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Rupkatha Journal on Interdisciplinary Studies in Humanities

Aims

The Rupkatha Journal on Interdisciplinary Studies in Humanities (ISSN 0975-2935) derives its name from 'rup' (form) and 'katha' (words), which, when combined, mean 'myth' in Bengali. The journal gets its inspiration from the etymology and follows the principle that anything which has a form, visual, aural or mental could be studied from interdisciplinary perspectives. The journal seeks to promote criticism of emerging literature, innovation and art. One of its basic objectives is to promote interdisciplinary research for the study of the human condition, culture and the elimination of discrimination in a globally connected world.

- Aesthetic Studies: critical discussion, case study, computational analysis
- Animal Studies: Ethics, Aesthetics, Sports, Civilization and Biodiversity
- Cultural Studies, Critical Religion
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- Emerging Critical Theories involving Interdisciplinary Studies
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- Sci-Fi: the aesthetics of science, the science of aesthetics
- Scentific Philosophy: Artificial Intelligence, Biology, Economics, Neuroscience, and Psychology
- World History of Literature and Art
- World literatures and indigenous studies

Scope

The fundamental idea for interdisciplinarity derives from an evolutionary necessity; namely the need to confront and interpret complex systems. An entity that is studied can no longer be analyzed in terms of its singular objectivity but as a contending hierarchy of discourses emerging from multiple or variable branches of knowledge. We encourage authors to engage in inter political and intercultural discussion involving interdisciplinary perspectives from areas within and beyond humanities and the humanist sciences, wherever applicable. Authors must be first sure of the high value of their papers in their comparison to international standards and then submit their papers. Submission areas include but are not limited to the following.

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Paradise Lost and the Dream of Other Worlds

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ABSTRACT

The doctrine of plural worlds is an ancient concept which received a new lease on life as a result of developments in astronomy in the sixteenth century. In his epic Paradise Lost, John Milton repeatedly references this idea. Milton uses the concept of plural worlds in two distinct forms: at the literal level, he invokes the possibility of plural worlds within the created universe of the poem, and on a more metaphorical level, he invokes the possibility of the existence of several distinct but overlapping worlds. This paper seeks to consider how and why Milton uses this idea in the ways he does.

[**Keywords:** Milton, Paradise Lost, Galileo, Bruno, astronomy]

Paradise Lost is a poem about the fall, but in it, Milton puts a surprising amount of astronomical detail, and the Miltonic universe is worked out with painstaking precision. When Satan finally emerges from the welter of chaos he beholds heaven, and 'fast by hanging in a golden chain / This pendant world' (PL.II.1051-52). We tend to forget that by world here Milton does not mean the earth, or even the solar system, but rather the entire created universe. Indeed in Paradise Lost, 'world' is never synonymous with 'earth' (Gilbert 444). Satan, having with wandering feet and indefatigable wings arrived at his intended destination of the new world must now penetrate this world from the outside. There is a word in Gnosticism for the far-journeying stranger who comes to earth: allogenes he is called, the 'other-born' (Nuttall 93). Satan, thus, can be said to traverse worlds, and he traverses them not only when the word is used in the astronomical sense of a celestial body possibly capable of supporting life, but also in the more general sense of an independent, completely identifiable sphere of existence with all that pertains to it. This paper proposes to discuss the various worlds—literal and conceptual—that the arch-fiend traverses over the course of the poem.

Astronomy, as a science, had attained a paradigmatic structure way back in classical times, but was in the sixteenth and seventeenth centuries in a state of acute crisis (Kuhn 67-69). Milton lived and worked in this time of extraordinary science, and this is reflected in his poem. His universe is a completely imaginary and completely imagined construct with no direct parallel amongst the various hypotheses about the structure of the universe that were being bandied about in his day. Rather, it is a patchwork of various systems and concepts that Milton knits together as he feels will best serve his purpose. In this

paper, I would like to focus on one concept in particular: the theory of the plurality of worlds. The idea is an ancient one: it had been discussed by the ancient Greeks, who appear to have believed that there is a successive or coexistent infinity of world-universes, and achieved notable importance before being rejected by Plato and vehemently denied by Aristotle. Eusebius, Hippolytus and Theodoret all condemned the doctrine, and Saint Augustine denied it in his City of God before placing it in his book of heresies, as did Saint Isidore of Seville in the seventh century. In 1277, however, Stephen Tempier, Bishop of Paris, officially condemned the proposition that God (prima causa) is unable to create a plurality of worlds. Most discussions in the succeeding centuries focused on the question of whether it was possible for God to create more than one world, not whether more than one world had been created or existed. By the sixteenth century, the general doctrine had expanded to include a composite of Grecian and medieval beliefs. At this time it came to be closely associated with the Copernican helio-centric hypothesis (McColley, "Astronomy of 'Paradise Lost'", 238-43). To understand how and why this happened, we must turn our attention to Galileo, the only contemporary Milton saw fit to name in his poem:

> From hence, no cloud, or, to obstruct his sight,
> Star interposed, however small he sees,
> Not unconform to other shining globes,
> Earth and the garden of God, with cedars crowned
> Above all hills. As when by night the glass
> Of Galileo, less assured, observes
> Imagined lands and regions on the moon:
>
> (PL.V.257-63)

The simile likens the angel(Raphael) observing the earth to Galileo observing the moon through his telescope, but it also specifies a crucial difference between the two: Raphael is sure of the veracity of what he sees, but Galileo 'less assured' imagines 'lands and regions' on the moon. The above is the only occasion where Milton invokes Galileo by name, but it shares in common with the other allusions the reference to the telescope. Whenever Galileo is referred to in the poem he is imagined to be looking through a telescope at some celestial object: on this occasion, he is looking at the moon. What interests me at this instance is what Milton imagines him seeing on the moon—'imagined lands and regions', says Milton, and so recalls his first reference to Galileo, which came in Book I. Satan's shield, we are told,

> Hung on his shoulders like the moon, whose orb
> Through optic glass the Tuscan artist views
> At evening from the top of Fesole,
> Or in Valdarno, to descry new lands
> Rivers or mountains in her spotty globe.

(PL.I.287-91)

There is no doubt that the unnamed astronomer here is Galileo, and the moon he is said to view is, by and large, like the moon Galileo claimed to have seen through the telescope in his Sidereus nuncius (The Starry Messenger), which was published in 1610 and which Milton may well have read. In the literary tradition, the moon was usually depicted as a perfect orb, the cosmological point at which mutability gives way to eternity. Milton invokes the perfect moon elsewhere in Paradise Lost, but this moon— the one Galileo is viewing through his telescope—is far from perfect. It is 'spotty', and if it reflects the earth, it answers stain for stain. My interest, however, is in the intention Milton imagines for the astronomer, who is attempting to 'descry new lands / Rivers or mountains' on the lunar surface. In Sidereus nuncius Galileo had described and pictured the surface of the moon as he saw it through his telescope. Though his telescope was weak by modern standards, it nevertheless allowed him a clear picture of the hills and troughs on the surface of the moon. When making these findings public, he also noted that the moon shone because the earth reflected the light from the sun on to it (Debus 96). Coupled with the Copernican hypothesis, which had displaced the earth from the centre of the universe to being just one of the planets (literally 'a wanderer') while putting the sun in the middle, these pronouncements gave powerful impetus to speculations about the possibility the existence of plural worlds.

The Copernican system had come to be associated with the idea of an infinite universe because of the problem of stellar parallax. If the earth revolved around the sun annually, the argument ran, an observer on earth should experience a measurable shift in his view of any given star. However no such angular variation could be detected, which suggested one of two possibilities: either that the earth was in fact stationary; or that the universe was vastly larger than had hitherto been assumed. Acceptance of the Copernican hypothesis thus came to imply taking a stand on the size of the universe as well (Debus 84-89). Grant McColley has argued that the idea of an infinite universe is to be found in Copernicus's De revolutionibus orbium coelestium (On the Revolutions of the Heavenly Spheres; 1543) itself, pointing out that Copernicus, after having by a combination of means (using dialectic, an accepted axiom of physics, and citing Ptolemy) established that what is infinite cannot move, stated that the sphere of the fixed stars which contains itself and all is for that reason immobile—leaving his readers to deduce from this the obvious: that the sphere of the fixed stars is therefore of an infinite, or at all events indefinite (a word he also uses), magnitude ("Copernicus", 525-33).

However, whether Copernicus so asserted the infinitude of the universe or not is of little moment, because there is no doubt that a number of well-informed, well-respected and well-read astronomical writers came to associate the idea of an infinite universe with the Copernican hypothesis. The earliest of these was Thomas Digges, who in 1576 appended to a new edition of his father Leonard's perpetual

almanac (A Prognostication Everlasting) his A Perfit Description of the Celestiall Orbes, according to the most aunciente doctrine of the Pythagoreans, latelye revived by Copernicus and by Geometricall Demonstrations approved, which was largely a loose translation of Copernicus's De revolutionibus, and which presents, by diagram and by text, the infinite heavens and a finite interior concavity of the solar system (Debus 87-89). Kepler, in his De stella nova in pede serpentarii (On the New Star at the Foot of Ophuicus; 1606), objects to the idea of the 'fixarum infinitate' on the grounds that it leads to unexpected and unfortunate consequences, and blames its appearance and continuance on the axiom that what is infinite cannot be moved. He then states that Copernicus's eighth sphere in De revolutionibus is infinite, saying that this came about because Aristotle demonstrated that the world was infinite through motion, and Copernicus by removing motion ended up conveying upon the eighth sphere infinitude. And in 1651, in his Almagestum novum, Giovanni Riccioli proposes to refute the arguments in favour of the infinite universe which he finds in the works of Copernicus and his followers (McColley, "Copernicus", 529-30). Thus, we find the association of the Copernican heliostatic system with an infinite universe well entrenched by the time of Milton. Meanwhile, popular encyclopaedic works such as John Swan's Speculum mundi, which was first published in 1635 and reprinted several times during the course of the century, kept the concept of plural world-systems alive in the popular imagination.

Giordano Bruno was the first to associate an infinite universe with the doctrine of plural worlds. Indeed, when he was burned at stake as a heretic in Rome in 1600, one of the charges leveled against him was his claims about the existence of a plurality of worlds and their eternity. Bruno had, earlier in his life, traveled to England, where he met Philip Sidney, lectured at Oxford and completed work on his treatise De l'Infinito Universo et Mondi (On the Infinite Universe and Worlds; 1584). Bruno was before Milton's time, but it is not inconceivable that the latter may have heard of him, and particularly of his demise. Bruno's association of the Copernican system with a plurality of worlds soon acquired apparent astronomical authority in the eyes at least of laymen with the publication of Galileo's Sidereus nuncius, where he pointed out the similarity between the earth's surface and the lunar surface as he had observed it, and also stated his belief that the earth reflected the light of the sun onto the moon. If the moon was like the earth, and if the earth, as per Galileo's statements in his booklet as well as Kepler's preface in his reprint of the same, moved through space and was a bright shining object, then it seemed to the general public that the earth was not much different from the other planets and stars after all. And if the earth was inhabited, why might not other planets be?

The literature of the age reflects these astronomical conceptions and confusions, and frequently we find the association of the heliocentric system with the doctrine of plural worlds. Sometimes the possible inhabitants of these other worlds are also imagined. Years before Bruno, Ariosto had already located a

Fool's Paradise on the moon in Orlando Furioso. John Donne, in Ignatius His Conclave, suggests, after referring to Galileo's observations, that the Jesuits are the proper people to colonise the moon. In his An Anatomie of the World: The First Anniversary he grumbles about the 'new Philosophy' which 'calls all in doubt'(205), and links the heliocentric hypothesis with the doctrine of plural worlds while indirectly attacking it. Michael Drayton writes a satire entitled The Man in the Moone, while Ben Jonson in News from the New World attacks the telescope before following up with satiric references to the idea of life on the moon. Robert Burton in his Anatomy of Melancholy discusses the Copernican theory and its implications at length and in such terms that his readers may well have understood the plurality of world systems to be a part of the former hypothesis, rather than just an incidental addendum. And even Kepler writes an early science-fiction story called Somnium, about a voyage to the moon, in which he imagines that on the moon, earthset looks like a mountain on fire. The idea also pops up in more specialized texts: in his Platonick Song of the Soul Henry More moved definitely from the simple Copernican theory to the idea of an infinite number of inhabited worlds (McColley, "Theory of Plurality", 319-325).

Milton was likely familiar with works, by John Wilkins and Alexander Ross, that defended and attacked the idea of plural worlds respectively (McColley, "Dialogue on Astronomy", 728-62). In his The Discovery of a World in the Moone (1638), John Wilkins argued that the moon was a body very much like the earth and that it was therefore likely to be inhabited. Speculating about the moon allows Wilkins to imagine the earth itself as it would appear from the moon. Milton's Raphael does much the same in Book VIII, when he asks Adam to imagine that the earth

> To the terrestrial moon be as a star
> Enlightening her by day, as she by night
> This earth? Reciprocal, if land be there,
> Fields and inhabitants:
>
> (PL.VIII.142-45)

For Wilkins the possibility of a lunar world opens up imaginative prospects hitherto undreamed of. Raphael, immediately after postulating the possibility of lunar civilization, proceeds to discuss the idea of plural worlds:

> …and other suns perhaps
> With their attendant moons thou wilt descry
> Communicating male and female light,
> Which two great sexes animate the world,
> Stored in each orb perhaps with some that live.
>
> (PL.VIII.148-52)

Raphael, of course, neither confirms nor denies the existence of either lunar life or multiple worlds, and his cosmological account is ultimately an imaginative tour de force designed to show Adam that it doesn't matter what happens in other worlds. 'Dream not of other worlds' (PL.VIII.175), says the angel, because what matters is what happens here: 'be lowly wise: / Think only what concerns thee and thy being' (PL.VIII.173-74).

The principal religious objection to the idea of multiple worlds stemmed from the challenge it posed to scriptural accounts of the creation. Wilkins attempted to reconcile this difficulty by distinguishing between two senses of the word 'world', which, according to him, could mean in a general sense the whole universe, or an inferior elemental body of matter. He suggested that many worlds in the second sense might be considered to exist within one world in the first sense (Dodds 168-70). Paradise Lost equivocates in a similar fashion when it accommodates the idea of infinite space within the confines of what appears to be a finite Ptolemaic universe. Catholic and Protestant theologians alike disliked the idea of plural worlds, not only because of the challenge it posed to scripture, but also because it was a singularly difficult idea for them to refute. Being almighty, God could certainly have created a plurality of worlds had He wished. And since God's ways are, by definition, beyond human ken, inscrutable and unknowable, it is conceivable that God had in fact created multiple worlds. The existence of plural worlds, therefore, was a highly contentious issue, and as an idea could prove to be disturbing, or imaginatively enabling. For Wilkins, it was obviously the latter. Alexander Ross, in The New Planet No Planet, or the Earth No Wandering Star, except in the Wandering Heads of Galileans (1646), makes it very clear that he finds the hierarchical disruption that would inevitably proceed here on earth if one were to carry an acceptance of the multiplicity of worlds to its logical conclusions deeply disturbing (Dodds 168-70). Milton seems to find the idea of multiple worlds both fascinating and disturbing. The idea is tantalisingly invoked at various points throughout the epic, but always treated with cautious ambiguity.

