nihilo*. Dimitri Gutas and Sabra point out that al-Kindi was not only the first recognised philosopher in Islam, he was also the first to reject, displace, and concede the Aristotelian principle of eternity of the world in preference for "*creatio ex nihilo.*"[346] Al-Kindi's interpretation subsequently did cause rifts as noted in the differences between the Mu'tazilite and Ash'arite philosophers. Just as Ibn Sina and Ibn Rushd held varying positions on the question of eternity of the world or *creatio ex nihilo*. However the difference is that there was no necessary binding authority restricting dissimilarities in opinion, as Sabra points out, most Arab philosophers were

[346] See Sabra, "Situating Arabic Science: Locality Versus Essence," 663. See also Gutas, "Geometry and the Rebirth of Philosophy in Arabic with Al-Kindi."

"philosopher-scientists" and not "theologians."[347] Even as al-Kindi compromised on the traditionally held Hellenistic position that favours eternity of the world, the root of the ethical problem that is presupposed with any discussion of creation, the existence of the soul that might be eternal and afterlife, is also exactly in the literalising of the philosophical soul, the project of Aristotle's *De Anima*. The complication is precisely, if philosophy is to proceed by adducing from physics, or physical phenomena, then how is the phenomenon of the existence of the soul as intellect to be explained?

Eugene Thacker states this problem rather succinctly in the preface to his book *After Life*, "More often than not, life is understood to be something that, though it is not lived exclusively by human beings, is, however, thought, exclusively by human beings."[348] In his book, Thacker is tracing the connections and influence of the text of *De Anima* within post-Aristotelian Western Scholastic tradition, up to modernity. In locating the historical accounts of the reception of Aristotle's work into Scholasticism and Western academia, the proposition set out in the book is to try and

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[347] Sabra, "Situating Arabic Science: Locality Versus Essence," 663.
[348] Thacker, *After Life*, ix.

think if or not it is possible to think about life as a philosophical question, and, not as a philosophical problem "reducible to biology nor sublimated with theology?"[349] For example, the root of the mainstream moral and ethical unease with processes involving the creation of novel living forms is not simply a metaphysical concern. The nature of concern is expressly biological that refers to real life, and, the ethical dilemma is intertwined and enmeshed within modes of thinking caught between the more nuanced and literal traditions of interpreting religious and even foundational philosophical texts. Within these traditions, the meeting of Greek philosophy with theology forms the bases of what Thacker describes as the concept of life "poised between biology and theology."[350] This line of thinking becomes possible based on the point, as Thacker expresses it and I quote, "Aristotle's ontology of life depends on a split within the central concept of *psukhê*, and that split is one between life and the living."[351] Furthermore, Thacker states that the outlaying impetus of his book is to address the fact that the text of *De Anima* tends to "frustrate the veneer of modernity's disciplinary boundaries of biology,

[349] Ibid., xii.
[350] Ibid., 102.
[351] Ibid., 17.

theology, and philosophy."[352] The proposition in the book is to test if it is possible to move beyond the influence of Aristotle's ideas about the phenomena of life as presented in *De Anima* in Western philosophy. One strategy that he proposes to get out of thinking particularly in binary terms, is to explore the concept of life across different philosophical systems and think outside the reoccurring methodological themes that discuss "Life-as-time, life-as-form, and life-as-spirit" in Western philosophy.[353] He calls these non-Western philosophical trajectories "ellipses."[354] One of the trajectories is the non-syllogistic tradition of Arabic philosophy. In *After Life*, Thacker introduces the work of Shihab al-Din Suhrawardi (d.1191) founder of Sufi *Ishraq*/Illuminationist School to address the "contradiction of life as nothing" that emerges out of negative theology of Pseudo-Dionysius (d.6AD) and John Scotus Eriugena (d.877).[355] Thacker is looking the work of Pseudo-Dionysius *Corpus Areopagiticum* as an example of Neoplatonic influence as well as the tensions resulting from contradictory pairing of Aristotelian, Neoplatonic philosophy with Christian

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[352] Ibid., xii.
[353] Ibid., 250.
[354] Ibid., xii. Moreover, elliptical thinking contrasts syllogistic methods of reason as exemplified by the Aristotelian tradition.
[355] Chapter Two "Superlative Life" in ibid., 25-95.

thinking, which raises the issue of the limits of thought in thinking about the divine. Similarly, according to Thacker, like the negative theologian, Suhrawardi's scholarship is notable for his synthesis approach towards different philosophical systems. Additionally he shares the motif of light to conceptualize both the divine, and uses it as a metaphor for all that can be concretely known.[356] The way I understand Thacker's ellipses is twofold. First, to introduce illuminist ideas founded by Suhrawardi the philosopher to think if *psuchê* defined as the bifurcation between life and living, divine and earthly, light and darkness of the negative theologians can be thought in non-binary terms, and, at the same time to maintain the significance that thinking about life is contingent upon living. More precisely, the difference between life and living and intellect cannot be *nothing*. That is, in the medieval context to think of a concept that while retaining the difference between divine life and mortal living, except not in terms light and dark as opposites, but more in Suhrawardi terms as a "luminous void."[357] Light in Suhrawardi terminologies is the entire spectrum and this includes all

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[356] Aristotle also makes references to light as it is related to making objects sensible. See CH. 7 418 b 8 419 a 4 79 in Aristotle, *De Anima*.
[357] Thacker, *After Life*, 94.

shades and colours from light to dark, visible, and invisible. Darkness in Suhrawardi's thought is a barrier that although keeps distinct the known from the unknown, nonetheless belongs to the same continuum of possible existences.[358] Despite the shared symbol of light, there are contextual differences.[359] For instance, it is important to note that Ibn Rushd and Suhrawardi were contemporaries.[360] Yet, it was Ibn Sina, who influenced Suhrawardi. Furthermore as discussed earlier, Ivry's article also shows that Ibn Sina represents a non-literal interpretative voice in reading Greek philosophy of Islamic philosophical scholarship.[361] As another example, remarkably Ibn al-Haytham anticipated Suhrawardi by more than a hundred years with his study of optics that not only set the model for the scientific method, but also Ibn al-Haytham was driven by the same leitmotiv to prove that the study of light was key to the knowledge of all that can be known. It is equally

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[358] Ibid., 91-95.
[359] See Chapter Six "Knowledge is Light" (Sufism) Franz Rosenthal, *Knowledge Triumphant : The Concept of Knowledge in Medieval Islam*, Brill Classics in Islam (Boston, USA: Brill Academic Publishers, 2006), 169-207.
[360] Ibn Rushd was also writing his *Commentaries* on Aristotle's *De Anima* during 1158-1186 making his scholarship contemporary with Suhrawardi.
[361] Gutas points out Ibn Sina's scholarship as misleadingly ascribed in favour of the mystical traditon, contrary to the evidence. Gutas, "The Study of Arabic Philosophy in the Twentieth Century: An Essay on the Historiography of Arabic Philosophy," 9.

significant to note that he was the first to categorically state that Plato's "rays" were imaginary constructs that aid measurement as discussed in Chapter 2.

Consistent with the idea of elliptical thinking, the split between life and living is also denied in Ibn 'Arabi's thinking. There is however a notable difference. That is, in his line of thinking, limits to rational methods cannot be overcome or supplanted by more methods that are rational and, equally, religion cannot be understood without the aid of logical thinking and imagination. For example, as discussed in the past sections, *barzakh* is a kind of imaginal barrier, a limit that also links the divine imagination with human imagination.[362] *Barzakh* enables the capacity for reason and reflection. What emerges here as a result is a concept of imaginal that depends upon the facilities of imagination and abstract thought to get past what delimits reason.[363] In this framework, the additional capacity for abstract thought through the imaginal that

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[362] Salman H. Bashier explains Ibn 'Arabi like Aristotle accepts that limit is the essence of every thing, however his conception of limit is more Platonic, i.e. "things participate in the limit not that the limit constitutes the final part of a thing." Bashier, *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*, 86.

[363] Samer Akkach in his paper points out that the role of imagination and images is an under studied facet of Ibn 'Arabi's ontological framework. See Akkach, "The World of Imagination in Ibn 'Arabi's Ontology."

defines the parameters of human capacity to think about life and thought as such, and, *wujud* encompasses the ability to imagine and participate in this animating force of living life. It can therefore be said that the possibilities inherent within imaginal together with the quest for reason and discovery, is the thing that joins and at the same time distinguishes all forms of living and thinking about what it is to be living. In this system, abstract thinking not only aids the empirical; body and soul, rational and irrational, all together are processes that makeup what it is to know. In this way *wujud*, which is also the real relates to the acts finding, seeking, and doing, that joined up form the matter that makes us alive. Aristotle's *Psuchê*, *anima*, soul accordingly gets differentiated; *wujud* is a terminological distinction to know what it is to be alive.

Real

Art is the surface that mirrors life. It characterizes the artist. Art is the image of the maker, the one who sees, and the one who does or takes action on the basis of what is propelled by perception. In this way, the image is symbolic of a particularly human generated activity. Most outstandingly, art symbolizes the gift for abstract thought

based on observation. Not as a contradiction, mathematical writing it could be said is a facility for intuitive thought that makes it possible to manoeuvre pictures (mathematical objects), and concepts across a surface plane to generate ideas.[364] Like the arts, mathematics also underwrites a way of seeing. For example, programming language that enables simulation is governed by rules of mathematics.[365] To explore this idea, throughout this thesis I studied the link of making as it defines the correspondence between vision and knowledge in terms of the effects of the past processes of mathematization of the visual plane. Historically, in many parts of the Muslim world, mathematical analysis of vision in the eleventh century laid the foundations for early Arab astronomy, paving the way forward for the making of the scientific method. Later when scientific literature on optics was translated from Arabic into Latin, in Western Europe, the mathematization of the visual plane, perspective, changed the course of both science and art

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[364] For a detailed analysis of semiotics of mathematics see Rotman, *Mathematics as a Sign : Writing, Imaging, Counting*.

[365] Rotman explains unlike the projects of classical mathematics that set to solve premises that in principle could be predicted, aided by computer technology "simulation-empirical mathematics" can test the outcomes of process that would otherwise be unfathomable. See "Will the Digital Computer Transform Classical Mathematics," *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 361, no. 1809, Information, Knowledge and Technology (2003): 1682.

during the Renaissance. Historians of science and art point out that the art of perspective symbolized a break from medieval past. Similarly, scientific work in European Renaissance of the sixteenth century onwards was fuelled by a reaction against philosophical tradition and reasoning aligned within medieval scholasticism. Contemporary forms of especially organic media arts, I argued on the basis of ideas explored by Hans Blumenberg in his essay "Imitation of Nature" are also attached to the same reactive spirit that deemed it necessary for human industry to split from nature as a pre-condition that defines Western modernity. The difference is, the organic media or Bio Art works symbolize proof of not Man's self-sufficiency but mastery of nature. On this basis what differentiates organic media or Bio Art from the other technologically driven arts is the material under study. Especially as any control of biological materials can never be simply a show of an appreciation of our scientific self. For example, Eduardo Kac's art titled Alba is not merely complex because the process of creating a transgenic animal is complicated. Alba also symbolically unravels the fundamentals of ordering and classification that fall to disarray in the face of living art.[366] Alba as a

[366] For example, the categories of Aristotle that make judgement

work of art disrupts the tidy categorical distinctions that hold apart the natural and artificial, real and imaginary, model and copy, mammal and hydromedusae for example. In the fact that this particular transgenic rabbit was conceived and lived as an artwork, Alba is a portrait that epitomizes human capacity for, in the words of the artist, life invention. If Aristotle reversed Platonic objection to art by introducing the idea that "representation restructures our experience of reality, not how art parallels reality" then what kind of art is a genetically modified rabbit?[367] Alba not only makes art and life as one, but also voids aesthetic distance necessary and central to Aristotle's critique of Plato's charge against imitation *mimesis*. The novelty of transgenic art wanes in the shadow of facts, especially as this animal remained confined to the lab, further problematizing the point that as a live art object, Alba is as autonomous as a chair. In the form of a created thing, Alba is a model to rethink the relationship of art to Bio Art, and Bio Art to living life. Artworks made up of organic media, the transgenic rabbit Alba can perhaps tell

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possible are: substance or being, quantity, quality, relation, place, time, posture, having or possession, action and passion.

