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The journal is dedicated to the publication of academic essays on the subject of literature and science, broadly defined. Essays on the major forms of literary and artistic endeavour are welcome (the novel, short fiction, poetry, drama, periodical literature, visual art, sculpture, radio, film and television). The journal encourages submissions from all periods of literary and artistic history since the Scientific Revolution; from the Renaissance to the present day. The journal also encourages a broad definition of 'science': encapsulating both the history and philosophy of science and those sciences regarded as either mainstream or marginal within their own, or our, historical moment. However, the journal does not generally publish work on the social sciences. Within these confines, essays submitted to the journal may focus on the literary and scientific productions of any nation or group.

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Kinaesthetic, Spastic and Spatial Motifs as Expressions of Romantic Irony in E. T. A. Hoffmann's *The Sandman* and Other Writings

Val Scullion

E. T. A. Hoffmann's *The Sandman* has attracted a plethora of critical interpretations since it was first published in 1816, the most famous being Freud's essay on *The Uncanny* (1919). Many critics have focused on the motif of the eye and the legend of the Sandman who steals children's eyes when they refuse to go to sleep. The legends of Narcissus, Pygmalion and the Doppelgänger, which underpin the narrative of Hoffmann's novella, have also provided scope for psychological, poststructuralist, feminist, historicist and meta-romantic criticism.¹ This article examines Hoffmann's motivic preoccupation with kinaesthesia, spasticity, kinetic energy and paralysis.² First, it seeks to interpret the con- and in-voluted narrative structure of *The Sandman* as formally symbolic of the Romantic³ idea of infinite perfectibility, in which the process of becoming is in continuous and creative flux.⁴ Furthermore, it will show that the pervasive motif of grotesque bodies and awkward motor-neural movement is dialectically at variance with the spiralling prose form of the novella, thus generating Romantic Irony through this formal inner contradiction.⁵ The aim is to interpret this Romantic Irony as a critique of the Romantic poet and his artistic quest.⁶ Second, the article demonstrates that Hoffmann's particular use of kinaesthetic and spastic

¹ For semiotic excess, deferral of meaning, and reader as author, see: Detlef Kremer, *E.T. A. Hoffmann: Erzählungen und Romane*. Berlin: Schmidt, 1999, pp. 68, 86, 85. For feminist readings underpinned by Freudian analysis see: Hélène Cixous, 'Fiction and its Phantoms: A Reading of Freud's "The Uncanny."' *The New Literary History*, 7.3 (1973), 525-48., pp.525-48; Jutta Fortin, 'Brides of the Fantastic: Gautier's *Le Pied de Momie* and Hoffmann's *Der Sandman*.' *Comparative Literature Studies*, 41.2 (2004), 257-75., pp.265-7; Ricarda Schmidt, 'E. T. A. Hoffmann's *The Sandman*: An Early Example of *Écriture Féminine*? A Critique of Trends in Feminist Literary Criticism.' *Women in German Yearbook*, 4 (1988), 21- 45., p.41.

² "Kinesis" means movement, but also the energy of movement, which causes bodies, or more abstract entities, to move. As an extension of this concept, "kinaesthesia" in human beings is "the inner sense of one's own body". See: Kevin T. Dann, *Bright Colors Falsely Seen: Synaesthesia and the Search for Transcendental Knowledge*. New Haven: Yale University Press, 1956. rpt. 1998, p.171. "Spasticity" means the condition or quality of performing involuntary, contractile movements.

³ The term "Romantic" applied to the Romantic literary period was in circulation amongst German scholars by 1800. Its first use in 1798 is generally attributed to Friedrich Schlegel. See: Friedrich Schlegel, *Characterisation and Criticism I (1796-1801)*. ed. Hans Eichner. München: Schöningh, 1967, pp.116, 182. Schlegel's idea of Romantic poetry is inclusive of literary prose fiction. All quotations attributed to Schlegel in this article refer to Friedrich, not to his brother.

⁴ Behler describes "infinite perfectibility" as the Romantics' perception of their historical period as "an all-pervasive moment of becoming", and their literature and criticism as in "a process of endless development" that would "yield new meanings from ever new modes of historical consciousness". See: Ernst Behler, *German Romantic Literary Theory*. Cambridge: Cambridge University Press, 1993. rpt. 2005, p.4.

⁵ Schlegel describes the contradictions inherent in Romantic Irony as the exercise of self-restraint (Besonnenheit) by the artist during the artistic process, so that he balances between "self-creation and self-destruction", stamping his self-hood onto his fictional work, and simultaneously mocking it as limited and fictional (37, 151). Romantic Irony, therefore, involves continuous oscillation rather than finite synthesis, a state of creative equilibrium often expressed by Hoffmann through the metaphor of hovering.

⁶ The masculine pronouns, "he", "his" and "him", are used advisedly throughout to refer to male artists.

metaphors is as much influenced by contemporary technology, science and graphic arts as by the German Romantic Movement.⁷

Although most critics now regard Freud's essay on Hoffmann's *The Sandman* as reductive, it did much to re-establish Hoffmann's reputation as a writer of fiction, and to dispel fallacious nineteenth-century criticism which attributed the madness of his artist figures to the author himself.⁸ Freud reads *The Sandman* as representing the castration complex, symbolised in the fear of losing one's eyes.⁹ Freudian analysis has spawned numerous critical studies, which engage with, extend or contradict his theories.¹⁰ Lucia Ruprecht's study, *Dances of the Self in Heinrich von Kleist, E. T. A. Hoffmann and Heinrich Heine* (2006) offers an analysis of the influence of dance on the work of those three authors. Her argument that, in the work of Kleist, Hoffmann and Heine, "bodily performances . . . bear testimony to, and articulate, an unspeakable, whether ineffable or censored [psychological] wound" is apposite to this study.¹¹ However, Ruprecht's main focus is the formation of subjectivity as part of the human condition, whereas my emphasis gives particular attention to the individual artist/writer and his relationship with contemporary ideas about Romanticism. Furthermore, putting aside Freud's perspective on castration, the loss of eyes is not only sexual but also suggestive of a dysfunctional body, which could be taken as a potent motif for a struggling writer.

Arabesques and kinaesthesia in the service of Romantic Irony

The arabesque structure of *The Sandman* demonstrates Hoffmann's consummate skill at combining apparently disparate narrative components.¹² This practice resembles

⁷ Contemporary developments in telescopic and optical lenses, electrical equipment for animal magnetism, anatomical experiments, and the vogue for building automata exemplify this claim.

⁸ See McGlathery's account of the changing reception of Hoffmann's work: James M. McGlathery, *E. T. A. Hoffmann*. World Authors 868. New York: Twayne, 1997, pp.21-25.

⁹ Sigmund Freud, 'The Uncanny,' in *The Standard Edition of the Complete Psychological Works of Sigmund Freud*. ed. and trans. James Strachey. London: The Hogarth Press and the Institute of Psycho-Analysis, 1955. rpt. 1991 xvii: 219-52.

¹⁰ For Freudian critical approaches, see: James M. McGlathery, *Mysticism and Sexuality: E. T. A. Hoffmann, Part Two: Interpretation of the Tales*. New York: Lang, 1985, p.57; Frederick Burwick, *The Haunted Eye: Perception and the Grotesque in English and German Romanticism*. Heidelberg: Carl-Winter Universitätsverlag, 1987, p.259; Siegbert, S. Praver, 'Hoffmann's Uncanny Guest: A Reading of *The Sandman*'. *German Life and Letters*, 18 (1965), 297-308., pp.300-3; Lee B. Jennings, 'Blood of the Android: A Post-Freudian Perspective on Hoffmann's *Sandman*.' *Seminar*, 22 (1986), 95-111., pp.97-9, 102; Samuel Weber, 'The Sideshow, or: Remarks on a Canny Moment.' *Modern Language Notes*, 88 (1973), 1102-33., pp.1105-10; John M. Ellis, 'Clara, Nathanael and the Narrator: Interpreting Hoffmann's *Der Sandman*.' *German Quarterly*, 54 (1981), 1-18., p.17; Malcolm V. Jones, 'The Sandman' and 'The Uncanny': A Sketch For an Alternative Approach.' *Paragraph*, 7 (1986), 77-101., p.78.

¹¹ See: Lucia Ruprecht, *Dances of the Self in Heinrich von Kleist, E. T. A. Hoffmann and Heinrich Heine*. Aldershot: Ashgate, 2006, p.15.

¹² "Arabesque", in this context, means an apparent digression, the centrality of which is often revealed through a retrospective understanding of the whole text. Stanley's critique of Hoffmann's narrative arabesques describes these looping forms as similar to polyphonic musical structures and to "the total concentration required of a dancer executing the arabesque turn in ballet in order to keep . . . the aesthetic line". See: Patricia Stanley, 'Hoffmann's 'Fantasy Pieces in the Style of Callot' in Light of Friedrich Schlegel's Theory of the Arabesque.' *German Studies Review*, 8.3 (1985), 399-419., pp.404-6. Rotermund uses Schlegel's phrase "artistically ordered entanglement" to describe Hoffmann's arabesque mode of writing, see: Erwin Rotermund, 'Musical and Poetic 'Arabesques' in E. T. A. Hoffmann.' *Poetica*, 2 (1992), 48-69., pp.59-60. All subsequent references are to this edition and are given in the text. See also: Friedrich Schlegel, *Characterisation and Criticism*, pp.218, 311. Schlegel

the weaving together of form and substance, as described by the contemporary writer and critic, Friedrich Schlegel.¹³ The woven texture of the novella works against definitive closure, giving the illusion that, even when the pagination stops, the reader never arrives at an ending. For example, the first narrative component comprises three letters, the first of which is analeptic. In that letter Nathanael describes the psychological and domestic catastrophe of his childhood. This allows the reader to understand Nathanael as an adult. The last component, after Nathanael's death, jumps forward several years in narrative time and describes a domestic tableau in which Klara sits contentedly with a future husband and family. This abrupt carnivalisation of Nathanael's tragedy by the addition of a fairy-tale ending has attracted much criticism.¹⁴ However, the addition is consonant with an arabesque narrative, which joins together heterogeneous and generically hybrid components without clear causation of events in the transition from one to another. The incongruous ending depicts domestic stasis after the rapid forward movement of events immediately preceding it. Thus, the first and last framing arabesques of *The Sandman* are integrally significant, the first providing an insight into Nathanael's neurosis and the last calling into question whether Klara's character was ever compatible for married life with a volatile poet. The ironic tone of the happy ending also undermines closure by inviting inexhaustible possibilities of interpretation. Form, substance and endless re-interpretations of the novella enact in narrative, textual and hermeneutic terms the contemporary Romantic idea of infinite perfectibility. The arabesque style of the novella halts and flows. Thus the form of the novel closely resembles periods of advance and stasis in Nathanael's frequently interrupted quest to excel as a poet.

The inner narrative components of *The Sandman* move sideways and forwards in narrative time and loop from one narrator to another. As Rotermund argues, the Hoffmannesque version of the Romantic arabesque style forces the reader to destroy what is "arbitrary" and to piece together the narrative bit by bit. Even though Rotermund is referring to the interwoven structure of Hoffmann's novel, *Tomcat Murr* (1820-1822), his observation is true of all Hoffmann's fiction (69). His use of "arbitrary", is probably taken from Schlegel (238, 389), but unarguably reiterates contemporary debates about artistic form. The relationship between the inner components becomes clearer after reading the whole text. Kinaesthetic and spastic imagery internally connects and contrasts with the formally sinuous shape of the narrative structure. For example, the unnamed narrator stops the story advancing after the three letters at the beginning by describing the difficulties of writing a story. He confesses how much he struggles, his thoughts boiling and whirling in his breast, to negotiate such creative manoeuvres.¹⁵ Nathanael's awkwardness is emphasised by its

describes arabesques generally as the most prominent trope of the Romantic period: p. 337. Hoffmann uses visual arabesques to frame his own illustrations for his novel *Tomcat Murr*, see: Ernst Theodore Amadeus Hoffman, *Ernst Theodor Amadeus Hoffman: Collected Works* Vols. 1, 2003; 2/1, 1993; 3, 1985; 4, 2001; 5, 1992. Frankfurt: Steinecke, Deutscher Klassiker Verlag, V: p.944, plates 1-4.

¹³ See: Friedrich Schlegel, *Characterisation and Criticism 1 (1796-1801)*. ed. Hans Eichner. München: Schöningh, 1967, pp.238, 389. All subsequent references are to this edition and are given in the text. In the early Romantic period, the terms, grotesque and arabesque, were often used interchangeably, only later diverging in meaning, see: Wolfgang Kayser, *The Grottesque in Art and Literature*. trans. Ulrich Weisstein. Indiana: McGraw-Hill, 1966, p.22. Schlegel's footnote to fragment 389 states that grotesque is synonymous with arabesque, see: Friedrich Schlegel, *Characterisation and Criticism*, p.238.

¹⁴ Indicatively, Holbeche describes the closing paragraph as 'crass', see: Yvonne, J. K. Holbeche, *Optical Motifs in the Works of E. T. A. Hoffmann*. Göppingham: Kümmerle, 1975, p.104.

¹⁵ See: Ernst Theodor Amadeus Hoffmann, *Collected Works*, III: p.25. Subsequent parenthetical references to Hoffmann's writing are to this edition of his collected works.

extreme contrast with the narrator's skilful handling of chaotic thoughts and his ability to keep his balance when on the move. The difference between the fictional narrator and Nathanael is that the narrator (and the author) successfully completes the novella, whereas Nathanael's progress towards becoming a poet eventually falters. For example, at the ball Nathanael dances stiffly and lumpenly in time with the automaton, Olimpia, believing her to be a real woman. His motor functions are poor, which metaphorically suggests that his apprenticeship as a poet is not running smoothly. Through the advice of a fictional Professor of Poetry and Rhetoric present at the ball, Hoffmann indirectly guides the reader to interpret the mobility of the dancing couple as metaphor (3: 46). Of course, this advice can be followed in several ways. A common critical reading interprets the ball as a satire against the stereotyping of women in bourgeois society, since many of the assembled company also believe Olimpia to be a real woman.¹⁶ However, for the purpose of the argument here, the important point is that it ironises Nathanael's misconceptions and immaturity.

Kinaesthetic and spastic motifs recur in many guises throughout the story, bringing cohesion and structural irony to the novella. In contrast to *The Sandman's* sinuous arabesque structure, its dominant metaphors feature motoric jerkiness and paralysis. This halting movement, both in the narrative and the kinaesthetic images, bears all the hallmarks of Romantic Irony, which characteristically operates in a switch-back motion. Schlegel describes Romantic Irony as a kind of self-parody, wit or Socratic irony in which positive and negative elements oscillate until the critic/reader becomes giddy. Uncertainty of interpretation arises from the rhythmic overlap of jest and seriousness in the text (108, 160). As a formal equivalent in *The Sandman*, propulsive (moving forward) narrative arabesques are in tension with its spastic motifs. The effect of this Romantic Irony is to critique Nathanael's endeavours. Nathanael, like many artist figures in Hoffmann's work and Romantic literature in general, represents the artist who faces many trials during his apprenticeship. The particular mode and genre of writing used to present this trial in *The Sandman* is macabre comedy. The set of kinaesthetic motifs that Hoffmann weaves through the narrative shows Nathanael failing to gain control over his body or to move it forward. This is concomitant with his lack of development as a writer.

The influence of Romantic writers

Hoffmann's work belongs to and mediates the texts and debates of German Romanticism. In Europe, a massive cross-fertilisation of ideas took place between artists, philosophers and scientists during a period of political upheaval and rapid paradigm-shift at the end of the eighteenth and the first two decades of the nineteenth century. Hoffmann's letters and diaries, which understate his struggle to survive in the teeth and aftermath of the Napoleonic occupation of Germany, testify to his participation in these changes and exchanges of ideologies, literature and culture. A compulsive bibliophile, he acknowledged, among many other writers, the influence of Novalis, Wackenroder, and Tieck (whom he knew).¹⁷ This list is not in the least exhaustive, but suggestive of the context of *The Sandman* within Romantic literature.

¹⁶ See: Nicholas Royle, *The Uncanny*. Manchester: Manchester University Press, 2003, p.47; John M. Ellis, 'Clara, Nathanael and the Narrator,' pp.11-12.

¹⁷ Hoffmann described himself as uplifted by the ideas of Schlegel and Novalis in diary entries for 12 January and 17 April 1812, both written during bouts of illness. (1: 378, 407). The title and contents of his first published piece (1803), which purports to be a letter from a monk to his friend, bear a notable resemblance to Wackenroder's *Outpourings of an Art-loving Friar* (1797). His own fairy-tales were

In pursuit of the harmony of body and soul, Novalis advocated the breaking down of barriers between art and science; feeling and reason; and the material and spiritual world.¹⁸ His Romantic novel, *Henry Ofterdingen* (1802), encapsulates his anti-binary way of thinking and demonstrates the importance to the early Romantics of the genre of romance or quest. The novel's protagonist, Ofterdingen, has a dream vision, in which a prophetic spirit inspires him with the words: "World turns to dream and dream to world".¹⁹ The vision sets Ofterdingen on his quest to become a poet. Hoffmann's fiction similarly combines everyday life with the world of dreams. However, their amalgamation is often uncanny, whereas Novalis's dream world tends to be more mystical. As a polymath, Hoffmann has close affinities with Novalis's promulgation of encyclopaedic knowledge.²⁰ The former's literary language invariably merges auditory and visual images, colour, tone and rhythm; and his broad knowledge of literature, fine art, music, philosophy, science, technology and psychology blends into and informs all his writing and musical compositions.