Satan, having finally found a passage down to earth, without further ado flings himself down to wind with ease his oblique way

> Amongst innumerable stars, that shone
> Stars distant, but nigh hand seemed other worlds,
> Or other worlds they seemed, or happy isles,
> Like those Hesperian gardens famed of old,
> Fortunate fields, and groves and flowery vales,
> Thrice happy isles, but who dwelt happy there
> He stayed not to inquire:

(PL.III.565-71)

Satan sails past stars which appear to be stars at a distance but which, close at hand, take on the appearance of other worlds, but he does not stay to wonder who dwells in these other worlds he passes. Presumably, Satan could have veered off to investigate one of these other worlds, but by apparently ignoring them he seems to close off the possibility of an alternate narrative sequence. If Satan had made landfall on some other world, the story on earth could have been different.

Milton's narrative problem in Paradise Lost is that because he has taken a narrative of events and turned it into a narrative of causes, his readers already know, before they read even a single line of the poem, what will happen in it. He must, therefore, somehow find the means to accommodate within the narrative structure of a single poem both the events leading up to an as-yet-unknown choice(Adam's) and the known consequences of that choice(the fall). Satan does not stay to look, but by invoking these other worlds Milton allows us the momentary illusion of the possibility of an alternate narrative. For the same reason, within the body of the poem, Milton works to keep several coexistent but ultimately distinct worlds --- using the word in the more general sense of a realm of existence --- in constant interaction. Satan, the great cosmographic voyager, is fittingly the character who most traverses the bounds between worlds. He starts off being a native of heaven, falls to rule in hell, then battles his way through chaos to infiltrate earth. These three spatially distinct worlds of heaven, hell and earth are among the most important, sharing a hierarchical relationship, and are in constant, if tacit, interaction with each other. God knows perfectly well what has happened, is happening, and will happen in hell and earth, and shares as much of this as he sees fit with the angels. Satan and the devils speculate about heavenly plans and the state of earth and man, before Satan sets out to see for himself. Adam and Eve are afforded tantalising glimpses of heaven and worrying hints of hell, principally by the 'divine Historian' (PL.VIII.6-7) Raphael, but also from their encounters variously with God, Satan, and the angelic guards. And the narrator also travels from one to the other: he speaks of his 'obscure sojourn' (PL.III.15) down to hell and through chaos, and of presuming 'Into the heaven of heavens' (PL.VII.13). At least two of the invocations are unmistakably shaded with autobiographical detail, and remind us not only that the poet is, ultimately, human and based firmly on earth, but also that though he may be writing of the time before the fall when humanity was yet sinless, he is writing in the post-lapsarian world. While heaven, hell and earth are spatially differentiated from each other, other worlds have different boundaries. The pre-lapsarian world that Adam and Eve inhabit until Book IX is qualitatively different from the post-lapsarian world that they come to know and that we (Milton and his readers) were born into. In this epic, however, it is also physically different—nature 'through all her works gave signs of woe' (PL.IX.783) when humanity falls; and it is not only the garden of Eden, or the flora and fauna of earth that is affected:

God has the angels alter the entire structure of the created universe. Similarly, there are the worlds of male and female, which are distinct but complementary; and of angelic and diabolic, which share an antagonistic relationship.

When Raphael comes to warn Adam and Eve of their approaching trial by Satan, he uses the carrot and stick approach. Obey, keep faith, and in time, he tells Adam, your bodies may at last turn all to spirit and you may 'winged ascend / Ethereal, as we'(PL.V.498-99); but if you succumb to temptation and break union with God, then your future is death and the torments of hell. Satan's first temptation of Eve takes a similar form: in her dream, he offers her the fruit he has tasted, asking her to partake of it also.

> Taste this, and be henceforth among the gods
> Thy self a goddess, not to earth confined,
> But sometimes in the air, as we, sometimes
> Ascend to heaven, by merit thine, and see
> What life the gods live there, and such live thou.
>
> (PL.V.77-81)

He holds the fruit to her mouth, she cannot 'but taste' (PL.V.86) and the next thing she knows, she's up in the clouds with him. For all that this is an aborted, and therefore unsuccessful, temptation, it is not unimportant, for it rehearses some elements of the argument that Satan will use later in his successful temptation. Indeed, Satan throughout the poem rehearses arguments that will contribute towards his final temptation, at the heart of which is an offer to greater knowledge. One aspect of this increased knowledge —and the one that appears finally to sway Eve—is the offer of access to a different world, the world of the 'gods' (PL.IX.714).

At the heart of the epic lie the parallel worlds of the human and the divine. Paradise Lost is a poem premised on the assumption—theologically absolutely sound— that human existence, even before the fall, was not, and could never be, in any sense similar to God's existence, and that thus humanity could never hope to share the divine perspective on anything. This is made evident in the opening invocation itself: the poem aims to 'justify the ways of God to men' (PL.I.26). The pre-condition for any such enterprise is the tacit acknowledgement that God's ways do need to be justified, and acknowledging this means acknowledging that the divine perspective can never be shared by humans, and that God's world will never be ours. It has long been recognised that the dramatic element with which Milton has the most trouble in his poem is God; ithas also been acknowledged that in some ways this was perhaps inevitable. The reality of God's situation is such that no human can be expected to understand it truly. We may intellectually comprehend it, as Milton obviously tries to, but empathy in this one case is largely beyond our ken.

Though the worlds of the human and the divine can never cross they are mediated between in the body of the poem, in the first instance by the figure of the Son who offers himself up as sacrifice to redeem humanity. Though Christ's sojourn on earth is outside the scope of the poem it nevertheless underlies and shadows the epic, looming large over the narrative. The angels and devils also provide a conduit for human perceptions of the divine, by offering their own perspectives on God for human consideration. Raphael tells Adam of the war in heaven, revealing to him 'secrets of another world' (PL.V.569), and he does so with divine sanction. It is, I think, no accident that Satan consistently tries to tempt Eve, and only through her, Adam: Adam, after all, has held converse with God Himself, and might not believe Satan's 'glozing lies' (PL.III.93) quite so readily as Eve, who has not had the benefit of that experience. She has only heard His voice, possibly, or the voice of some spiritual being maybe --- she is not sure --at the time of her first awakening, and this fact renders her rather more open to accepting Satan's representation of God as 'the threatener' (PL.IX.687). Satan himself has journeyed to earth through the 'dark unbottomed infinite abyss' (PL.II.405) of chaos for the express purpose of seeing for himself 'another world' (PL.II.347). One of Satan's subsidiary interests in coming to earth is to see if the devils can come and live here, for the devils would like to leave hell and 'in some mild zone / Dwell not unvisited of heaven's fair light / Secure' (PL.II.397-99).

Satan's rebellion caused the breach in the angelic ranks that led to the rise of the devils. It should therefore come as no surprise that of all the worlds in Paradise Lost, the angelic and diabolic are not only in direct confrontation with each other but are also evenly matched. Though the rebel angels are susceptible to pain and the loyal angels are not, the war in heaven is basically a stalemate that ceases only when the Son intervenes. Perhaps because the breach is recent these worlds occasionally continue to overlap. Satan can still assume the innocent form of a 'stripling cherub' (PL.III.636) and fool the archangel Uriel who possesses 'perfect sight' (PL.IV.577). Raphael tells Adam that 'by doom' (PL.VI.378) the names of the rebel angels are 'Cancelled from heaven and sacred memory, / Nameless in dark oblivion let them dwell' (PL.VI.379-80), yet earlier in his narrative to Adam he has already named the unfallen Satan: 'great Lucifer' (PL.V.760). Angels and fallen angels alike are likened to stars in the poem, and Satan can continue to appear as a star even as he returns to hell after effecting the fall of mankind: 'At last as from a cloud his fulgent head / And shape star bright appeared' (PL.X.449-50). Finally, there is the case of Abdiel, the only angel to be first seduced and then repulsed by Satan, who comes closest to bridging the sundered worlds of the angelic and the diabolic but ultimately demonstrates the fact that the breach isunbridgeable. The boundary between the worlds of the angels and the devils was defined by a choice and continues to be marked by it, much as the boundary between the pre-lapsarian and post-lapsarian worlds will be.

However, for the angels and devils, unlike for the humans, that pivotal decision is already in the past. Satan has already fallen when Paradise Lost opens, but Adam is yet to be created.

As already noted, Milton invokes the idea of other worlds -- whether physical or conceptual -- in order to solve the particular narrative challenges he faced. This is also why the epic is marked by such peculiar temporal dislocations and chronological confusions. The past, present and future are distinctly different worlds in the poem, but they regularly and frequently overlap and even merge into each other. What for Milton and his readers is the past is frequently the present for the characters in the poem and even, in some cases, their future (the events outlined by Michael in Books XI and XII). Even more disconcertingly, our future is part of the (apparent) present for God, because, as already mentioned, God's temporal vision is completely unlike ours. Keeping his readers off balance with regard to time is one way Milton can reconcile the fact that while, in the poem's terms, the pivotal choice is yet to be made and all the characters are as yet innocent of any knowledge of how things will pan out, the readers, and indeed Milton himself, now live in a world shaped by the consequences of that choice. Keeping his readers and characters off balance by having several coexistent but ultimately distinct worlds in constant interaction with each other throughout the poem is another way to solve the same problem, because the mere possibility of a different world keeps alive the possibility of an alternative narrative. Even as we know, rationally, that there is no other story but the one we are living the outcome of, we can hope --- as perhaps Milton also fleetingly allowed himself to hope --that somewhere, somehow, things had been different. The stars that Satan flies past, which 'nigh hand' seem to be other worlds, are likened by Milton to 'those Hesperian gardens famed of old, / Fortunate fields, and groves and flowery vales, / Thrice happy isles'(PL.III.568-70): the references are all to various classical and pagan paradises, where the blessed dwell in bliss. Milton may not have meant anything by it --as Alastair Fowler observes, 'the proleptic allusion to our own Fall might sufficiently account for the passage' (177-78) -- but then again he may have meant everything by it.

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A Science Fiction in a Gothic Scaffold: a Reading of Mary Shelley's Frankenstein

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ABSTRACT

Frankenstein or The Modern Prometheus is a unique blend of two genres: Gothic and science fiction. While it follows the gothic convention of tale within tales, its epistolary framework and keeps intact its unrestrained lengthy articulations, it explores at the same time the innovative marvels of modern science. The fire that Prometheus stole form Zeus to help mankind is ingeniously replaced in the novel by the spark of electricity. The novel also puts to question some traditional social assumptions.

[Keywords: Frankenstein, Mary Shelley, Gothic, monster]

While Epic of Gilgamesh is considered to be the primal text of science fiction many consider Frankenstein to be the first science fiction in English (1818). Frankenstein is a science fiction. It is also a gothic novel. The anecdote of the cold and wet summer of Geneva is well known, where simply to assuage the monotony, Lord Byron had proposed that each present should write a ghost story. Amongst those present were Mary and Percy Shelley, Claire Clairmont (Mary's stepsister) and Lord Byron along with his physician friend, Joseph Pollidori. All had undertaken the task but were soon wearied of it. Mary was the only person to have written a complete novel. In her preface to 1831 edition Mary speaks of an awful dream that led to the conception of Frankenstein:

When I place[d] my head on my pillow, I did not sleep, nor could I be said to think. My imagination, unbidden, possessed and guided me, gifting the successive images that arose in my mind with a vividness far beyond the usual bounds of reverie. I saw -- with shut eyes, but acute mental vision,-- I saw the pale student of unhallowed arts kneeling beside the thing he had put together. I saw the hideous phantasm of a man stretched out, and then, on the working of some powerful engine, show signs of life, and stir with an uneasy, half vital motion. Frightful must it be; for supremely frightful would be the effect of any human endeavour to mock the stupendous mechanism of the Creator of the world. His success would terrify the artist; he would rush away from his odious handywork, horror-stricken. He would hope that, left to itself, the slight spark of life which he had communicated would fade; that this thing, which had received such imperfect animation, would subside into dead matter; and he might sleep in the belief

that the silence of the grave would quench for ever the transient existence of the hideous corpse which he had looked upon as the cradle of life. He sleeps; but he is awakened; he opens his eyes; behold the horrid thing stands at his bedside, opening his curtains, and looking on him with yellow, watery, but speculative eyes.

Critics, however, eye the passage with skepticism. Many hold that the novel is in fact based on valid scientific research and that it also predicts a possible future discovery. Interestingly, the subtitle of the novel The Modern Prometheus refers to a figure in Greek mythology who stole fire from gods to help mankind. There also subsists a story of Prometheus the plasticator who is said to have created mankind out of clay. The two myths when amalgamated together makes the fire itself a symbol of animation of life. In the novel Victor Frankenstein defies god by creating life himself.

Frankenstein is introduced as a student with an ardent yearning towards understanding the secrets of nature (p37). His father is 'not scientific' and therefore, he receives/ [instead of has] no proper guidance in childhood.

He has to struggle, for gathering scientific knowledge with a 'child's blindness' (p38). He reads Cornelius Agrippa with enthusiasm and his father's comment that "it is a sad trash" only serves to increase his avidity. He eventually buys volumes of Paraclesus and Albert Magnus. Thus, Mary gives us a logical development of Frankenstein's interest from the 15th Century occult philosopher and alchemist, whose volume De occulta philosophia libri tres, was then treated as modern occult study, to the natural philosophers and alchemists like Albertus and Paracelsus, who are linked because of their impressive theory of elixir of life. Albertus is also credited with the discovery of arsenic and silver nitrate.