[367] Terryl L. Givens, "Aristotle's Critique of Mimesis: The Romantic Prelude," *Comparative Literature Studies* 28, no. 2 (1991): 133.

us how a body can be made, repaired, re-configured, and yet, the question remains persistent. Does the rationalization of biological processes in the language of mathematics tell us much more about what *life* is than famously claimed by scientist Francis Crick after the discoveries concerning the structure of the DNA molecule for example?

The etymological origins of the word bio belong to ancient Greek, meaning "combining form of life/life giving cause or way of living", and particularly human living is "distinct from animal life, organic life."[368] At the molecular scale, in the abstract language of mathematics categorical distinctions of the term bio from organic or animal life becomes questionable as cellular biology is able to show that materially the animal and the human are more connected at the cellular scale than imagined by the medieval scientists for example. Hence, the problems associated with defining the parameters of life and intelligence, especially starting molecular scale up, retains its centrality for technology studies in much the same way, as it remains a theological or philosophical riddle. Biotechnology ethicists discuss the legal issue,

[368] Oxford English Dictionary, "Bio," (Oxford, UK: Oxford University Press, 2013).

however, artists complicate what the phenomenon of life is or could be.[369]

For example, the GFP factor that makes Alba unique represents not merely the drive to see and to understand by seeing. GFP makes it possible to visualize gene expression, and related intercellular activity in-situ. It is like the possibility for life to see itself living, growing. For instance, see molecular biologist Bo Xu's 2006 entry to the Art of Science Competition at Princeton University, entitled Green Heart (see Figure 27). This artwork is a multifactorial set of two composite images showing zebra fish. About the image Bo Xu states,

> These microscopic images are of two green zebrafish composing the shape of a green heart. The green color in the top image results from the fluorescence of the Green Fluorescent Protein (GFP) under excitation of blue light. GFP is expressed in the fish driven by the Nodal-response element. The bottom image shows the zebrafish under white light.[370]

The composition of the image of the two zebrafish in embryonic stage arranged in the shape of a heart represents

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[369] For example, the legal and political dimension has regained relevance due to the advances in field of biotechnology. However, even as technology makes it possible to rearrange cellular matter, and Kac is able to push artistic boundaries, he was not allowed to take Alba home.

[370] Bo Xu, "Green Heart," Princeton University, http://www.princeton.edu/artofscience/gallery2006/view.php%3Fid=6.html. Accessed, 13 December 2013.

an illustration of great and yet not, uncommon anthropomorphosis that scientific images are subjected to. Similarly, a particular difficulty for mystical theology Thacker explains was to find the adequate vocabulary for framing ontological questions defining the bifurcation between Divine life and human living.[371] Likewise, N. Katherine Hayles critiques the mingling of computer operations with human desires with that she calls "anthropomorphic projection", which she argues, "creates a cultural Imaginary."[372] That is, the computer represents a system whereby human orientated values are projected on an array of digital artefacts.[373] The title Green Heart and the composition of the image falls into this "Imaginary" category that are at the core of a kind of sentimental attachment that paradoxically surfaces in the language of not only biologists as they are looking at the subject of their study.

Nicole C. Karafyllis is noted for her scholarship and contribution to philosophy, particularly her ideas that extend Aristotle's writings on the subject of biology in

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[371] Thacker, *After Life*, 37-39.
[372] See "Prologue: Computing Kin", N. Katherine Hayles, *My Mother Was a Computer : Digital Subject and Literary Texts* (Chicago, USA: University of Chicago Press, 2005), 5.
[373] Ibid.

light of advances made in twenty-first century molecular biology. The emphasis of Karafyllis's scholarship is on Aristotle's concept of *anima vegetative* the soul of plants, which she argues is the shared vegetal feature of growth that connects all living forms.[374] Karafyllis coined the term "biofact" in 2001 to address the change in praxis of life sciences where the lab is not longer simply a room for the study of specimen. Instead, labs as Karafyillis explains, are "hothouses", "incubators", and "media rooms" where scientists are working on creating, growing, and crafting new varieties of living organisms. Biofact is defined by Karafyllis as the condition of "in-between-ness" which allows scientists the ability to redesign "growth before it has taken place" between all types of organic matter.[375] This way not only does the distinction between the natural and artificial become indistinct, but also the ability to harness pre-growth bring the natural within the remit of design.[376] The element of directed "endogenous design" that specifically uses the ability in organic matter to "self-

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[374] Nicole C. Karafyllis "Endogenous Design of Biofacts: Tissues and Networks in Bio Art and Life Science" in Jens Hauser, "Sk-Interfaces : Exploding Borders, Creating Membranes in Art, Technology and Scoiety," ed. FACT : Liverpool (Liverpool, UK: Liverpool University Press, 2008), 48.
[375] Ibid.
[376] Ibid., 46-48.

start" without leaving a visible trace is what Karafyllis explains is the key characteristic of biofacticity.[377] Karafyllis analysis of the ability of certain types of matter to self-start is in the tradition of Aristotle's definition of *psuchê* (Aristotle's movement or motion). To illustrate her point Karafyllis uses the example of a material such as a seed that by itself must have the potential to grow and develop with or without technical intervention or design. This ability to control and engineer the capacity of organic matter to "self-start" is biofact. Biofact is what gets harnessed in lab work.[378] As much as the term is in keeping with new knowledge of biology through technology, on the contrary it does not say much more about how the ability to self-start comes be distributed within some kinds of matter made of an arrangement of carbon, oxygen, hydrogen, and nitrogen molecules. Neither can it say more about why this matter can have the ability to self-start, nor think what is it to self-start?[379] In her essay

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[377] Ibid., 46-47.

[378] The Aristotelian concept of *psuchê* forms the ground from much philosophical work in molecular biology, related ethics, and impact on art. For example, Keekok Lee uses the term "Biotic artefact" in a similar manner. See Keekok Lee, *Philosophy and Revolutions in Genetics : Deep Science and Deep Technology*, Renewing Philosophy (Basingstoke UK, and New York USA.: Palgrave Macmillan, 2003).

[379] Living organisms are made of a small selection of the 92 naturally occurring elements. Carbon, hydrogen, nitrogen, and

for the *Sk-Interfaces* exhibition catalogue, it is possible to detect a paradoxical rift in thinking about life in terms of mind and body, and, body and soul. She writes at the outset,

> We are experiencing a general tendency towards re-materialization in new media art, which is taking place in light of an ongoing biologization of the soul, the innermost part of living beings which is assigned no specific location.[380]

That said, the idea of "biologization of soul", however much it may refer to advances in molecular biology that is blurring dualist thinking in terms of mind and body, natural and technological dichotomy, and shows that growth is the connective feature of organic matter. It does not explain what this ability to self-start, or grow is, yet, technology can control what growth can do.

The three examples of the artist, the molecular biologist, and philosopher discussed above are telling of the way technological advances in molecular biology are shaping cultural, philosophical, and moral attitudes towards

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oxygen make 96.5% of an organism's weight. The rest includes sodium, magnesium, phosphorus, sulphur, chlorine, potassium, iron, and calcium. See A. Johnson B. Alberts, J. Lewis et al., Molecular Biology of the Cell, (New York, USA: Garland Science, 2002), http://www.ncbi.nlm.nih.gov/books/NBK26883/. Accessed, 13 December 2013.

[380] See Karafyllis in Hauser, "Sk-Interfaces : Exploding Borders, Creating Membranes in Art, Technology and Scoiety," 43.

how life, living, and body is perceived. At the same time, none are any closer to answering how *psuchê* or the ability to self-start, growth, or intellect comes to be. What we do know about *psuchê* is, what it can do.

In all the doing, that includes researching for cures or creating genetically modified unique creatures or lab specimens, thinking about life inadvertently becomes necessary part of work. This space for contemplation is created precisely because both artists working alongside scientists with organic media and molecular biologists share the surface of the image. That is, a large part of this work involves looking at monitor screens hooked up to all varieties of scanning, calculating, and measuring devices. Moreover, data converted into images is shaping what gets believed as certain. Biological matter at the abstract molecular level, through the image screen joins what cannot be seen with the seen, and, the known. Yet, there are key differences. The production of scientific knowledge is restricted by demands of reproducibility of experimental data. Stringent rules govern experiments and curtail what can qualify and is passed as scientifically valid. The problem however is that the scientific method demands its techniques, and solutions are reiterable. Biological materials at the cellular level although might be

reproducible, for instance, example of cloning of cancer cell-line HeLa is well known. Yet, in the specific nature of biology itself there is paradox. Even at the cellular level, for instance, in every case of cancer, the biological make-up of the cancer cell that causes the particular type of cancer will be different, and rather individuated. Repetition in biology is never exactly the same as inorganic matter. Alternatively, as discussed in earlier chapters, even as the material complexity of life is broken down and made comprehensible as facts, or biofacts that allow for the creation of unique species such as Alba the transgenic rabbit, and expendable genetically modified lab mice. In all instances, making unique living bodies involves both material knowledge of biology that is joined up by technological systems, and, living art objects like their lab counterparts are made up of blood, bone, flesh, and skin. Even as the simple binary that distinguishes the realm of art objects from scientific specimens dissipates, the problem is that in the making of unique and complex organisms, the arts leave the domain of purely the imaginary, and enter the world of the bloody and messy. And with the bloodiness and the messiness, comes responsibility in the real. If life and art, and, art and *techne* is the ability to think mirrored in the objects and things of the

world through the sensible, *wujud* is the ability to recognise the blood and the mess in the real.

Number Sense

The word *wujud* also translates as existential reality. In the past chapters, I used it to attend to the knotty and complex nature of ethical problems that come to surface in the acts of engineering unique organisms. Given *wujud* is finding out, the crisis of inviolability of life becomes a different kind of ethical problem. As I elaborate throughout the thesis, the fundamental problem of making new biological things is that biology aided by technology is reshaping once thought settled ontological securities. It is refashioning the ontological commitment to what characterizes something within specific parameters. The standard model for classification becomes tenuous when living things are looked at the molecular level. Art made out of organic media furthermore demonstrates that past the surface of the skin, entities that were considered fixed, pre-given, privileged, and set within the hierarchal orders of plant and animal life, have become fluid. Molecular biology in addition to the multitude of flora and fauna brings to the discussion of the living creatures, the unit of a cell. As a somewhat

shapeless, formless entity, the cell can not only be reengineered, and reconfigured, but also bits of cell can be grafted, translocated from one body type form into another. The cell stands as an entity that links all organisms from unicellular to the complex and multicellular. Similarly, the classical project rooted in empiricism becomes abstract with molecular biology. As with all types of objects that can be counted and measured, the body also can be translated into an arrangement of numbers. Examples of these numbers include the base pairs in a single DNA molecule, the number of chromosomes in a cell, sets of chromatin fibres, the lengths of the fibres and so on. Organisms are also in this manner listed on the basis of chromosome count. This is how we get to know that ferns, rats, and fish have more chromosomes than the Homo sapiens. The chemical composition written as AGTC is mathematically a set of 4 nucleobase. Moreover, all types of molecular gene content can be organised in the form of a number chart. Except, when the body becomes noted, and abstracted in an arithmetic system, in the process of abstraction as a number, it also gains all category affiliations, and genealogical characteristics of the nature of numbers. A fitting example of the appreciation of the complexity associated with thinking about numbers is quoted by Rotman at the start of his book *Ad Infinitum* that begins with the polemic by mathematician Leopold Kronecker (d.1891)

who proclaimed to provoke, "God made integers, the rest is the work of Man."[381] As Rotman explains, numbers are conceived co-joined with counting. And, scientists predominantly work on the uncritical "presumption" that numbers are "timeless", "originless" boundless and "uncreated" and therefore open and available to the prospect of infinite variations and counting systems, however.[382] When the mixing and counting substances are biological then the idea of life invention or creation takes on a whole new ambit of meaning. Biologically engineered art in the form of a transgenic rabbit is the result of abstraction of the body grouped in sets of numbers at the molecular level, scaled up Alba becomes a form that embodies two concomitant or parallel abstractions. The first abstraction termed Being belongs to the realm of the Gods of religion, and the second is mathematics. Alba is the effect of second realm of abstraction and therefore is the phenomenon of biology rendered into mathematical script mediated via the digital computer. Characterized as a process defined by operational manoeuvrability of virtual that is making environmental