Wilhelm Heinrich Wackenroder and Ludwig Tieck's work often focused on the incompatibility of the artist's vocation with the necessity of living in a material, peopled world. This tension between art and life is repeatedly expressed through metaphors of whole-and-part body movement, spasm and the maintenance of balance, together with the allegory of travelling. In Wackenroder's *Fantasies on Art for Friends of Art* (1799), for example, the musician, Berklinger, strives to reconcile the everyday demands of his life with his desire to reach a dream-like state of consciousness in which he can compose.²¹ He describes this higher consciousness in terms of physical isolation and constriction of body movement, a position in which even his hand would not be able to reach out and touch a fellow human being (76). Instead he gloomily perceives himself as attached to the world for the duration of his life, suspended like an Aolian harp, and subject to the vagaries of the wind in order to make music (79).²² Wackenroder's 'A Wondrous Oriental Fairy-Tale about a Naked Saint' (1799) in *Fantasies* offers another variation of kinaesthesia as a motif to represent the creative process. In this allegory, the saint may be read as an artist (whether writer, painter or musician) who has transcended the limitations of the material world. He spins above the ground in "mighty hurtling wheels of time" where Art, personified, reaches out its "shining hands from heaven...so that we hover above the desolate abyss in a bold position, between heaven and earth" (66-7). In this telling example of poetic levitation, he physically vibrates with anxiety and, after a transfiguring experience, ascends to heaven in angelic form. Wackenroder's imagery unarguably influenced Hoffmann's much more ironic presentation of Serapion in *The Hermit Serapion* (1820). The *Naked Saint* may also have shaped the motifs of

influenced by Tieck's and, in a letter to him in 1820, Hoffmann described Tieck's collection, *Fantasia*, as "magnificent". See: Ernst Theodor Hoffman, *Selected Letters of E. T. A. Hoffmann*. ed. and trans. Johanna C. Sahlin. Chicago: Chicago University Press, 1977, pp.274, 300.

¹⁸ See Behler's commentary on Novalis's encyclopaedic philosophy: Ernst Behler, *German Romantic Literary Theory*, p.287.

¹⁹ Novalis, *Henry Ofterdingen*, Vol. 1. *Novalis's Writings: The Works of Friedrichs von Hardenberg*. ed. Richard Samuel and Hans-Joachim Mähl. Stuttgart: Kohlhammer Verlag, 1960-88, p.319.

²⁰ For example, Novalis's *Brouillon*, published in 1788-1799.

²¹ Wilhelm H. Wackenroder and Ludwig Tieck, *Fantasies on Art for Friends of Art*. 1799. Deutscher National-Litteratur, Historische Kritische Ausgabe 145. Berlin: Spemann, 1885, pp.75-9. All subsequent references are to this edition and are given in the text.

²² In Hoffmann's novel, *Tomcat Murr* (1820-21), the name of the mad painter, Leonhard Ettlinger, is probably a reworking of Wackenroder's musician, Joseph Berglinger.

spinning and circles of fire in *The Sandman*. Nathanael has a similar mental obsession with circles, but he gyrates inelegantly and the transformation of his consciousness is downwards or away from the centre towards madness.

In historical accounts of German Romanticism, it is a familiar fact that Wackenroder and Tieck planned their writing together and Tieck published Wackenroder's texts after the latter's death. Tieck was also influenced by the Schlegel brothers, to whom he dedicated his collection of stories and fairy-tales called *Fantasmus*.²³ The fairy-tales follow in the steps of Wackenroder, but are often more satiric, which would, no doubt, have had particular appeal for Hoffmann. Tieck's novel, *Franz Sternbald's Wanderings* (1798), exemplifies the Romantic theme of the artistic quest. Sternbald, like Ofterdingen, journeys by indirect routes and makes progress circuitously. The brief sketch of Novalis, Wackenroder and Tieck's work already suggests that the motif of body movement, whether in a personal space or a large spatial area, tends to be symbolic of the imaginative process of creating works of literature or other arts.

Hoffmann's writing reveals its debt to these antecedent novels and fairy-tales. In *The Sandman* images of kinaesthesia and spasticity, in extreme forms even seizure, correlate with Nathanael making progress and marking time during his troubled journey from child to adulthood. Hoffmann's fiction persistently focuses on the awkward or gauche bodily presence of artist figures in pursuance of their arts. For example, the old painter, Bickert, in *The Mesmerist* (1814); the writer, Anselmus, in *The Golden Pot* (1814); the violin-dismantler, Krespel, in *Councillor Krespel* (1819); and the composer and musician, Kreisler, are all physically challenged, as well as spiritually driven, when facing detours and setbacks. Even Anselmus who, unlike Nathanael, eventually reaches the dream kingdom of Atlantis, the world of poetry (2/1: 321), is clumsy. His journey is tortuous, interrupted at one stage by immobilisation inside a glass bottle. The common feature of all Hoffmann's wandering artists is that their travelling towards and entry into the realm of the imagination demands as much physical toil as spiritual elevation. Although, like his fellow writers, Hoffmann used body movement as an aesthetic metaphor for artistic expression, he favoured grotesque variants of this motif. Even though biographical criticism has its limitations, it must be of some significance that his own physical hyperactivity gave him an especial awareness of restless muscle movement.²⁴

Since motoric functions of various parts of the body and travelling across extensive spatial areas occur frequently as metaphors for the creative process in German Romantic literature, it is not surprising to find another variation in the motif of the dance. For example, Heinrich von Kleist's allegorical story, *On the Marionette Theatre* (1810), is apposite and contrastive to Hoffmann's *The Sandman*. Although principally a playwright, Kleist nevertheless published a collection of prose fiction in 1810. This collection engaged with contemporary politics and the problems of becoming a successful artist while living under the Napoleonic occupation of Germany. The motifs of Kleist's story concern the beauty of physical movements executed without conscious thought. The principle dancer of a local theatre explains

²³ Ludwig Tieck, *Fantasmus*. Vol. 6. *Ludwig Tieck: Collected Works*, Frankfurt: Frank, Deutscher Klassiker Verlag, 1985, pp.9-10.

²⁴ Bleiler describes Hoffmann's hyperactivity thus: "The mobile features of his-deeply lined face were in perpetual motion . . . His hands and feet, too, shared this activity, and the simile may have occurred to the others at the banquet that he was like a stick puppet in his movements". See: Ernst Theodor Amadeus Hoffman, *The Best Tales of Hoffmann*. ed. E. F. Bleiler. New York: Dover, 1967, p.v.

to the narrator why he gives his engrossed attention to the movement of marionettes whose limbs swing like pendulums. The dancer "added that this movement was very simple; that every time, when the centre of gravity was moved in a straight line, the limbs already described curves; and that often . . . the whole puppet fell into a kind of rhythmic movement which resembled dance".²⁵ The force which "lifts" the limbs into the air is greater than the one that "feters" them to the ground (559), whereas the most light-footed of human dancers is weighted down by bodily mass. The dancer concludes that desiring the graceful movement of a puppet in motion is a worthwhile, but eventually unattainable, goal.²⁶

In comparison, Hoffmann's automaton, Olimpia, moves in strict clockwork time, imitating but not expressing human movement. In a macabre reversal, her dancing partner, Nathanael, becomes mechanised. This Hoffmannesque emphasis on the grotesquerie of the dance sets him apart from Kleist. Both Kleist and Hoffmann's dancers, as representatives of artists in general, fail to reach their end-goal, but the means to the end are different. Kleist's dance motif of the string puppet suggests a freely swinging weight that barely touches the ground. Hoffmann's Nathanael needs to trust the weight and energy of his own body, which is capable of moving sympathetically to music if it were not artificially governed by the automaton (3: 39). Kleist's motif is an image of transcendence, while Hoffmann's is one of transcendence through groundedness. Yet both writers use kinaesthetic metaphors to symbolise the Romantic quest, whether the aim is to create a dance, poem, painting or musical composition. In summary, the examples above are recurrent enough to show that German Romantics, alongside a vast range of other tropes, did use metaphors of kinaesthesia, kinetics and travelling to signify creativity. Hoffmann belongs to this family of writers, while imprinting his own mark on their shared mode of writing. If awareness of the whole body in relation to itself and the space it moves in (kinaesthetic awareness) is associated with writing poetry (painting or composing), then, conversely, bodily disintegration or spasticity is symbolic of loss of creativity. Thus, by extension of this metaphoric schema, violent movement and violation of body parts come to signify miscreation or loss of creativity. There is, certainly, a distinctive emphasis in *The Sandman* on grotesque variants of kinaesthesia. Oppositional motifs of spasticity and paralysis in this novella provide an ironic counterpoint to images of progressive locomotion.

Callot's grotesque engravings – irony and dynamic movement

In literary and theatrical traditions the grotesque embraces principles of digression, paradox, oxymoron, comic relief and satire, and displays itself in farce, low comedy and burlesque. Writers such as Rabelais, Cervantes, Sterne and Swift, all of them

²⁵ Heinrich Kleist, 'On the Marionette Theatre,' in *Heinrich Kleist: Collected Works*. Frankfurt: Müller-Salget, Deutscher Klassiker Verlag, 1990, III: 555-63., p.556. All subsequent references are to this edition and are given in the text.

²⁶ Further formative influences on Hoffmann's use of the dance motif may stem from Goethe's depiction of Lotte in *The Sufferings of Young Werther* and Mignon in *Wilhelm Meister's Apprenticeship* (Goethe 9: 469). See: Johann Wolfgang Goethe, *The Sufferings of Young Werther*. trans. Bayard Quincy Morgan. London: Calder, 1964, pp.33-4; *Wilhelm Meister's Theatrical Mission and Wilhelm Meister's Years of Apprenticeship*, Vol. 9. *Goethe: Collected Works: Letters, Diaries and Conversations*. Frankfurt: Voßcamp und Jaumann, Deutscher Klassiker Verlag, 1992, p.469. See also Broszeit-Rieger's interpretation of Mignon's egg-dance as a Romantic allegory for the production of meaning: Ingrid Broszeit-Rieger, 'Practice and Theory of Dance in Goethe's *Meister*.' *Neophilologus*, 90.2 (2006), 303-20., p.316.

favourites of Hoffmann, worked in the genre of the grotesque. The work of painters and engravers also fed into Hoffmann's perception of artistic form. As has been well documented, he chose to model the themes and structure of his writing on the illustrations of French engraver, Jacques Callot, whose original carnivalesque illustrations he first saw in Berlin.²⁷ He dedicated *Fantasy Pieces* (1814), his first collection of novellas, fairy-tales and musical anecdotes, to Callot, expressing his passionate interest in the engraver's dancing demons, peasants and clowns, and the burlesque figures of the *commedia dell' arte* (2/1: 17-18). Unarguably, the influence of Callot had a residual effect on his second story collection, to which *The Sandman* belongs.

Hoffmann was particularly inspired by Callot's engraving, *The Temptation of St. Anthony*, in which "thousands of figures come to life" and "stride powerfully forth" (17). He confessed that he could not get enough of Callot's grotesque forms, which "emerge beside each other, even within each other, yet without confusing the eye, so that individual elements are seen as such, but still blend with the whole"(17). Above all he wished to emulate Callot's irony because, he averred, it combines the fantastic with common subjects from everyday life and "derides man with his paltry works and endeavours" (18). In both versions of Callot's *St Anthony* engraving, hybrid creatures mingle with human beings, all of them energetically engaged in mundane, nightmarish or scatological activities. There are multiple Bosch-like vignettes of balletic demons that dance, fly or dangle from precipices and towers, while peasant dancers step it out firmly on the ground. Perhaps vestiges of these grotesque motifs find an attenuated expression in the penultimate episode of *The Sandman* when, after Nathanael has pushed her over, Klara holds on to the parapet of the tower until rescued, for longer than human strength could endure. Callot's fantastic world defies gravity. The visionary and spatial features in his picture, which influenced Hoffmann so much, are transmuted into narrative themes and composition, and replicated in Nathanael's demonic behaviour on the tower.

Hoffmann eventually possessed prints of Callot's *Sfessanian Dances* (circa 1621 sequence).²⁸ These engravings of ballet dancers encapsulate the dynamics of balance. They execute arabesques with speed and energy, while at the same time their suggested phalluses and carnival masks provide an ironic comment on their fluidity and beauty of movement. Their bodies are grotesquely distorted, but they are also poised in a spin. They combine elements of both *zanni*, the clown, and *balli*, the dancer. Their masks appear to enlarge the eyes and elongate the nose. Metaphorically, eyes and noses are phallic, but also carnivalesque. Masks limit the vision of the wearers, deceive onlookers about the identity of the wearer and give licence for temporary aberration and transgression.

The mood of menacing comedy in Callot's figures is traceable in *The Sandman* in the character, Advocate Coppelius, the principle agent of the plot. He

²⁷ Although Hoffmann admired Hogarth as a satiric artist, he chose Callot's engravings as a model. Walter Scott in 1827 condemned Hoffmann for preferring the work of Callot, whose "garden" produced "wild and fantastic weeds", to those of Hogarth, whose "garden" was "carefully cultivated" and testified to his moral fibre. See: 'On the Supernatural in Fictitious Composition; and particularly on the Works of Ernest Theodore William Hoffman (sic).' (*London Foreign Quarterly Review*, 1 (1827), 60-98., p.94.

²⁸ See: Gerald Kahan, *Jacques Callot: Artist of the Theatre*. Athens: Georgia University Press, 1976, pp.11-20, figs 1-24. Hoffmann had the prints re-engraved and simplified as illustrations for his *Princess Brambilla: A Caprice in the Style of Jacques Callot* (1820); see: Lucia Ruprecht, *Dances of the Self*, pp.74-95.

does not dance, but his heavy gait and repeated tread on the stairs over many years prompt the child, Nathanael, to identify him as the Sandman. His massive head, large nose, a pair of piercing eyes and wig of inadequate size mark him out as grotesque (3: 15). His hairy hands and hissing voice also terrify the children in Nathanael's family (16). In the penultimate episode on the tower, Nathaniel perceives Coppélius to be of variable size, both microscopically small at the foot of the tower and then rising to the size of a giant (49). This metamorphosis reinforces the idea of distortion and instability. Professor Spalanzani, the fraudulent trickster who, together with Coppélius, made the automaton, also has piercing eyes and an ill-proportioned body. There are discernible resemblances here to Callot's series of dwarf figures called *Gobbi* (1616), all of whom have beady eyes within large mask-like surrounds, and absurdly misshapen heads and bodies.²⁹ The scene on the stairs when Coppélius and Spalanzani fight for possession of the automaton is authentic slapstick farce (3: 44). Both of these characters are figurative of artists because they are artificers as well as academics, and both are roundly mocked. The poet, Nathanael, also cuts a comic figure who absurdly careers off course but, as argued below, lacks their powerful gaze. This web of motifs which links body dynamics, clowning and looking gives Hoffmann the scope to lampoon the aspiring artist who strives to create, but fails to keep a sense of equilibrium in the process.

Hoffmann's use of Callot-like grotesques in the examples above brings to the fore the invariable alliance between kinaesthesia and kinetics in *The Sandman*. This motivic connection has a negative side which subverts the idea of bodily wholeness and co-ordination and includes violent dismemberment, animated body-parts, and inanimate objects injected with movement. The pattern is so persistent that kinaesthesia and kinetics begin to emerge as integral to the themes of the novella, rather than being merely decorative. Hoffmann indisputably knew that the grotesque could be used as a satiric tool, and had a strong propensity to mock anything self-congratulatory.³⁰ His own version of the grotesque is distinctively dynamic. Eyes, in particular, are often grotesquely relocated in places unnatural to them. Much critical attention has been accorded to the ocular grotesque in the novella, but the particular emphasis here is on the kinetic distortion of the whole body and is directed at exploring Hoffmann's handling of Romantic Irony.³¹

The childhood trauma, which shapes Nathanael's future life, begins with the wrenching and twisting of his joints in their sockets, as well as with a threat to his eyes. In the letter that opens *The Sandman*, he relates how, as a child, he secretly watched his father engaged in an experiment with Coppélius, a visitor to his family home whom he dreaded. What he saw shocked him so much that he fell out of his hiding-place. Hoffmann's own pen-and-ink sketch of this scene captures the imminent

²⁹ See: Gerald Kahan, *Jacques Callot*, pp.92-4, figs. 70-6.

³⁰ See: Ernst Theodor Hoffman, *Selected Letters*, p.324. When accused of libel in his novella, *Master Flea* (1822), Hoffmann wrote a letter from his deathbed in defence of its publication. The defence quoted Karl Flögel's *A History of Grotesque Comedy* (1788). Hoffmann's endorsement of Flögel's theories suggests that the motif of the grotesque in his own work was consciously chosen, fully informed and symbolic.

³¹ See: Wolfgang Kayser, *The Grottesque*, pp.71-6; Siegbert S. Prawer, 'Hoffman's Uncanny Guest,' p.303; Maria M. Tatar, *Spellbound: Studies on Mesmerism and Literature*. Princeton, New Jersey: Princeton University Press, 1978, p.130; Yvonne, J. K. Holbeche, *Optical Motifs*, p.88; Detlef Kremer, *E.T. A. Hoffmann*, p.84; Frederick Burwick, *The Haunted Eye*, pp.264-5 and Martin Willis, *Mesmerists, Monsters, and Machines: Science Fiction and the Cultures of Science in the Nineteenth Century*. Ohio: Kent State University Press, 2006, pp.55-61.

moment as Nathanael peeps out with a startled expression from behind curtains, just before he tumbles from his hiding place to the floor (3: 17, 921 - fig. 2). Coppelius then seized him, manipulated his hands and feet, threatened to take out his eyes, hurled him towards the furnace, singed his hair and caught up lumps of coal to throw in his eyes. Brantly's critical reading that Coppelius and Nathanael's father are attempting to make a homunculus is expedient because it provides motivic cohesion.³² The fictional Klara's suggestion that the scientific experiment is alchemical does not explain Coppelius's interest in joint-articulation and artificial eyes. Violent movement and physical violation are often associated with miscreation, or creativity that is out of joint in Hoffmann's work. For example he uses the same metaphor in *The Mesmerist*, published two years earlier, in which the tormented artist, Bickert, describes his dream of a devil taking him apart "like a jointed puppet", to see how it would look "if a foot might grow out of my neck or my right arm might be joined to my left leg" (2/1: 190). In *The Sandman*, the body in a state of trauma brings on temporary paralysis. In his letter to Klara, Nathanael describes himself as motionless, as if held under a spell or "pressed under a heavy, cold stone" (3: 16, 19) while he watched Coppelius at his furnace. After being violated by Coppelius, a convulsion passed through his limbs and he blacked out. Later, after an accidental explosion that killed his father, Nathanael became unconscious. His early identification of the Sandman with Coppelius sets up a cycle of terror, trembling, paralysis and recovery, which is repeated until he dies.