Victor Frankenstein primarily undertakes, but fails to fulfill his ambitions by studying alchemy. It is with his introduction to modern science that he is able to discover, what is called in the novel, the 'astonishing secret'. When the first teacher he meets at the university dismisses alchemy with impatience, Frankenstein remains unconvinced. He is yet unwilling to accept a science that could replace his fantasy with realism. He, however, finds a way of reconciling the promised grandeur of alchemy with reality under the influence of the arguments placed by the second professor. This Professor, M. Waldman says:

The ancient teachers of this science …promised impossibilities, and performed nothing .The modern masters promise very little; they know that metals cannot be transmuted, and that the elixir of life is a chimera. But these philosophers,whose hands seem only made to dabble in the dirt, and their eyes to pour over the microscope or the crucible, have indeed performed miracles. They penetrate into the recesses of

nature, and show how she works in her hiding places. They ascend into the heavens; they have discovered how the blood circulates, and the nature of the air we breathe. They have acquired new and almost unlimited powers; they can command the thunders of heaven, mimic the earthquake and even mock the invisible world with its own shadows.(p.47)

Central to Victor Frankenstein's thinking is the incident of the scorching of the oak stump, struck by lightening. "I never beheld anything so utterly destroyed". (p,39) This leads to Frankenstein's ensuing discovery of the cause of generation of life. Here an obvious law of electricity was evident that 'a man of great research and natural philosophy' introduces Frankenstein to. In the 1818 edition Victor Frankenstein hears of Franklin's research with electricity from his father. The 1831 edition dismisses the father as unscientific, and introduces galvanism, (p,39) as a technique of invigorating nerve impulses. Mary Shelley had no formal schooling, but she was well read. She was aware of Luigi Galvani's experimentation (University of Bologna,1780) that had demonstrated that electricity flows through nerves. The scientific society was thrilled by the possibilities of this energy. Researches were enthusiastically conducted throughout Europe on its application. An attempt was also made to bring Harriet Shelley back to life after her suicide by drowning (December 1816) by applying electric shocks.

Ingeniously, Mary Shelley attempts no specific details of Frankenstein's experiments and discoveries. His report of his own credit is also imprecise: "I made some discoveries in the improvement of some chemical instruments which procured me great esteem and admiration in the university."(p,51)

Instead, the novel provides us with the details of the education that Frankenstein's scientific mind is exposed to. First, he becomes acquainted with science of anatomy and observes the 'natural decay and corruption' of the human body. Next, he studies the 'cause and progress' of this decay, and spends his days and nights in the vaults of charnel houses. Next, he observes how the good health of human beings is despoiled and wasted as he ages. He analyzes and examines even the trivial causes 'as exemplified in the change form life to death, and death to life'. This approach of Mary Shelley helps to establish that what Frankenstein creates is by way of experimentation and not by magic:

Not that like a magic scene it all opened upon me at once: the information I had obtained was of a nature rather to direct my endeavours so soon as I should point them towards the object of my search,…I was like the Arabian who had been buried with the dead, and found a passage to life, aided only by a glimmering, and seemingly ineffectual, light. (p.53)

Alchemy is hollow because it only has reference to dreams, modern science is effective and can become justly miraculous because it unravels nature so as to ridicule the imperceptible world with its "own shadows". In empirical research and inspection nature is perceived through dispassionate apparatus rather than by the aspiration or imagination. Frankenstein eventually finds out that this new discipline can also be used to engineer a product of human imagination. Though later in the novel his scientific instruments are identified with the creation of the monster himself, Frankenstein's mission is made explicit as selfless and messianic:

A new species would bless me as its creator and source; many happy and excellent nature would owe their being to me. No father could claim the gratitude of his child so completely as I should deserve theirs. (p,55)

Again it is because of his consideration of the human species that Frankenstein refuses to create the mate for his monster, the Eve for the Adam and destroys what he had begun to create under the fervent request of the monster.

If we press for a literary antecedent for Mary Shelley's novel it would rather be Samuel Johnson's Rasselas (1805) that deals with the efforts of decision about what to do with life, and not the popular gothic novel, Mrs. Radciff's Mystery Of Udolpho (1794) that was famed to have the power to scare its readers. In Jane Austen's Northhanger Abbey we hear a character say:

The person, be it gentleman or lady, who has not pleasure in a good novel, must be intolerably stupid. I have read all Mrs. Radcliffe's works, and most of them with great pleasure. The Mysteries of Udolpho, when I had once begun it, I could not lay down again; -- I remember finishing it in two days -- my hair standing on end the whole time.

Frankenstein clearly carried no such intentions. Though a popular notion associates Frankenstein with Bram Stokers Dracula (1897) the two novels are diverse in tenor, argument, and objective. Dracula's monster is not monstrous in appearance but is gruesome in deeds. The evil in him is irremediable. The creature that Victor Frankenstein creates is monstrous in appearance. First, he is oversized, secondly, his features are related to each other by contiguity, they and are not distinguishable as external features separately from the muscles and arteries that are also coarsely discernible. The contrast that is introduced with the lustrous black hair and pearly white teeth becomes drastically negligible in his eyes. His 'watery eyes' are 'almost of the same colour as the dun white sockets'. He has wrinkled skin and straight black lips.

His physical appearance is therefore repulsive. If we reflect, we find that, human beings do not appear more coherent than the corporeal disjointed display that the monster represents. Victor Frankenstein's creation is, thus, in a sense a breakdown of the unified vision of man into contradictory assortment of qualities that presents the very idea of representation of man as an unjustified, disordered and hideous matter. But the ugliness of the monster initially encloses a loving and tender disposition. It is noteworthy that the creature Frankenstein creates lacks a name. He is variously called 'monster', fiend' and 'wretch'. Although he is meant to be a man-made marvel who would "pour a torrent of light into our dark world", who as "a new species who would bless" its creator (p,55) ,he, in fact turns out to be a parody, a dismal/pathetic joke just as Frankenstein himself turns out to be a parody of Prometheus , or a kind of fiendish parody of Milton's god. Victor Frankenstein's behavior seems reckless and preposterous despite all his methodical application in the field of science. He receives his creation with scorn and horror solely for the reason of his physical appearance. He thoughtlessly and heartlessly discards him immediately after creating him. It does not occur to him that the new born, the oversized baby, ludicrously grotesque, is thereby left helpless in an environment of hostility where nature itself is feral. Later, in his confession to Captain Walton, Frankenstein, however, reflects on the unpredictable "feelings of human nature", reports how he, who had selected his features to be beautiful, had laboured hard for almost two years "for the sole purpose of infusing life into an inanimate body" (p,59) flees after he discerns his creation:

I beheld the wretch-the miserable monster whom I had created. He held up the curtain of the bed; and his eyes, if eyes they may be called, were fixed on me. His jaws opened, and he muttered some inarticulate sounds, while a grin wrinkled his cheeks. He might have spoken, but I did not hear; one hand was stretched out, seemingly to detain me, but I escaped, and rushed down stairs. I took refuge in the courtyard belonging to the house which I had inhabited ;where I remained during the rest of the night, walking up and down in the greatest agitation, listening attentively catching and fearing each sound as if it were to announce the approach of the demonical corpse to which I had so miserably given life.(p,60)

Thus the creator himself, who in Walton's appreciative judgment, is 'noble', 'cultivated' and a 'celestial spirit' is not without contradiction himself:

In my education my father had taken the greatest precautions that my mind should be impressed with no supernatural horrors .I do not ever remembered to have trembled at a tale of superstition, or to have feared the apparition of a spirit. Darkness had no effect upon my fancy; and a churchyard was to me merely the receptacle of bodies deprived of life, which, from being the seat of beauty and strength, had become food for the worm.(p, 52)

Yet when he remembers the creature he had given life he exclaims:

Oh! No mortal could support the horror of that countenance. A mummy again endued with animation could not be so hideous as that wretch. I had gazed on him while unfinished; he was ugly then; but when those muscles and joints were rendered capable of motion it became a thing such as even Dante could not have conceived. (p,61)

Frankenstein remains blind to the fact that he has let loose a power in the world, that he himself has assumed to be fearful, and even though the creature may not be aesthetically agreeable, he must remain accountable to his creation. Nevertheless, Frankenstein shrinks away from all responsibility and emphasizes that he is irreproachable of all transgression expect for the act of creation itself. Frankenstein, in effect, turns out to be an idealist and naïve young man who nonetheless has faced great and unparallel adversity. Despite the monster's fervent appeals Frankenstein's concerns assumingly remain with the well being his own species. In contrast to Frankenstein's ostensible immobility, his helpless creation, frequently called the monster, is active. His love for his creator is unreciprocated and despite all his pleadings, he succeeds in making little favorable impression on Victor Frankenstein:

I am thy creature, and I will be even mild and docile to my natural lord and king, if thou wilt also perform thy part, the which thou owest me. Oh Frankenstein be not equitable to every other, and trample upon me alone, to whom thy justice, and even thy clemency and affection is most due. Remember that I am thy creature; I ought to be thy Adam; but rather the fallen angel, whom thou from joy for no misdeed. Everywhere I see bliss, from which I alone am irrevocably excluded .I was benevolent and good; misery made me a fiend. Make me happy, and I shall again be virtuous.(p,112)

Mary Shelley would have been delighted to watch Shrek in which the storyline swaps the fairytale stereotypes, where the charming handsome fairytale hero finally surfaces to be mean and selfish, and the ogre, neither courteous nor handsome is revealed as the actual Hero with the big heart. Furthermore, when Fiona is released from her curse by the true love's kiss she does not become the predictable princess but turns into an ogress forever and Shrek assures her and the spectators that she still is beautiful. The tale flouts all our traditional assumptions of good and bad. The inner qualities are unconventionally shown to exist independent of all apparent assumptions.

In the (2007) Zemeckis adaptation of the Anglo –Saxon epic poem Beowulf we find an unsullied treatment of Grendel, who is portrayed as one who is misunderstood rather than evil.The culpability of Grendel's hostility falls on the humans who sinned against him and therefore invited retribution.

The original poem gives us the impression that the monsters are outcasts because they're bad. As professor Stephen T. Asma proposes, the new film humanizes the monster and tries to articulate that the monsters are considered evil because they are outcasts.

In Frankenstein, as Frankenstein's creature is a monster by physical appearance, love is denied to him and the man directly responsible for his tragic state repeatedly presses that he is not liable. With the gradual development of the novel's incredible subterfuge, the supposedly inhuman figure is rendered increasingly human, while his human creator is rendered inhuman, frozen much like the arctic landscape, in an attitude of meticulous rejection. When Frankenstein tracks the demon into the snowy regions, the demon helps him in his search, and even leaves food for him but Frankenstein supposes that good spirits direct his steps:

Sometimes, when nature, overcome by hunger, sunk under the exhaustion, a repast was prepared for me in the desert that restored and inspired me. The fare was, indeed, coarse, such as the peasants of the country ate; but I will not doubt that it was set there by the spirits that I had invoked to aid me. (p,238)

It is unusual that a man of such scientific knowledge should believe in 'good spirit'. The creature's appeal is so lost on him that he tells Walton that another scientist might as well succeed where he has been unsuccessful.

In this parable many archetypal chords are struck by the demon. He reiterates in a condensed form, as Frankenstein consents to hear his whole tale from the moment of his birth to the moment of their meeting (Chapters XI-XVI), the history of man's racial consciousness. He learns to speak, read, write, discovers the importance of fire, the meaning of a home and the value of different human emotions by closely watching the De Lacey family. The evils of society is increasingly revealed to the monster as he continues to closely watch and hear the De Lacys. The naïve giant gradually learns of the division of property, of the evils of poverty, of virtue amongst mankind, of vice and bloodshed, of unfair distribution of wealth, of man made divisions of social ranks, and noble birth.

Through the monster's narration Mary Shelley attempts to explain the process of development of consciousness, how the material objects are gradually recognized and distinguished by a new born that later come to acquire meanings and signifiers:

It is with considerable difficulty that I remember the original era of my being; all the events of that period appear confused and indistinct. A strange multiplicity of sensations seized me, and I saw, felt, heard, and

smelt, at the same time; and it was, indeed, a long time before I learnt to distinguish between the operations of my various senses. (p,115)

The monster reads three books of symbolic significance, Goethe's Sorrows of Young Werther, Plutarch's Lives and Milton's Paradise Lost. He thereby comes to identify himself primarily with Adam but finally with Satan. He reminds us of the tragic figures like Oedipus and Hamlet and of their incurable quest for the answer to the mysteries of life in his,

"…what was I? Of my creation and creator I was absolutely ignorant; …was I then a monster ,a blot upon the earth ,from which all men fled ,and whom all men disowned?"(p,136),Or, "Cursed, cursed creator ! Why did I live? (p,155)

Interestingly, the readers do not identify themselves with Victor Frankenstein the scholarly, self-devoted scientist, but with the malformed creature whose awe and wonder at who he was, where did he come form, find a resonance in the reader's heart although he consciously distinguishes himself from the human species:

"Am I not shunned and hated by all mankind? You my creator , would tear me to pieces, and triumph; remember that, and tell me why I should pity man more than he pities me?" (p,166)

It is also curious that Mary's power of eloquence and also the novel's romantic unreciprocated love is expressed through the monster. He is thus, not simply a supernatural, gothic being, beyond the dominion of realism. The outlandish creature that is brought into existence by man's creativity is not merely a ghostly being or fairy tale reminder from gothic horror novel.

The wretched does not die within the story. He leaps out of the cabin window determined to make an end to his desolate life: "I shall die. I shall no longer feel the agonies which now consume me, or be the prey of feelings unsatisfied, yet unquenched." (p,261)

Frankenstein's world questions the theistic assumptions of good and evil. That these are merely subjective perceptions is made explicit in the way the 'monster' is considered to be 'good spirit' , 'wonderful', when the De Lacy's benefit from his work, and regarded a monster when perceived by his physical appearance. In such a modern backdrop tragedy does not take place, predetermined by destiny as in Greek Tragedies , but is fabricated by man. While Dracula or the other Gothic tales are works of fantasies, Frankenstein has the hypothetical and the deterrent note of science fiction within the corpus of

a gothic novel.

The fame that the novel had achieved after its publication makes us reflect on its innovative and unique thought that it incorporated at that time (1818/1831). While it followed the gothic convention of tale within tales, its epistolary framework with its unrestrained lengthy articulations that reminds us of the cursed mariner form Coleridge's Rime of Ancient Mariner, it can also be seen as a human response to the incontestable Paradise Lost. Its ingenious structure allows the creator and his creation, divergent, but closely linked voices, to apply Hegelian dialectic, a thesis and an antithesis. The novel was meant to portend the absence of any possible synthesis, and not simply to amuse, for, the word 'Prometheus' stands for the 'foreseer'.