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[381] Brian Rotman, *Ad Infinitum : The Ghost in Turing's Machine Taking God out of Mathematics and Putting the Body Back In : An Essay in Corporeal Semiotics* (Stanford, California: Stanford University Press, 1993).
[382] See "How Ideal Are the Reals" in *Mathematics as a Sign : Writing, Imaging, Counting*, 92.

changes in the real, like the Gods, any person who is able to exercise mathematical agency over biological substances in the twenty-first century, such the artist and his art are able re-enter the creative domain formerly restricted to the Gods alone.[383] Alain Badiou explains, "The heart of any "Aristotelian" relation to mathematics is to consider mathematics as not a thought."[384] Mathematical thoughts are possible without corresponding moorings in what is actually feasible, and Aristotelian axioms are grounded in material reality "set against the principle of maximum audaciousness" that characterizes Platonic mathematics.[385] Aristotelian positions differ in several key ways that Badiou enumerates: a, Actual infinities are doubtful, b, Delimit mathematical assertions to the remit of the possible, c, Mathematics allow multiple rational possibilities inscribed in algorithmic language, precisely, mathematics are akin to sets of rules that underwrite all that can exist and mathematics is "the general logic of what is rationally possible."[386] In the mixing of the possible existences, the ideational of Platonic mathematics substantiated as numbered forms of molecular data, make possible the audacious in

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[383] See "Making Marks on Paper" in ibid., 64-65.
[384] Badiou, *Briefings on Existence*, 101.
[385] Ibid., 103.
[386] Ibid., 102-03.

thought by the most "uncompromising mathematical machine", that is extending the limits of the thinkable, but also what is feasible and rationally possible.[387] And creativity is one of the processes that makes an appearance in the form of transgenic artworks that show that mathematics augmented by computer technology can make even unthinkable or fictive entities sensible. Perhaps this is the reason why futuristic things tend to glow in the dark, a glow that is at the same time replacing the traditional leitmotiv associated with the divine? Yet, as Rotman emphasizes, the "computer is a material machine" and argues that this fact has far reaching theoretical consequences both for mathematics and systems that use mathematics as it introduces real limits to what is possible.[388] Aristotle believed that mathematics was a distinctly ideal form of computation, "it is an art grounded in reason, though in no way does it make a dent in Being."[389] Ibn Rushd condemned the science of astronomy based on mathematical modelling because he believed computation "contains nothing existent (*lays minh sha maujud*)" and calculation does not correspond to "existence (*li-l-*

[387] Rotman, "Will the Digital Computer Transform Classical Mathematics," 1676.
[388] Ibid., 1688.
[389] Badiou, *Briefings on Existence*, 102.

wujud)."[390] From the combination of the Platonic mathematics with Aristotelian optics and geometry emerged the scientific method. The literal reading of both classical philosophy and the Qur'an contributed to the waning of Arab influence in the sciences, specifically as both systems represent an inflexible attitude to synthesis approach that is a mark of binary thinking. Two kinds of cultures emerge. One culture makes a *violent* break with the doctrine of nature and the other culture is in not allowing this intellectual synthesis to take place, represented presently by an upsurge in especially Islamic fundamentalism that equally belongs to the literalist tradition. Both these positions are the same in the sense that they represent the extreme. The question is, can computation make a dent in Being/being? Ibn 'Arabi's answer would be yes and no. For the human, and the human sciences the consequences however, mostly belong to the earthly *real*.

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[390] Saliba, *Islamic Science and the Making of the European Renaissance*, 179. Lord M Rees made a similar point at the 2011 Romanes Lecture, stating that even so it is possible to compute any "physical process", "this isn't the same as being conceptually graspable." See lecture transcription Lord M Rees, "Limits of Science," (Oxford, UK: University of Oxford, 2011), 9.

Plates

Figure 1.
Alhambra; Alcazar; cupola of the "Salon de los Ambajadores
14th century
Granada
ARTstor Collection
Photo Credit: Erich Lessing Culture and Fine Arts Archives/ART RESOURCE, N.Y.

The Artist and his Canvas Leo Villareal at Bay Bridge
Photo: Lucas Saugen

Figure 2.
Leo Villareal, 2013
The Bay Lights
25,000 LED lights
Photo: Lucas Saugen
http://blogs.kqed.org/bayareabites/files/2013/02/baylights-lucas-saugen1000.jpg
Accessed, 13 December 2013.

Photo: b.vimeocdn.com

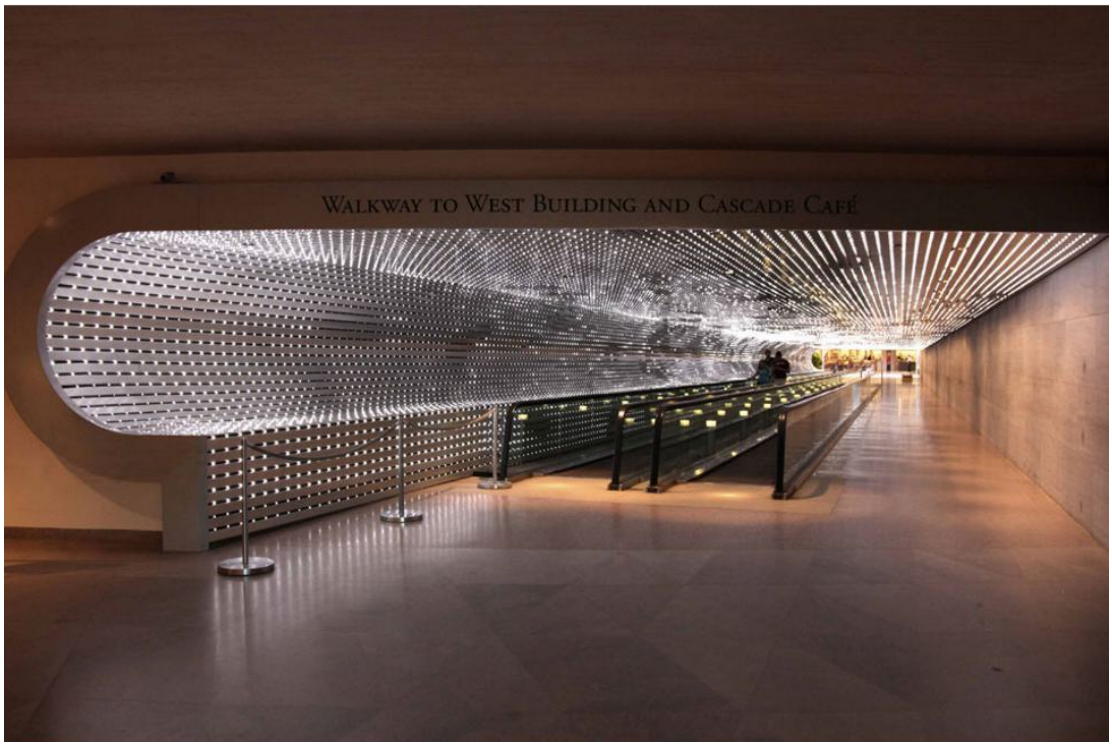


Figure 3.
Leo Villareal, 2008
Multiverse
National Gallery of Art, Washington DC
Complex light sculpture
Photo: National Gallery of Art, Washington DC
Accessed, 13 December 2013.

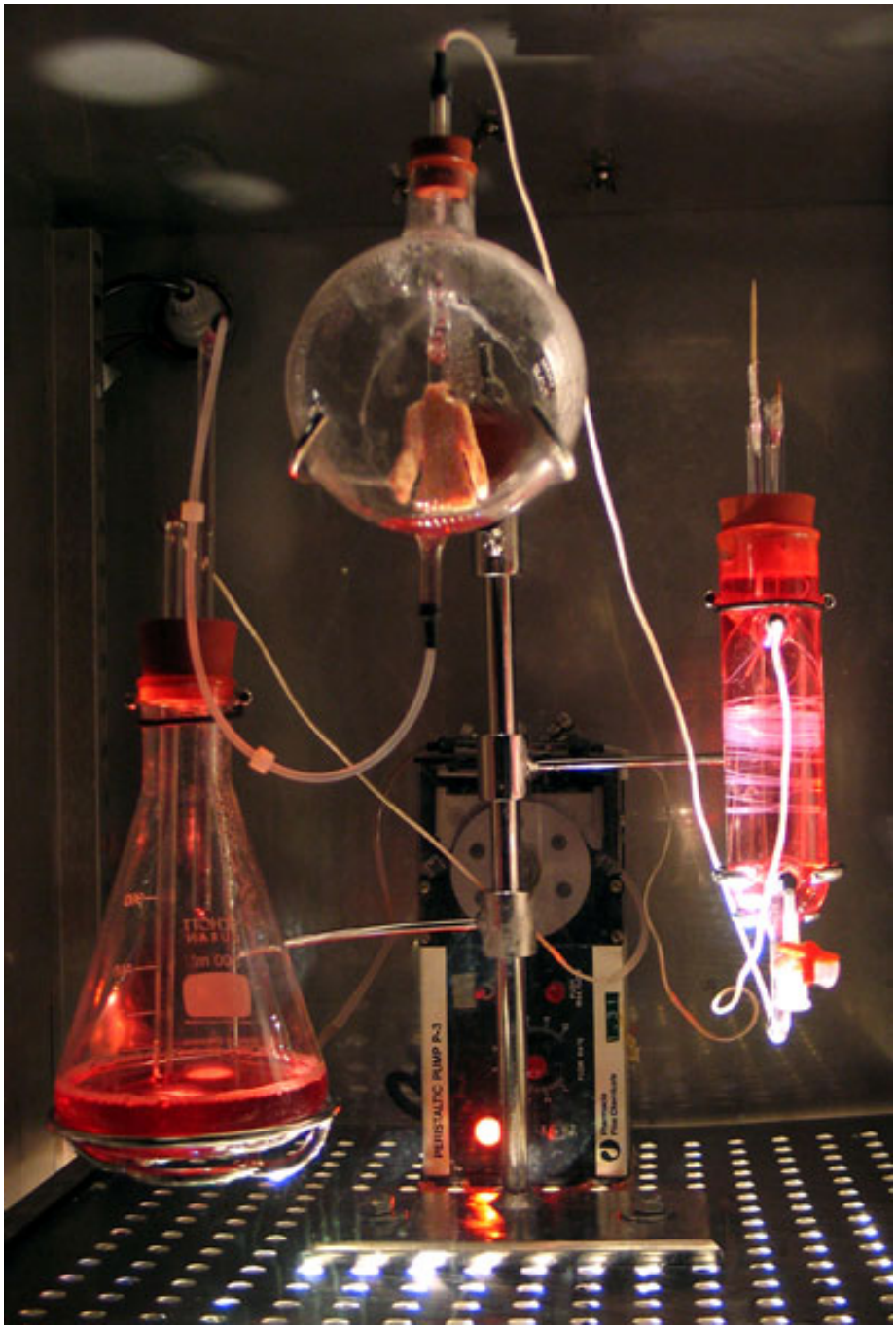


Figure 4.
Oron Catts & Ionat Zurr, 2006
Victimless Leather
Photo: http://www.tca.uwa.edu.au/vl/images.html
Accessed, 13 December 2013.

Figure 5.
Oron Catts & Ionat Zurr, 2003
Disembodied Cuisine, installation
L'Art Biotech, Nantes, France, 2003
Photo: tcaproject.org/projects/victimless/cuisine
Accessed, 13 December 2013.

Figure 6.
Andrew Krasnow, 2005
Shitkickers
Human source skin (race type White)
Photo: Urban Times
Image courtesy of the artist and GV art
http://urbantimes.co/magazine/2012/02/the-ethics-of-bioart-explored/gv-art-andrew-krasnow-shitkickers/
Accessed, 13 December 2013.