Nathanael's ability, or lack of ability, to control his body, is reiterated in many ways in *The Sandman*. Hoffmann's use of this kinaesthetic motif is more complex than a simple analogy between mastering dance movements and taking control of the creative imagination. For example, the scene of the ball dramatises, among other things, the danger of losing touch with human physicality and retreating into the solipsistic world of fantasy. Nathanael succeeds in executing a dance with Olimpia, but he never gains control over the maelstrom of emotions that rack his encounters with her/it. He does not achieve a conscious state of mental or physical equilibrium in the material world. This state of balance has affinities with the contemporary aesthetic of "Besonnenheit", which might be translated as artistic level-headedness or self-restraint.³³ The unbalanced Nathanael dances under the illusion that Olimpia is a physical entity, and it is the brutal shattering of that illusion which tips him towards madness. An informative comparison lies in Hoffmann's Kapellmeister Johannes Kreisler, the central human character in Hoffmann's musical essays and anecdotes, *Kreisleriana* (1814), and his novel, *The Life and Opinions of the Tomcat Murr* (1820-1). Kreisler's gait demonstrates that a kind of ethereal weightlessness, such as Wackenroder's saint and Kleist's string puppets possess, is not a prerequisite for the imaginative leap into writing poetry or, in Kreisler's case, into composing music. Kreisler never overcomes his jerky movements. Nonetheless, he acquires enough physical co-ordination (to use the kinaesthetic motif) to control his creative imagination within the confines of the visible and tangible world. Speaking of himself in the third person, Kreisler explains his name in this much-cited quotation:

You cannot get away from the word Kreis, a circle, and heaven grant that you may then immediately think of those wonderful circles in which our entire

³² See: Susan Brantly, 'A Thermographic Reading of E. T. A. Hoffmann's *The Sandman*.' *German Quarterly*, 55 (1982), 324-35., p.326.

³³ See Friedrich Schlegel, *Characterisation and Criticism*, pp.37, 151.

existence moves, and from which we cannot escape, even should we want to resist. Kreisler circles in these circles, and it may well be that, tired out by the hyperactivity of St. Vitus dance which constrains him, and battling with the dark inscrutable power which circumscribed these circles, he often yearns . . . to free himself. (5: 78)

After long years of apprenticeship, the mature Kreisler learns to accept material and psychological parameters, and to harness his chaotic visions within them. His truly inspired moments of musical composition fluctuate with a sceptical view of himself and the world. Within the parameters of Romantic Irony, Hoffmann presents him as a figure of fun *and* a composer of beautiful church music.

By comparison, the adult Nathanael teeters on the edge of madness when he dreams of Coppélius touching Klara's eyes as they stand at the altar. The burning eyes leap into his breast, while Coppélius "hurls him into a circle of flames" (3: 31). Later, in a horrific adaptation of the Pygmalion myth, Nathanael watches the tearing apart of the mechanical doll, Olympia. Spalanzani picks up her eyes fallen from their sockets and throws them at Nathanael's chest, "Now madness seized him with its red-hot claws and entered his inner being, tearing his mind to pieces". His vision of a horrific dance causes him to shout at her "Spin fiery circle! Come on! . . . Spin wooden dolly, hey, spin . . ." (45). He hurls the same insult at Klara before pushing her over the edge of a tower in the penultimate episode of the narrative. Nathanael's vision of spinning in flames symbolises the elevated state of consciousness from which the artist creates.³⁴ His flights of imagination, so disapproved of by Klara, produce a poem that conjures up further deadly visitations from the Sandman and augurs his own death. However, as events unfold, Nathanael fails to control the kinetic energy of spinning or the white heat of inspiration. He does not learn to manoeuvre himself like Kreisler. His uneven decline from inspired poet to raving madman is charted in a mock-heroic way, graphically dramatised in scenes where he reels in the ecstasy of poetic ideas, dances in turgid fashion, and leaps about "like a tormented animal" (48).

Hoffmann's appropriations from science and technology

Metaphors of violent body movement are repeatedly associated with a crisis in poetic vision in *The Sandman*. As a variation, sensitive trembling and flowing energy (possessed by the fictional narrator) indicate the potential for poetic inspiration. Catherine Minter's detailed correlation between artistic sensibility in eighteenth- and early nineteenth-century German literature and the work of several influential scientists, is certainly relevant here.³⁵ For example, of the neuro-physical science of vitalism and the vitalist Albrecht von Haller, she writes "[he] provid(ed) what to the eighteenth-century mind was strong evidence that the nerves are hollow fibres filled with a subtle fluid (the nervous fluid or vital spirits) rather than solid vibrating 'strings'".³⁶ It is highly probable that the paradigms of vitalism influenced

³⁴ See Brantly's pertinent analysis of Hoffmann's use of metaphors of heat, fire and flickering light as symbolic of poetic inspiration and, conversely, ice and darkness as associated with its destruction: Susan Brantly, 'A Thermographic Reading,' pp.332-3.

³⁵ Contextually, sensibility means "hair-triggered" sensitivity and "an intense emotional responsiveness to beauty and sublimity, whether in art or nature". See: M. H. Abrams, *A Glossary of Literary Terms*. Fort Worth: Harcourt & Brace, 1993, pp.190-1.

³⁶ Catherine J. Minter, 'Literary 'Empfindsamkeit' and Nervous Sensibility in Eighteenth-Century Germany.' *The Modern Language Review*, (2001), 1-15. 9 Feb. 2008.

contemporary received understanding of the union, rather than the separation, of body and mind. In brief, the human brain was judged to be the *sensorium commune*. As the seat of sensation, the *sensorium commune* was regarded as the percipient centre to which sense-impressions were transmitted by the nerves. The sensorium was believed to operate through one unified sense, which fused differentiated stimuli. The vitalistic driving force of perception was thought to be feeling and emotion, rather than reason, cognition and abstract thought. This medico-scientific understanding of the sensorium informed the contemporary cultural validation of "hair-triggered" sensibility, which was considered a great virtue of character, unless indulged to excess (3-8). Minter's analysis of how Jean Paul Richter and fellow writers appropriated the vocabulary of eighteenth-century German neuro-science in order to express Romantic sensibility is helpful in understanding Nathanael and the artists he represents (2, 8-9).³⁷ As one of these writers, Hoffmann himself had a detailed knowledge of contemporary science, medicine and psychology.³⁸ His descriptions of Nathanael's sensibility and "hair-triggered" responsiveness to any situation conflate medical and Romantic terminology. Nathanael's hypersensitivity is conjointly muscular, neural *and* embodied in his life as a poet. It is, therefore, doubly significant that he "trembled" when Coppelius climbed the stairs (3: 13); and "felt himself shake in his innermost heart" when Coppola knocked on his door (34).

In addition to his familiarity with eighteenth-century medical science, Hoffmann was fascinated by the mechanical bodies of automata.³⁹ He admired their ergonomics and made use in his literary writing of that brief moment when the onlooker could not be quite sure whether they were mechanical or sentient, dead or alive.⁴⁰ A compelling example in *The Sandman* occurs when Nathanael associates Olimpia with the legend of the dead bride (40). Post-Freud, one can anachronistically and confidently describe such moments as "uncanny".⁴¹ However, in historical context, the contemporary reader, unlike the writer, might well have been more aware of the reputation and popularity of automata than of current neuro-scientific ideas. It is likely, though speculative, that Hoffmann's main readership did not theorise too deeply about the uncanny aspects of the novella, but rather, simply enjoyed the "shudders" that the story engenders in a similar way to enjoying the spectacle of a working automata. Whether one takes a historicist or psychological interpretive approach to Nathanael's downfall, it is clear that the release of his repressed fears and

<<http://www.encyclopedia.com/doc.1G1-80448776.html>>, p.2. All subsequent references are to this edition and are given in the text.

³⁷ Jean Paul Richter wrote the Foreword to Hoffmann's first story collection.

³⁸ Maria M. Tatar, 'Mesmerism, Madness, and Death in E. T. A. Hoffmann's *The Golden Pot*.' *Studies in Romanticism*, 14 (1975), 365-89., pp.366-7.

³⁹ Hoffmann visited displays of working automata in Danzig (1801) and Dresden (1813). See Kremer's account of Hoffmann's precise knowledge of automata and artificial intelligence: Detlef Kremer, *E.T.A. Hoffmann*, p.68. Hoffmann's novella, *Automata* (1819), explores extensively the contrast between the Romantic artist and working automata.

⁴⁰ Todorov cogently argues that the reader's uncertainty whether a fictional character or situation is "real" or supernatural produces the literary uncanny, see: Tzvetan Todorov, *The Fantastic: A Structural Approach to a Literary Genre*. trans. R. Howard. Ohio: Cleveland University Press, 1973, p.26.

⁴¹ Robertson reads Hoffmann's reference to the uncanny legend of the dead bride as an allusion to Goethe's poem *The Bride of Corinth* (1798), see: *E. T. A. Hoffmann: The Golden Pot and Other Tales*. ed. and trans. Ritchie Robertson. Oxford: Oxford University Press, 1992, p.403. Kremer also remarks on the uncanny effect when a mechanical doll triggers a fantasy of creative power that collides with its extreme opposite – the horror of death, see: Detlef Kremer, *E.T.A. Hoffmann*, pp.68, 81-2.

desires is largely triggered by the incongruous movements of a mechanism that simulates human kinetics.

Contemporary technologies that made possible the projection, magnification and distortion of images were also adapted and reworked as literary motifs by Hoffmann. Phantasmagoria and magic lantern shows were at the height of popularity in Europe in the late-eighteenth century. Hoffmann himself designed and executed phantasmagorias for the Bamberg Theatre.⁴² Alongside many references to these in his fiction, the affectionate portrait in *Tomcat Murr* of the necromancer, Master Abraham, bears witness to Hoffmann's enjoyment of mechanisms, illusion, mirrors and magic. Surviving antique magic lanterns betray their mechanical movement as each wooden-framed glass slide is inserted. Though revolutionary in their time, their projected images are jerky and unsteady. This suggests that Hoffmann's literary use of optical distortion must have had an even stronger contemporary impact than is obvious to today's reader. Moreover, transportation into a dream world through visual illusion is a compelling metaphor for Romantic transcendence.⁴³ The kinetic motifs of *The Sandman* aptly suggest that Nathanael, as a representative of all Romantic artists, needs to negotiate the flickering, phantasmagoric images of his mind in order to render his visions in palpable form.

With the overlapping motion of magic lantern slides, the phantasmagoric grotesque in *The Sandman* merges together motifs of mobile eye-balls and eye spectacles. Another variation of these ocular and optic motifs, which are synecdochic of disembodied eyes, is a pocket-spyglass. Coppelius, impersonating an Italian pedlar of optical goods named Coppola, spread out these flickering, gleaming "eyes" on Nathanael's table, where they "stared at Nathanael . . . and flaming glances jumped about ever more wildly and darted their blood-red rays" into Nathanael's breast (3: 35).⁴⁴ Hoffmann creates a macabre theatrical scene as Coppelius/Coppola, in clown-like fashion, takes more spectacles from his wide pockets than one coat could be expected to hold. This scene is a fine example of Romantic Irony, described by Schlegel as combining jest and seriousness (108, 160). Nathanael's failure to sense anything comical, however black, in the pedlar's performance renders him vulnerable to manipulation. Before the confidence trickster leaves, he gives Nathanael the pocket-spyglass so that he can see Olimpia in close focus. The spyglass is a literal object, a metaphor *and* a performative agent, which drives forward the momentum of the plot by increasing Nathanael's manic behaviour and facilitating his death. The motifs of kinaesthesia and kinetics come into play in yet another variation here because a spyglass appears to cause distant objects to leap forward in one bound. In the penultimate scene on the tower, Nathanael inadvertently directs his spyglass onto

⁴² See: David Charlton, ed., *E. T. A. Hoffmann's Musical Writings: Kreisleriana, The Poet and the Composer, Music Criticism*. Cambridge: Cambridge University Press, 1989, p.64. See also Myrone's account of contemporary German phantasmagoria in: Martin Myrone, Christopher Frayling and Marina Warner, *Gothic Nightmares: Fuseli, Blake and the Romantic Imagination*. London: Tate, 2006, pp.146-7.

⁴³ Castle encapsulates the connections between theatrical phantasmagoria and the nineteenth-century poetic imagination by noting that it "conveyed exquisitely . . . that state of neurasthenic excitement in which images whirled chaotically before the inward eye, impressing on the seer an overwhelming sense of their vividness and spiritual truth". See: Terry Castle, *The Female Thermometer: Eighteenth-Century Culture and the Invention of the Uncanny*. New York: Oxford University Press, 1995, p.159.

⁴⁴ That the fictional narrator, refracted through Spalanzani, calls Coppola Coppelius (3: 44-5), shows they are one character. Metaphoric interpretations of Coppelius impersonating Coppola invite ideas of doubling and the *doppelgänger*.

Klara standing by his side, causing a grotesquely enlarged image of her to jump into view. Although the narrator does not spell out cause and effect, it is the suddenly enlarged image of Klara which initiates Nathanael's final manic episode, in which his muscles convulse and he pushes Klara over the parapet (to which she clings for dear life). This precedes Nathanael noticing Coppelius below the tower, goading him to jump to his death. Thus, his whole body is disturbed, not solely his eyes (49). The grotesquely distorted telescopic image and Nathanael's bodily dysfunction are closely associated just before his definitive paralysis in death.

Furthermore, *The Sandman* makes a figurative link between travelling circuitously, circling, climbing steps and stairs, and pushing a lever, which are related kinaesthetic metaphors through which Hoffmann expresses, rather than theorises, his perception of Romantic aesthetics. An initial context for this is the contemporary scientific research into electricity and the popular obsession with animal magnetism. Many critics have noted Hoffmann's use of the mesmerist, magnetiser, magus or magician as representative of the artist, for example Alban in *The Mesmerist* and Count S---i in *The Uncanny Guest* 1820.⁴⁵ The mesmerist was believed to have a powerful gaze, which caused the person gazed upon to move involuntarily. Webber relates artistic creativity and electrical magnetism in the following way:

Hoffmann's tales recurrently set up magnetic fields and electric circuits in order to galvanise fictional life. . . . Not only the electric eye, but also discursive power, the charged narrative, takes galvanic effect. Through the electric conduction of the story the narrator is able to subject his readers or hearers to his mastery. . . . By operating the right levers, [Hoffmann] contrives to induce live currents into the narrative machinery and to vivify the automaton. (155)

Although the leverage metaphor is not prominent in *The Sandman*, except as a parody in Olympia's clockwork mechanism, Hoffmann frequently used the idea of fine adjustment or fine-tuning to suggest the creative process of lifting the artist to higher levels of consciousness and of sustaining the reader in higher realms of the poetic imagination.⁴⁶ The sense of force and danger in these electrical and mechanical metaphors is strong, and the potential for the creative process to double-back and electrocute or crush the artist is ever present. The eccentric artist figure, Councillor Krespel, exemplifies the artist who has curbed the excesses of his own (and temporarily his daughter's) creativity in order to stay relatively sane. He combines to perfection a physical condition characterised by involuntary gestures, jerks and leaps, together with a disposition that is attuned, like "a lightening conductor", to the higher realms of the imagination (4: 54).

⁴⁵ For readings of Hoffmann's symbolic use of mesmerism, see Liane Bryson, 'Romantic Science: Hoffmann's Use of the Natural Sciences in *The Golden Pot*.' *Monatshefte*, 91.2 (1999), 241-55., p.243; Maria M. Tatar, *Spellbound*, pp.132-42; Andrew J. Webber, *The Doppelgänger: Double Visions in German Literature*. Oxford: Oxford University Press, 1996, pp.148-184; Siegbert, S. Praver, 'Hoffmann's Uncanny Guest,' p.303; Martin Willis, *Mesmerists Monsters and Machines*, pp.54-61.

⁴⁶ In fictional discussions about literary principles between the Serapion brothers, Hoffman uses the lever and circle motifs together. He combines them in a dialogue following the anecdote, The Hermit Serapion (1819) to describe the poet, Serapion, who permanently inhabits his own imaginative world, unaware of the "lever" and the "circle" of the material world around him. Unlike Wackenroder's naked saint, who becomes the apotheosis of the artist, Serapion is much ironised by Hoffmann (*The Serapion Brothers* 4: 68).

In *The Sandman* the eyes of the artist figures, Coppelius and Spalanzani, have mesmeric power.⁴⁷ As briefly alluded to earlier, Coppelius's "greenish cat's eyes" and Spalanzani's "small, piercing eyes" have life-changing effects on those around them. Coppelius/Coppola displaces his magnetic influence into the optical lenses he displays to Nathanael. The influence of these multiple eyes on Nathanael is galvanising and destructive. In contrast to these artist figures, Nathanael's eyesight is dull, which he puts down to juvenile terror stemming from witnessing Coppelius and his father engaged in experimentation (3: 18).⁴⁸ In the long term, this experience stunts his growth as a poet. As an alternative to a Freudian reading of eyes as a phallic motif, his pale eyes and fear of losing his eyes form part of an extended metaphor concerning the lack of poetic power to inspire his listeners. Passionate reading of his poetry to the two women he loves fails to activate either the automaton Olympia, or his fiancée Klara, except for eliciting her disgust. Both are static in different ways. Klara's only extreme involuntary physical exertion occurs when Nathanael pushes her over the parapet. She is invariably composed as if for a portrait or tableau (28, 49). Olympia, in a comparable way, is either stilted or immobile once her spring mechanism has wound down.⁴⁹ Neither Klara nor Olympia is "endowed with an electrical current sufficient to charge the atmosphere" of the novella, or "spark the imagination" of the writer, as are many muse-like women in Hoffmann's work.⁵⁰ On the other hand, the fictional narrator of *The Sandman* gains control over "the swirling bustle of multiple abstract forms" in his head and searches for effective, highly-charged words to give "an electric shock" to his readers (26). The kinetic imagery of swirling and electrical current symbolises the search for a concrete form in which to express the Romantic imagination. The narrator, who may be taken as a composite of successful artists, taps into the energy and moving chaos of his imagination. In contrast, the words of the poet, Nathanael, are only intermittently "electrified" or "electrifying".