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Interdisciplinarity in 19th and Early 20th Century: Reflections on Ecosystem Services of Forest

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ABSTRACT

Reflecting on forest functions links forestry and the society since the 19th century, thus demanding early forms of interdisciplinarity. In this essay we trace back the history of the research on forest functions to its very beginning. We present the most influential conceptualizations on this topic in the last 180 years. Including forestry science, political science, history, and economics, protagonists met this challenge by showing an interdisciplinary interest in their other works, too. Since the 19th century, many different terms have been used to describe the relationship between forestry and society, including 'forest uses', 'forest effects', 'forest tasks', and 'meanings'. This did not only lead to a confusing use of terms but the protagonists did not build on, and connect with each other either. For that reason, a research tradition could not be established. The overview of the development of the different terms is followed by a suggestion to amalgamate the concepts: Today, a society's demands to a forest should be named 'tasks' of a forest. If the forest is producing 'natural effects' that make it possible to satisfy these 'tasks', we should talk about 'services' that are delivered by the forest.

[Keywords: Interdisciplinarity, 19th century science, forestry, humanities, social sciences, forest functions, ecosystem services, forest effects, forest meanings, forest tasks]

Terms to clarify, terms to nebulize

What are ecosystem services? What are landscape functions? And what are the cultural and scientific columns for such a concept of evaluating a landscape? In this article, we try to find answers to these questions by examining the concept of forest functions, a concept that has been in use in German forest science since the early 19th century. Forest functions describe the relationship between forests and the society: What do humans expect of forests and what are forests (and forestry) able to provide? On the threshold between humanities, social sciences and forest science, the question of forest functions is one of the first scientific inter- and transdisciplinary discussions.i It has even established such a tradition. In contrast to established theory of landscape functions as presented by Bastian and Schreiberii, we focus on forests as a certain part of landscape.

The meaning of the concept of forest functions has changed constantly since it has first been mentioned in the 19th century. Looking at early forest science literature, we find many different names for one and the same thing. Our second task is, therefore, to offer a distinct concept of differentiation between the terms forest uses, forest effects and forest tasks. These terms are not only meshed up but also used synonymously, thus leveling out the slight differences between them and undermining any scientific discussion.

We can show, that from the first scientific works dating from the early 19th century on, the names of the functions of forests as landscape types have changed but that the inherent meaning has stayed the same throughout all time.

We do not intend to write a history of misunderstandings or synonyms. Therefore, a distinct definition of what we call a forest function is necessary. According to Victor Dieterich (1953)iii a forest function is a societal demand posed to forests like wind protection or water retention. Among the functions are the capital, the income, the work, the resource, and the area function. Dieterich intended to describe the relationship between forests and people (p.24). His aim was to show the role of forests to people's welfare. His assumptions have been very influential to modern forest scientists not because he was the first one to name it, but due to his concise elaboration and logical composition of ideas. With his Funktionenlehre of 1953 he formed a doctrine. The widespread references among forestry literature lead to an adaptation of his quota to our concept. Dieterich (1879 – 1971) was Professor for Forest Policy and Economics in Munich.

Traces of Dieterich's function-doctrine in the early 19th century

Dieterich's doctrine of 1953 relied on earlier works. Before he had begun the theoretical reflections on forest functions, other forest scientists had published similar ideas, but no coherent concepts. Already in 1807, Konrad Anton Zwierlein (1755 – 1825), a Bavarian spa doctor, published "On the great influence of forests on culture and happiness of states"iv in which he postulated forests' health promoting abilities. This was in line with the German Zeitgeist that had recently rediscovered forests as 'national' landscapes.v At this time, an additional medical surplus was very welcome which makes it hard for nowadays readers to separate Zwierlein's medical from the inherent national goals. Without much ado he scaled his individual experiences of treating patients in a spa in a Bavarian forest up to the national level. What the fresh forest air does to sick patients it also does to states, and in 1807, during the Napoleonic wars, the German states were sick indeed. Even if his conclusions seem to be de trop today, he was the first to postulate the positive effects of forests to humans and even to the society.

In 1825 Alexandre Moreau de Jonnès (1778 – 1870) wrote his influential "Memoires sur le déboisement des forêts"vi, which were published by the royal academy in Brussels, and which therefore had a wide and international audience.vii All these treatises ventilated ideas of positive effects of forests on humans, cultures and even states besides wood production. These effects were known for a long time, even Plato had mentioned the notion that deforestations change the physical setting of a countryside and might even result in severe problems for its inhabitants (Plato: Critias). In the early modern time, several Spanish and Portuguese captains had similar notions when they compared the inhabited but clear-cut coastlines of the Mediterranean to the newly found shores full of mangroves and forests of the New Indies. These notions lacked the practical usefulness for a long time. They were rumors among early modern explorers, but did not enter any scientific discussion.

When the French Revolution with its large deforestations resulted in severe harms to welfare, many forest administrations reported damages. This was the starting point for a scientific approach to the general welfare functions of forests. It becameobvious, that the public interest in forest protection now included a forest's mechanical protective effects. Now, a forest's influence on the temperature and the humidity of the air and the ground was examined. Each result contributed to the notion that forests even out climatic amplitudes, that they have a positive effect on water circulation and protect against strong winds and avalanches.

1900: Forest functions between welfare and economic benefits

Around 1900, forestry science had accomplished major steps in the research on these welfare functions. Max Endres, professor of forest policy in Munich summarized the respective researches in 1905 and called them welfare effects ("Wohlfahrtswirkung").viii Inadvertently, his outline shows much more than a simple summary of 19th century research progress. It was one of the first genuine interdisciplinary works. Himself being a forest scientist and a professor for forest policy, he collected results from different disciplines to produce advances in the understanding of forest's natural effects and tried to make these effects useful for the welfare of mankind. Furthermore, he suggested implementing other discipline's research methods into forest science in case they seemed promising. Nevertheless, problems aroused.

These welfare functions were there, as different disciplines proofed, but no one wanted to pay for them. They were not remunerable in the 19th and early 20th century. More and more demanded a protection of these forest functions, but for forest owners and foresters, a financial refunding was hard to get. Furthermore, the protection restricted the wood production which was the only economic resource that forest owners could rely on in the end of the 19th century. A discussion arose, that even disavowed a

forest's welfare functions in complete. Julius Lehr (1845 – 1894)ix, a political economist and forest scientist, argued that the ideas of forest welfare functions arose out of a "hot romantic feeling"x (p. 110) but could not withstand a "cool multi-perspective consideration" (ibid.). Having these catchwords in mind, it seems like irony that his argumentation lacked the scientific grounding, but had some good points. His arguments were cited frequently but normally rejected as being too extremist. Nevertheless, Lehr applied a strictly economic view on the problem. A natural effect that does not pay off cannot be called 'function'! To him, it seemed to be easier to deny all forest effects that do not play an economic role and focus on effects that contribute vitally to a forest owner's income.

Forest functions to the national socialist society

In 1943 Konrad Rubner (1886 – 1974), a professor of forestry in Tharandt/Dresden, had published a textbook on forestry science. Rubner discovered "tasks of forestry"xi (p.7) and referred to Heinrich Eberts earlier conceptual work.xii Eberts was a German professor of forest policy and economics. In the 1940s, he wrote a bill for the national socialist federal forest law and was later an assistant secretary of state. Konrad Rubner's perspective was far-reaching, when he included social, national economic (p. 8), and national cultural tasks, and in line with the Zeitgeist, when he reflected on people's cultural and military economic and military technical tasks (p. 9) which could nowadays be read as national socialist aftermaths. The two latter tasks would form a military political forest function, which would be able to elevate the people's will and force to fight. There, he took a bow in front of the national socialist policy agenda. In this period of time, all landscapes were included into a special concept which reflected racial ideas of a Germanic superiority and economic ideas of autarchy, the theory of blood and soil (Blut-und-Boden-Theorie). Rubner did not refer literally to this concept, but some of his principles can only be understood in the national socialist context that combined cultural and military rearmament. Rubner applied concepts of "forest functions" (p. 472), "meanings" (ibid.), "tasks" (ibid.) and "effects" (ibid.) of forests. At first sight his treatise looks concise but in fact it lacks a coherent logic. Terms and meanings are mixed up and used as synonyms. But he can take credit for having introduced the terms into the scientific discussion. His treatise is summed up by a concept of seven "forest functions" (p. 473), including ethno-cultural, national cultural, national economic, military economic and technical, ethno-political and social functions.

Forest functions in the period of reconstruction after World War II

Victor Dieterich approached the forest-function-doctrine in 1953.xiii He described the interactive system between forest and man using the terms "benefits", "welfare benefits", "effects" and "functions". Dieterich applied "benefits" and "effects" synonymously. To Dieterich, benefits ("Leistungen") are

natural effects of forests like wind deceleration. These "benefits" become "welfare benefits", when they fulfil a societal demand, p. ex. wind protection. According to Dieterich, the societal demand is called "forest function".

The benefits or effects of a certain forest are depending on the characteristics of the forest and changing by and by. The natural effects which interact with human needs are named welfare benefits (Wohlfahrtswirkungen) (p. 234). On part of these welfare benefits is the resource-function (Rohstoff-Funktion), which supports society with forestproducts. The function-doctrine differs from the job-function (Arbeits-Funktion), the income-function (Einkommens-Funktion) and the capital-function (Vermögensfunktion). In addition, Dieterich described the area-function (Flächen-Funktion) which includes all other forest-functions like water, soil, climate, emission-control, nature conservation or recreation. Within this area-function he included a protective effect of forests (Schutzwirkungen des Waldes). There is no stringent differentiation of the used terms. Dieterich integrated the whole forest-function-concept into the idea of welfare benefits (Wohlfahrtswirkungen). He subsumed the protective effect of forests in three groups: 1. influence of the climate, 2. impact on water balance and erosion and 3. non-material benefit for man (p. 234). The individual functions are not independent but interconnected. Trade-offs might occur. The pursuit of each single function might challenge another function. Conflicts between different functions are identified among the resource-function (Rohstoff-Funktion) and the area-function (Flächen-Funktion). Problems are caused by restrictions for the forestry in difference to the social services ("Wohlfahrtswirkungen"). At the same time like Dieterich, Richard E. McArdle, a Chief of the US Forest Service and professor of forestry, described the multifunctional forest use as a coexistent preparation of different products and benefits at same area. McArdle could also rely on his previous scientific work.xiv

The forest-functions to the industrial society

Geared to Dieterich, Hubert Rupf, president of the state forestry in BadenWürttemberg, discerned in 1960 the resource-function (Rohstoff-Funktion), the receiptsfunction (Einnahme-Funktion) and the reserve-function (Reserve-Funktion).xv Furthermore he named the job-function (Arbeits-Funktion), the protective-function of the forest (Schutz-Funktion) and the social-function as very important to human well-being. Like Dieterich, Rupf used the term social services (Wohlfahrtswirkungen) and supposed the different kinds of protective-functions for climate, water and soil. Rupf argued, that in 1960 social services would follow in backwash of a common forestry but in the years to come they would become an integral part of forest and landscape planning. This forestry operated with the view to a maximum clear profit. This perception was termed as "backwash-theory" (Kielwassertheorie) (p. 549).xvi

Eight years later, Karl Hasel (1909 – 2001), professor of forest policy, history and nature conservation in Göttingen analysed the future perspectives for the German forestry within a modernist industrial society.xvii The protective and the social function (Schutz- und Sozial-Funktion) of forests would become more and more important and finally subdue the resource-function (Rohstoff-Funktion). On the annual German forestry meeting of 1968, Hasel designated the primacy of the resource-function and the incomefunction (Einkommens-Funktion) as not longer up to date. Even though he only took up notions that other foresters already had some years earlierxviii, it was a hard threat to most German foresters who witnessed the importance of wood during the Second World War and the post war period.

To Hasel, the social services of forests are no secondary effect of a regular silviculture but seen with the eyes of industrial workers, the most important effect of forests. Hasel stated that the resource-function (Rohstoff-Funktion), the protectivefunction (Schutz-Funktion) and the recreation-function of forests should be equal contents of the current forestry (p. 36). The regional German situation requires the implementation of all forest-functions at the same area and at the same time. But the importance of the various functions could differ.

Hasel's memorandum could be seen as the beginning of the German concept of integrative multifunctional forestry. He identified a couple of tasks like timber-production, landscape planning and human well-being. To him, not all kind of the many forest benefits would be countable in timber or economic profit (p. 55). This was a truth hard to take for regular foresters of his time. Not only had that most of them seen the importance of wood during the period of the German post war recovery, but also his concept devaluated the economic output of their everyday work. A shift from wood production to recreational activities meant more or less the giving up of forestry the way as they knew it. They deeply feared a professional degradation. Therefore, Hasel's thesis was hard contested.

But things are never as bad as they seem. The first guideline for mapping protective- and recreation-functions in forests appeared in 1974. Its intention was the sustainable protection and increase of all benefits of forests. This could be seen as a compromise between Hasel's position and the traditional view. In connection with the protective- and recreation-function August Henne (1921 – 2006), a Hessian forest scientist, used the term 'infrastructural benefit' of the forest.xix This concept was used to map German forests, although there were antagonisms between the terms socialfunction (Sozial-Funktion), immaterial benefit (immaterielle Leistung), social services

(Wohlfahrtswirkung) and the comitative effects (Komitativwirkung). The idea of integrative multifunctional forestry was fixed in the first German guideline for mapping the forest-functions.

Generally, the satisfaction of multiple functions was expected in one single forest with one silvicultural activity (p. 13), which makes again for a conflict in pursuing each single function. The approach of the guideline separated a couple of tasks of the forest which are inseparably connected with a distinct silvicultural activity. The guideline distinguishes the three columns of sustainable forestry: resource-and-economy (Rohstoff- und Nutzen), protection (Schutz) and recreation (Erholung). Potential conflicts are not specified in view of the economic-function (Nutzfunktion). The economic-function is assumed on the whole forest area and not regionally specified. The German guideline integrated the water pollution control, the soil conservation, the avalanche protection, the climate protection, the emission control, screen-forests, protection of roads and protected forests for cultural or ecological aims in the term of protective-function (Schutzfunktion). Additionally, the German forest function map (Waldfunktionenkartierung) contains other legally protected areas. Forests with a focus on recreation activities are related to the recreation-function (Erholungs-Funktion). The second edition of the German guideline for mapping protective- and recreation-functions in forest was published in 1982 and remained almost unmodified up to now.