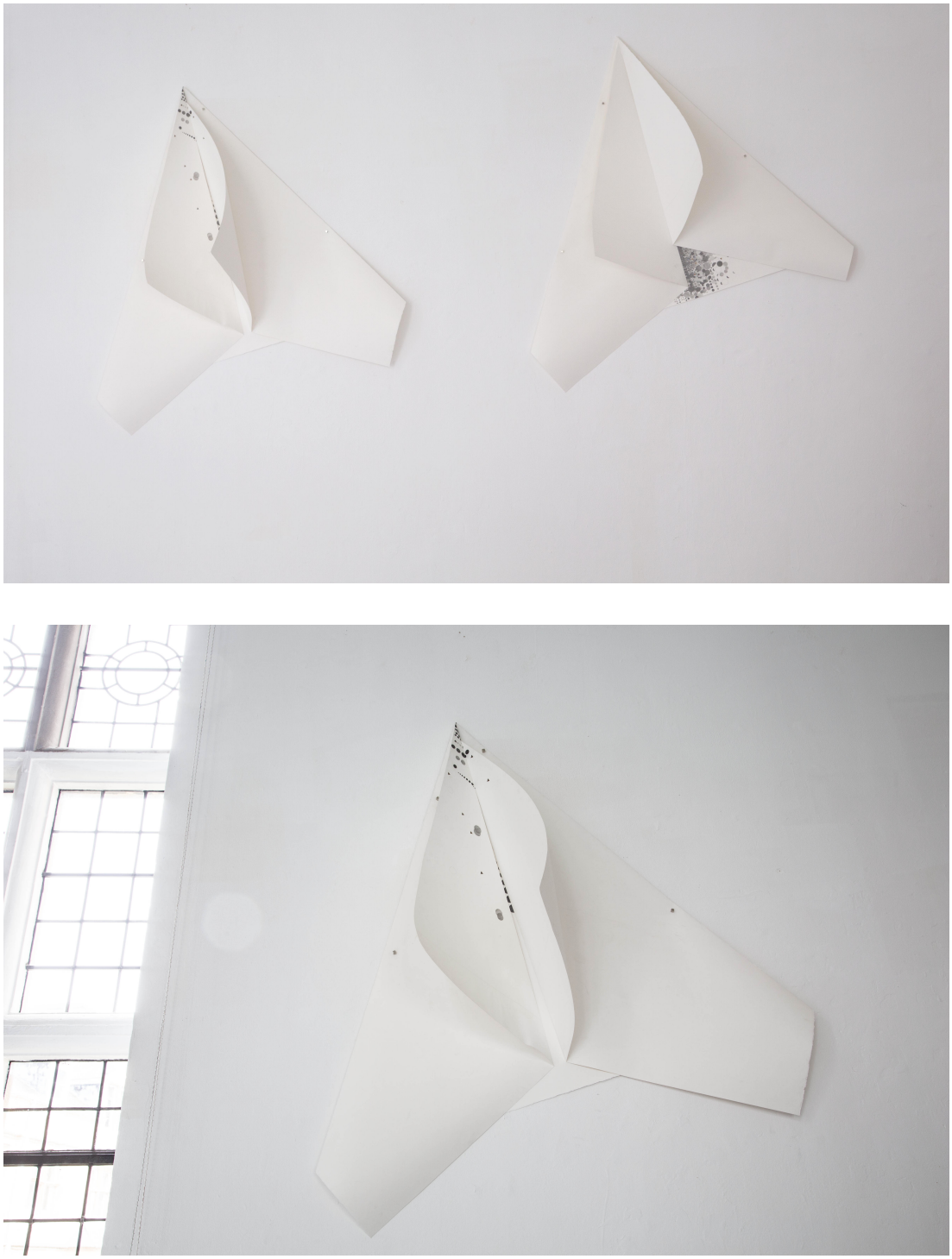
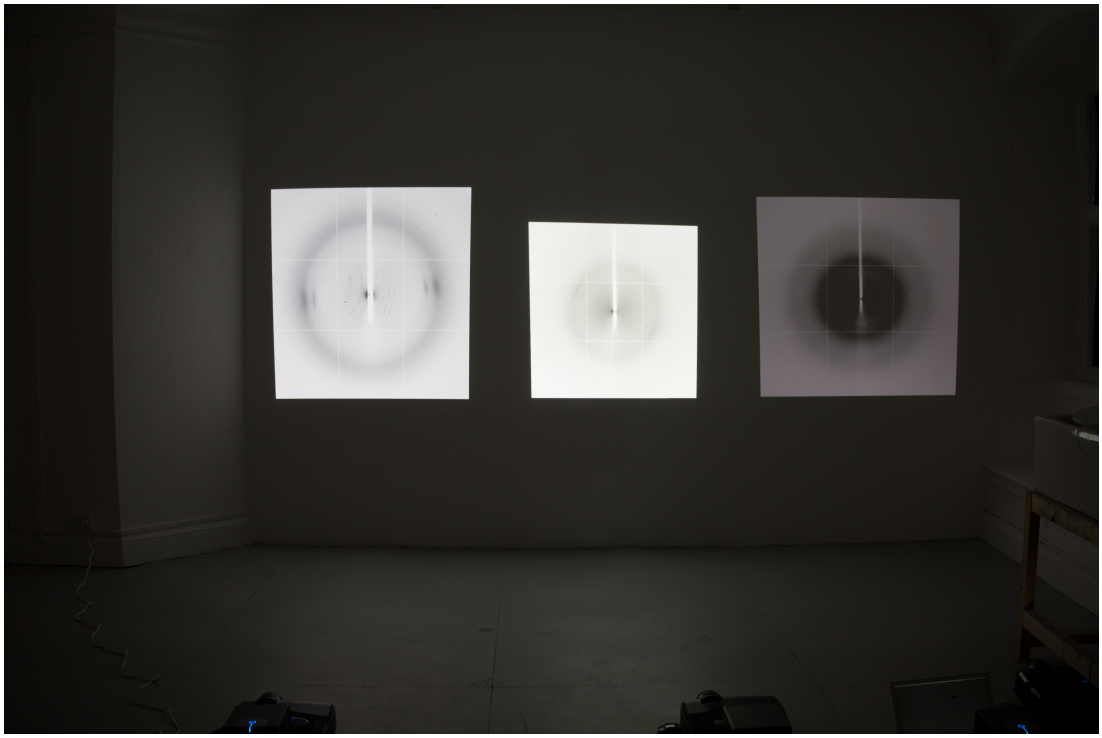


Figure 7.
Mariah Lookman, 2009-13
Molecular Warfare, 1 & 2
Graphite on paper
153 x 99 x 153
Photo: Courtesy the artist
(See footnote 138 & 204.)

Figure 8.
Mariah Lookman, 2012-13
Flies the Night Sky, 365
Folded paper
Installation size variable
Photo: Courtesy the artist
(See footnote 138.)



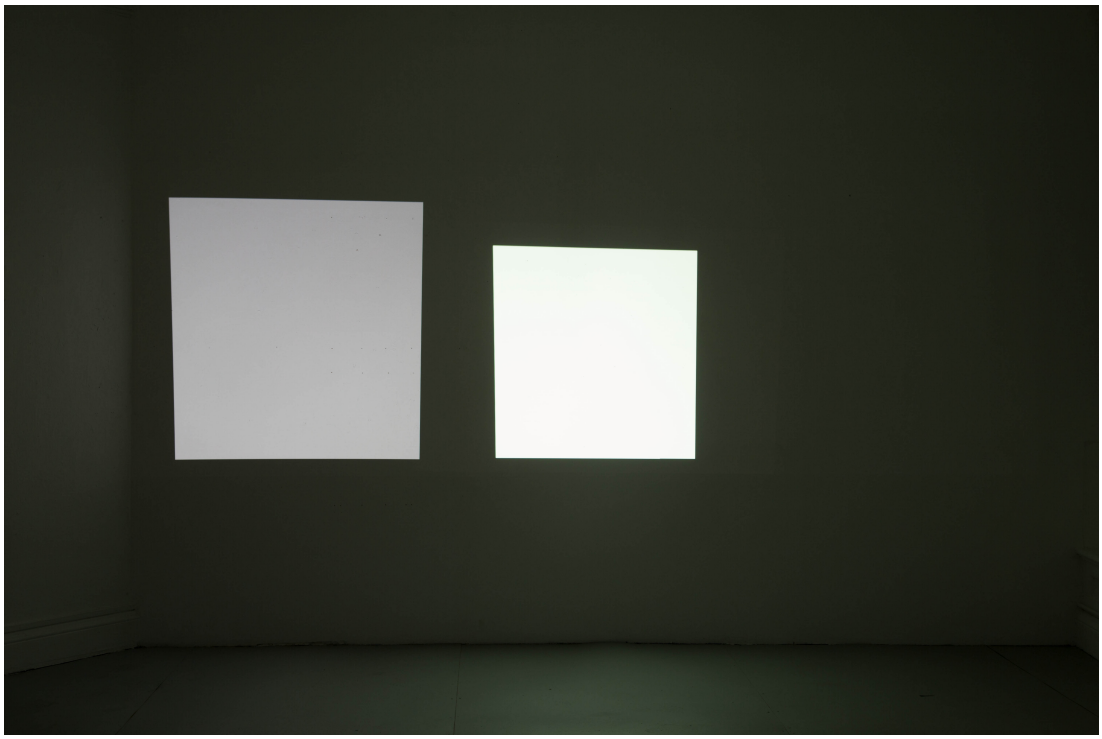


Figure 9.
Mariah Lookman, 2011-13
Dol Bel
Multiple projection digital animation and sound
10 min: 5 sec
Photo: Courtesy the artist
(See footnote 138.)

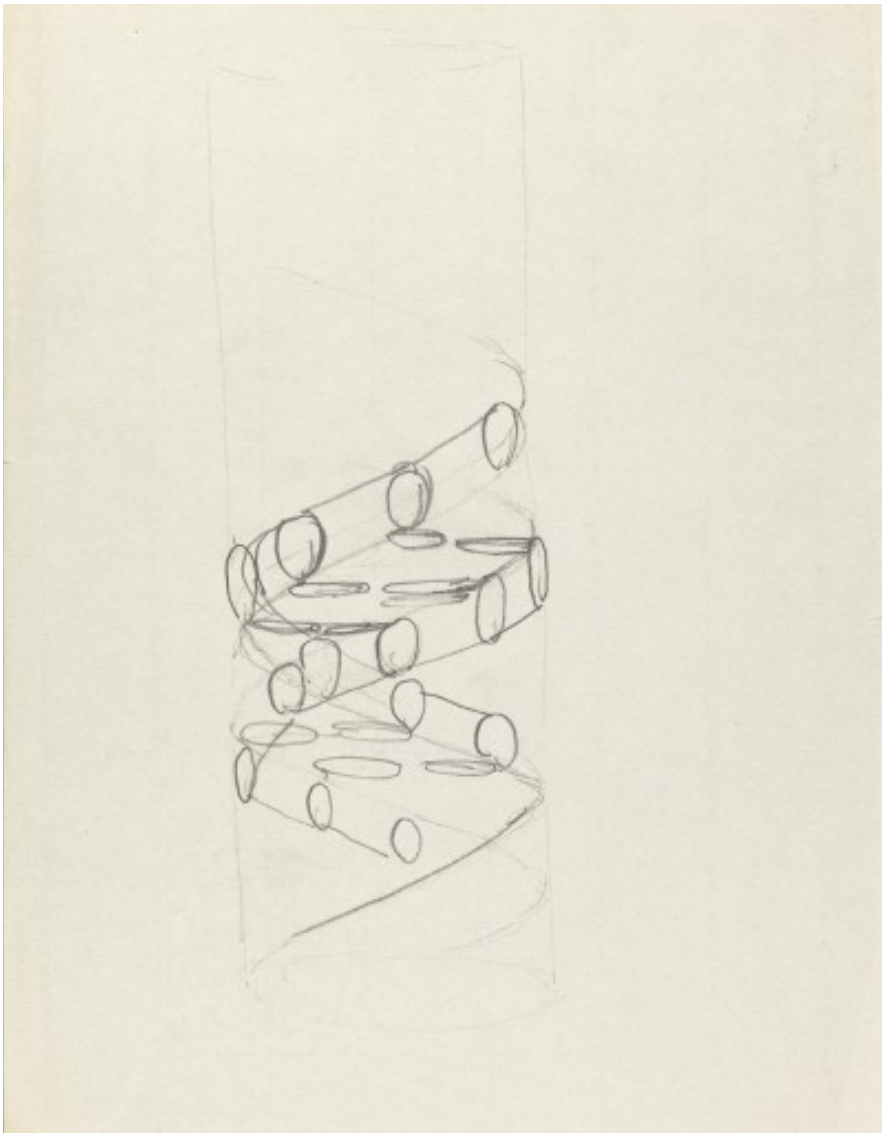


Figure 10.
Francis Crick, 1953
Illustration of the double helix that forms the structure of DNA molecule
Photo: Wellcome Library, London
Archives and Manuscripts, PP/CRI/H/1/16/1
http://wellcomeimages.org