Romantic antics and artistry in Hoffmann's stories

Metaphors of suspension and level-headedness, widely used by German writers at the beginning of the nineteenth century as part of the developing discourse of Romanticism, are also reworked by Hoffmann. A common Romantic "principle" urged artists to maintain a state of balance between the spiritual and the material. One of Schlegel's maxims, for example, states that the true Romantic artist is suspended between two spheres. Temporarily balanced between creative chaos and order, he is empowered to "hover in the middle on the wings of poetic reflection" (116, 182-3). Clearly this concept of the creative process has a lightness and airiness not present in Hoffmann's *The Sandman*. Even in his musical writings, which employ the imagery

⁴⁷ Tatar traces the mesmeric influence of many "magnetic personalities [with] a penetrating gaze and basilisk-like eyes" in Hoffmann's fiction, but not with regard to *The Sandman*: Maria M. Tatar, *Spellbound*, p.130.

⁴⁸ Although Ruprecht's argument about the effect of eyes and kinesis in *The Sandman* is illuminating, her claim that "Olimpia and Coppelius are being deliberately kept animate by the protagonist's burning gazes, and by the glowing colours of his writings" cannot be substantiated. See: Lucia Ruprecht, *Dances of the Self*, p.70.

⁴⁹ Belgardt's claim that "the most comprehensive meaning of Olympia" is "the embodiment of a spiritual world of higher understanding and perception, of the poetic ideal" is not convincing. See: Belgardt, Raimond, 'The Artist and the Puppet: Towards an Interpretation of Hoffmann's *Der Sandmann*.' *German Quarterly*, 42.4 (1969), 686-700., p.692.

⁵⁰ Tatar usefully describes several "electrical muses", who offer a stark contrast to Klara and Olympia: Maria M. Tatar, *Spellbound*, pp.127-30.

of rarefied flight to signify Romantic transcendence more persistently than does his prose fiction (2/1: 53, 4: 103-4), Hoffmann still retains the notion that the composer, or artist of any kind, achieves "flight" only after an apprenticeship. Hoffmann describes Beethoven's instrumental music and Gluck, Mozart and Spontini's operas in this way.⁵¹ He observes that creative genius cannot be taught, but neither, without considerable development and practice, can the budding composer "walk on his own without the need for a leading rein" (5: 627). The point need not be laboured that Nathanael's flights of the imagination are eventually abortive. He cannot hold together two opposing ideas of poetic inspiration and groundedness; neither can he sustain an ironic view of himself and the experiential world with all its complexity and ugliness.

The aesthetic concept of airy suspension was readily available to Hoffmann in contemporary fairy-tales. He regularly reworks it to ironise Romantic images of flying and breaking the bounds of earth.⁵² Indeed, the artists in his fiction are frequently shown to need the weight of self-irony to keep them sane. The painter, Bickert, in *The Mesmerist*, is one such pragmatist. Ottmar, an enthusiast in that novella, describes reaching the higher realms of imagination in terms of climbing a step-ladder. Bickert mockingly observes that "Once we believe we are quite high . . . we tumble down disgracefully and, through the giddiness which gets hold of us, we realise that the thin air in these higher regions does not suit our heavy heads" (2/1: 193). The German word for giddiness, "Schwindel", is a pun meaning both giddiness *and* swindle or deception. Thus, the metaphor of falling emphasises the dangers of solipsism and the questionable rewards of a Romantic dream world. The dialogue between Bickert and Ottmar is also "Romantic" in a formal, structural sense by anticipating how, in the later collection, *The Serapion Brothers* (1819-1821), Hoffmann intersperses and embeds his artistic formulations between and within stories. The dialogical structure of the four volumes of *The Serapion Brothers* typifies the Romantic aesthetic which favours fragmentary writing that mixes genres and discourses.⁵³

One of the main contributors to aesthetic discussion of Serapiontic principles is the narrator, Theodore, who describes the Romantic artist in this way:

I think that the bottom of the ladder to heaven on which one wants to climb up into higher regions must be grounded in life, so that everyone is able to climb up. If, having climbed higher and higher, he [the artist] then finds himself within a fantastic magical realm, he will come to believe that this realm too is part of his life, and that this realm is actually the most wonderfully beautiful part of it. (4: 721)

⁵¹ Hoffmann praises Beethoven's high degree of "Besonnenheit" (circumspection) as well as his true genius (2/1: 55). Appositely, Benert analyses Hoffmann's ecstatic review of Beethoven's Fifth Symphony by drawing attention to the convergent and positional concepts which underpin Hoffmann's critical position, and by arguing that Hoffmann's comment: 'Beethoven's music operates the lever of fear, of horror, and pain, and awakens the infinite yearning that constitutes the essence of Romanticism' (2/1: 54), "couple[s] evocations of the infinite with allusions to the mechanical", see: Colin Benert, 'Dividing Time: Musical Memory and the Dis-closure of Fate in E.T.A Hoffmann's *Automata*.' *Studies in Romanticism*, 45 (2006), 559-634., p.613.

⁵² See Chapin's reading of Hoffmann's use of metaphorical elevation, not as connoting escape, but as suggesting intensification of experience within a single, material world: Keith Chapin, 'Lost in Quotation: The Nuances behind E. T. A. Hoffmann's Programmatic Statements.' *Caliber: 19th-Century Music*, 30.1 (2006), 44-64., p.48.

⁵³ Schlegel describes this Romantic aesthetic by mixing examples from Dante, Shakespeare and Cervantes, see: Friedrich Schlegel, *Characterisation and Criticism*, p.337.

This kinaesthetic metaphor is illuminating in retrospect with regard to *The Sandman*. It is a banal observation that most of its characters do not live or work on the ground floor of buildings. This entails much use of stairs and steps, giving Hoffmann the scope to introduce the Gothic menace of footsteps echoing on the stairs, and the gruesomely macabre effects of fighting on stairs or falling from a height. By the penultimate episode, the recurring preoccupation with kinetics and contractile body movements renders the spiralling steps within and the encircling parapet at the top of the tower particularly resonant.

Bickert and Theodore's metaphor of climbing, one of many that Hoffmann uses to illustrate his aesthetic principles, suggests that the artist who separates himself from the rest of humanity loses touch with either or both the infinite and the material world.⁵⁴

Nathanael's fall from the tower is figured in the metaphoric ladder. Theodore's kinaesthetic verbs, "aufsteigen" (to climb or rise up) and "aufklettern" (to climb or clamber up), imply the physical and sensory effort required by the writer to progress. Fluency of movement is not necessary, but co-ordination between eye, hand and foot is. Such kinaesthetic control has to be laboured after and learnt. Simultaneously, (the Serapion brother) Theodore's biblical reference to Jacob's Ladder between heaven and earth (*Genesis* 28: 11-19) invokes the notion of ascent and controlled descent as symbolic of poetic inspiration. By transferring the concept of Jacob's mystical dream to the artist's task, Theodore's comparison encapsulates the special gifts of the artist as a mediator between spirit and matter. Climbing up and down the ladder implies both the need for some degree of kinaesthesia to prevent precipitous descent *and* an elevated vision to lift the poet, painter or musician upwards.

Nathanael's intermittent spasticity weakens his ability to ward off either internal or external invasive forces. He fails to "dance within the circle" (5: 78) of his life.⁵⁵ He cannot stay balanced nor make progress in any direction. His final (down)fall, both from the tower and the metaphoric ladder, follows a long tradition of mock-heroic romance narratives in which the hero falls short of his aspirations. In accord with the positional motifs of the circle, the lever and the ladder, *The Sandman* shows that the pathway between the spiritual and the material world is a continuum where the poet wanders back and forth, across, or up and down. The kinetic and kinaesthetic motifs suggest that the maturing artist strives to avoid a divided life. He positions himself medially and travels expansively. He chooses to move along a continuum, instead of delimiting himself, in binary fashion, to the mundane on the one side or the infinite on the other.

This interpretation of motor-muscular co-ordination and three-dimensional movement as Romantic motifs differs in emphasis from R. Murray Schafer's comment that "[e]xtension horizontally into space is almost unknown" in Hoffmann; and also from Mirjam Jooß's reading that Hoffmann's presentation of creative

⁵⁴ Hoffmann was much influenced by the Romantic idea that an aesthetic principle was not rigid, but rather "a mental view, a visual perception, and not at all a systematisation or construction of the results and contents of knowledge", see: Ernst Behler, *German Romantic Literary Theory*, p.77.

⁵⁵ For philosophical corroboration of this argument, see Chapin's account of Hoffmann's circumscribed world in terms of contemporary German positive idealism: Keith Chapin, 'Lost in Quotation,' p.50.

inspiration is invariably a "two-fold" movement upwards.⁵⁶ However, the analysis offered here is consonant with Hoffmann's professed admiration for Callot's aesthetic practice of creating pictorial compositions "from the most heterogeneous elements" (2/1: 17).⁵⁷ A close literary equivalent of Callot's spatiality of design occurs in Hoffmann's first story, *Sir Gluck* (1809). The dominant motif of horizontal circumambulation is significant in this story of Romantic quest. The narrator wanders around the even spread of streets in Berlin, periodically meeting the composer Gluck, a visitor from the spirit world (2/1: 19-31).⁵⁸ These excursions allow him sporadic and, finally, triumphant access to Gluck's visions. In contrast, Nathanael only makes quixotic progress in his journey towards poetic inspiration.⁵⁹ He does succeed in writing impassioned poems, which conjure up the Sandman and prophesy the future, but his creative vision careers off course, ending, before the last arabesque leaps forward in narrative time, in his death.

Conclusion

The Sandman is syncretically enmeshed with the German Romantic Movement. However, Hoffmann's ironic presentation of the artist quest has a distinctive "signature". His strikingly graphic images have a quirky animation, making them verbal equivalents of his idiosyncratic line-drawings.⁶⁰ *The Sandman's* vigorous kinaesthetic and kinetic motifs are as much influenced by contemporary engraving, technology and medical science as by literature. Its recurrent body metaphors represent a vitalistic flow of creative energy that manifests itself in a multi-directional momentum. These offer a negative critique of artistic compartmentalisation of perceptions, and specifically of the Romantic impulse to transcend or escape material, sensory constraints. Hoffmann demonstrates a nuanced and pragmatic Romanticism.

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⁵⁶ R. Murray Schafer, *E. T. A. Hoffmann and Music*. Toronto: Toronto University Press, 1975, p.161; Mirjam Jooß, 'Attempting to Solve the Paradox of E. T. A. Hoffmann's Musical Aesthetics.' *WMA Forum*, (2007) 1-10. Word and Music Association. 2 Feb. 2008. < <http://www.wordmusicstudies.org> >, pp.5-6.

⁵⁷ Hoffmann uses motifs of the mosaic and the kaleidoscope in Serapiontic discussions to express spatial, rather than vertical, aesthetic structure. Rotermund usefully interrogates the "flattening", heterogeneous effects of both these literary motifs, see: Erwin Rotermund, 'Musical and Poetic,' p.54.

⁵⁸ Critics dispute whether the revenant, Gluck, is "real" or imagined in this story, see Schmidt's summary: Ricarda Schmidt, 'Classical, Romantic and Postmodern Musical-Aesthetic Paradigms in E. T. A. Hoffmann's *Sir Gluck*,' in "*Seelenaccente*" – "*Ohrenphysiognomik*". *Zur Musikanschauung E. T. A. Hoffmanns, Heines und Wackenroders*. ed. Werner Keil and Chris Goer. Hildesheim: Olms, 2000. 11-61., pp.15-16. Whichever interpretation is favoured, the argument here concerning spatial and kinetic motifs still holds.

⁵⁹ The physical antics of Cervantes' anti-hero, Don Quixote, shaped Hoffmann's love of the grotesque. Forced to bed by fatal creeping paralysis in February 1822 Hoffmann sent a dictated letter to Dümmler, asking for Tieck's translation of Cervantes' novel. The letter states: "I am astonished how much it matters to me, for *Don Q.* is truly a book to cheer one's spirit!" See: Ernst Theodor Hoffman, *Selected Letters*, p.328. Equally, the picaresque adventures of Rabelais and Sterne's characters made their mark on the internal dynamics and arabesque structure of Hoffmann's writing.

⁶⁰ Hoffmann's own cartoons of Kreisler careering about, one foot on the ground and arms flung wide, illustrate this dynamic quality (5: 944, figs. 5, 6 and 7).

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'The World-Renowned Ichthyosaurus': A Nineteenth-Century Problematic and Its Representations

John Glendening

I

The first edition in English of Jules Verne's *Voyage au centre de la Terre* (1864), published in 1871 as *A Journey to the Centre of the Earth*, like the original features an epic combat between two enormous marine reptiles but identifies one of them as "the world-renowned ichthyosaurus".¹ One of many alterations this British rendition imposes upon the second, expanded edition of Verne's novel (1867), the spurious "world-renowned" was added not only to heighten interest, but also, quite likely, to appeal to nationalism since ichthyosaur fossils were first identified, described, and publicized in England. The story of early ichthyosaur discoveries has been told often enough, with recent stress upon the scientific acumen and potential, once downplayed because of gender and class, of fossil collector Mary Anning.² At Lyme Regis, Dorset—the epicenter of paleontological shocks and excitement that radiated out to Britain and beyond—beginning in 1811 Anning discovered and excavated the first fossilized ichthyosaur skeletons recognizable as "an important new kind of animal".³ Her once undervalued scientific credentials, however, represent but one of the ways in which the ichthyosaur of scientific and popular imagination swam in unsettled cultural waters.

As the first large prehistoric reptile discovered and identified in England, the ichthyosaur ("fish-lizard") built upon and furthered the British enthusiasm for natural history, geology, and fossil collecting that flourished especially in the first half of the nineteenth century. It also participated in the century's contentious scientific-religious confusions about the earth's age, the origins of species, the causes of extinctions, and how to comprehend ancient, gigantic animals unaccounted for by the Bible. This essay concerns how the nineteenth-century idea of the ichthyosaur "evolved", changing as scientific discovery overlapped other cultural arenas. Fossilized ichthyosaur remains, initially almost inexplicable, haltingly but progressively took on the flesh of scientific knowledge about the form and behavior of the thing itself, while broader cultural shaping of the creature's supposed nature and significance lost ground. I will give some attention to scientific findings about the ichthyosaur, from

¹ Jules Verne, *A Journey to the Centre of the Earth*. London: Griffith, 1871, <<http://www.gutenberg.org/dirs/1/8/8/5/18857/18857.txt>>, 15 Sept. 2009, Chapter 30. n. pag.

² Anning became widely known as a fossil collector, but her background and gender meant that she was in no position to publish or address learned societies; there is much evidence that she would have been capable of doing both under less discouraging circumstances. On Anning's abilities and obstacles, see: Christopher McGowan, *The Dragon Hunters: How an Extraordinary Circle of Fossilists Discovered the Dinosaurs and Paved the Way for Darwin*. Cambridge, Massachusetts: Perseus, 200, pp.16-20; Deborah Cadbury, *The Dinosaur Hunters: A Story of Scientific Rivalry and the Discovery of the Prehistoric World*. London: Fourth Estate, 2000, pp.3-12, 25-32; and especially Hugh Torrens, 'Mary Anning (1799-1847) of Lyme: 'The Geatest Fossilist the World Ever Knew'.' *The British Journal for the History of Science*, 28 (1995), pp.257-84.

³ See: Christopher McGowan, *The Dragon Hunters*, p.23. Fossilized ichthyosaur remains had been found before but were interpreted "as belonging to some sort of crocodile" (22). See also: Dennis R. Dean, *Gideon Mantell and the Discovery of Dinosaurs*. Cambridge: Cambridge University Press, 1999, pp. 58-60 for the early descriptions of ichthyosaurs based on Anning's finds.

the early nineteenth century to the present. My focus, however, is upon the variable interplay between nineteenth-century scientific and literary-artistic understandings of "the ichthyosaurus", a text that interacted in various ways with its societal context to influence how it could be read. Verne's mid-century *Journey* introduces the trends and contingencies that informed ichthyosaurus representations, including pictures and models, while references in novels by Thomas Hardy and Joseph Conrad suggest the ichthyosaurus's significance at century's end. This creature, like other radically new phenomena at odds with familiar categories of thought, presented a compelling problem, one both entangled with human aspirations and anxieties and receptive to the interpretive imagination.

II

Although early investigators soon recognized the ichthyosaurus's skeletal structure as reptilian, one of the first things that struck observers about the specimens being disinterred from cliffs and quarries was the similarity the streamlined shape of the living animal must have borne to those of present-day dolphins and fast-swimming fish.⁴ Of even more obvious note were immense jaws lined with scores of conical teeth. Equally apparent were its enormous eye sockets, which of themselves indicated to early analysts their predatory nature, causing one commentator to style it "the tyrant of the deep".⁵ With imposing teeth and eyes, the largest of the early specimens—Mary Anning's initial find of a nearly complete fossil measured thirty feet—suggested a creature out of myth and legend; Verne heightened this effect by making his version a hundred feet long and spectacularly ferocious. This mythic quality coupled with the realization that it actually existed made the ichthyosaurus particularly strange and interesting—as was the case for the other great extinct reptiles, frequently described as "dragons" and "monsters" that soon followed it in being first described in the early nineteenth century: the plesiosaur, megalosaur, iguanodon, and pterodactyl.⁶

This strangeness is subtly enhanced by the best-known translation of *Journey*, which attaches ichthyosaurs and other prehistoric animals to the bible-based strangeness implicit in the theory known as pre-Adamatism. The following discussion of this and related ideas entails a temporary detour away from ichthyosaurs in order to consider some of the scientific and religious issues that swirled around these animals and lay behind Verne's description of one.