One year later the economic-function, the protective-function and the recreationfunction were co-equally integrated in the first German federal forest act (Bundeswaldgesetz) (BWaldG, § 1, BGBl. I, S. 2585) as they were mentioned in the guideline earlier. This law followed a couple of federal laws, which dissented since 1949 from the one-side focus on the economic-function. The federal forest act's aim is the preservation and increase of the forest with the objective of a sustainable preservation of the three named and listed functions. Mentioned are in detail the ecological environment (Umwelt), the ecosystem (Naturhaushalt), the climate (Klima), the water balance (Wasserhaushalt), pollution control of the air (Luftreinhaltung), the soil fertility (Bodenfruchtbarkeit), the landscape (Landschaftsbild), the agro- and infrastructure (Agrar- und Infrastruktur) and the recreation (Erholung der Bevölkerung). Therefore the law demands the sustainable correct forest management (ordnungsgemäße Waldbewirtschaftung).

The current guideline (2003) for mapping protective- and recreation-function in forest contains nearly the same functions of the initial version of 1974. In addition to the term "function" Helmut Volk and Christoph Schirmer, two forest scientists, uses the term benefitxx (Leistungen). The principle demands to save all benefits of the forest by a sustainable silviculture. Effects (Wirkungen) of the properties of forests are described for each all mentioned forest-functions (Waldfunktionen). Diverging from the guideline's firstversion, now potential conflicts between the different functions are identified. The economic-function is still assumed for the whole forest area. Using the example of the forest guideline of the federal state Brandenburg the conceptual confusion becomes apparent. The Brandenburg guideline

declares that forest functions (Waldfunktionen) are the effects of the forest (Waldwirkungen) which are used for the service to the public

(Daseinsvorsorge) (p. 8). They differentiate in economic-, protection- and the recreationfunction (Nutz-, Schutz- und Erholungsfunktion).

Protagonist	Year	Occupation	Issue
Zwierlein, K. A.	1807	Spa doctor in Bavaria	Influence of forests on culture and happiness of states
de Jonnès, M.	1825	Explorer, statistician in France	Memoires sur le déboisement des forêts
Dieterich, V.	1953	Professor of forest policy inMunich	Definition of forest functions
Lehr, J.	1887	Professor of national economics	Denial of any forest function beside the economic function
Rubner, K.	1943	Ministry officer of silviculture and dean of the forest faculty in Eberswalde/Berlin	Tasks of forestry
Eberts, H.	1932	Prussian forest government and chair of forest policy and forest administration	Tasks of forestry
McArdle, R. F.	1953	President of U.S. state forestry	Multifunctional forest use as a coexistent preparation of different products and benefits at same area
Rupf, H.	1960	President of the forest government of Baden-Württemberg and head of the forest research institute Baden-Württemberg	„Backwash-theory" („Kielwassertheorie")
Hasel, K.	1968	Professor of forest policy, forest history and nature conservation in Göttingen	Importance of the protective and the social function in content of the future perspectives for the German forestry
Henne, A.	1974	Head of the forest research institute of Hesse	First guideline for mapping forest function
Volk, H. & Schirmer, C.	2003	Head of the department of landscape management and member of the department of forest ecology of the forest research institute Baden-Württemberg	Current guideline for mapping protective- and recreation-function in forest
Hockenjoos, W.	2007	Member of the forest government and the nature conservation organisation of Baden-Württemberg	Political and forestry trends to an increasing focus on the economic-function
Windisch, G.	2008	Director of the Bavarian forest government	The economic function is able to achieve all forest function in a sustainable way
Krott, M.	2009	Chair in forest and nature conservation policy in Göttingen	Consequences of the reforms of the German forest management for the forest services

Forest functions and the post-industrial society

Actually, the integrative multifunctional forestry is still propagated. But current political and forestry trends, including severe cuts in subventions are geared to an increasing focus on the economic-function. Wolf Hockenjos, a high ranking state forester of Baden-Württemberg and nature conservationist argued in 2007xxi that the multifunctional forester becomes a partial timber-producer (p. 21). The director of the Bavarian forest management, Georg Windisch,xxii president of the Bavarian state forests, believed that the economic-function is able to achieve all forest function (p. 11) – in a sustainable way! In 2009, the forest political scientist Max Krott analysed the long list of reforms of the German forest management.xxiii To him, the reform-process of the recent years seems to have the objective of an economically efficient and market-oriented management. This could turn out to become a problem for forest-functions without a demand on capital markets (p. 13) e.g. for the 'classical' welfare functions.

Clear definitions of forest functions, tasks, and services

A long time multifarious terms are used to describe and explain the integrative multifunctional forestry. The articles contain the terms function (Funktion), use (Nutzen), protection (Schutz), social and recreation functions (Sozial-/Erholungsfunktion), tasks (Aufgaben) and effects (Wirkungen). All along the identified social requirements are nearly the same. Differences are explicit in the weight of the varying demands (Ansprüche). The meaning of the used terms differs between the issues, over the years and even inside a publication. Based on the specified concepts we will try to develop a consistent idea to understand the relationship between man and forest.

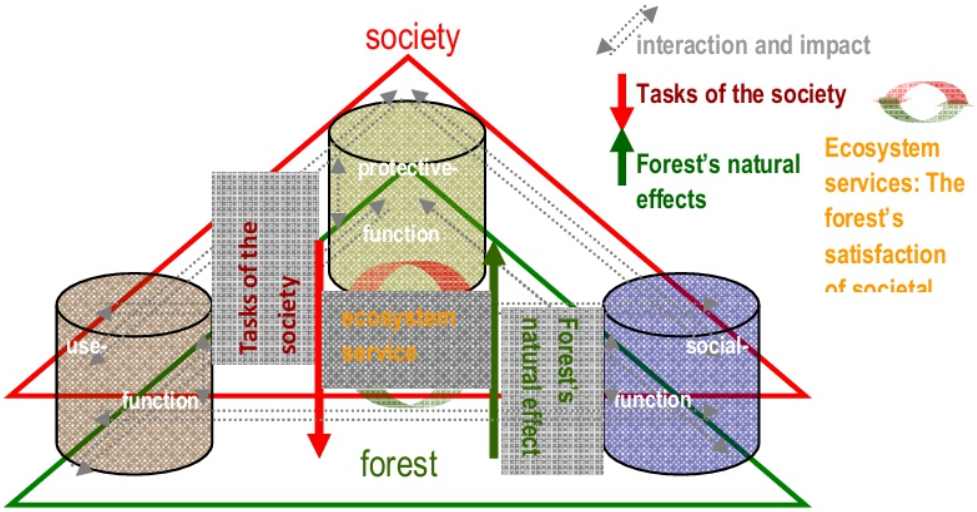

Fig. 1: Ecosystem services as the societal tasks satisfied by forest's natural effects. A concept of understanding integrative multifunctional forestry

Figure 1 shows our concept of ecosystem services in forestry. It gives a picture of forest-effects in context of understanding the German idea of integrative multifunctional forestry. Here, the economic-function, protective-function and the social-function are equal aspects of the triangle of sustainable silviculture. Nevertheless, conflicts may occur between and within the three columns which are caused by dependencies and interactions. Each society has demands to forestry. The demands change by and by. However, forests produce natural effects. These are limited by the ecosystem and the characteristics of each distinct forest.

As could be proved in this essay, the forest functions very often are named 'tasks', 'benefits', 'effects' and 'social services' or 'welfare benefits'. We suggest that a society's demands to a forest should be named 'tasks' of a forest. If the forest is producing 'natural effects' (or synonymously 'natural benefits') that make it possible to satisfy these demands, we should talk about 'services' that are delivered by the forest, whereas the term 'welfare benefits' describes the same but seems to be old-fashioned today. This link of a forest's task and service can be called an 'ecosystem service' like discussed in the millennium ecosystem assessment.

Conclusion

For about 120 years forestry is constantly losing ground in economic terms. Once being the main source of income to the state, German forests lost their economic importance step by step to the industry and later to the third sector. War-time recoveries were a flash in the pan (Bader 2009; Bader 2010).xxiv

Forest functions, tasks, and services give a meaning to forestry that goes beyond sheer wood production. They place forestry within the society and its needs, thus allowing the hope for remuneration of forests and forestry beyond wood selling. Scientifically, they link natural science dominated forestry science with humanities and social sciences. The professional background of scientists who developed the concepts of forests functions in the last hundred years shows that inter- or at least transdisciplinary working scientists who look beyond their own scientific horizon prevail. Therefore the conclusion is that research on landscape and forest functions is done at best in an interdisciplinary mode. Nevertheless, the long-lasting discussion involved many synonymous and inconsistent terms. Therefore, our model states as follows:

A society assigns tasks to forests and forestry. Forests produce natural effects. If these effects satisfy the tasks, we should talk about forests' ecosystem services.

Notes

i For the concept of both inter- and transdisciplinatity, we rely on the defintions given by Krott, see Krott, Max: Umweltgeschichte durch starke Disziplinen – Vom richtigen und falschen Einsatz der Interdisziplinarität, in: Reeh, Tobias; Ströhlein, Gerhard; Bader, Axel (Ed.): Kulturlandschaft verstehen. ZELTForum - Göttinger Schriften zu Landschaftsinterpretation und Tourismus - Band 5, Göttingen 2010, pp. 25 – 38.

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Autopoiesis and Cummings' Cat

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ABSTRACT

Cummings shattered language, but he did so with precision. The result is a visual poem marked by extreme linguistic upheaval permeated with mathematical and pictorial order—a poem, in other words, that epitomizes linguistic chaos. One such poem explores the acrobatics of a falling cat, "(im)c-a-t(mo)." Because of the tension between order and disorder in the poem, the concepts of autopoiesis and fractals from chaos theory provide helpful language to illuminate the poem's textual dynamics, which then provides a foundation to look deeper into the ideas Cummings explores.

[Keywords: Cummings, Autopoiesis, Fractals, Chaos, Visual Poem, Animal]

"Imagine that we are in freefall with zero total angular momentum. Our problem is to reorient ourselves, say right-side-up, by changing our shape. Such a problem is faced by gymnasts, falling cats, satellites, etcetera. Our first objective is to control our net orientation. This can be represented by a rotation matrix g. Our control variables are the deformations dx of our shape. Our possible shapes are represented (locally) by a continuous vector variable x.... Let Q denote the configuration space of a given deformable body.... The group g of rotations about the center of mass remains, and acts on Q by rigidly rotating configurations. We write this action as

$$q \in Q \rightarrow gq = q' \in Q$$

where g is the rotation...."

Richard Montgomery
from "Gauge Theory of the Falling Cat"

"...suddenly,for no apparent reason,the animal executes a series of crazily acrobatic antics—'Fall(-)leAps!flOat(-)tumblIsh?-drIft(-)whirlF(Ul)(lY) &&&'

"...after which,he wanders away looking exactly as if nothing had ever happened...whereas,for me,the whole universe has turned upside-down in

a few moments....”

E. E. Cummings
Selected Letters

In Dreams in the Mirror, Richard Kennedy discusses Cummings' aversion towards mathematics. It was not a focus in his home schooling, and during his middle school years, he continued struggling with it (29, 30). Cummings' early experiences with math, Kennedy argues, affected his later years as well (29). This may explain why the mathematical statements within Cummings' poetry contain a trickster-like, defiant twist, such as two times two is 5 (CP 221), the multiplication of the "sky times earth" (CP 599), and "one's not half two. It's two are halves of one" (CP 556).1 Quoting Richard Montgomery's mathematical exploration of falling cats may therefore seem counterintuitive. Unless one is familiar with the mathematical nomenclature, the notation alienates, and before this article even begins, the reader may have moved on. Nonetheless, Montgomery's work establishes one concept. Though a cat's fall through the air is instinctively simple, it is, on the other hand, intensely complex. Montgomery uses advanced math to begin articulating the cat's movement. And begin is not used lightly, for Montgomery's article is twenty-five pages long, and it accompanies twelve other hefty essays dedicated to the mathematical exploration of falling cats.

E. E. Cummings also explored the gyrations of a falling cat, and although he did not use the signs of mathematics, his poem can be just as alienating. For reasons that will unfold, I approach "(im)c-a-t(mo)" through applying the nomenclature from chaos theory. Chaos theory, specifically the notion of autopoiesis, provides helpful language through which to articulate the surprises that emerge when exploring the textual dynamics of Cummings' cat.

Cummings' chaotic typographies often contain an exclamation mark. A survey of Cummings' repetitive use of the "!" begins to reveal its consistent suggestiveness (CP 348, 396, 421, 423, 429, 487, 653, 655, 722, 1040). Often, an exclamation mark sits within a linguistic tension between upheaval and pattern. This tension epitomizes chaos, for chaos denotes not randomness but rather a simultaneous presence of both disorder and order (Hayles 216). Often with Cummings' more radical experiments, the linguistic upheaval (disorder) intermingles with either a mathematical or pictorial pattern (order) thereby creating the harmonious tension of what I call "(dis)order," and the presence of (dis)order within "(im)c-a-t(mo)" readily encourages an exploration from the perspective of chaos theory.

Autopoiesis, a term from chaos theory, emerges from the Greek meaning "self creation" ("auto", "-poiesis"). Chaologists use the term to explore the patterns (and life) that emerge from the edge of chaos, or rather, from the most fecund locale within the harmony of (dis)order. Vladimir Dimitrov and Lloyd Fell explain the precarious balance along the edge of chaos that begins when a system (or as I will demonstrate, a poem) is "thrown into an out-of-equilibrium zone" and into an edge between order and disorder ("Autopoiesis"). If the system falls deeper into disorder, the intensity of change threatens to overwhelm it entirely, pushing it into sheer randomness; likewise, if order increases, the system falls back into a predictable pattern ("Autopoiesis"). But if a system remains buoyed up in the edge of chaos, more and more innovative, autopoietic emergences spontaneously happen.

Autopoietic emergences are ubiquitous: the Eye of Jupiter, the eddies of a stream, thunderstorms, thumbprints, and the sand dunes of Colorado. Autopoiesis is even the foundation of one theory concerning the origin of life (Briggs 154-155), and perhaps it is the only convincing theory concerning the how of life's origin. Autopoietic happenings are often fractal, exhibiting self-similar patterns across multiple scales (Briggs 90). Significantly, in fractal patterns, the smaller scales exhibit the same level of complexity as the larger scales: "reduction never simplifies" ("Autopoiesis"). In other words, a fragment always encapsulates the whole. One reason why complexity permeates every scale of a fractal pattern is because each scale exists within the autopoietic, self-creation. Colorado's sand dunes demonstrate the fractal characteristic of a self-created system (Stull):

The wind-sculpted ridges and valleys occur on several scales, for the dunes that are hundreds of feet tall contain smaller systems of dunes within dunes, right on down to the ridges left by a tourist's footprints.