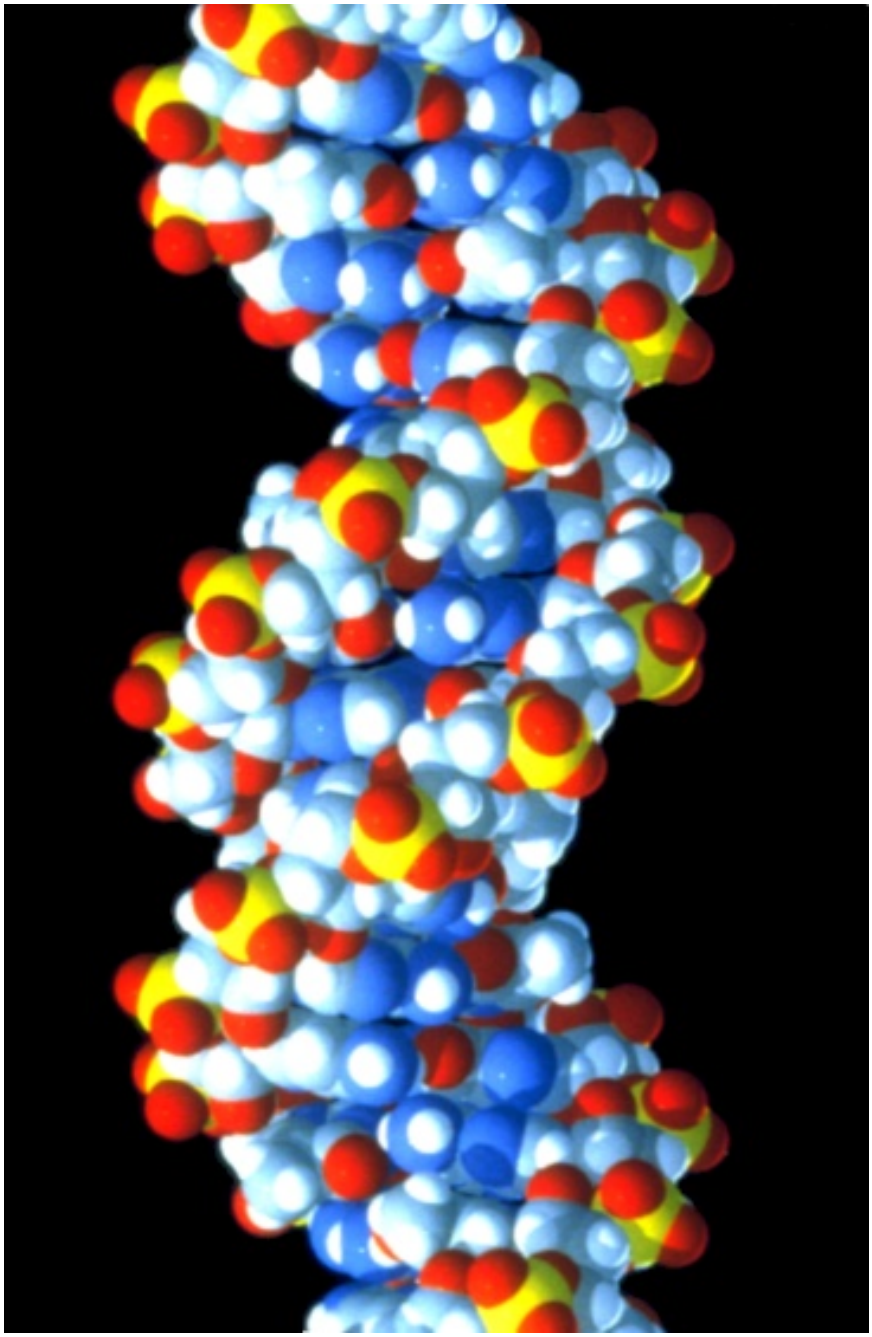


Figure 11.
DNA molecule close up, 2006
Photo: Elapided at fr.wikipedia
http://commons.wikimedia.org/wiki/File:DNA_molecule_closeup.jpg
Accessed, 13 December 2013.

Figure 12.
Eduardo Kac, 2000
Eduardo Kac and Alba, the fluorescent bunny
Photo: Chrystelle Fontaine
www.ekac.org/gfbunny.html
Accessed, 13 December 2013.

Figure 13.
Eduardo Kac, 2000
Alba, the fluorescent bunny
Photo: Chrystelle Fontaine
http://www.ekac.org/gfpbunny.html
Accessed, 13 December 2013.

Figure 14.
Eduardo Kac, 2001
Flag Alba
http://www.ekac.org/albaflag.html
Accessed, 13 December 2013.

Figure 15.
Eduardo Kac, 2001-02
FREE ALBA!
Color photographs mounted on aluminum with Plexiglas
91.4 x 118 cm, ed.5
http://www.ekac.org/nytimes_freealba.html
Accessed, 13 December 2013.

Figure 16.
Eduardo Kac, 2006
Featherless
Painted resin
25 x 6 x 4 cm, ed. 5
http://www.ekac.org/featherless.html
Accessed, 13 December 2013.

Figure 17.
Eduardo Kac, 2011
Lagoglyphs: Porcelain
15 x 15 x 4 cm, edition of 150
http://www.ekac.org/lagoglyph.porcelain.html
Accessed, 13 December 2013.

Figure 18.
Bryan Crockett, 2000
Ecce Homo
Marble, epoxy, and stainless steel
76.2 x 101.6 x 177.8 cm
Photo: Lehmann Maupin Gallery & Nature Magazine
http://www.nature.com/nrg/journal/v3/n12/fig_tab/nrg950_F5.html
Accessed, 13 December 2013.

Figure 19.
Jo Spence and Terry Dennett 1982-86
http://www.jospence.org/picture_of_health/p_o_h_4.html
Accessed, 13 December 2013.

Figure 20.
Hannah Wilke, 1992-93
Intra Venus No. 4
Diptych. 2 cibachrome photographs, edition of 3
181.6 x 120.6 cm each
Photo: Donald Goddard

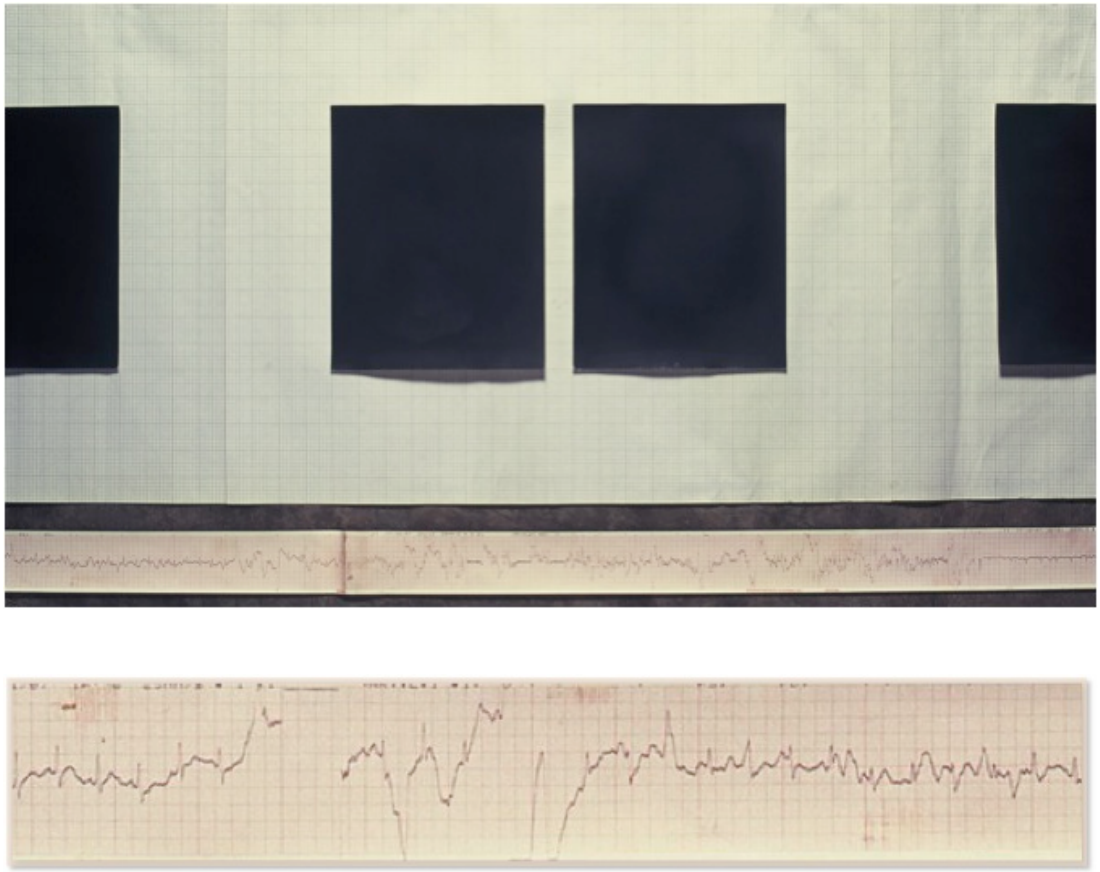


Figure 21.
Lala Rukh, 1997
Heartscape
EGC print, graph paper and photographic paper
45.72 x 487.68 cm
Photo: Courtesy the artist

Figure 22.
Mariah Lookman, 2009-13
Portrait of the Inside, 1
Graphite, pencil, and pen on paper
228 x 45 cm (approx.)
Photo: Courtesy the artist
(See footnote 204.)

Full Colour 11, Installation view

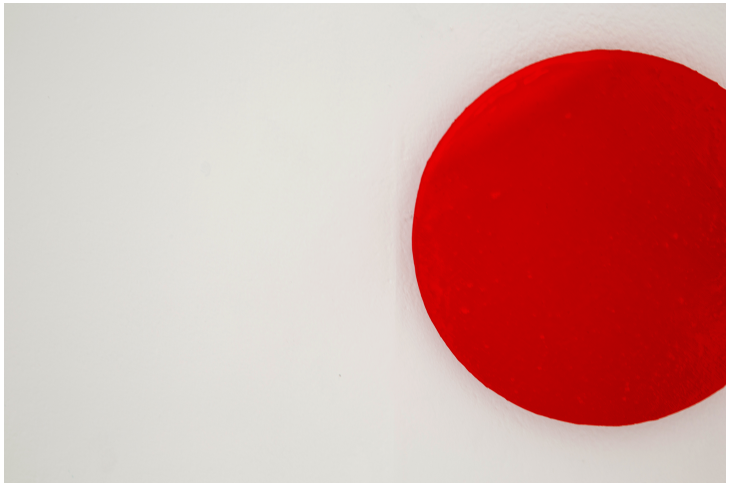


Figure 23.
Mariah Lookman, 2011
Full Colour, 11
Oil on wood
19 cm each
Photo: Courtesy the artist
(See note 302.)