Rendered by a scientifically-minded Anglican priest, Frederick Amadeus Malleon (1819-97), the 1877 English translation entitled *A Journey into the Interior of Earth*, the basis of many later editions, is far more accurate than the 1871 version but nevertheless makes emendations that, by responding theologically to the mass of geological information and misinformation Verne weaves into his narrative, bear upon the ichthyosaurus and its nineteenth-century significance. In this vein, on four occasions when Verne employs the term "antediluvians", Malleon translates it as

⁴ Although the earliest discovered specimens, dating from the Jurassic, were dolphin or fish shaped, not all ichthyosaurs, especially the early ones, fit that description. For discussion of ichthyosaurs from the early to late Mesozoic, see: Christopher McGowan, *Dinosaurs, Spitfires, and Sea Dragons*. Cambridge: Harvard University Press, 1991, pp.219-56.

⁵ See: Anon., 'Abstract of a Paper on the Fossil Ichthyosaurus Lately Purchased for the Birmingham Philosophical Institution, Read on the 1st of May, 1837.' *The Analyst: A Quarterly Journal of Science, Literature, Natural History, and the Fine Arts*, 7 (1837), 233-40., p.236.

⁶ Besides the ichthyosaurus, Anning discovered the first plesiosaur and the first English remains of a pterodactyl (pterosaur).

"preadamite" rather than as the obvious cognate "antediluvian".⁷ For example, in leading up to the reptilian combat, the narrator muses upon "the monsters of the preadamite world, who . . . preceded the animals of mammalian race upon the earth".⁸ In the nineteenth-century "pre-Adamite", or preadamite, assumed as one of its meanings the generalized idea of "ancient" or of the later "prehistoric", although not quite to the degree that "antediluvian" and its French equivalent had done, terms that also had a somewhat wider circulation. But as used by Malleon, "preadamite" also recalls the Genesis-based notion that God created the earth and various life forms, including humans, long before He did Adam and Eve—an implication that "antediluvian" does not carry. While "pre-Adamite", without necessary biblical reference, became attractive to nineteenth-century geologists who believed in an ancient earth—since "antediluvian" originally meant only the comparatively short period of time between the biblical Great Flood and the Creation—the word's theological history tinges Malleon's handling of Verne's novel.

Pre-Adamatism was given prominence by Isaac de la Peyrère (1596-1676). The theological core of his position was that a New Testament passage ascribed to Paul about divine law and the sinfulness that preexisted Law (Romans 5:12-14) refers to commandments given to Adam rather than Moses, and therefore that humans must have existed before Adam; de la Peyrère elaborated upon this theory to argue that Gentiles were descended from Pre-Adamites, Jews from Adam and Eve. Advocates of pre-Adamatism sometimes founded their beliefs upon the two creation stories in Genesis: the first, Genesis 1:1-2:4, in which the names Adam and Eve do not appear, was thought to cover a vast expanse of time that witnessed God's pre-Adamite creations, while the succeeding one concerned the creation of Adam and Eve and the "Adamite" world. Pre-Adamite humans were sometimes employed to explain the multiplicity of races, and in the nineteenth century the idea was enlisted to support pseudo-scientific racism with the idea that non-white races were descended from ancient Pre-Adamites inferior to the Caucasian Adam and Eve; however, Pre-Adamites sometimes were imagined as superior to Adamites—Adam and Eve's descendants. Sanctioned by literalist readings of the Bible, the belief that the earth was only a few thousands of years old had prevailed until challenged by late eighteenth- and early nineteenth-century geology, but pre-Adamatism had already posited the idea of the world's ancientness.

When used in more restricted senses, rather than as what developed into a widely employed synonym for "ancient", "antediluvian" also had an involved history. As described in Genesis, the antediluvians were Adam's descendants who preceded the great flood, and many stories elaborated upon the Biblical account (Genesis 1-6) of their natures and the why and wherefore of their destruction. The non-canonical *Book of Enoch* presents such an account. There was general agreement that antediluvians were different from modern humans—Genesis reports their immense ages—and sometimes the whole antediluvian world was comprehended as in various

⁷ I learned of departures from Verne's language via the Project Gutenberg e-text of Malleon's translation, the headnote to which cites Christien Sánchez for detecting inconsistencies and providing examples. Forewarned, I noticed other inaccuracies, along with the "pre-Adamite" translation of "antediluvians", and subsequently Mr. Sanchez kindly sent me further instances of the clergyman's Bible-related adjustments to Verne's text.

⁸ Jules Verne, *Journey to the Interior of the Earth*, trans. Frederick Amadeus Malleon. London: Ward, 1877, < <http://www.gutenberg.org/dirs/etext03/8jrny10.txt> >, 15 Sept. 2009, Chapter 33. n. pag. Subsequent references to Malleon's translation are to this online edition and are given by chapter within the text.

ways fundamentally different from the current one. The great comparative anatomist and seminal paleontologist Georges Cuvier (1769-1832) understood the biblical flood as the last of a series of extermination events that had wiped out many species of flora and fauna; others, including some geologists, were comfortable in asserting the biblical flood as a singular occurrence that obliterated antediluvian humans and many animal species. The Great Flood fit well with catastrophism, the idea, primarily the legacy of Cuvier, that violent events such as floods, earthquakes, and eruptions fashioned the Earth in its current form. It appealed to geologists who sought to interpret the Bible literally and thus, in support of biblical authority and a recent Creation, thereby oppose the new wave of early nineteenth-century geologists who accepted evidence of an ancient earth; however, as Ralph O'Connor's *The Earth on Show* (2007) demonstrates in its extensive examination of "science as literature" in the first half of the nineteenth century, this opposition, at its most intense in the 1830s, was not always clear cut, with positions overlapping in complicated ways.⁹

Pre-Adamatism did not initially have anything to do with geology, but early nineteenth-century geologists used "pre-Adamite" to refer generally to an ancient Earth and, since most geologists considered themselves devout Christians, to differentiate that immense epoch from the recent, relatively brief one of human occupation that included the Great Flood. The idea that pre-Adamite humans existed was far less acceptable to scientists, since verified non-modern human remains were not discovered until mid-century, although Cuvier left room for such speculation, on the basis of which William Beckford's novel *Vathek* (1786) refers to Pre-Adamites, thereby influencing Lord Byron to do likewise in his closet drama *Cain* (1822).¹⁰

A relatively minor but resilient force through the nineteenth-century, pre-Adamatism appeared in new versions published not long before Malleson's translation of *Journey: Isabelle Duncan's Pre-Adamite Man* (1860), popular enough to warrant multiple printings over the course of several years, and Dominick M'Causland's *Adam and the Adamite: The Harmony of Scripture and Ethnology* (1864).¹¹ Both attempted to reconcile religion with science, biblically assimilating

⁹ See: Ralph O'Connor, *The Earth on Show: Fossils and the Poetics of Popular Science, 1802-1856*. Chicago: University of Chicago Press, 2007, p.393. In general, O'Connor's project complicates binary oppositions conventionally applied to nineteenth-century positions relevant to earth history—science and literature, science and religion, amateur and professional, and so forth. Subsequent references are to this edition and are given in the text.

¹⁰ In Beckford's novel, the corrupt Caliph Vathek descends into Hell to obtain "the treasures of the pre-adamite sultans, who had been monarchs of the whole earth" but now lie as "fleshless forms" in a doleful state of suspended animation, punished for their pride and crimes, as Vathek will be as well. See: William Beckford, *Vathek*. Third rev. ed. London: Clark, 1816, pp.210-15. In Byron's *Cain*, the title character says to Lucifer, who has presented him with a dispiriting vision of earth history replete with death and extinction, "Thou hast shown me wonders: thou hast shown me those / Mighty Pre-Adamites who walked the earth / Of which ours is the wreck". See Lord George Gordon Byron, *Cain, A Mystery*, in *The Complete Poetical Works*. ed. Jerome McGann and Barry Weller. Oxford: Clarendon, 1991, VI: 227-95, pp.2.2.358-60. In his Preface, Byron states that he "partly adopted . . . the notion of Cuvier, that the world had been destroyed several times before the creation of man", but although this idea derives from "different strata and the bones of enormous and unknown animals found in them", the fact that no human remains had been found in them means that "The assertion of Lucifer, that the pre-adamite world was also peopled by rational beings much more intelligent than man, and proportionately powerful to the mammoth . . . is, of course, a poetical fiction . . ." (229-30). Byron expresses the intimidation that the idea of extinction, as disseminated especially through Cuvier's influence, exercised on the nineteenth-century mind.

¹¹ Although *Vathek* and *Cain* present Pre-Adamites as once mighty humans, M'Causland believed them to be degenerate precursors of modern inferior races.

geological evidence for an ancient earth. Paschal Beverly Randolph's 1863 *Pre-Adamite Man*, however, eschewed reconciliation between the two spheres and instead attempted a strictly scientific approach.¹² Tracing pre-Adamatism from its theological origins through its science-related manifestations in the nineteenth century, David N. Livingstone, in his detailed expositions of the idea's complex history, presents the theory as an important instance, especially in its nineteenth-century form, of "the harmonizing tactics that have been deployed to keep alive the marriage of science and religion."¹³

While not overtly religious, Verne apparently also was interested in such harmonizing, especially regarding an ancient earth to which both pre-Adamatism and nineteenth-century geology attested.¹⁴ To some degree the balancing of science and religion occurs in Chapter 32 when Axel, Verne's narrator, recounts a lengthy waking dream in which he retrogresses through time, witnessing various stages of the earth's history back to its creation—an instance of a tradition of visionary time travel that O'Connor notes as part of a pervasive nineteenth-century penetration of geological writing and representations by literary approaches (246-56, 272-75).¹⁵ In Axel's vision, the earth's development comes about through natural processes, but he supplements his descriptions with biblical references. For example, in Malleon's translation, Axel says, "I return to the scriptural periods or ages of the world, conventionally called 'days,' long before the appearance of man when the unfinished world was as yet unfitted for his support" (ch.32). A French version of the phrase "conventionally called 'days'", however, does not appear in Verne's original. Verne is willing, via Axel, to employ, perhaps with a touch of irony, the belief that over a great expanse of time the pre-human world was directed toward conditions that would allow human habitation. Malleon adds the well known idea, sometimes adopted by partisans of pre-Adamatism, that the six days of creation of Genesis were in fact six ages or epochs each of enormous duration.

Elsewhere Axel's vision is overtly touched by Verne's skeptical treatment of Genesis-derived beliefs. This occurs when he has Axel ironically describe an extinct creature, "the Anoplothere", as "a singular animal taking after the rhinoceros, the horse, the hippopotamus, and the camel, as if the Creator, in too much of a hurry in the first hours of the world, had put together several animals in one".¹⁶ Apparently not appreciating Verne's fanciful disrespect, Malleon censors the reference to divine fallibility, reducing the passage to "the anoplotherium (unarmed beast), a strange creature, which seemed a compound of horse, rhinoceros, camel, and hippopotamus" (ch.32). Verne's willingness to reconcile science and religion is limited, unlike that of Malleon with his beliefs in part deriving from, or at least consistent with, pre-Adamatism.

In Chapter 39 Malleon again promotes "preadamite" over "antediluvian" for his translation of Verne's "antediluvians" when the appearance of one of the

¹² See: David N. Livingstone, *Adam's Ancestors: Race, Religion, and the Politics of Human Origins*. Baltimore: Johns Hopkins University Press, 2008, p.111.

¹³ David N. Livingstone, 'The Preadamite Theory and the Marriage of Science and Religion.' *Transactions of the American Philosophical Society*, 82.3 (1992), i-81., pp.ix-x.

¹⁴ Verne's long-time editor, Pierre-Jules Hetzel, pressed him to display, or at least not violate, Christian piety in his various narratives.

¹⁵ O'Connor's book discusses many scientific texts and exhibits that appeal to readers' and viewers' imaginations by conducting them to various stages of earth history.

¹⁶ Jules Verne, *Journey to the Centre of the Earth*. trans. William Butcher. Oxford: Oxford University Press, 1998, p.152.

protagonists, afflicted by a violent storm and strange electrical phenomena, suggests "a comparison with preadamite man, the contemporary of the ichthyosaurus and the megatherium". Malleson provides a corrective footnote, "Rather of the mammoth and the mastodon. (Trans.)", but leaves intact the possibility of a literal "preadamite man", an implication the retention of "antediluvian" would not have made. As is evident elsewhere in his novel, Verne knows that humans did not coexist with ichthyosaurs but the idea, perhaps explained by the excitement with which Axel recalls the episode, fits with the imaginative thrust of science fiction that makes Verne's explorers encounter ichthyosaurs and other extinct creatures mixed together from different geological eras. Indeed, Verne supplies a specimen of a human who lives in the midst of prehistoric animals and contemporaneously with ichthyosaurs and other extinct animals: a gigantic herder of mastodons, glimpsed from afar, whom Malleson, again pushing his biblical notions beyond what Verne warrants, identifies as "preadamite" rather than as Verne's "antediluvian" (ch.39). *Voyage* galvanized the novelistic tradition of confronting characters with extinct prehistoric animals; it occurs, for instance, in early twentieth-century novels by Arthur Conan Doyle and Edgar Rice Burroughs, in *Jurassic Park* (1990) and its movie spin-offs, and in numerous cartoons, printed and animated, stretching from the mid-nineteenth century to today.

Verne's minor efforts, and Malleson's stronger ones, to harmonize science and religion is part of the complicated story of nineteenth-century geology—its many discoveries, competing and overlapping theories, and interactions with society at large. For example, John Breyer and William Butcher point out that Verne's novel adopts the theories of both progressionism and directionalism (48). Progressionism means that geological and fossil evidence illustrates a trajectory of increased biological complexity leading to humans and the modern world, a pattern informing *Voyage* throughout; until after Darwin's *Origin of Species* (1859) even geologists generally understood progressionism to entail a form of special or separate creations, with ever more sophisticated species independently appearing across the ages, via divine agency, in consonance with changing environments. At the same time, however, progressionism sometimes accommodated the idea that individual species themselves tend toward degeneration, as evidenced in Axel's statements that fossils show "both fish and reptiles alike are more perfect the further back they were created" and—anticipating the upcoming encounter with the enormous crocodile-like ichthyosaur—that "even the largest and most formidable crocodiles and alligators, are but feeble reductions of their fathers of the first ages".¹⁷ Mid-nineteenth century directionalism held that ancient geological processes, whether acting catastrophically or gradually, represent changes caused by the cooling of the earth from an early condition of great heat. It was a natural complement to progressionism for those wishing to reconcile geology and religion, since a cooling earth could be understood as divinely mandated progress toward habitation suitable for humans. Breyer and Butcher note that directionalism also informs a number of Axel's statements (48-49).

Some religious orientations accepted both the idea of directional history as progress—the world becoming more suitable for mammalian and ultimately human life—and of species degeneration—individual groups of animals falling off in

¹⁷Quoted in: John Breyer and William Butcher, 'Nothing New Under the Earth: The Geology of Jules Verne's *Journey to the Centre of the Earth*.' *Earth Sciences History*, 22.1 (2003), 36-54., pp.49-50; *Journey to the Centre of the Earth*. trans. William Butcher. Oxford: Oxford University Press, 1998, pp.151,156. Subsequent references in each case are to these editions and are given in the text.

sophistication or complexity. Louis Figuier's popular *La terre avant le deluge* (1863, 1872) articulates the orderly scheme in which God perfects individual life forms while replacing lower with higher ones. Of late Jurassic ichthyosaurs and their reptilian contemporaries, he says, "Nature seems to have wished to bring this class of animals to the highest state of development", and he asserts that all prehistoric animals demonstrate that "the organization and physiological functions go on improving unceasingly, and that each of the extent genera which preceded the appearance of man, present, for each organ, modifications which always tend towards greater perfection". Figuier ends his discussion of ichthyosaurs and plesiosaurs by stating, "let us learn . . . to recognise, with admiration, the divine proofs of design which they display, and in their organisation to see only the handiwork of the Creator".¹⁸

This injunction appears to express the influence of natural theology, most famously advanced in the works of William Paley and his analogical "argument from design": that design proves the existence of a designer, and copious evidence of design in nature proves the existence of God. Natural theology directly or indirectly influenced most early geologists and other naturalists, who perceived instances of divine handiwork consistent with their scientific findings. William Buckland's *Geology and Mineralogy: Considered with Reference to Natural Theology* (1837), in one of the earliest published descriptions of ichthyosaurs, discusses the perfection of design in the ichthyosaur species that had been discovered to that point and concludes that "we cannot but recognise throughout them all, the workings of one and the same eternal principle of Wisdom and Intelligence, presiding from first to last over the total fabric of Creation"¹⁹. In Britain natural theology sometimes merged with directionalism and progressionism, promoting as "an article of faith among natural theologians [the belief] that both the history of the Earth and the history of life represented the unfolding of a divine plan designed to produce an Earth perfectly suited for human habitation".²⁰

In the following passage James A. Secord, while challenging the simplistic story of nineteenth-century science vs. religion, argues that geologists used progressionist earth history to wean Christians away from a biblical literalism opposed to the implications of geological evidence:

The vast majority of the public continued to believe that the Creation, the Fall, and the Flood were defining moments in the physical history of the world. If geologists were to change this, some compelling account would have to take their place. Their findings challenged some interpretations of the Flood and the Creation, but could offer instead a divinely directed story of progress, preparing the earth for humans. Scripture and science were never locked in inherent conflict; had they been, introductions to geology would have been consigned to the gutter press. Rather, geologists (many of

¹⁸ Louis Figuier, *The World Before the Deluge*. ed. H. W. Bristow. London: Cassel, 1872, pp.220,223. All subsequent references are to this edition and are given in the text.