I suggest another example of autopoiesis, the textual dynamics of Cummings' "(im)c-a-t(mo)" (CP 655). Though I use other terms from chaos to explore Cummings' cat (including feedback loops), autopoiesis is the most crucial. It illuminates why a poet may deviate into what looks like sheer nonsense. When prose or the traditions of verse keep language in check by restricting it to predictable patterns, the chaotic flux of language remains latent. Cummings allows the flux to surface, and just as autopoiesis signifies the wonders that emerge from the chaos of the earth, it likewise captures the interpretive wonders that emerge from the linguistic edge of chaos epitomized in Cummings' cat poem.

At first glance, the poem seems innocuously motionless—just a bunch of familiar signs arranged in an unfamiliar manner:[2]

(im)c-a-t(mo)
b,i;l:e

FallleA
ps!fl
OattumblI

sh?dr
IftwhirlF
(Ul)(lY)
&&&

away wanders:exact
ly;as if
not
hing had,ever happ
ene

D

But as the reader lingers in the text, the language becomes more dynamic. John Pollock suggests that the linguistic upheaval creates a "mental dislocation," which requires great mental "agility" on the part of the reader (45). The mental acrobatics resemble, then, the physical agility of the cat:

We struggle to make sense of what's happening with the words before us. Our eyes dart back and forth, spiraling down the page like the gyrations of a plummeting animal. If we're as agile mentally as most cats are physically, we immediately start to restructure our experience by working out what the poem's 'about.' (45)

Pollock establishes the concept that the linguistic upheaval becomes a metaphor, specifically, an experiential metaphor. The reader's mind falling through the poem identifies with the cat's body falling through the air. But focusing upon the text's mimesis of the cat's falling body expands Pollock's insight. The moment the cat falls, it loses its order, its immobility. The first three stanzas exhibit great linguistic upheaval thereby suggesting the cat is out of control. The moment the content of the poem reveals that the cat lands, the language becomes increasingly readable. The cat regains complete control and walks off as if nothing had ever happened.

However, a paradox permeates the text. Order and disorder coexist. An eerie balance of grouped letters and a mathematical pattern of lines per stanza support the linguistic upheaval:

2 (im)c-a-t(mo)
b,i;l:e

3 FalllleA
ps!fl
Oattumbll

4 sh?dr
Iftwhirlf
(Ul)(lY)
&&&

5 away wanders:exact
ly;as if
not
hing had,ever happ
ene

1 D

The presence of mathematical patterns tantalizes the reader, for the first three stanzas are no longer pure disorder. They are infused by a subtle order. The balanced groups of two letters suggest that the cat (and Cummings) never lost complete control, and the observation that the two groups of letters are always

split suggests a connection with the cat's front and hind feet, powerfully foreshadowing how the cat, against all odds, pulls off a landing. Despite appearances, order, though diminished, is still present.

Like the balanced letters, the lines-per-stanza intensify the tension between order and disorder. The poem and the cat begin already out-of-order with two lines composing the first stanza (instead of one). Nonetheless, the progression of lines-perstanza reinforces the order of the poem and therefore the cat's control during the fall: 23-4-5-1. And yet, the fact that the numerical sequence ends with the number one, the beginning, perplexes the order. In chaos theory, feedback signifies the phenomenon where an output is reintroduced back into the system as an input (Briggs 25-26).[3] In the poem, the last stanza (output) becomes the input for counting. The end of the poem begins: 1...2-3-4-5. The feedback loop is strengthened if the reader reads the poem's last letter, the "D" (ln 15), as the first word of the poem, the: D c-a-t..., or the c-a-t....Both the mathematical pattern and the linguistic playfulness encourage a re-reading of the poem and therefore a re-visiting of the chaotic dynamics of the cat's fall.

This revisiting reveals at least five iconic moments that emerge autopoietically.4 The first occurs the moment the poem begins: "(im)c-a-t(mo) / b,i;l:e" (ln 1-2). In a letter to his Japanese translator, Mr. Ishibashi, Cummings provides a clue to the autopoietic iconicity therein: "I am looking at a relaxed "c-a-t";a creature motionlessly alive—'(im)(mo)b,i;l:e'" (Letters 231). The iconic discovery occurs when the reader sees the word "c-a-t" fall into the word immobile, thereby breaking the immobility in half in order to declare I'm mobile. This iconic interpretation emerges autopoietically, for it only exists because the linguistic disorder intermingles with the orderly pattern of paired letters.

Similarly, the following iconic moments emerge from the poem's harmonious (dis)order. Moreover, they are fractal as they explore the recurring motif of the "flip" on four different equally complex scales: the overall poem, the stanza, the line, and the individual signifier. On the macroscale, flipping the poem around and around until it is horizontal reenacts the cat's fall and landing:5

(im)c-a-t(mo)
b,i;l:e

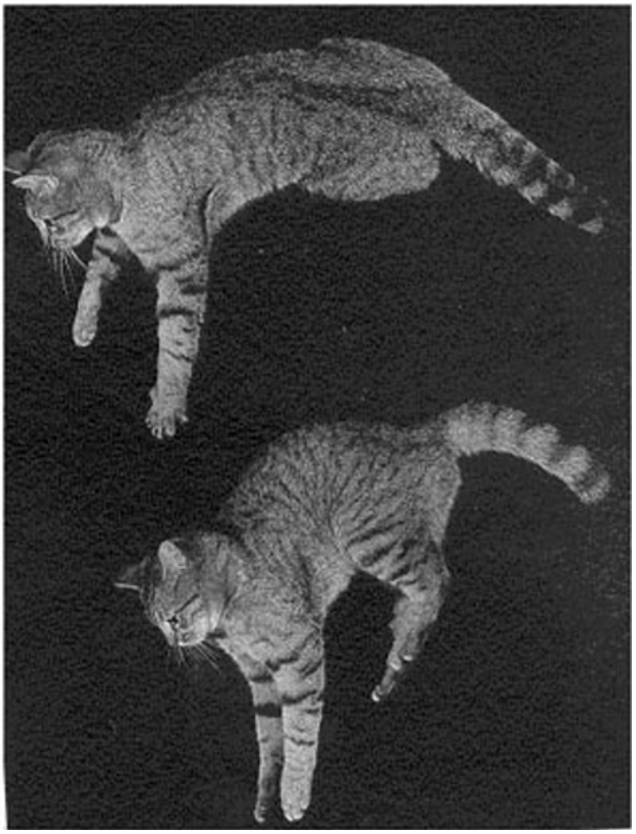
FallleA
ps!fl
Oattumbll

sh?dr
lftwhirlF
(Ul)(lY)
&&&

away
wanders:exact
ly;as if
not
hing had,ever happ
ene
D

The poem tucks its hind legs in (ln 3, 5), while the front legs extend towards the ground (ln 10, 13). I see the first line of the poem as the cat's tale, the third stanza as the cat's belly, and the last line of the poem as

the cat's head (ln 15). A picture helps distinguish the shape (Halliday):



The cat, like the poem, must flip or it will land directly on its head, the "D." But the cat's head only exists because of the tension of (dis)order. If happened was not fragmented, and if the poem ended with five lines-per-stanza, then the head would not exist. The poem, though, is an orderly-out-of-order 2-3-4-5-1, the word happened is shattered, and thus the pictorial shape emerges autopoietically. The shape of the poem on the macroscale adds another layer to the overall tension of (dis)order. Now, the linguistic upheaval is supported by a mathematical pattern of counting, a balanced pairing of letters, and it is all contained within a pictorial silhouette of the cat's body.

Another flip occurs on the scale of the stanza. In the first stanza, the lowercase I and o in the first line flip around and become uppercase in the last line of the second stanza:

(**i**m)c-a-t(m**o**)
b,i;l:e

FallleA

ps!fl
Oattumbl**l**

The space and time that separates the two lines suggests that, as the cat falls through space and time, it is able to perform, surprisingly, an august, physical gyration. The text, therefore, embodies the motion of

the cat as it repositions itself in midair.

The final two flips occur on the microscale of the individual line and the solitary sign. To frame the iconic moment, one must wrestle with why Cummings had the cat fall, and then leap:

FallleA
ps!fl
OattumblI

This is the miracle of the cat. Once the cat falls, it seems to push off of nothing but air in order to "leA / p" back into control. The iconic "A" expresses the explosive gesture of the cat to leap in midair, and Cummings places the "A" at the edge of the line near the open space of the page thereby emphasizing the leap's groundless beginnings.6 Further analysis reveals, though, that the ordering of fall leaps floats contains autopoietic flips. Due to the order of balanced letters, and due to the sheer linguistic upheaval, Cummings allows a portion of the word leaps to sit on the same line as a portion of the word floats. Provocatively, an exclamation mark splits the balanced pair of letters. As suggested earlier, the presence of the exclamation mark within Cummings' visual poems often alerts the reader to both (dis)order as well as the ever present autopoiesis of iconic signs. This line, perhaps more than any other, captures the joy of autopoietic discovery as two flips transform it:

ps!fl
fl!ps
flips

The gyrations of the text embody the gyrations of the cat, and the motif of the flip emerges within the individual line and solitary exclamation mark. The joy is heightened as the linguistic flips end up spelling the word flips, and all of this demonstrates the essence of an autopoietic, fractal pattern. The complexity is not diminished even on the microscale of the line and individual punctuation mark.

And we must not forget that Cummings based part of his poetics upon experiences at Coney Island. What he says of the rollercoaster applies to the poem:

Whereas at the circus we are merely the spectators of the impossible, at Coney we ourselves perform impossible feats—we turn all the heavenly somersaults imaginable and dare all the delirious dangers conceivable; and when, rushing at horrid velocity over irrevocable precipices, we beard the force of

gravity in his lair, no acrobat, no lion tamer, can compete with us. (258)

Cummings emphasizes that the participant becomes a performer:

We repeat: the essence of Coney Island's 'circus theatre' consists in homogeneity. THE AUDIENCE IS THE PERFORMANCE, and vice versa. If this be formula, let us make the most of it. (259)

It is therefore not enough for the reader to identity the four textual flips within the cat poem; she or he must reenact them. As a performer, I see all four flips occurring simultaneously—the entire poem tumbling off the page and leaping in mid air, the i / o orbiting through the stanza, the "ps" and "fl" gyrating, and the exclamation mark flipping—all at once, not unlike an Olympic diver who twists, turns, and somersaults into the water, swimming off as if nothing had ever happened.

The autopoietic flips throughout the poem are striking in their own right, but a realization that the poem revisits a common motif in Cummings' work adds another layer to the poem's interpretive richness.7 In "Eco-iconicity in the poetry and poem-groups of E. E. Cummings," Terblanche and Webster explore the "i/o dance" (157) in several poems. The neologism "eco-iconicity" emerges through applying an ecological perspective to the interplay between iconic elements in Cummings' individual and grouped poems:

If in iconicity 'form mimes meaning,' then in eco-iconicity formal elements like syntax, word division, visual placement on the page, the use of white spaces, and what might be called a transformational semantics all work together to mime the dynamic processes of the ecosystem. (155)

As an iconic sign, the "o" in Cummings' work is Protean as it can be seen "as a moon, as eyes, as an entrance, as an icon of completeness and circular motion, as a marker of the female force or tendency in collaboration with the male 'I', and more" (156). Cummings' famous "i" is often a symbol for the self-transcendence of the alive-individual (nonlectures 81).

When we approach "(im)c-a-t(mo)" within the context of the "i/o dance," the autopoietic interpretation deepens. As explored above, the poem expresses an iconic gyration as the lowercase "i" and "o" reverse and become uppercased in the fifth line. The "I", the cat, the alive-individual, realizes its exclamatory potential through entering the openness of possibilities ("o") that such a fall becomes. During the fall, the "i" and "o" must orbit one another in order to flip, and therefore the word "dance" aptly describes their iconic motion. As the dance progresses, the "i" merges with the exuberant sign of the exclamation mark,

and when the reader's imagination flips the "!" into an "i" thereby conflating them, the reader can infer that the cat is, indeed, the self-transcendent individual. Through entering the openness of the fall ("o"), the cat ("i") experiences the completeness of being "!"—which is not unlike Cummings' leaf in "l(a":

l(a
le
af
fa
ll
s)
one
l

iness (CP 673)

Whereas the leaf falls into loneliness thereby arriving (paradoxically) at the selftranscendence of iness, so the cat falls and experiences what could be termed !ness.

However, none of these autopoietic surprises would happen if the poem did not dwell within an linguistic edge of chaos. Indeed, one step further into disorder, and the poem would fall into "a deep chaos in which it may be overwhelmed with change" ("Autopoiesis"); likewise, one step closer towards pattern, and the poem would regain order thereby diminishing the surprise and mystery of a fractal landscape inhabiting an edge of chaos. But the poem perpetually hovers in an edge of chaos, creating a fertile ground for reader performance and reader interpretation. The poem reveals that language can be just as chaotic and wonderfully complex as the natural world itself, and as a result, the reader is (hopefully) inspired not only to look at the poem, but also to turn her or his eyes to witness the self-creations of the earth.

I wonder what Richard Montgomery would think of Cummings' "(im)c-a-t(mo)." Would he dismiss it simply because of its arcane typography? Would he glimpse the tension of order and disorder? Would a textual flip surprise him? Would his curiosity become frustrated (much like mine when looking at his math) due to the fact that tracing the linguistic maneuvers requires more than a cursory knowledge of poetics? I would like to discover what captures the mystery of a cat's fall more, Montgomery's math or Cummings' poem. Regardless, a cat's fall is sublime enough for mathematicians and a trickster-poet to explore with utter bewilderment.

Notes

1 Provocatively, well before Mandelbrot created the term fractal in 1975, Cummings used math to clearly articulate a fractal statement: "one's not half two. It's two are halves of one" (CP 556). A "wholeness," signified by the number "one," is present on all scales. The number "two" is whole, but even if it is divided in half, each half contains its own wholeness. The part is just as complex as the whole. We will see this in Cummings' "(im)c-a-t(mo)," but another great example of it is the Mandelbrot set, discovered in the complex plane of mathematics. Though the Mandelbrot set informed much of my understanding of autopoiesis, I find that integrating an explicit discussion of it ends up usurping too much space—so awesome is its infinite landscape. An excellent introduction to it, however, can be viewed here..

2 My initial observations of Cummings' cat poem appear in "Chaos & the 'New' Nature Poem: A Look at E. E. Cummings' Nature Poetry."

3 Strikingly, a mounting thunderhead exhibits a feedback loop as well when a down draft becomes an input for an internal updraft, thereby augmenting the growth of the storm. Countless autopoietic surprises emerge from thunderheads, which is one reason why we sit rapt before them. Likewise, the feedback loop in the poem, which leads the reader back into the linguistic (dis)order, generates many surprises for the patient reader.