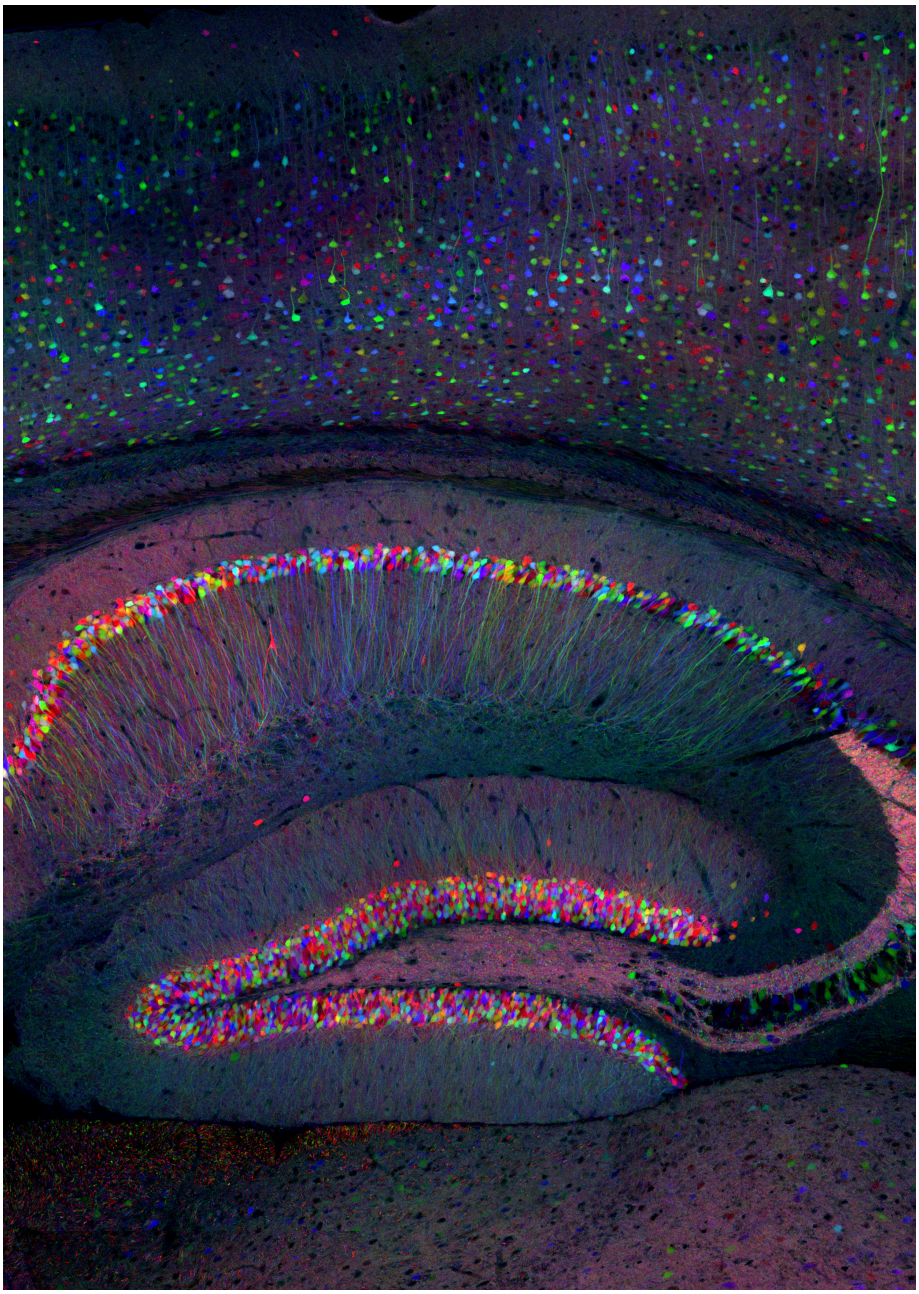


Figure 24.
Harvard Center for Brain Science, 2007
Hippocampus and Cortex
Brainbow
http://cbs.fas.harvard.edu/usr/connectome/brainbow/hippoc-cortex_less-red_final.jpg
Accessed, 13 December 2013.

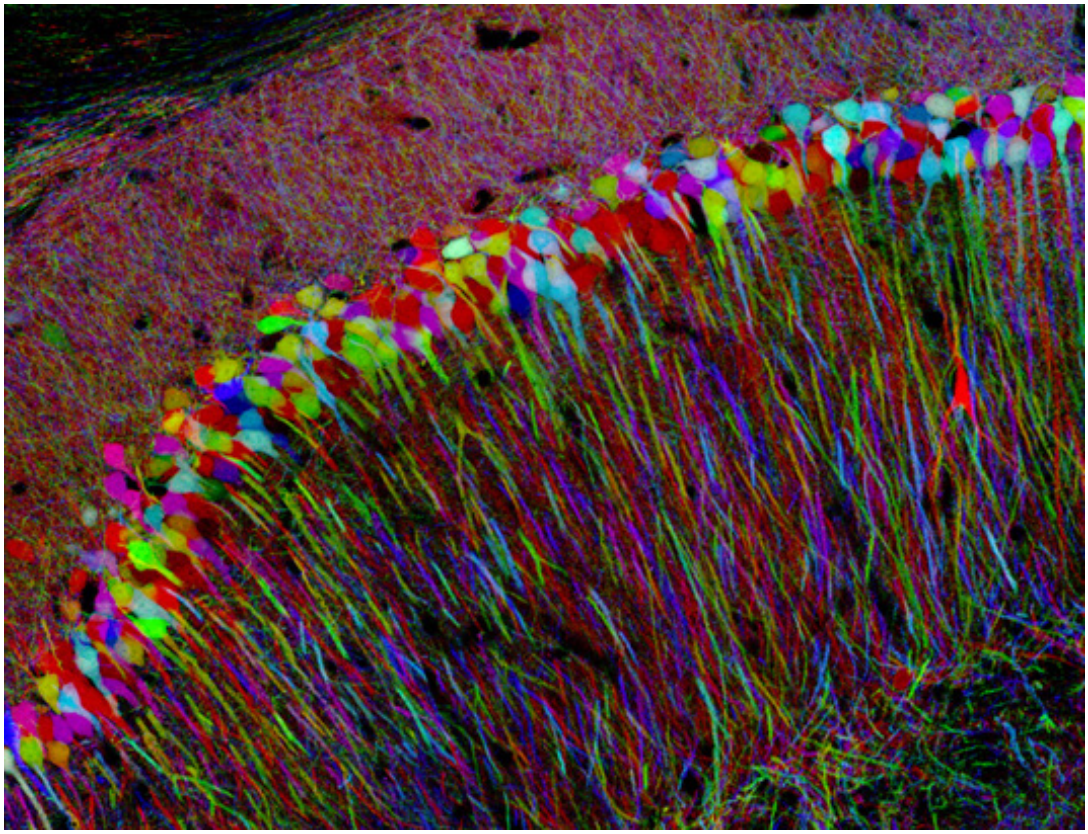


Figure 25.
Harvard Center for Brain Science, 2007
Hippocampus CA
Brainbow
http://cbs.fas.harvard.edu/usr/connectome/brainbow/brainbow2.2.jpg
Accessed 13, December 2013.

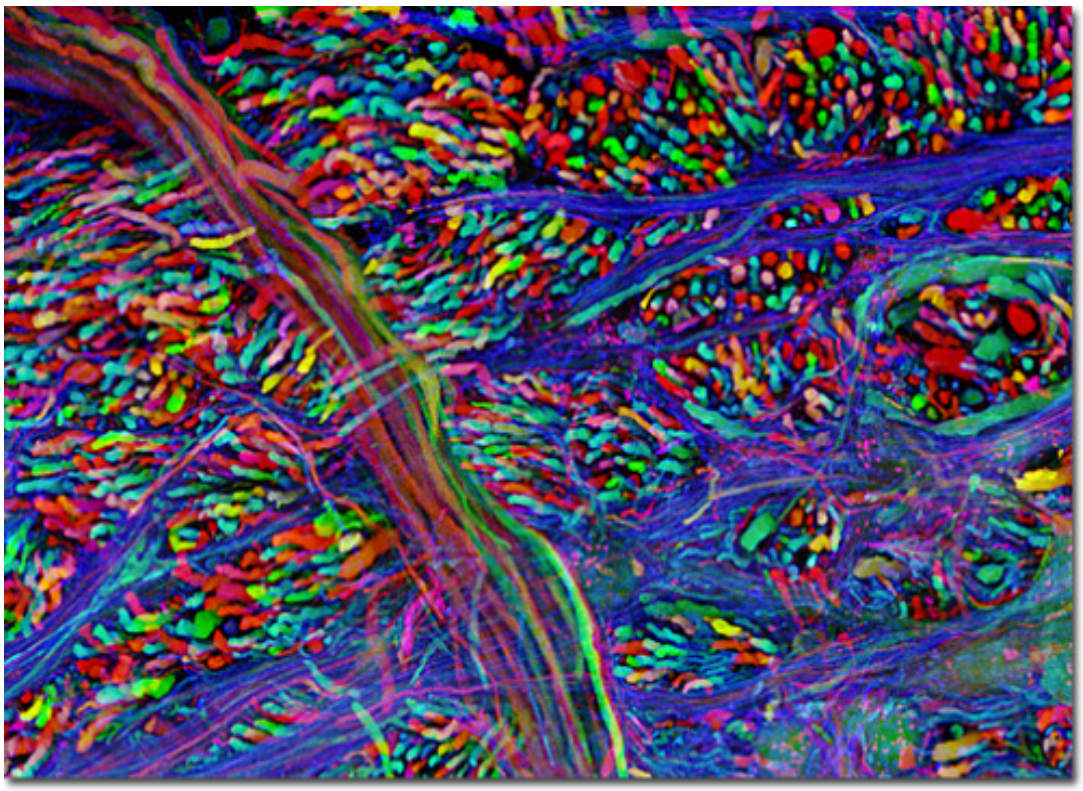


Figure 26.
Harvard Center for Brain Science, 2007
Brainstem
Brainbow
http://cbs.fas.harvard.edu/usr/connectome/brainbow/brainbow7.jpg
Accessed, 13 December 2013.

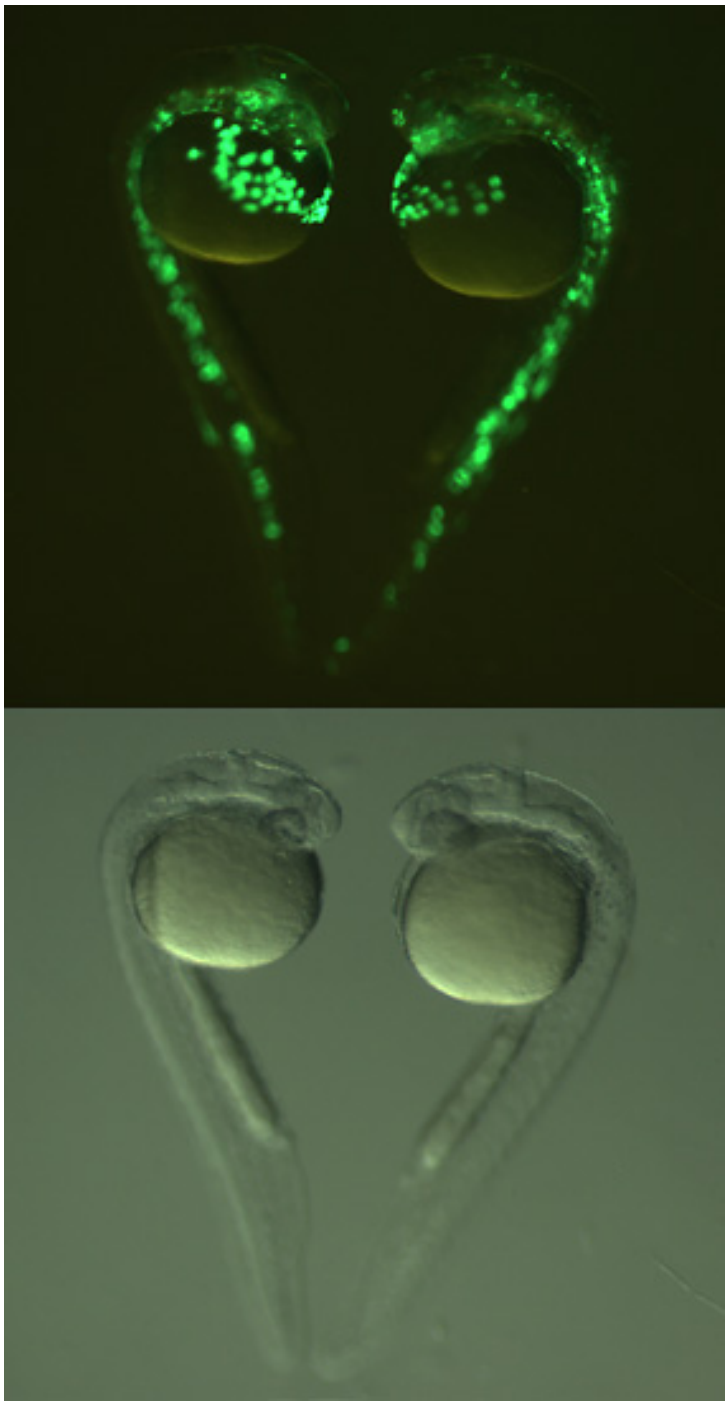


Figure 27.
Bo Xu, 2006
Green Heart
Department of Molecular Biology
Composite microscope image
Princeton Art of Science Online Gallery
http://www.princeton.edu/artofscience/gallery2006/view.php%3Fid=6.html
Accessed, 13 December 2013.