¹⁹ Buckland, William, *Geology and Mineralogy: Considered with Reference to Natural Theology*, 1836. 2 vols. Philadelphia: Carey, 1837, I: p.146.

²⁰ A Bowdoin Van Riper, *Men among the Mammoths: Victorian Science and the Discovery of Human Prehistory*. Chicago: University of Chicago Press, 199, p.65.

whom were clerics) wished to create a space for a science that was in danger of being reabsorbed into theological exegesis.²¹

Many non-scientists followed the progressionist line. For example, John Harris's popular *The Pre-Adamite Earth: Contribution to Theological Science* (1846) uses geological discoveries as part of its detailed description of "how the development of the earth constituted an extended preparation for its later human occupants" while going out of its way to reject biological evolution.²² Harris agreed with the chief geologists of his time in accepting an ancient earth coupled with the recent creation of humans while strenuously rejecting "transmutation", the pre-Darwinian term for evolution, as being unbiblical and counter to geological evidence. Thus he quotes from geologist and paleontologist Louis Agassiz on the subject of ichthyosaurs: "One of the first observations to be made on the ichthyological fauna of the old red sandstone is, that it is wholly peculiar to this formation".²³ Progress is observed from geological system to system, era to era, but each constitutes a separate sphere of divine creation with no evolutionary overlaps.

While progressionism could be reconciled with divine wisdom, to some, as the vigorous rejections of Harris and others suggest, it indeed strongly suggested transmutation, an idea with which naturalists were familiar in the first half of the century and which most dismissed out of hand as unbiblical and dangerous. This connection caused some pious naturalists to reject any sort of progressionism. For example, the Presbyterian minister George Young, who in 1819 gained notoriety for his ichthyosaur discoveries, acknowledges the idea of evolution but draws back: "Some have alleged, in support of the pre-Adamite theory, that . . . we discern . . . a gradual progress from the more rude and simple creatures, to the more perfect and completely organised; as if the Creator's skill had improved by practice. But for this strange idea there is no foundation: creatures of the most perfect organization occur in the lower beds as well as the higher".²⁴ The idea that God, the perfect designer, needed to improve on imperfect designs struck some as preposterous.

Verne draws on the geological theories of his time, often with much the same expression of awe fostered by natural theology, but without the argument from design or any other clear theological investment. Adopting the idea of temporally localized biological degeneration within the context of overall long-term improvement, he presents his ichthyosaur as not only "the most frightful of all the antediluvian reptiles" but as a supreme expression of nature's creative power. It reigned for ages when "hideous monsters held absolute sway" and were provided "with the most complete structures. What gigantic organisms! What exceptional strength!" (159,156). Verne dignifies the ichthyosaur as both the high point of reptilian development and a dramatic moment in the development of life on earth, an expression of both progressionism and directionalism.

Both doctrines, however, soon had to contend with Charles Lyell's uniformitarianism, which as presented in his influential *Principles of Geology* (1830-

²¹ James A. Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation*. Chicago: University of Chicago Press, 2000, p.57.

²² David N. Livingstone, *Adam's Ancestors*, p.82.

²³ John Harris, *The Pre-Adamite Earth: Contributions to Theological Science*. London: Ward, 1846, p.219.

²⁴ Quoted in: Simon Winchester, *The Map that Changed the World: William Smith and the Birth of Modern Geology*. New York: Harper-Perennial, 2002, p.113.

33) argued for the continuity of natural processes, operating in a steady-state fashion, while denying progress or directionality in either geological or biological spheres. In this regard, Lyell unguardedly speculated that ichthyosaurs, along with other extinct reptiles, might someday return when environments again become suitable for their habitation.²⁵ This flight of fancy could be simply rhetorical, but since the *Principles* holds that God created different species at different times (in specific "centres of creation" from which they then spread out), it is possible Lyell indeed believed that God, in the mystery of his ways, might similarly recreate an extinct species.

In *Journey to the Centre of the Earth* the ichthyosaur does return, in fictional form, an embodiment of lurid sublimity with "huge jaws," "rows of aggressive teeth," and "bloody eye as big as a man's head" (158, 159). And having already returned via the excavations of Mary Anning and others and the reconstructions of paleontologists and artists, this creature—the first great extinct reptile identified in England and soon represented by many specimens—became an iconic focal point in nineteenth-century speculations about the history of life on earth. From early in the century it was interpreted and reinterpreted through scientific research and speculation and through popular imaginings.

III

Studying ichthyosaur fossils turned up by Mary Anning and others, William Conybeare and his colleague Henry De la Beche, a clergyman, drew inferences about the appearance and behavior of the living animals while going out of their way to reject the idea that they might have evolved.²⁶ Perhaps Conybeare's most culturally resonant insight or imaginative leap, expressed in an 1824 letter to De la Beche, was that ichthyosaurs might have taken advantage of the long, vulnerable-looking necks of plesiosaurs, which "must have kept as much as possible out of reach of ichthyosauri, a very junior member of whom with his long powerful jaws would have bit his neck in two without ceremony". Martin J. S. Rudwick quotes this passage in his book *Scenes from Deep Time*, which surveys nineteenth-century visual representations of the distant past, many of them showing ichthyosaurs in their imagined environments.²⁷ Rudwick's earliest example is an 1830 drawing by De la Beche that was lithographed to raise money for the financially strapped Mary Anning, whose discoveries near Lyme Regis had helped propel his career along with those of other prominent geologists such as Connybear, William Buckland, and Richard Owen. "[R]eproduced endlessly" and "serving as a model . . . for almost all later artists",²⁸ *Duria antiquior* ("ancient Dorset") depicts various extinct marine animals but is dominated by ichthyosaurs. One is seizing a fish, a second spouts water from the top of its head, and a third basks on a rock. The most prominent ichthyosaur, however, is biting into the

²⁵ Charles Lyell, *The Principles of Geology*. 3 Vols. 1830-33. Chicago: University of Chicago Press, 1990, I, p.123.

²⁶ Regarding the links noted between ichthyosaurs and crocodiles, in 1821 Conybeare and De la Beche wrote that "some physiologists . . . have most ridiculously imagined" that such connections support evolutionary theory but that "nothing less than the credulity of a material philosophy could have been brought for a single moment to entertain it—nothing less than its bigotry to defend it". Quoted in: Ellis, Richard, *Sea Dragons: Predators of the Prehistoric Oceans*. Lawrence: University Press of Kansas, 2003, pp.66-67.

²⁷ See: Martin J. S. Rudwick, *Scenes from Deep Time: Early Pictorial Representations of the Prehistoric World*. Chicago: University of Chicago Press, 1992, p.44.

²⁸ Stephen Jay Gould, 'Preface,' in *The Book of Life*. ed. Stephen Jay Gould. New York: Norton, 1993, 6-21., p.9. All subsequent references are to this edition and are given in the text.

neck of a plesiosaur in accordance with Conybeare's suggestion. Stephen Jay Gould calls this "the image par excellence of early-nineteenth-century reconstruction" of prehistoric animals (9).

As established early on by fossilized stomach contents and coprolites, the ichthyosaurs ate fish, and recent finds had shown Conybeare and De la Beche that the animals propelled themselves with paddles as depicted in the latter's design. They did not, however, spout or leave the water, they did not—at least those whose remains were recovered early in the century—have the lizard-like tails shown in the picture, and the nineteenth century offered no evidence that they fought with plesiosaurs. There was still much to learn about these creatures but, consequently, much scope for imagination in reproducing their appearance and activities. In particular, the nineteenth-century imagination was captured by the idea of the ichthyosaur's ferocity, which for all anyone knew might have caused it to attack plesiosaurs.

De la Beche began the tradition of visually presenting the ichthyosaur as a supreme killer—not just eating fish but attacking plesiosaurs—although with its enormous jaws lined with phalanxes of teeth, over two hundred of them in some specimens, it is inevitable in any case that it would be visually and verbally promoted as such.²⁹ This legacy of violent aggression indirectly leads to Verne's scene in which the ichthyosaur and plesiosaur fight, although there the plesiosaur is presented as a frightening and worthy opponent—but not as prey, since the ichthyosaur will abandon the carcass of its slain opponent: "These animals attack one another with indescribable fury. They raise mountains of water. . . . Hisses of frightening volume reach our ears. The two animals are tightly embraced. . . . Everything is to be feared from the rage of the victor" (159). Verne indirectly inherits this scene from De la Beche via a print by Edouard Riou, one of a series accompanying Louis Figuier's *La terre avant le deluge*—from which, as Breyer and Butcher show in their analysis, Verne extensively plagiarized in his novel's scientific passages. A powerful rendition of ferocity, the picture shows the animals facing off, rising up out of churned up sea, the ichthyosaur spouting two jets of water that arch back over its head and the plesiosaur, with its long curved neck, looking as if about to strike like a snake as it rears up above its adversary (231).³⁰ Of the ichthyosaur Figuier says, "Its destructiveness and voracity must have been prodigious" (220).

Also commissioned to illustrate Verne's *Journey*, published the next year, Riou contributed two scenes of reptilian combat that, in the appearance of the animals, follow his illustration in Figuier's book. The first of the *Voyage* prints featured in Chapter 33 shows the plesiosaur's jaws clamped onto the back of the other's head, while the second has the ichthyosaur biting into the neck of the plesiosaur, which appears to be screeching. They are powerful images capturing the dynamism of Verne's scene by showing the combatants writhing about and splashing up masses of water from a turbulent sea. As in the earlier picture, the ichthyosaur closely resembles a crocodile. Understandably, early on artists often modeled ichthyosaurs on crocodiles and alligators, the largest extant reptiles, whose aggressiveness was well known.³¹

²⁹ O'Connor suggests other reasons why ancient animals were depicted as vicious (422-28).

³⁰ See Louis Figuier, *Before the Deluge*, p.231.

³¹ Conybeare and de la Beche, however, who in 1821 published the first scientifically respectable descriptions of ichthyosaur skeletons, had noted a number of crocodile-like features coupled with those of fish. See: Deborah Cadbury *The Dinosaur Hunters*, pp.28-29.

Vicious aggression is one of several qualities signified by most, though not all, nineteenth-century ichthyosaur representations; extinction and scientific progress are two others that I will discuss. Regarding violence and the popularity of depicted fights between great extinct reptiles, Gould simplistically asserts that "Victorians loved Tennyson's description of 'nature red in tooth and claw'" (8). Victorians, however, had ambivalent feelings about natural violence, often appreciating its portrayal but also, for example, founding societies to eliminate blood sports.³² Indeed, the famous "red in tooth and claw" phrase in *In Memoriam*, A. H. H. (1850) and its reference to prehistoric creatures as "Dragons of the prime, / That tare each other in their slime"³³ address Tennyson's horror at nature's ways, and some late Victorians felt this abhorrence all the more after confronting Darwin's amoral vision of "the conflict of nature", "the survival of the fittest", and the massive death and extinction of the less fit.

In the nineteenth century ichthyosaurs were, along with other prehistoric reptiles, frequently called "monsters" in both scientific and nonscientific writing. In envisioning the new and strange, the imagination generally draws upon, then magnifies and distorts, what it already knows. Thus ichthyosaurs were long connected with monstrous versions of crocodiles. But they were also consistently presented as hodge-podges of features belonging to various animals, the connection of dissimilar parts also being an index of monstrosity. For example, Figuier, citing Georges Cuvier, assigns the ichthyosaur "the snout of a dolphin, the head of a lizard, the jaws and teeth of a crocodile, the vertebrae of a fish, the head and sternum of a lizard, the paddles like those of a whale, and the trunk and tail of a quadruped" (221).

Also monstrous was their image as mechanisms of mindless predation. In 1840 Thomas Hawkins, following a passage in which he draws reasonable inferences about the function of the ichthyosaur eye, slides into a garish rendition of the animal's behavior, a reanimation consistent with the "spectacular display" that Ralph O'Connor has shown to dominate popular science in the nineteenth century: "By such inductions we revive the habits of Creatures long vanished away, and recolor the ardent Monster fleeing through the expanse of Sea like lightning to his distant prey, with a lust quenchable alone in gore". (14) The author of an 1850 article calls ichthyosaurs "the tyrants of the deep" (312). For H. N. Hutchinson, in his review of what had been known and thought about ichthyosaurs up until the 1890s, they are still "hungry formidable monsters" (61). Contributing to their negative image was the belief, held by many throughout the nineteenth century, that they were cannibals. Originating in the influential inferences of William Buckland, the idea primarily was based on the small fossilized ichthyosaur skeletons sometimes found inside those of larger ones. Although some naturalists believed, correctly as it turned out, that most or all of these were offspring as well as evidence that ichthyosaurs gave live birth, the idea fit too neatly with the general prejudice against reptiles—that their behavior, appropriate for cold-blooded animals, represented a monstrous inversion of human sensibilities.

³² James Turner describes "the startling upsurge of [British] animal welfare activity in the decade after 1800" connected with increasingly romantic and sentimental conceptions of nature (24, 31-33), a trend that continued throughout the century. Some, of course, continued to enjoy animal violence and, no doubt, its representation.

³³ Alfred Tennyson, *In Memoriam* A. H. H., ed. Erik Gray. New York: Norton, 2004, p.41. All subsequent references are to this edition and are given in the text.

The nineteenth-century's negative view of ichthyosaurs was not limited to their seemingly monstrous appearance and behavior. They also represented extinction and did so powerfully, since the greater its size and the longer it survived as a species, the more impressive the fact that a prehistoric creature had died out and the more extinction might also be associated with the fate of humans. Another of Henry De la Beche's pictures, drawn about the same time as *Duria antiquior* and frequently reproduced and discussed in recent years because of its historical and entertainment value, is a cartoon entitled "Awful Changes" that shows an upright "Professor Ichthyosaurus," dressed in long coat, wearing spectacles, and standing on a rock, lecturing to a group of other ichthyosaurs gathered attentively around and below him, some of them partially submerged in water. Referring to a sample human skull, he says that the feeble jaws show why the species became extinct. The picture was long thought to represent geologist William Buckland, famous for his histrionic lecturing style, but Martin J. S. Rudwick has argued convincingly that it parodies Charles Lyell and his belief that ichthyosaurs might someday return under environmental conditions conducive to their existence.³⁴ Although De la Beche "lithographed [it] for distribution among his friends",³⁵ and Buckland apparently used a version of it in his lectures at Oxford, which were attended by "eager crowds of genteel students",³⁶ the picture was not widely distributed. Nevertheless, it touches a cultural nerve. The picture not only satirizes Lyell and what struck some as a visionary form of geology consistent with an imagined return of ichthyosaurs, but also draws attention to the fraught subject of extinction as the possible, or even inevitable, fate of humans.

De la Beche's cartoon characters are humorous and harmless, reversing the aura of monstrosity more often than not attached to verbal and visual treatments of ichthyosaurs, but the inversion involving extinct humans and extant ichthyosaurs broaches the idea that humans are not a special case, central to God's universe, but rather just another species destined for a limited tenure on earth. This disturbing prospect was expressed most famously in Tennyson's *In Memoriam*, in which human significance is subverted by evidence "[f]rom scarped cliff and quarried stone" indicating a future in which humans become merely debris or fossils "blown about the desert dust, / Or sealed within the iron hills" (41). As more and more fossils were identified it became increasingly clear that most fossil species were no longer around. Ichthyosaurs, which by late in the century had turned up by the scores in the form of multiple genera and species, and which geological evidence showed had survived as a group for a vast time span, over 150 million years, only to disappear, offered a particularly strong reminder of extinction.

At times the ichthyosaur, along with other of the great extinct reptiles, evoked other, more indeterminate moods from authors and no doubt readers as well. For instance, such creatures might elicit a sense of strangeness or uncanniness or, as O'Connor notes in calling attention to "Thanatos to Kenelm" by the early nineteenth-century poet Thomas Lovell Beddoes, a mood of nostalgia for ages past. In a poem embedded in the text, the speaker, Thanatos, tells that "The mighty thoughts of an old world / Fan, like a dragon's wing unfurled, / The surface of my yearnings deep; / And solemn shadows then awake. . . ." But these shadows speak not only to yearning or

³⁴ See: Martin J. S. Rudwick, 'Caricature as a Source for the History of Science: De la Beche's Anti-Lyellian Sketches of 1831.' *Isis*, 66 (1975), 534-60; *Scenes*, p.48-50.

³⁵ Martin J. S. Rudwick, *Worlds Before Adam: A Reconstruction of Geohistory in the Age of Reform*. Chicago: University of Chicago Press, 2008, p.327.

³⁶ See: Ralph O'Connor, *The Earth on Show*, pp.77,74.

nostalgia but to unease: they "awake, / Like the fish-lizard in the lake, / Troubling a planet's morning sleep". Thanatos says the ancient earth "Haunts shadowy my domestic mood"³⁷. Here the ichthyosaur attaches itself to a dream vision of an ancient world whose strangeness unsettles a contemporary sense of what is real and true, making our world, and ourselves, strange as well. Who are we and our everyday world in relation to the vast, alien, only dimly perceived expanses of the past?

Although Ichthyosaur representations often pointed to ferociousness and the process of extinction—both potentially disturbing and especially so in light of evolutionary theories that associated humans with "lower" and often seemingly bestial life forms—and sometimes simply to a feeling of strangeness, they also assumed other, more positive significations, occasionally overlapping less congenial ones and sometimes prominent enough to mark a distinction. As already noted regarding De la Beche's "Awful Changes", despite its implications about human extinction, the ichthyosaur occasionally served as a source of humor or whimsy that could render it, at least superficially, less "awful"—in its original sense of fearful and awesome. As the ichthyosaur became better known to a general public, light references to it became possible. For instance, an anonymous author in Charles Dickens's *All the Year Round*, his weekly journal directed toward a general readership, begins an 1865 essay about hobby horses by asking, "Is there anyone who does not keep a hobby-horse? . . . I should like to see such a man, as a curiosity not equaled even by a living specimen of the dodo, or a yearling ichthyosaurus making its first clumsy essays towards amphibious perfection".³⁸ With its apparent post-Darwinian nod toward evolution, something the reader would not have to take seriously in this context, the author also touches on both extinction and reconstructions of ancient animals, his own brief reconstruction a humorously vivid one.