4 The three ampersands, "&&&" (ln 9), are iconic for the path of the falling cat as well, and this interpretation is strengthened by Cummings' acrobat poem. After establishing the somersaults and aerial acrobatics of the trapeze artists, he has two meet: "&meet&" (CP 539). The reader readily infers that the path of the ampersands reenacts the path of the acrobats who suddenly become one, clasping hand to forearm. The cat, as an acrobatic creature, creates similar paths during its fall. However, I am not including these iconic signs in the body of the essay because they are not created autopoietically. In other words, the ampersands are not dependent upon the edge of chaos in order to emerge. That said, the ampersands contribute to the poem's fractal dimension as they reinforce the self-similar pattern of flipping and gyrating through the air on the scale of the individual sign.

5 Skeptics may doubt and dismiss this observation, passing it off as merely finding whatever shape one wants while "cloud gazing." Cummings, though, loved that "precision which creates movement" (CP 221). Any careful reader, at some point, will wonder, "Why are lines ten and thirteen so long? Huh, strange"—or something to that effect. With Cummings, one must pursue these questions that often emerge only for a flash from the subconscious before the conscious mind reasons them away.

6 A similar use of the explosive "A" can be seen in "r-p-o-p-h-e-s-s-a-g-r" (CP 396) where the grasshopper ":l / eA / !p: / S" (ln 7-10). In many respects, Cummings' poetics involves a kind of composting, or recycling, of myriad signifiers and gestures. He places the same signifier in a different

context thereby making it gesture in different ways.

7 Too often, unseasoned readers dismiss Cummings thinking that once we "get the gimmick," there is nothing else left to say. Like all poets, Cummings developed themes, motifs, and ideas. Here, we enjoy the iconicity, but then we must move into a discussion of the ideas. Cummings' cat poem has, quite arguably, just as much to say about the "still point of the turning world" (ln 62) as T. S. Eliot's "Burnt Norton," but this connection cannot be made unless we move from the iconicity to the idea. Strikingly, Eliot makes an ontological statement about language in "Burnt Norton,"

Words strain,
Crack and sometimes break, under the burden,
Under the tension, slip, slide, perish,
Decay with imprecision, will not stay in place,
Will not stay still. (ln 149-53)

...which is something Cummings knew and celebrated.

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The Forking Paths of Open Your Eyes and Vanilla Sky

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ABSTRACT

In March 1992, researchers from both sides of the Atlantic Ocean inaugurated in Paris the conference Épistémocritique et Cognition, thus giving official birth to epistemocriticism. This new branch of literary criticism incites us to make a re-appropriation of culture as a whole. Essentially, this perspective calls on us to explore the relations between literature and science. The purpose of my paper is to extend epistemocriticism to film studies. Thus, I analyse how bifurcation theory and Borges's story "The Garden of Forking Paths" operate as main interdiscoursive artefacts in Alejandro Amenábar's Open Your Eyes and in Cameron Crowe's Vanilla Sky. Accordingly, I believe that extending this perspective to film studies, we can achieve a better understanding of what happens in these forking-paths films.

[Keywords: epistemocriticism, bifurcation theory, Open Your Eyes, Vanilla Sky, literature, science, Alejandro Amenábar, Cameron Crowe]

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I–
I took the one less traveled by,
And that has made all the difference.
Robert Frost

In Prelude to a Dream, the documentary about the making of Vanilla Sky, the filmmaker Cameron Crowe tells us how Alejandro Amenábar's film Open Your Eyes captivated him. His fascination with the Spanish movie led him to create a new version of it, a Hollywood remake. In his words, the film is "a story, a puzzle, a nightmare, a lucid dream, a psychedelic pop song, a movie to argue over and, most of all, a movie that extends an invitation. Wherever you want to meet it, it will meet you there" (Prelude). Thus, I have accepted this invitation and asked the meeting to take place at a crossroad: I compare both films from the viewpoint of epistemocriticism.i Specifically, I will approach them using the lens of the mathematical theory of bifurcations.

At the beginning of the nineties,ii this new branch of literary theory and criticism was developed by a group of researchers from France, Canada and the US. Epistemocriticism incites us to "make a re-appropriation of our culture as a whole: the past and the present, the sciences with the literature." (Pierssens 1993, 7).iii According to William Paulson, "the epistemocritical project is a defence and an illustration of literature: it's about refusing that literature be pushed to the aesthetical, formalist or ideological margins by highlighting that the texts, knitted with knowledge, know way more than the fields of study" (121).iv

In the particular case of this study, I have a double reason for proceeding this way. On one hand, in 1991, Thomas Weissert shows in his article, "Borges's Garden of Chaos Dynamics," how the Argentinean writer "anticipated the two essential characteristics of the bifurcation theory's method of modeling natural systems – i.e., the frequent occurrence of random splittings in a system's dynamic flow and the inexorable nonlinearity of nature" (237). Thus, through Weissert's analysis, we evidence that Borges's story is a jewel in terms of epistemocriticism, for it's not only pregnant with scientific principles but it forestalls them. Accordingly, I believe that extending this perspective to film studies, we can achieve a better understanding of what happens in these forking-paths films, a category where Open Your Eyes as well as Vanilla Sky belong.v

On the other hand, in "Film Futures" David Bordwell compares four films – Sliding Doors, Too Many Ways, Blind Chance and Run Lola Run – with Jorge Luis Borges's "The Garden of Forking Paths." In his analysis, Bordwell states that "the exfoliating tendrils of Borges's potential futures have been trimmed back to cognitively manageable dimensions, by means of strategies characteristic of certain traditions of cinematic storytelling" (91). He then proceeds to chart what he considers seven conventions on which these forking-path films rely. Accordingly, he concludes that "whatever films or novels or plays we choose, though, I suggest that we will find that the concept of alternative futures will be adapted to the demands of particular narrative traditionspruning the number of options to those few that can be held in mind, finding new uses for cohesion devices and repetition, relying on schemas for causality and time and space" (101-102). In "Nearly True: Forking Plots, Forking Interpretations" Edward Branigan responds to Bordwell by introducing an interesting comparison: he shows the closeness of Bordwell's analysis to Daniel Dennett's model of consciousness based on the concept of "multiple drafts." However, Branigan agrees with "Film Futures" in that "narrative is not built on principles of physics or philosophy, but with the use of folk psychology" (105).

I would like to suggest that if Bordwell had been aware of Wiessert's approach to Borges's story and hence had included such scientific principles in his viewpoint, his conclusions would have been more

stimulating. Since Bordwell remains within the conventional scope of analysis, he can only complain that such films deceive him when compared to Borges's "Garden."vi

Therefore, the purpose of my analysis is to use the mathematical theory of bifurcation in order to shed light on Amenábar's creation, the American remake and finally, to show the pertinence of epistemocriticism in film studies.

A nightmare, a lucid dream

In order to avoid repetition, I will initially focus on the Spanish cinematographic production and present the correspondence of characters in both films in Table #1. Then, I will introduce the variations of Crowe's film.

Open Your Eyes is the story of a man, César, who wears a mask to hide his disfigured face. He is imprisoned in a psychiatric institution and after several encounters with a psychologist, Antonio, he tries to come to terms with the fact that he has been accused of murdering his fiancée, Sofía. However, according to him, Sofía was not Sofía for she had been supplanted by his former lover, Nuria.

The young man, the heir of a corporative empire after the death of his parents, had led a lustful and luxurious life until his best friend, Pelayo, arrived to his birthday's party in Sofía's company. César falls in love and, as he is corresponded by Sofía, they spend their first night talking in her apartment after running away from the insistent Nuria. When César walks to his car to return home, Nuria is waiting for him and invites him for a ride. In fact, she speeds up driving off a curve and smashing her car against a wall and instantly killing herself. César is disfigured. Although he finds himself at an endless road, he tries to recover his previous life. Seemingly, this life bifurcation has taken him nowhere: he is at a critical point where he is being accused of murder and has to face the impossibility of remembering what had really happened.

The story unfolds into an unexpected ending as none of the previous possibilities are real. In fact, César has been kept in cryogenic preservation after signing a contract with "Life Extension." This company has offered him the possibility to wait until surgery is developed so that he can have his face restored. Thus, after committing suicide, his body was frozen and the service offered by "Life Extension" has allowed him to experience a simulated life of his choice. However, this imagined life has taken a nightmarish turn due to malfunctioning, an error that will be corrected as a company representative offers César a new deal.

Having in mind the linear recount of the events to summarize what happens in the film, we may proceed to its analysis, by encompassing namely two stages: the different levels of reality and the bifurcations in the map. At the end, I will briefly compare the original film and the remake.

Levels of reality

Ana María Barrenechea, in her excellent book about Borges, presents the disposition of the different nestled levels that constitute his Garden's world as if they were Chinese boxes. Following this configuration – sometimes also called Russian dolls – Amenábar's movie also plays with the different layers of reality. Moreover, the passage from one level to the other is not always clear as the cinematographic sequences frequently melt them, especially as César elaborates a Scheherazade style tale where he intertwines memories with imaginary scenes. For instance, the film opens up with a man woken up by a recorded message of a feminine voice: "Abre los ojos." The man, César, gets up – he showers, dresses, and gets in his car – and after a couple of minutes of car driving, he realizes that there is not a soul in the streets of Madrid. He stops in the middle of a wide avenue, gets out of the car and starts a frantic race. The feminine voice repeats "Abre los ojos" and César wakes up realizing he had been dreaming.vii

In Table #2, I have plotted the disposition of the different levels of reality that conform Abre los ojos. I consider that César's dreams are the film's first level. The second one is the physical world where events actually take place. However, the line that separates them is very thin, especially because we –just like the psychologist– have no direct access to the real world where things in fact happened to César and we have to conform ourselves with the storyline he builds up for the psychologist. Actually, the conversation that takes place in the closed space of the psychiatric institution with the therapist constitutes the third level of reality.

Initially, the shadow of a fourth level of reality is foreseen with the mysterious irruption of a male character who appears on T.V. talking about cryogenic conservation. Later, this man appears in public spaces until he openly addresses César, revealing that the world that surrounds them is created and governed by César himself. Finally, César traces the link to the name he yells in his nightmares: "Eli." He convinces the psychologist to take him to the offices of the company named "Eli," therefore opening up a completely new level: upon the signature of a contract with this company and after committing suicide, César has been given the possibility of living in a dream world while awaiting the progress of medicine.

At this stage, César has to face the fact that 150 years have gone by and that he is actually alone in the world – a fact that somehow came to surface in his dream of the desert city. Everything we have previously seen, including the psychologist who brought him there, is nothing but a simulation. Eli has provided him with a dream world of his own; however, his subconscious has sabotaged his creation transforming it into a nightmare where he has killed the woman he loves. A last conversation with Eli's representative takes place at the top of a skyscraper and César is offered a new deal. After verifying Eli's version by causing the appearance of Antonio, Pelayo and Sofía by simply invoking them with his mind, César accepts the new contract. The world surrounding him, a century and a half older and emptied of human beings, constitutes the ultimate level of reality within the film. The cinematographic perspective from the top of the skyscraper confirms the postulate of the emptiness of the world indicating that dreaming is the only acceptable way of life under such circumstances. Thus, César jumps off the building.

Bifurcations maps

In Borges's story we read: "In all fictional works, each time a man is confronted with several alternatives, he chooses one and eliminates the others; in the fiction of Ts'ui Pên, he chooses – simultaneously – all of them. He creates, in this way, diverse futures, diverse times which themselves also proliferate and fork" (5). My purpose in sketching the alternatives faced by César in his nightmarish existence is to see how many diverse futures coexist in the film and if we can make sense out of all the apparent contradictions that configure the plot.

As Weissert states: "A bifurcation is a splitting, a decision point where the system must take one path or the other" (234). In Abre los ojos we don't observe directly the splittings César encounters but we can determine them through his conversation with the psychologist. Dreams and recalled or imagined scenes –some of them recurrent although not exactly the same– alternate each other and at a given moment no one – not even César, nor Antonio, nor the spectators – can affirm with any certainty what the facts are: did César kill Sofía or Nuria? But wasn't Nuria already dead? Was César's face redone by the surgeons? Then, why does he still wear a mask? And other such features. The participation of Eli is disclosed, the events take an unexpected turn and the pieces begin to fit, although configuring a strange jigsaw puzzle.

I believe this situation can be more easily understood if we have in mind what happens in nonlinear models as they bifurcate, because César's life, with its different layers of reality and many forks, shows many characteristics of nonlinear systems. "Researchers have found that frequent successive bifurcations in the flow of a physical system indicate the system's transition to chaos. Similarly and somehow symmetrically, the flow may, at some later time, make the transition out of chaos into some

ordered state via a succession of reverse bifurcations or convergences" (Weissert 234).

In order to observe the bifurcations that occur in the film, in Table #3 I have represented the forking paths of Abre los ojos. At each fork, the upward branch corresponds to a negative answer, whereas the downward one is a positive one. The first bifurcation depicted corresponds to the question "Does César stay with Nuria?" If he did, it would only be an affair, as the many short-term sex relationships that populate the young tycoon's life. If the answer is no, we then proceed to "Does he fall in love with Sofía?" If the answer is negative, Sofía would be just another of his multiple conquests. And so on.

On the chart, I have indicated in blue the path that César follows. Nevertheless, things swiftly change and after recovering Sofía's love and having his face redone by the surgeons, he seems to lose his mind, or else the world has. César finds himself in a maze where Sofía has transformed herself into Nuria whose name is now Sofía. He is also told that there was never another woman named Sofía and there are no traces of a car accident. Thus, the path seems to have jumped to options B or C shown in green: he either is mad or knowingly has killed his fiancée. However, according to César himself, he stands in front of the options E or F at the end of the blue track.

As the conversation with Antonio deepens, they discover the unsuspected branch shown in yellow. Sofía never accepted César after the accident. He recovered the control of the company but went into a profound state of loneliness. In despair, he found out about the cryogenic conservation firm, signed the contract, committed suicide and was frozen. Although he had signed to receive the services of a simulated dream life, apparently due to the intervention of César's subconscious, the dream turns into a nightmare: the blue path. Moreover, the simulation is contaminated by visions from the green path, and with images that correspond to even more remote branches, such as the ones in pink. For instance, in situation A, César meets Sofía in a park and tells her he had a nightmare of being part in a car accident and that he will never see her again. Another example is the situation depicted in D, where he and Sofía are together but he's still disfigured.

Now, had everything gone well with the life extension services, César would have reached the point I have marked with the sign of infinity –highlighted in light blue–, for it would be an endless love story with Sofía after having his face redone.