Bibliography

Addas, Claude. *The Quest for Red Sulphur : The Life of Ibn 'Arabi*. Translated by Peter Kingsley. Golden Palm Series. 1993 ed. Cambridge, UK: Islamic Texts Society, 1989. Ibn 'Arabi ou La quete du Soufre Rouge.

Akkach, Samer. "The World of Imagination in Ibn 'Arabi's Ontology." *British Journal of Middle Eastern Studies* 24, no. 1 (May 1997): 97-113.

Al-Khalili, Jim. *Pathfinders : The Golden Age of Arabic Science*. 2012 ed. London, UK: Penguin, 2010.

Al-Tawil, Hashim Mohammed. "Early Arab Icons: Literary and Archaeological Evidence for the Cult of Religious Images in Pre-Islamic Arabia." PhD dissertation, University of Iowa, 1993.

Alberti, Leon Battista. *On Painting*. Translated by Cecil Grayson. 1991 ed. London, England: Penguin Books, 1436.

———. *On Painting (1435-36)*. Translated by John R. Spencer. 1970 ed. New Haven, USA: Yale University Press, 1956.

Aristotle. *De Anima*. Translated by R. D. Hicks. Cambridge, UK: Cambridge University Press, 1907. 350 B.C.E.

B. Alberts, A. Johnson, J. Lewis et al. *Molecular Biology of the Cell*. New York, USA: Garland Science, 2002. http://www.ncbi.nlm.nih.gov/books/NBK26883/.

Badiou, Alain. *Briefings on Existence*. Translated by Norman Madarasz. Intersections: Philosophy and Critical Theory. edited by Rodolphe Gasche. 2006 ed. Albany, New York: State University of New York Press, 1998.

———. *Ethics : An Understanding of Evil*. Translated by Peter Hallward. 2002 ed. London, UK: Verso, 2001.

Ball, Philip. *Unnatural : The Heretical Idea of Making People*. London: The Bodley Head, 2011.

Bartky, Elliot. "Plato and the Politics of Aristotle's "Poetics"." *The Review of Politics, Special Sesquicentennial Issue* 54, no. 4 (Autumn 1992): 589-619.

Bashier, Salman H. *Ibn Al-'Arabi's Barzakh : The Concept of the Limit and the Relationship between God and the World*. Albany, New York: State University of New York Press, 2004.

Baudrillard, Jean. *Impossible Exchange*. Translated by Chris Turner. London, UK: Verso, 2011.

Belting, Hans. "The Double Perspective: Arab Mathematics and Renaissance Art." *Third Text* 24, no. 5 (2010): 521-27.

———. *Florence and Baghdad*. Translated by Deborah Lucas Schneider. Cambridge, Massachusetts and London, England: The Belknap Press of Havard University Press, 2011. Florenz und Baghdad : Eine westostliche Geschichte des Blicks.

———. "Perspective: Arab Mathematics and Renaissance Western Art." *European Review* 16, no. 02 (2008): 183-90.

Benjamin, Walter. *The Work of Art in the Age of Mechanical Reproduction*. Translated by J. A. Underwood. Great Ideas. 2008 ed.: Penguin, 1936.

Blumenberg, Hans. "'Imitation of Nature' : Toward a Prehistory of the Idea of the Creative Being." *Qui Parle* 12, no. 1, The End of Nature (Spring/Summer 2000): 17-54.

Borges, Jorge Luis. *The Book of Imaginary Beings*. Translated by Norman Thomas di Giovani. 2002 ed. London, UK: Vintage, 1967.
Broadie, Sarah. *Nature and Divinity in Plato's Timaeus*. Cambridge, UK: Cambridge University Press, 2012.
Bryson, Norman. *Vision and Painting : The Logic of the Gaze*. London, UK: Macmillan, 1983.
Burke, Shane. "Justifications for Patents as Applied to Human-Animal Chimeras." *European Intellectual Property Review* 34, no. 4 (2012): 237-43.
Butler, Declan. "Publication of Human Genomes Sparks Fresh Sequence Debate." *Nature*, 15 February 2001, 747-48.
Catalyst, The Arts. http://www.artscatalyst.org/about/.
Cetina, Karin Knorr. *Epistemic Cultures : How the Sicences Make Knowledge*. Cambridge Massachusetts and London, England: Harvard University Press, 1999.
Chittick, William C. *Imaginal Worlds : Ibn Al-'Arabi and the Problems of Religious Diversity*. Albany, New York: State University of New York Press, Albany, 1994.
———. "Presence with God." *Journal of the Muhyiddin Ibn 'Arabi Society* XX (1996).
Chun, Wendy Hui Kyong. *Programmed Visions*. Software Studies. edited by Lev Manovich Matthew Fuller, and Noah Wardrip-Fruin Cambridge, Massachusetts and London, England: The MIT Press, 2011.
Coghlan, Andy. "Craig Venter Close to Creating Synthetic Life." *New Scientist*, 16 March, 2013, 5.
Compier, Abdul Haq. "Rhazes in the Renaissance of Andreas Vesalius." *Medical History* 56, no. 01 (January 2012): 3-25.
Consortium, The Chimpanzee Sequencing and Analysis. "Initial Sequence of the Chimpanzee Genome and Comparison with Human Genome." *Nature*, 1 September 2005, 69-87.
Council, Science & Technology Facilities. "Large Hadron Collider." Science & Technology Facilities Council, http://www.lhc.ac.uk.
Creswell, K. A. C. "The Lawfulness of Painting in Early Islam." *Ars Islamica* 11/12 (1946): 159-66.
Crick, Francis. "DNA." In *Wellcome Archives and Manuscripts*. London, UK: Wellcome Library, 1953.
Crick, J D. Watson and F.H. "Molecular Structure of Nucleic Acids; a Structure for Deoxyribose Nucleic Acid." *Nature*, April 25, 1953, 737-8.
Descartes, Rene. *The World and Other Writings*. Translated by Stephen Gaukroger. Cambridge Texts in the History of Philosophy. edited by Karl Ameriks and Desmond M. Clarke Great Britain: Cambridge University Press, 1998. Le Monde 1664.
Elkins, James. *The Poetics of Perspective*. Ithaca, USA and London, UK: Cornell University Press, 1994.
Fakhry, Majid. *Averroes (Ibn Rushd) His Life, Works and Influence*. Oxford, England: Oneworld Pulications, 2001.
Falco, Charles M. "Ibn Al-Haytham and the Origins of Computerzied Image Analysis." *2007 International Conference on Computer Engineering & Systems* (2007): xx-xxiii.

Fayyaz Ahmed, Jeffery Wyckoff, Elaine Y. Lin, et al. "Gfp Expression in Mammary Gland for Imaging of Mammary Tumor Cells in Transgenic Mice." *Cancer Research* 62 (2002): 7166-69.

Foucault, Michel. *The Birth of Biopolitics : Lectures at the College De France 1978-79*. Translated by Graham Burchell. edited by Arnold I. Davidson. 2008 ed. Basingstoke, UK: Palgrave Macmillan, 1978-79.

———. *The Birth of the Clinic : An Archaeology of Medical Perception*. Translated by A. M. Sheridan Smith. 1994 ed. New York, USA: Vintage Books, 1973.

———. *The Order of Things : An Archaeology of the Human Sciences*. Routledge Classics. 2009 ed. London, UK and New York, USA: Routledge, 1970.

Fraassen, Bas C. van. *Scientific Representation: Paradoxes of Perspective*. Clarendon Press, Oxford: Oxford University Press, 2008.

Frangenberg, Thomas. "Perspectivist Aristotelianism: Three Case-Studies of Cinquecento Visual Theory." *Journal of the Warburg and Courtauld Institutes* 54 (1991): 137-58.

Galison, Lorraine Daston and Peter. *Objectivity*. 2010 ed. New York, USA: Zone Books, 2007. First.

Galison, Peter. "Ten Problems in History and Philosophy of Science." *Isis* 99, no. 1 (March 2008): 111-24.

Gessert, George. *Green Light : Toward and Art of Evolution*. Leonardo. edited by and Roger F. Malina Sean Cubitt Cambridge, Massachuesetts and London, England: The MIT Press, 2010.

Givens, Terryl L. "Aristotle's Critique of Mimesis: The Romantic Prelude." *Comparative Literature Studies* 28, no. 2 (1991): 121-36.

Groys, Boris. "Art in the Age of Biopolitics: From Artwork to Art Documentation." edited by Documenta 11, 108-14. Ostfildern, Ruit: Hatje Cantz, 2002.

Gutas, Dimitri. "Geometry and the Rebirth of Philosophy in Arabic with Al-Kindi." In *Islamic Medical and Scientific Tradition : Critical Concepts in Islamic Studies*, edited by Peter E. Pormann, 3-13. London, UK: Routledge, 2011.

———. "The Study of Arabic Philosophy in the Twentieth Century: An Essay on the Historiography of Arabic Philosophy." *British Society for Middle Eastern Studies* 29, no. 1 (May 2002): 5-25.

Hauser, Jens. "Biotechnology as Mediality: Strategies of Organic Media Art." *Performance Research: A Journal of the Performing Arts* 11, no. 4 (2006): 129-36.

———. "Sk-Interfaces : Exploding Borders, Creating Membranes in Art, Technology and Scoiety." edited by FACT : Liverpool. Liverpool, UK: Liverpool University Press, 2008.

Hayles, N. Katherine. *My Mother Was a Computer : Digital Subject and Literary Texts*. Chicago, USA: University of Chicago Press, 2005.

Heidegger, Martin. *On the Way to Language*. Translated by Peter D. Hertz. 1982 ed. USA: Harper San Francisco, 1971.

Helmreich, Stefan. "What Was Life? Answers from Three Limit Biologies." *Critical Inquiry* 37, no. 4 (2011): 671-96.
Hirst, Damien. "Biopsy Paintings." 2006.
———. "Cancer." Flies and resin on canvas, 2004.
Holly, Michael Ann. *Panofsky and the Foundations of Art History*. 1987 ed. Ithaca, USA and London, UK: Cornell University Press, 1984.
Huff, Toby. *The Rise of Early Modern Science: Islam, China and the West*. Cambridge, UK: Cambridge University Press, 1993.
HumanBrainProject, The. "Human Brain Project: Overview." The Human Brain Project, http://www.youtube.com/watch?v=JqMpGrM5ECo&list=UUd5sWIVavCp4hzp2mFWI2qg.
———. "Sp7: High Performance Computing." The Human Brain Project, http://www.youtube.com/watch?v=In8Qhy7_4TA&feature=c4-overview&list=UUd5sWIVavCp4hzp2mFWI2qg.
Huxley, Aldous. *Brave New World*. 2007 ed. London, UK: Vintage, 1932.
Hylton, Wil S. "God of Small Things " *The New York Times Sunday Magazine*, June 03, 2012, MM46.
Isa, Ahmad Muhammad. "Muslims and Taswir." *The Muslim World* 45, no. 3 (1955): 250-68.
Ivry, Alfred L. "The Arabic Text of Aristotle's "De Anima" and Its Translator." *Oriens* 36 (2001): 59-77.
Izutsu, Toshihiko. *Sufism and Taoism : A Comparative Study of Key Philosophical Concepts*. 1984 ed. Berkley, Los Angeles, London: University of California Press, 1983.
J. F. R. Kerr, A. H. Wyllie, and A. R. Currie. "Apoptosis: A Basic Biological Phenomenon with Wide-Ranging Implications in Tissue Kinetics." *British Journal of Cancer* 26, no. 4 (August 1972): 239-57.
Jr., Samuel Y. Edgerton. *The Renaissance Rediscovery of Linear Perspective*. New York, USA: Basic Books, 1975.
Kac, Eduardo. "Kac." http://www.ekac.org.
———. "Natural History of the Enigma." http://www.ekac.org/nat.hist.enig.html.
———, ed. *Signs of Life : Bio Art and Beyond*. edited by Roger F. Malina and Sean Cubitt, Leonardo. Cambridge, Massachusetts and London, England: The MIT Press, 2007.
———. *Telepresence and Bio Art : Networking Humans, Rabbits and Robots*. The University of Michigan Press, 2005.
Kass, Leon. "New Beginnings in Life." Chap. 1 In *The New Genetics and the Future of Man*, edited by M P Hamilton, 15-63. Grand Rapids, Michigan: W B Eerdmans, 1971.
Keller, Evelyn Fox. "Physics and the Emergence of Molecular Biology: A History of Cognitive and Political Synergy." *Journal of the History of Biology* 23, no. 3 Autumn (1990).
———. *Refiguring Life : Metaphors of Twentieth-Century Biology*. The Wellek Library Lectures at the University of California, Irwine. New York, USA: Columbia University Press, 1993.
Kemp, Martin. *Behind the Picture : Art and Evidence in the Italian Renaissance*. New Haven, USA and London, UK: Yale University Press, 1997.