In 1885 the humor magazine *Punch* published another response to ichthyosaurs. May Kendall's "Ballad of the Ichthyosaurus" begins with an explanatory headnote—"The Ichthyosaurus laments his incomplete development and imperfect education. He aspires to better things"—and is accompanied by a picture of an upright ichthyosaur standing next to a globe and wearing a mortarboard. The evolutionarily disadvantaged speaker laments his condition as a relic: "I ABIDE in a goodly museum, / Frequented by sages profound: / In a kind of a strange mausoleum, / Where the beasts that have vanished abound". Speaking on behalf of his extinct compeers, and as in Dickens's scenario humorously supplying an evolutionary context but this time an expressly Darwinian one, Kendall's ichthyosaur says that "Ere Man was developed, our brother, / We swam, and we ducked, and we dived, / And we dined, as a rule, on each other— / What matter, the toughest survived!". Appropriately for the conservative *Punch*, the silliness of a talking museum exhibit undercuts ideas of human evolution and survival of the fittest, and it softens that of extinction by pointing to a cause of non-survival that need not worry our brainy species: "the brain of the Ichthyosaurus / Was never a match for its eye"³⁹—and the average reader presumably was familiar enough with ichthyosaurs by this point in the century to know it was famous for its enormous eyes. Late in the century H. N. Hutchinson credits a Professor Blackie with the following effort: "Behold, a strange

³⁷ See: Ralph O'Connor, *The Earth on Show*, p.453; Beddoes, Thomas Lovell, 'Thanatos to Kenelm, and The Song by Thanatos,' in *The Works of Thomas Lovell Beddoes*. ed. H. W. Donner. Oxford: Oxford University Press, 1935, 141-42., p.142.

³⁸ Anon., 'Hobby-Horses.' *All the Year Round*, 9 Sept. 1865, 163-66., p.163.

³⁹ May Kendall, 'Ballad of the Ichthyosaurus.' *Punch*, 14 Feb. 1885, 82.

monster our wonder engages! / If dolphin or lizard your wit may defy. / Some thirty feet long, on the shore of Lyme-Regis, / With a saw for a jaw, and a big staring eye"—and with "a very small brain" as well.⁴⁰

The idea of engaging wonder suggests another way in which ichthyosaurs could be comprehended as relatively benign. Consistent with the nineteenth-century's enthusiasm for the educational and edifying, and for knowledge responsibly disseminated to various social classes, ichthyosaur descriptions or reproductions were sometimes advanced as simply interesting educational phenomena representative of scientific progress; as such they were presented as unproblematic, theologically or otherwise. For example, an 1848 article in *The Saturday Magazine* entitled "The Ichthyosaurus, or Fish Lizard" accompanies an illustration of an ichthyosaur skeleton with a text that addresses "readers [who] have no opportunity of seeing the fossil remains of this gigantic reptile"; implicit is awareness that, through increasing numbers of museum exhibits and publicly accessible private fossil collections, some readers would in fact have seen such remains in person. Directed at the common reader, the article first explains the meaning of the word "fossil" and then, citing and quoting from Buckland's *Geology and Mineralogy* for authority, describes the fossil remains and what they suggest about the creature's behavior. It concludes by contending that "this curious relic of a former period . . . highly illustrates the handy works of that ALL-POWERFUL BEING who 'made heaven and earth, the seas, and all that in them is'".⁴¹ This passage recalls Buckland's and Figuier's admiring descriptions that evidence the advance of scientific knowledge and celebrate the sophistication of God's creations. It also suggests that the museum, "that strange mausoleum", had become what seemed the natural and authoritative environment for viewing ichthyosaur remains or reproductions, bringing them alive for the imaginative observer-adventurer.

Regarding the reconstruction of ichthyosaurs, probably the most significant symbolic moment in the pageant of scientific advancement staged for the public occurred in 1854 at Sydenham, on the southern outskirts of London, where the Crystal Palace had been relocated from its original site in Hyde Park following the Great Exhibition that it had housed. The 1851 Great Exhibition of the Works of Industry of All Nations featured exhibits meant to teach visitors about mid-nineteenth-century fruits of knowledge, especially in the areas of science, technology, and history, and especially British knowledge and its application. The Crystal Palace at Sydenham continued the task of public edification and continued, in its revolutionary glass and cast-iron construction as well as in its contents, to celebrate the advancement of human knowledge and capabilities. Upon the Palace's 1854 reopening, visitors to its grounds encountered a new display that exhibited such advancement and became very popular: a collection of full-sized models of various extinct Mesozoic reptiles situated in a reconstruction of their original environment complete with vegetation and an artificial lake with islands on which the reptile reproductions were situated. They had been created by sculptor Waterhouse Hawkins under the guidance of Richard Owen,

⁴⁰ Quoted in: H. N. Hutchinson, *Extinct Monsters and Creatures of Other Days: A Popular Account of Some of the Larger Forms of Ancient Animal Life*. London: Chapman, 1892, p.61.

⁴¹ J. G. C., 'The Ichthyosaurus, or Fish-Lizard.' *The Saturday Magazine*, 8 April 1843, 136.

the greatest of British comparative anatomists and an early describer of fossilized vertebrate remains. This exhibit has been much written about in recent years.⁴²

Except perhaps for the two pterodactyls, the most accurate, in light of present day understanding, of the species displayed are the three ichthyosaurs; by mid-century ichthyosaurs were known through many specimens, some of which were complete or nearly so. Its relatively accurate reconstruction contrasts with that of the exhibit's dinosaurs, known through fewer and quite incomplete fossil remains. For example, the massive iguanodon stands on four legs rather than two, its form and stature mammalian. According to Adrian Desmond, Owen wanted the models to look more advanced than extant reptiles, undercutting pre-Darwinian evolutionary theory by suggesting that the creatures represented at Sydenham had, rather than evolved into mammals, long before already reached the high point of reptilian development and then degenerated into the present-day reptiles that seemed so clearly inferior.⁴³

A notable characteristic of the Sydenham models is that they abandon the tradition of making extinct saurians look ferocious and predatory and pursue instead the goal of public edification for all, a goal that perhaps could best be achieved by not disturbing women and children or inciting the lower class through representations of mindless aggression. The ichthyosaurs simply bask on land after having emerged or half emerged from the water. The generally unthreatening appearance and peaceful activities of the creatures might reflect as well their creators' wish to deliver them, because of Owens's antipathy to evolutionary theory, from the imputation of reptilian primitiveness that teeth-bearing or predatory gestures would have conveyed. At the same time, in keeping with natural theology, they might speak to God's beneficence as the creator of admirably sophisticated creatures rather than monsters. A number of such considerations consciously or unconsciously must have influenced their design.

In any event, the Sydenham installations demonstrated scientific knowledge and admirably participated in the scientific and technological triumphalism of the Great Exhibition, and they also show that there are always mistakes to make and undo. As Professor Lidenbrock says in *Journey to the Centre of the Earth*, "Science . . . is composed of errors, but errors that it is right to make, for they lead step by step to the truth" (146). The errors and rectifications involve the ideal, never entirely attainable, of scientific objectivity and rigor as well as their interpenetration by subjective understandings and those of a wider culture. Gould asserts not only that the genre of fossil iconography combines scientific objectivity with the fact that "we reconstruct according to our own prejudices and our standard images", but also that "the interplay of these two factors—the externally empirical and the internally social—captures the central dynamic of change in the history of science" (7).

The dynamic of change operated more readily in the case of the ichthyosaur than it often does. A chief prejudice to be overcome was that the ichthyosaur was simply or merely a vicious killer consistent with the popular understanding of crocodiles. The ichthyosaurs at Sydenham had moved away from this image, since they do not resemble crocodiles as do some early reconstructions. Incomplete and

⁴² See especially: James A Secord., 'Monsters at the Crystal Palace,' in *Models: The Third Dimension of Science*. ed. Soraya de Chadarevian and Nick Hopwood. Stanford: Stanford University Press, 2004, 238-69.

⁴³ Adrian Desmond, 'Designing the Dinosaur: Richard Owen's Response to Robert Edmond Grant.' *Isis*, 70 (1979), 224-34., p.228. See also: Adrian Desmond, *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London*. Chicago: University of Chicago Press, 1989. Here Desmond gives a detailed account of the resistance of British scientists to pre-*Origin* evolutionary theory, especially Lamarckism with its support among British radicals.

misinterpreted evidence, however, led to mistakes. For example, they are depicted as having crawled from the water upon their paddles, whereas they were not amphibious—a notion apparently still prevalent in 1865 when Dickens playfully referred to the ichthyosaur's evolution toward terrestrial living. Also, the features known as sclerotic rings, circles of bone around the eye, were depicted as exposed, but in fact they were embedded in the eyes themselves, apparently to help them withstand water pressure. Most importantly, they lack fleshy features not known until late in the century when fossils from the Holzmaden deposits in Germany revealed the outline of complete bodies. Presented with this new evidence, scientists recognized that most of the ichthyosaurs they had been studying had dorsal fins and vertical, fish-like tails, making them resemble dolphins more than ever and establishing them as a textbook case of convergent evolution in which different species independently assume similar forms in response to similar environmental conditions.

Richard Owen, however, deserves credit for his recognition that the tails of the ichthyosaurs he studied were not simply pointed like those of crocodiles, although most nineteenth-century visual representations, judging from Martin Rudwick's examples in *Scenes from Deep Time*, presented them that way. Early specimens consistently showed the same abrupt downward turn in the tail portion of the spine, and Owen concluded it must have resulted from force exerted by a vertical tail. Therefore under his influence the Sydenham ichthyosaurs feature tails ending in vertical spade-shaped configurations, since he understandably had failed to realize that the downward bend had in fact supported the lower fluke of a forked tail.⁴⁴ The process of scientific discovery also led to recognition that the small ichthyosaur skeletons embedded in larger ones probably do not indicate habitual cannibalism, as distastefully attractive as that idea had been.⁴⁵ It also led to the late nineteenth-century triumph of evolutionary theory, although many found that theory more distasteful than attractive because of the Darwinian stress on natural selection and survival of the fittest.

IV

By the end of the century the ichthyosaur had become commonplace enough that its significance was often reduced from that of something wondrous, whether fearful or not, to mere representative of a defunct species, something like the dodo. In *The Time Machine* (1895), for instance, H. G. Wells has his narrator say of the distant future "that horses, cattle, sheep, dogs, had followed the ichthyosaurus into extinction".⁴⁶ But for scientists and many late nineteenth-century non-scientists the ichthyosaur also necessarily carried evolutionary meaning. Earlier in the century evolutionary theory was available but spurned by naturalists and knowledgeable laymen like Jules Verne, who never entertained the concept even though *Journey to the Centre of the Earth* appeared after the *Origin*. The primary evolutionary theories available prior to Darwin's were Lamarckism, denigrated for being unbiblical and for its association with the freethinking and radicalism of the French Revolution era out of which it

⁴⁴ It was thought by some that the bends, perhaps at a weak point in the skeletons, might have happened as the result of pressures exercised after death. For discussions of Owen, ichthyosaur reconstruction and convergent evolution, see: Stephen Jay Gould, 'Bent Out of Shape,' in *Eight Little Piggies: Reflections in Natural History*. New York: Norton, 1993, 79-94.

⁴⁵ The research of Roland Böttcher concludes that ichthyosaurs do not merit their cannibalistic reputation. See: Michael Benton, 'The Myth of the Mesozoic Cannibals.' *New Scientist*, October 12, 1991, 40-44.

⁴⁶ H. G. Wells *The Time Machine*. London, 1895, p.15.

emerged, and Robert Chambers's "developmental hypothesis", which, as set forth in the widely read *Vestiges of the Natural History of Creation* (1844), was notorious with scientists and rejected on any number of grounds.⁴⁷ By later in the century the situation had changed especially because of Darwin, and scientists unwilling to accept his explanation for evolution generally did accept the masses of evidence he offered for evolution itself. This same attitude held true for much of the well-educated population, but Thomas Hardy and Joseph Conrad accepted both Darwin's evidence and his theory of evolution via natural selection.⁴⁸

Therefore, in the 1890s, application of Darwinian theory imbues two references to ichthyosaurs, each part of a simile, found in Thomas Hardy's *The Woodlanders* (1887) and Joseph Conrad's *Heart of Darkness* (1902; serially published in 1899). Of the three primary but not invariable registers of meaning I have attached to nineteenth-century understanding of these animals—aggressiveness, extinction, and scientific progress—these instances most focus on extinction or, more precisely, on death, since extinction is death writ large, and they do so in a manner reminiscent of Tennyson's gloomy meditation on the fossil record. They register a pessimistic adoption of Darwinism in which death dominates life. The passages take for granted a degree of reader familiarity with ichthyosaurs, which as we have seen were widely known to Victorians even though their fame gradually had been eclipsed by that of the dinosaurs whose fossils scientists had been discovering and identifying since the 1830s. The two novelists, however, eschew the celebration of science that is so central to Verne's *Journey*. And as atheists, Hardy and Conrad have no interest in reconciling science with religion. Rather, at a point in history not long before ichthyosaurs largely leave popular consciousness, the representative value of Hardy's and Conrad's ichthyosaurs is that, for all their alien strangeness, they are inflected with basic human apprehensions and thus in some ways represent us.

The novelists' references, taken in their narrative and thematic contexts, involve three interrelated concepts that connect ichthyosaurs, and through them evolutionary thinking, to the human condition: death/extinction along with both the destructive conflict and the inadequate adaptation that helps produce them. In *The Woodlanders* these factors apply to the woods in which the novel is set. Part wild and part cultivated for the timber that sustains the local economy, they evidence the Darwinian sort of competition, struggle, and death that for Hardy informs both nature and culture. For instance, from the woods arises "the creaking sound of two overcrowded branches . . . which were rubbing each other into wounds on old trees".⁴⁹ The personification is appropriate, for the locals struggle in much the same way as they try to make their living from timber. The narrator also describes trees from which:

⁴⁷ Predictably, Chambers placed the ichthyosaur in an evolutionary sequence: "The first remove from the fish is the ichthyosaur. . . . With piscine body and tail, and fins advanced into a paddle form, it has a true crocodilian head". See: Robert Chambers, *Explanations: A Sequel to Vestiges of the Natural History of Creation*. 1845.

Vestiges of the Natural History of Creation and Other Evolutionary Writings. ed. James Secord. Chicago: University of Chicago Press, 1994, p.82.

⁴⁸ See: John Glendening, *The Evolutionary Imagination in Late-Victorian Novels: An Entangled Bank*. Aldershot: Ashgate, 2007, pp.72-73, 228.

⁴⁹ Thomas Hardy, *The Woodlanders*. 1887. Oxford: Oxford University Press, 1985, p.13. All subsequent references are to this edition and given in the text.

huge lobes of fungi grew like lungs. Here, as everywhere, the Unfulfilled Intention, which makes life what it is, was as obvious as it could be among the depraved crowds of a city slum. The leaf was deformed, the curve was crippled, the taper was interrupted; the lichen ate the vigor of the stalk, and the ivy slowly strangled to death the promising sapling. (41)

In Hardy's world there is little that fulfills the aspirations of humans, beset as they are by consciousness of self and mortality and no longer at ease, because of the dictates of society, with the nature out of which they arose but can never fully escape.

Constraints with Darwinian overtones also affect the main character, Grace Melbury. Having been sent away by her timber-merchant father to be educated above the level of her former associates, she returns a polished lady no longer well suited to the cultural milieu and setting that produced her—an instance of faulty adaptation to environment, social more than natural. When the man her father had intended her to marry, the noble and self-sacrificing laborer Giles Winterbourne, loses his house and prospects through an unfortunate stroke of luck, with her father's encouragement she marries instead the young doctor, Edgar Fitzpiers, who wins her especially because of his education and prestigious family. Soon she realizes her social ambitions have connected her to an unsuitable spouse and it is the devoted Giles—simple, at ease with nature, and natural-seeming himself—whom she loves. But, this being a Hardy novel, it is too late. After a series of complications enveloping various characters, Giles dies as the result of trying to protect Grace's reputation after she abandons her adulterous husband. Before this occurs, however, Grace spends a long night and day alone waiting for Giles to return to his house.

It is at this point that Hardy produces a Darwinian scenario that leads to his allusion to ichthyosaurs. While waiting for Giles, Grace looks out on trees:

jacketed with lichen and stockinged with moss. At their roots were stemless yellow fungi like lemons and apricots, and tall fungi with more stem than stool. Next were more trees close together, wrestling for existence, their branches disfigured with wounds resulting from their mutual rubbings and blows. It was the struggle between these neighbors that she had heard in the night. Beneath them were the rotting stumps of those of the group that had been vanquished long ago, rising from their mossy setting like decayed teeth from green gums.

The narrator has slipped from Grace's point of view into his own, as he does in describing one tree in particular: "Above stretched an old beech, with vast armpits, and great pocket-holes in its sides where branches had been amputated in past times; a black slug was trying to climb it. Dead boughs were scattered about like ichthyosauri in a museum. . ." (234).