Hopefully, the correct path will be restored after César jumps off the building at the end of the film. This final scene sends us back to the beginning of the picture: once César's scream fades out, the screen turns black and we hear, just like at the beginning, the feminine voice "Abre los ojos."

Original vs. remake

Table #4 shows the bifurcations of Vanilla Sky. I will refer only to the aspects where the remake diverges from the original. I would say that basically, Cameron Crowe's remake of Abre los ojos differs from the former in its rhythm, the delineation of its characters, and the importance of the company owned by the young businessman in the development of the story.

Vanilla Sky opens up with a view of New York from the top progressively zooming in until entering into an apartment building and then fading into David being instructed "open your eyes" by the recorded voice. The perspective from the top –we will find at the end– corresponds to David's visions through his free fall from the skyscraper as he is committing suicide again to enter –hopefully– a new and satisfactory simulation of "Life Extension."

As the action moves from Madrid to New York, instead of the desert streets in the Spanish capital, David races alone in Times Square. Despite the absence of people, we see the screens flashing in the background, full of light and action. These fast moving images match very well the switch of the car: instead of the VW convertible, David drives a Porsche at high speed. In fact, once he awakens from this first dream and picks up his friend Brian, they almost have a car accident, scarcely escaping from being overrun by a truck. I have inserted the possibility of this accident as the first bifurcation of this movie.

In the remake, we come across characters with more outlined features: David doesn't only conquer every girl in town, his nickname is "citizen dildo;" once he leaves Sofía's apartment she doesn't stay in a state of wonder but jumps and yells with contentment; the car accident doesn't just disfigure David but also leaves him limping and with a rigid arm and enduring strong pains; David seems deeply affected by the actions of his father and the empire he inherited from him; the young businessman has decorated his luxurious apartment with musical artefacts as well as with huge photos from famous movies. This latter hobby will be used in his simulated dream by the superposition of film scenes.

The characters repeatedly utterstatements that refer to the multiple layers of reality: "Living in a dream," "I'll tell you in another life where we both are cats," "We created a whole world together: us versus them." As David has the impression that he has already been through certain events, people around him keep telling him "The subconscious is a very powerful thing." In the Spanish film these déjà-vu experiences are explained as malfunctioning of the brain. Moreover, the importance of bifurcations is clearly stated by Sofía: "Every passing minute is another chance to turn it all around."

A main variation of Vanilla Sky is the importance of the conflict between David and the board of directors who control 49% of the inherited company, a publishing empire. David is supposed to participate at the executive level although he's absolutelycareless. He calls the board the "Seven Dwarfs" remitting us again to a fantasy-like situation.viii

In Crowe's film, the struggle for power is of significant consequence in the unfolding of the nightmare. Once David has reconquered Sofía and undergone surgery, he explains the resurgence of Julie, the vanishing of Sofía and the accusation of murder by a conspiracy theory, all of which would have been elaborated by the board of directors to get rid of him. I have depicted this aspect by adding another bifurcation in the map of Vanilla Sky.

Final loop

Although the differences introduced by Crowe place his version closer to the mainstream cinema than the original movie,ix both films include puzzling scenes. When David says to Sofía "I am frozen and you are dead," the world depicted - and its multiple branches- is nothing but the outcome of a simulation. Thus, we should not be too surprised by the adequacy of using bifurcations theory to analyse these films for, in nonlinear dynamics, rerunning computer models to replicate nature constitutes a central practice. After all, the hibernating character is building his reality by playing with the different options he had initially been given until chance played a bad trick on him.x In his tentative to build himself a world, we just see how one particular reconstruction probably one among many– fails. Moreover, the end clearly indicates its feedback movement into the beginning, confirming the nonlinearity of the movie and indicating the possibility of entering into another loop of the services provided by Eli, where new paths –hopefully more satisfactory ones– can be followed.xi

Amenábar's film shares two main features with Borges's "Garden": the Chinese boxes and the forking paths. As Weissert has shown in the case of Borges's story, the text contains many ideas that refer to mathematics, mainly bifurcations theory. As Bordwell has shown, if we stay with folk reasoning, we fail to grasp the complexity of forking paths films. However, I believe I have been able to demonstrate that if –following Weissert's idea– we take the epistemocritic turn and we relate these cinematographic productions to bifurcations theory, we can achieve a better understanding of these puzzle-type films.

Table #1

Characters and actors

in Abre los ojos and Vanilla Sky

Abre los ojos		*Vanilla Sky*	
Character	**Actor**	**Character**	**Actor**
César	Eduardo Noriega	David Aames	Tom Cruise
Sofía	Penélope Cruz	Sofía Serrano	Penélope Cruz
Antonio (psychologist)	Chete Lera	Dr. Curtis McCabe	Kurt Russell
Pelayo	Fele Martínez	Brian Shelby	Jason Lee
Nuria	Najwa Nimri	Julie Gianni	Cameron Diaz

Table #2

Levels of reality in Abre los ojos

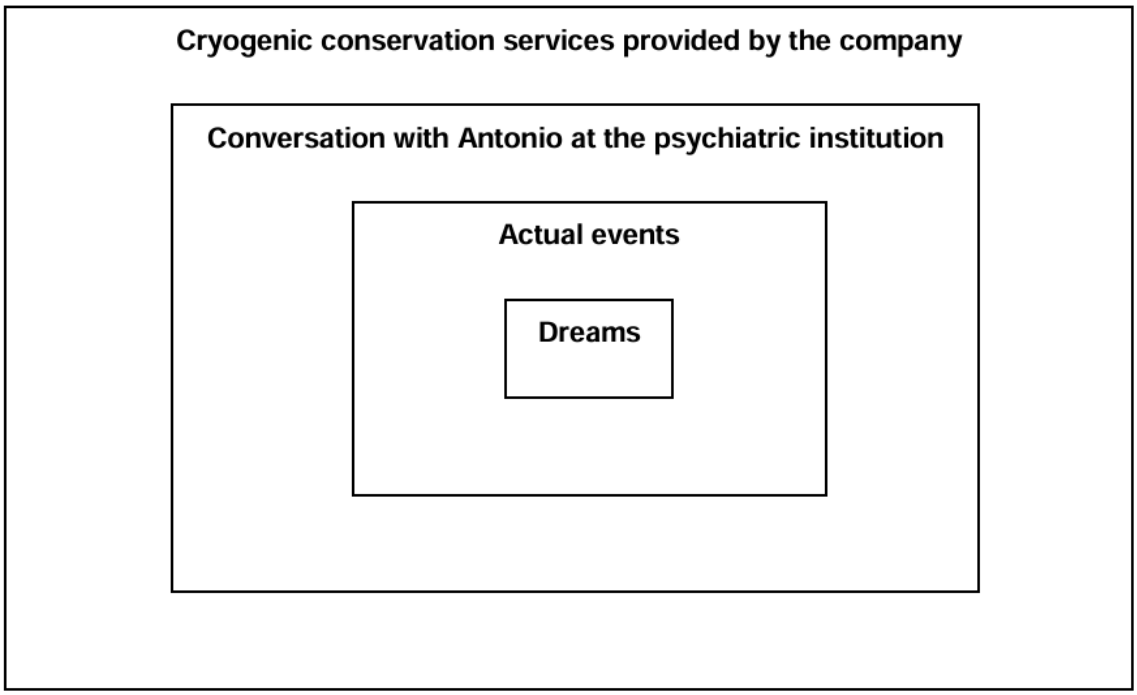


Table #3

Bifurcations map of Abre los ojos

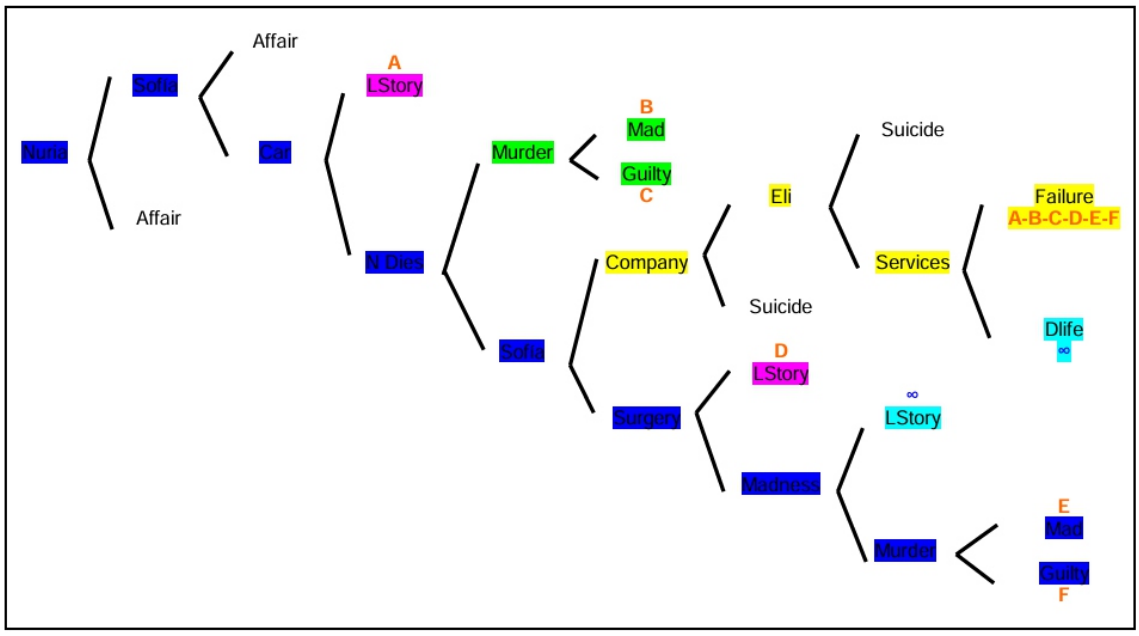
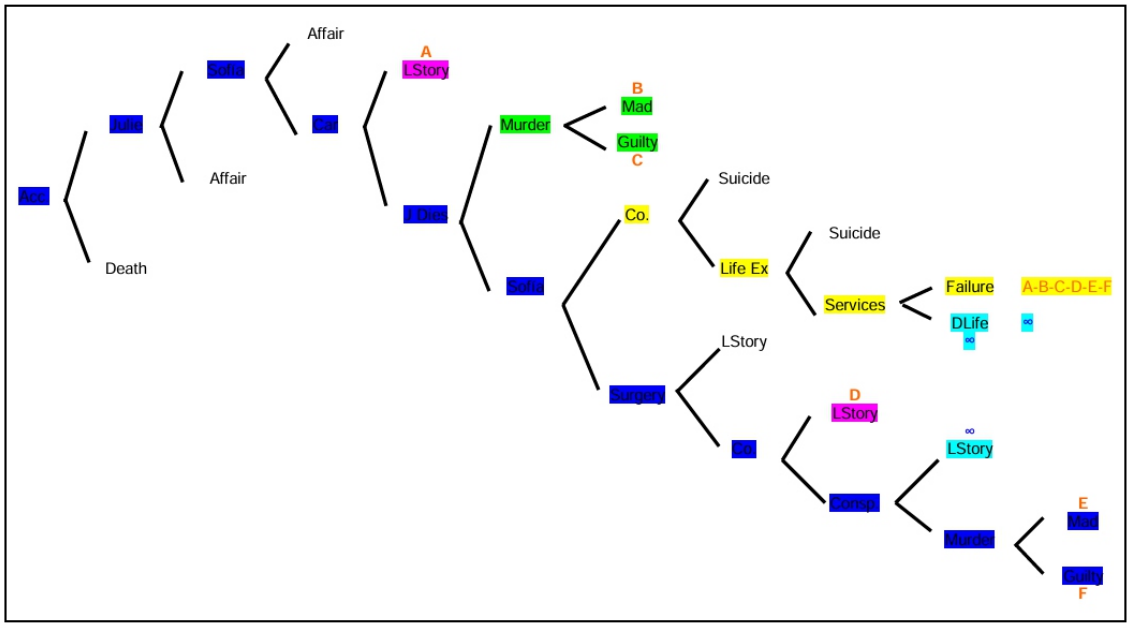


Table #4

Bifurcations map of Vanilla Sky



Notes

i The name epistemocriticism is introduced by Michel Pierssens in his book Savoirs à l'œuvre. Essais d'épistémocritique. Lille: Presses Universitaires de Lille, 1990.

ii In March 1992, researchers from both sides of the Atlantic Ocean inaugurated in Paris the conference Épistémocritique et Cognition, thus giving official birth to epistemocriticism. The articles presented at the conference were published in two volumes: Épistémocritiqueet Cognition 1. Théorie, Littérature, Enseignement. 10. 1992 and Épistémocritique et Cognition 2. Théorie, Littérature, Enseignement. 11. 1993.

iii "nous réapproprier notre culture comme un ensemble: le passé et le présent, les savoirs avec la littérature" (Pierssens 1993, 7).

iv "le projet épistémocritique est une défense et illustration de la littérature : il s'agit de refuser la marginalisation esthétique, formaliste ou idéologique des études littéraires en soulignant que les textes, tissés de savoirs, en savent plus long que les disciplines" (121).

vMarina Martín, in her analysis of Abre los ojos, uses the term "bifurcations" in its ordinary meaning, without incorporating its mathematical definition.

vi In Simerka and Weimer, the authors compare Abre los ojos and Vanilla Sky in terms of postmodernism. This approach seems quite adequate since the relations between Borges and postmodernism have been thoroughly studied. See, for instance, Fokkema, Douwe W. Literary History, Modernism, and Postmodernism. Amsterdam: J. Benjamins, 1984.

vii Of course, the name of the movie does not only refer to this awakening but also to the urgency of actually looking at reality.

viii If they are the dwarfs, David is the empoisoned Snow White waiting for the love kiss that shall wake him up.

ix Namely I would relate them to Hitchcock's Vertigo and David Fincher's The Game. Also, we can see that Amenábar's creation has already been taken into account in movies such as The Matrix.

x In his analysis of Vanilla Sky, Wilson states that the character has no choice to make, that David can only re-enter the hyperreality of capitalism.

xi An interesting shift in the film is the last question asked by David's lover as she speeds out of the road. In Abre los ojos, Nuria pushes César to respond: "Do you believe in God?" whereas in Vanilla Sky Julie urges David: "Do you love me?" As they fall off, we hear the man yelling: "No! God! God!" while David franticly says, "I love you, I love you!" Beyond the cultural differences that might be found in this swap, Amenábar's version is deeply related to the possibility of man as a creator of the reality – a subject which again sends us back to another of Borges's stories: "Circular ruins."

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