———. *The Science of Art : Optical Themes in Western Art from Brunelleschi to Seurat*. New Haven, USA and London, UK: Yale University Press, 1990.
———. *Seen/Unseen : Art, Science, and Intution from Leonardo to the Hubble Telescope*. Oxford, UK and New York, USA: Oxford University Press, 2006.
Kerstin Howe, Matthew D. Clark, Carlos F. Torroja, James Torrance, Camille Berthelot, Matthieu Muffato, et al. . "The Zebrafish Reference Genome Sequence and Its Relationship to the Human Genome." *Nature*, 17 April 2013 1-6.
Kimball, John W. "Transgenic Animals." William. C. Brown, http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/W/Welcome.html.
Landau, Rom. *The Philosophy of Ibn 'Arabi*. Ethical and Religious Classics of East and West. Vol. 22, London, UK: George Allen & Unwin Ltd., 1959.
Leaman, Oliver. *Averroes and His Philosophy*. New York, USA: Oxford University Press, 1988.
Ledford, Heidi. "Life-Changing Experiments: The Biological Higgs " *Nature*, 29 March 2012, 228-30.
Lee, Keekok. *Philosophy and Revolutions in Genetics : Deep Science and Deep Technology*. Renewing Philosophy. Basingstoke UK, and New York USA.: Palgrave Macmillan, 2003.
Lindberg, David C. "Alhazen's Theory of Vision and Its Reception in the West." *Isis* 58, no. 3 (Autumn 1967): 321-41.
———. *Theories of Vision from Al-Kindi to Kepler*. 1996 ed. Chicago, USA: University of Chicago, 1976.
Marks, Laura U. *Enfoldment and Infinity : An Islamic Genealogy of New Media Art*. Leonardo. edited by Roger F. Malina and Sean Cubitt: Massachusetts Institue of Technology, 2010.
———. "Infinity and Accident: Strategies of Enfoldment in Islamic Art and Computer Art." *Leonardo* 39, no. 1 (February 2006): 37-42.
Marmura, Michael E. "Al Ghazali." Chap. 7 In *The Cambridge Companion to Arabic Philosophy*, edited by Peter Adamson and Richard C. Taylor, 134-54. Cambridge, UK: Cambridge University Press, 2004.
Mitchell, Robert. *Bioart and the Vitality of Media*. Seattle, USA: University of Washington Press, 2010.
Mitchell, W. J. T. *Picture Theory : Essays of Verbal and Visual Representation*. University of Chicago Press, 1994.
———. *What Do Pictures Want? The Live and Loves of Images*. Chicago and London: University of Chicago Press, 2005.
———. "The Work of Art in the Age of Biocybernetic Reproduction." *Modernism/modernity* 10, no. 3 (2003): 481-500.
Mukherjee, Siddhartha. *The Emperor of All Maladies : A Biography of Cancer*. London: Fourth Estate, 2011.
Musallam, Basim. "The Human Embryo in Arabic Scientific and Religious Thought." In *Islamic Medical and Scientific Tradition : Critical Concepts in Islamic Studies*, edited by Peter E. Pormann. London, UK and New York, USA: Routledge, 2011.
O'Connor, K W. "Patents for Genetically Modified Animals." *Journal of Animal Science*, no. 71(Suppl. 3) (1993): 34-40.

Omar, Saleh Beshara. *Ibn Al-Haytham's Optics : A Study of the Origins of Experimental Science*. Minneapolis, USA: Bibliotheca Islamica, 1977.
Panofsky, Erwin. *Perspective as Symbolic Form*. Translated by Christopher Wood. 1997 ed. New York, USA: Zone Books, 1927.
Perchuk, Andrew. "Hannah Wilke Ronald Feldman Fine Arts." *Art Forum*, April 1994, 93-94.
Philip, Beatriz da Costa and Kavita, ed. *Tactical Biopolitics : Art, Activism, and Technoscience*. edited by Sean Cubitt and Roger F. Malina, Leonardo Cambridge, MA, London, UK: The MIT Press, 2008.
Plato. *Timaeus*. Translated by Benjamin Jowett. 1949 ed. Indianapolis, USA: Bobbs-Merrill, 360 B.C.E.
Pollack, Andrew. "A Dream of Trees Aglow at Night." *The New York Times* May 8, 2013, B1.
The Quran. Translated by Yusaf Ali.
Rees, Lord M. "Limits of Science." Oxford, UK: University of Oxford, 2011.
Reuell, Peter. "Brainbow Version 2.0." *The Harvard Gazette* (May 15, 2013). http://news.harvard.edu/gazette/story/2013/05/brainbow-version-2-0/.
Rorty, Richard. "The Fire of Life." *Poetry Magazine*, November 2007.
Rose, Nikolas. *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Information. edited by Paul Rabinow Princeton and Oxford: Princeton University Press, 2007.
Rosenthal, Franz. "Ibn 'Arabi between "Philosophy" and "Mysticism" : "Sufism and Philosophy Are Neighbors and Visit Each Other". Fa-Inna at-Tasawwuf Wa-T-Tafalsuf Yatajawarani Wa-Yatazawarani." *Oriens* 31 (1988): 1-35.
———. *Knowledge Triumphant : The Concept of Knowledge in Medieval Islam*. Brill Classics in Islam. Boston, USA: Brill Academic Publishers, 2006.
Rotman, Brian. *Ad Infinitum : The Ghost in Turing's Machine Taking God out of Mathematics and Putting the Body Back In : An Essay in Corporeal Semiotics*. Stanford, California: Stanford University Press, 1993.
———. *Becoming Besides Ourselves : The Alphabet, Ghosts, and Distributed Human Being*. Durham and London: Duke University Press, 2008.
———. *Mathematics as a Sign : Writing, Imaging, Counting*. Stanford, California: Stanford University Press, 2000.
———. *Signifying Nothing : The Semiotics of Zero*. New York, USA: St Martin's Press, 1987.
———. "Will the Digital Computer Transform Classical Mathematics." *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 361, no. 1809, Information, Knowledge and Technology (2003): 1675-90.
S. Bowers, A. P. Truong, R. Jeffery Neitz et al. "Design and Synthesis of Brain Penetrant Selective Jnk Inhibitors with Improved Pharmacokinetic Properties for the Prevention of Neurodegeneration." *The RSCB Protein Data Bank* (2011).

doi:10.2210/pdb3rtp/pdb, http://www.rcsb.org/pdb/explore/jmol.do?structureId=3RTP&bionumber=1.

Sabra, A I. *Optics, Astronomy and Logic : Studies in Arabic Science and Philosophy*. Aldershot, UK, Brookfield, USA: Variorum, 1994.

Sabra, A. I. "The Andalusian Revolt against Ptolemaic Astronomy: Averroes and Al-Bitruji." Chap. 7 In *Transformation and Tradition in the Sciences : Essay in Honor of I. Bernard Cohen*, edited by Evertt Mendelsohn, 133-53. Cambridge, UK: Cambridge University Press, 1984.

———. *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*. Translated by A. I. Sabra. Studies of the Warburg Institute. edited by J. B. TrappII vols. Vol. I: Translation, London, UK: The Warburg Institute, University of London, 1989.

———. *The Optics of Ibn Al-Haytham Books I-Iii : On Direct Vision*. Translated by A. I. Sabra. Studies of the Warburg Institute. edited by J. B. TrappII vols. Vol. II: Introduction, Commentary, Glossaries, Concordance, Indices, London, UK: Warburg Institute, University of London, 1989.

———. "Situating Arabic Science: Locality Versus Essence." *Isis* 87, no. 4 (December 1996): 654-70.

Saliba, George. *Islamic Science and the Making of the European Renaissance*. Cambridge, MA, London, UK: The MIT Press, 2007.

Schmitt, Carl. *Political Theology: Four Chapters on the Concept of Sovereignty*. Studies in Contemporary German Social Thought. edited by Thomas McCarthy Cambridge, Massachusetts, and London, England: The MIT Press, 1985.

Schrodinger, Erwin. *What Is Life? : The Physical Aspect of the Living Cell*. Cambridge, UK: Cambridge University Press, 1944.

Sells, Michael. "Ibn 'Arabi's Polished Mirror: Perspective Shift and Meaning Event." *Studia Islamica* 67 (1988): 121-49.

Sherlock, Amy. "Jo Spence: Space & Studio Voltaire." *Frieze*, September 2012.

Sinisgalli, Leon Battista Alberti and Rocco. *Leon Battista Alberti: On Painting : A New Translation and Critical Edition*. Translated by Rocco Sinisgalli. Cambridge, England: Cambridge University Press, 2011. doi:http://dx.doi.org/10.1017/CBO9780511782190.004.

Smith, A . Mark. *Alhacen's Theory of Visual Perception: A Critical Edition, with English Translation and Commentary, of the First Three Books of Alhacen's "De Aspectibus", the Medieval Latin Version of Ibn Al-Haytham's "Kitab Al-Manazir": Volume One*. Transactions of the American Philosophical Society, New Series. Vol. 91, Philadelphia, USA: American Philosophical Society, 2001.

Snow, C. P. *The Two Cultures*. 1998 ed. Cambridge, UK: Cambridge University Press, 1959.

Sontag, Susan. *Illness as Metaphor*. Toronto: McGraw-Hill Ryerson Ltd., 1978.

SPACE, London, and Studio Voltaire, London. "Jo Spence: Work (Part I & Ii)." In *Jo Spence Memorial Archive, London*, edited by

SPACE and Studio Voltaire. London, UK: Camden Press, London, 2012.
Stacey, Jackie. *Teratologies : A Cultural Study of Cancer*. London, UK: Routledge, 1997.
Staley, Kevin. "Al-Kindi on Creation : Aristotle's Challenge to Islam." *Journal of the History of Ideas* 50, no. 3 (Jul.-Sep., 1989): 355-70.
Taylor, Peter Adamson and Richard C., ed. *The Cambridge Companion to Arabic Philosophy*. Cambridge, UK: Cambridge University Press, 2004.
Thacker, Eugene. *After Life*. Chicago, USA and London, UK: The University of Chicago Press, 2010.
———. *Biomedia*. Electronic Mediations. edited by Mark Poster Katherine Hayles, and Samuel Weber. Vol. 11, Minnesota, USA: University of Minnesota Press, 2004.
———. *The Global Genome : Biotechnology, Politics, and Culture*. Leonardo. edited by Sean Cubitt and Roger F. Malina Cambridge, MA, and London, UK: The MIT Press, 2006.
———. *The Global Genome: Biotechnology, Politics, and Culture*. Cambridge, Massachusetts and London, England: The MIT Press, 2005.
Vasiliev, A. A. "The Iconoclastic Edict of the Caliph Yazid Ii, A. D. 721." *Dumbarton Oaks* 9/10 (1956): 23-47.
Viewpoint. "The Human Genome : Science Genome Map." *Science* 291, no. 5507 (16 February 2001): 1218.
Vine, Richard. "Review of Exhibition Hannah Wilke at Ronald Feldman." *Art in America*, May 1994.
White, John. *The Birth and Rebirth of Pictorial Space*. London, UK: Faber and Faber, 1957.
Wolfson, Harry A. "The Twice-Revealed Averroes." *Speculum* 36, no. 3 (July 1961): 373-92.
Wood, Christopher S. "Art History Reviewed Vi: E. H. Gombrich's 'Art and Illusion: A Study in the Psychology of Pictorial Representation', 1960." *The Burlington Magazine* CLI, no. December (2009): 836-39.
Xu, Bo. "Green Heart." Princeton University, http://www.princeton.edu/artofscience/gallery2006/view.php%3Fid=6.html.
Zylinska, Joanna. *Bioethics in the Age of New Media*. Cambridge, Massachusetts and London, England: The MIT Press, 2009.