The old beech is reminiscent of Darwin's metaphorical "Tree of Life", whose branches and twigs represent not only species arising from a common source and ramifying as they stretch upward through time, but also, as they die and fall off, extinct species that have lost the struggle for survival.⁵⁰ In this scheme ichthyosaurs are losers, castoffs from the tree of life. But they are so only through the interpretive imagination, which endows them with human significance by associating them with

⁵⁰ Charles Darwin, *On the Origin of Species*. 1859. facsim. ed. Cambridge: Harvard University Press, 1964, pp.129-30.

mutually antagonistic anthropomorphic trees and reconstructing them within the cultural space of a museum. But in Hardy's vision, human culture—the cause of the "amputations"—conspires with nature to human detriment, for struggle becomes all the more destructive because people have to adjust themselves to immensely complicated conditions, internal and external, constituted of both social and natural orders. Like the imagined ichthyosaurs, Grace and Giles fail to adapt or compete with the forces arrayed against them; essentially, Grace has failed to reconcile culture with nature while Giles has failed to do the opposite. Unfairly perceived in terms of non-adaptation rather than their extremely long-term evolutionary success, extinct ichthyosaurs signify the extinction of Grace's hopes and Giles's life, with the novel analogous to a bone-filled museum in so far as both strongly suggest the connection between the fates of ichthyosaurs and humans. Ultimately the ichthyosaurs represent humanity, self-consciously aware of "the Unfulfilled Intention", unfulfilled because of the impossibility that life can evade loss and limitation or defeat death.

In context, Conrad's reference also expresses Darwinian pessimism in which the import of ichthyosaurs is deflected toward the human. Marlow, the narrator of *Heart of Darkness*, recalls his long-ago experience as a captain employed by a Continental trading company to take a steamboat far up a great African river to relieve Kurtz, the trader at the Company's most interior station who, word has it, is very sick. But when Marlow arrives at the place he is to assume command, he finds the boat is at the bottom of the river, supposedly the result of an accident but in fact scuttled under orders of the local company manager. The official's motive is that Kurtz, although the Company's most successful supplier of ivory, appears destined to take over his job because he represents a faction at the European headquarters that wants the African operation to treat natives humanely. The Manager's behavior, however, represents more a rape of Africa than a trading operation, and he has delayed the trip meant to help Kurtz—something Marlow does not suspect until much later—hoping that he will have died in the meantime.

Marlow's involvement in repairing the boat leads up to his vision of an ichthyosaur. He has already seen appalling evidence of the death and destruction wrought by imperialist greed, but he also interprets the jungle and the natives as primitive forces just as inimical, in their way, to civilized ethical standards as the behavior of the Company, which he detests but in whose activities he finds himself implicated. Therefore, alienated and appalled, he attempts to deaden anxiety and secure meaning through a well-developed work ethic, single-mindedly dedicating himself to the task of retrieving and repairing the steamboat. At the same time he distantly hopes that Kurtz, purportedly a morally enlightened man, will somehow redeem him when the recovered boat arrives at the ivory trader's base of operations far up the river.⁵¹

In restoring the boat, however, Marlow and his helper are held up by a lack of rivets, the supply of which, unsuspected by Marlow at the time, the manager makes sure is long delayed. One night, in a kind of hysteria induced by frustration and

⁵¹ So eager is he to find meaning in the anarchic destruction he witnesses at the hands of the whites that he is willing, once the steamboat arrives at Kurtz's trading station, to downplay the man's degeneration into a moral monster who, in his domination of local tribes, had violated Western ethical standards even more thoroughly than had the Company. Thus Marlow interprets Kurtz's famous last words, "the Horror, the Horror," whose actual meaning is unclear, as Kurtz's last minute moral victory upon recognition of what he had done. In fact, Marlow needs to redeem himself for his involvement in moral darkness and meaninglessness by redeeming the man he once had looked to as a beacon of civilized values.

anxiety, Marlow and his fellow worker dance on the deck of the vessel, now raised from the water, celebrating their fantasy that the longed-for rivets surely must be about to arrive:

[W]e behaved like lunatics. We capered on the iron deck. A frightful clatter came out of that hulk and the virgin forest on the other bank of the creek sent it back in a thundering roll The great wall of vegetation, an exuberant and entangled mass of trunks, branches, leaves, boughs, festoons, motionless in the moonlight, was like a rioting invasion of soundless life, a rolling wave of plants piled up, crested, ready to topple over the creek to sweep every little man of us out of his little existence. And it moved not. A deadened burst of mighty splashes and snorts reached us from afar as though an ichthyosaurus had been taking a bath of glitter in the great river.⁵²

Here the ichthyosaur plays a much different role than in *The Woodlanders*, although again it functions within the context of Darwinian theory viewed darkly.

In his early fiction Conrad uses vegetation to depict a Darwinian struggle for existence, much as does Hardy, but he also imagines vegetation, in the form of jungle, as an alien force fundamentally antagonistic toward humans and something against which, if they are to survive, they must struggle but are ill equipped to do so.⁵³ For implicit within wilderness, understood as non-human reality, figures the greater enemy, an entire cosmos unconcerned with and uncongenial to human ambitions, making the accomplishments of civilization seem petty and transient. With its decentering of humans, now seemingly just another species with no special sanction, Darwinism plays into this anxiety. Marlow feels all this, but at the same time he also reads into nature a disquiet, heightened by his sense of moral culpability, that makes him into the alien, one not adapted to his environment and not well fitted to the struggle for survival. He displays these attitudes throughout the novel, as he does when on occasion he senses, in contrast, how admirably suited the natives are to the wilderness. They are non-modern, however, and Marlow, typical of his time, connects the "primitive" with savagery—with the abandonment of moral restraints that he fears as an atavistic potential in modern humans and modern civilization. This is another haunting idea that Darwinism helped fuel—that vestiges of earlier stages of evolutionary development not only linger but constitute a potential for degeneration.

Nature as epistemic phenomenon, then, is an antagonist, ultimately residing within as much as without, something alien-seeming but uncanny because imbued with repressed or partially repressed human fears, including the fear—consistent with pervasive fin-de-siècle pessimism about the future—that neither the individual nor modernity itself can survive.⁵⁴ Dark nature threatens to "sweep every little man of us

⁵² Joseph Conrad, *Heart of Darkness*. ed. Paul B. Armstrong. New York: Norton, 2006, pp.29-30. All subsequent references are to this edition and are given in the text.

⁵³ The jungle as site of a vegetative Darwinian struggle for existence appears in Conrad's *Almayer's Folly* (1895), *An Outcast of the Islands* (1896), and *Tales of Unrest* (1898). See: John Glendening, *The Evolutionary Imagination*, pp. 241-43, 247.

⁵⁴ British confidence had fallen off since mid-century and the self-celebratory Great Exhibition. By the century's end doubts had arisen in many people's minds stemming from imperial setbacks, the rise of powerful international economic and military rivals, a depressed economy, scientific and sociological theories concerning entropy and degeneration, the approach of a new century with unknown challenges, and—focusing these anxieties—the imminent death of Queen Victoria and the end of the age named after her. Anxiety about social, political, moral, and physical degeneration especially

out of his little existence". The wilderness "moves not", however, because in fact it is humankind—via a form of extinction Darwin did not anticipate—that through greed and fear and self-alienation someday will produce its own destruction. In dramatizing these anxieties Conrad employs the same conditions as Hardy—extinction, struggle, and failed adaptation—and he too could have made his ichthyosaur representative of a grim human destiny. He does something else instead.

Marlow's remarkable simile transmutes a noise, perhaps a hippo disturbed by the commotion on the boat, into the whimsical image of an ichthyosaur "taking a bath of glitter in the great river". Marlow's disordered state of mind while dancing on the deck partially explains the fanciful scene, but it is so out of keeping with what precedes it, the threat of human extinction, that there must be more going on if the passage is to make sense. Stripped of overtones of extinction, conflict, and failed adaptation, the ichthyosaur stands out in contrast to the preceding evocation of hostile nature and to Marlow's and his species' dilemmas. What Marlow has done, perhaps in the retelling of his experience rather than at the time, is invest the animal with what Marlow himself lacks during his traumatic African experiences. Whereas he feels alienated and morally sullied, the creature seems pristine, vital, and at home in its world, engaged in the salutary activity of "taking a bath". The ichthyosaur is a success rather than something that has failed, its bones consigned to a museum. Snorting turns into a grace note and a brute animal into a fairytale being. This is a relapse to the childhood romance that, briefly surfacing again in early adulthood, had caused Marlow to sign onto the steamboat job in anticipation of splendid and unproblematic adventure (7-8).

But the story then immediately returns to the need for rivets, to the truth that they would not come anytime soon, to the folly and fear of the rest of the novel, and to Marlow's dubious battle to construct a positive meaning that, like rivets, might hold his world together. Conrad's ichthyosaur conveys such a meaning: a dream of human freedom and ease, of release from fear of death and the burden of consciousness.

V

The ichthyosaur was not alone among extinct species in presenting scientific and religious challenges to nineteenth-century thinkers and educated readers, but as one of the first of the great reptiles recognized and soon found in considerable numbers, it was in the forefront of concerns about the creation and careers of species, offering many opportunities for scientific and artistic revisions, and it appeared in many guises as scientific knowledge colluded with extra-scientific influences. Verne, Hardy, and Conrad put their ichthyosaurs to different uses, while visual representations differed in response to new discoveries and oftentimes to the desire to appeal to both scientific and general audiences. Meanwhile scientific knowledge continued to accumulate.

More and more species of ichthyosaurs have been discovered, some as small as several feet in length, while recent finds suggest that one species produced individuals of over seventy feet—more along the lines of Verne's gigantic version.⁵⁵ The evolution of ichthyosaurs is better understood as well. For example, early species

influenced creative writers of the time, including Conrad and Hardy, as did the somewhat kindred phenomenon of literary naturalism, with its focus on the social and hereditary forces that dominate people's lives and suppress free will. Neither Conrad nor Hardy, however, assumes the clinical, scientific sort of detachment from their characters and stories promoted by naturalism.

⁵⁵ A specimen of *Shonisaurus sikanniensis* was first discovered in British Columbia in 1991.

are now known to have had the pointed lizard-like tails incorrectly assigned, in most nineteenth-century reconstructions, to the later porpoise-shaped Jurassic specimens that were the first discovered and only late in the century recognized as having dorsal fins and forked tails.⁵⁶ Based upon a remarkable fossil that shows the details of soft tissue, a recent discovery indicates that later ichthyosaurs had skins containing collagen fibers, like those of sharks, which made their bodies rigid and slick to assist in high-speed swimming, evidence that it most likely fed in deep waters by chasing down prey at speeds perhaps up to twenty-five miles per hour.⁵⁷ In a related development, various discoveries have established that the narrow spines of early ichthyosaurs evolved into the thick, stiff backbones of later ones as part of a change from undulating movement to the rapid propulsion enabled by well-developed vertical tails.⁵⁸ It now also appears that ichthyosaurs indeed might have attacked plesiosaurs.⁵⁹ But mysteries linger about the relationship of these two animals and about much else, including why ichthyosaurs became extinct and did so before the demise of plesiosaurs.⁶⁰ No longer thought of as "the world-renowned ichthyosaurus", it nevertheless remains an ongoing and productive problem offering, for anyone interested, scope for both scientific reasoning and the imaginative investment of reality with human significance.

⁵⁶ Expert Ryosuke Motani, as part of his "Ichthyosaur Page" website, provides a chart demonstrating "a general transition from lizard-shaped body plan to fish-shaped one through the evolution of ichthyosaurs. See: Ryosuke, Motani, *Ichthyosaur Page*. 03 July 2001.

<<http://www.ucmp.berkeley.edu/people/motani/ichthyo/intro.html>>, 1. Introduction.

⁵⁷ This finding was reported in 2008 by Theagarten Lingham-Soliar, who along with his team at the University of KwaZulu-Natal investigated the fossilized skin with an electron microscope.

⁵⁸ See Ryosuke Motani, 'Rulers of the Jurassic Seas.' *Scientific American*, Dec. 2000, 53-59., p.57.

⁵⁹ BBC news reported that ichthyosaur and plesiosaur fossils found on an Arctic island include a tooth of the former creature embedded in the neck bone of the latter. See: Paul Rincon, '“Monster” Fossil Find in Arctic.' BBC News. 5 Oct. 2006. <<http://news.bbc.co.uk/2/hi/science/nature/5403570.stm>> .

⁶⁰ It has been suggested that plesiosaurs became adept at eating young ichthyosaurs.

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Beauty Bare: The Sonnet Form, Geometry and Aesthetics

Matthew Chiasson and Janine Rogers

Beauty is the first test: there is no permanent place in the world for ugly mathematics.¹

Euclid alone has looked on Beauty bare...²

The appeal of the sonnet form over centuries is both unquestionable and curious. Most poets attempt a sonnet at one time or another in their career, and many readers in English, as well as other Western languages, have encountered a sonnet or two. While some might see the sonnet as an old-fashioned form, poets continue to produce them in great quantities, and new collections and studies of them continue to appear. Zachariah Wells, editor of one sonnet anthology, attributes the form's longevity to its "adaptability, flexibility, plasticity" through history.³ Others are more mystical in their ideas about the persistence of the sonnet: "Poets," Don Paterson reflects, "write sonnets because it makes poems easier to write. Readers read them because it makes their lives easier to bear".⁴ There is a long-held perception that sonnets teach us something about the very nature of poetry, especially in relation to poetic form. This is frequently cited as the justification for insisting that creative writing students try to write them, and that literature students learn to read them. But aside from the structural rigour of the form – with the attendant assumption that the more restrictive the form, the greater the poetic challenge (haikus have a similar status in this respect) – the actual reasoning behind the idea of the sonnet's edifying qualities remains vague.

Similarly, the sonnet's aesthetic qualities are frequently proclaimed, but slippery and difficult to articulate. Paul Oppenheimer writes that the sonnet has a "mysterious aesthetic" that reveals "a psychological, as well as an aesthetic, law, or equation, or archetype" that makes it one of the most "secure and enduring forms in poetry", but he remains vague as to what that is, precisely.⁵ Paterson connects the aesthetic and the psychological appeal of the sonnet: "a miraculous little form in which our human need for unity and discontinuity, repetition and variation, tension and resolution, symmetry and asymmetry, lyric inspiration and argumentative rigour, are all held in near-perfect oppositional balance" (xxvi-xxvii). It is frequently seen as having a meditative quality (xvi) – an interiority, which Oppenheimer suggests is due to its non-musical, purely literary, history of circulation. He provides convincing proof that despite the popular idea of *sonnet* meaning "little song," it was always

¹ G.H. Hardy, *A Mathematician's Apology*. Cambridge: Cambridge University Press, 1941, p.25. All subsequent references are to this edition and are given in the text.

² Edna St. Vincent Millay, 'Euclid Alone has Looked on Beauty Bare,' in *The Harp-Weaver and Other Poems*. 1920. New York: Harper, 1923, 74. All subsequent references are to this edition and are given in the text.

³ Zachariah Wells, *Jailbreaks: 99 Canadian Sonnets*. Toronto: Biblioasis, 2008, p.11. All subsequent references are to this edition and are given in the text.

⁴ Don Paterson, 'Introduction' in *101 Sonnets*. ed. Don Paterson. London: Faber, 1999, xi-xxvii., pp.xxvii. All subsequent references are to this edition and are given in the text.

⁵ Paul Oppenheimer, 'The Origin of the Sonnet.' *Comparative Literature* 34 (1982), 289-304., p.290. All subsequent references are to this edition and are given in the text.

intended for the written page.⁶ This textual presentation history is part of the aesthetic power for Paterson:

As poetry moved slowly off the tongue and onto the page, the visual appeal of an approximately square field on a sheet of white paper must have been impossible to resist. Which is what a sonnet *is*, first and foremost: a small square poem. It presents both poet and the reader with a vivid symmetry that is the perfect emblem of the unity of meaning a sonnet seeks to employ. (xvi)

Phrases such as "vivid symmetries" suggest that the sonnet's beauty might be connected to other fields in which symmetry is also frequently cited as an aesthetic component; in, for example, science and mathematics. Indeed one sonnet – Edna St. Vincent Millay's "Euclid Alone Has Looked on Beauty Bare" – seems to take as its topic the very idea of an aesthetic link between mathematics (and by extension science) and the sonnet form:

Euclid alone has looked on Beauty bare.
Let all who prate of Beauty hold their peace,
And lay them prone upon the earth and cease
To ponder on themselves, the while they stare
At nothing, intricately drawn nowhere
In shapes of shifting lineage; let geese
Gabble and hiss, but heroes seek release
From dusty bondage into luminous air.
O blinding hour, O holy, terrible day,
When first the shaft into his vision shone
Of light anatomized! Euclid alone
Has looked on Beauty bare. Fortunate they
Who, though once only and then but far away,
Have heard her massive sandal set on stone. (74)

Millay's sonnet has been cited by scientists, mathematicians and literary critics alike to articulate a definition of beauty. The poem is included in mathematical textbooks and specialized mathematical studies.⁷ It is also found in histories of mathematics and books that explore mathematical intersections with history and culture.⁸ The sonnet – especially the first line – occasionally appears as an epigram.⁹ It is also found in biographies of mathematicians, like Paul Hoffman's biography of Paul Erdős, *The*

⁶ See: Paul Oppenheimer, 'The Origin of the Sonnet.'

⁷ See: Robin Hartshone, *Geometry and Beyond*. New York: Springer, 2000, p.50; William McGown Priestley and F. W. Gehring, *Calculus: A Liberal Art*. 2nd edn. New York: Springer, 1998, pp.78-9; Philip J. Davis and Rueben Hersh, *The Mathematical Experience*. Boston: Birkhäuser, 1987, p.150.

⁸ See: William P. Berlinghoff and Fernando Quadros Gouvêa, *Math Through the Ages: A Gentle History for Teachers and Others*. Expanded Edition. New York: Mathematical Association of America, 2004, p.155; Robert Osserman, *Poetry of the Universe: A Mathematical Exploration of the Cosmos*. New York: Anchor-Random, 1995, p.6; Mario Livio, *The Golden Ratio: The Story of Phi, the World's Most Astonishing Number*. New York: Broadway, 2002, p.3.

⁹ See: H. E. Huntley, *The Divine Proportion: A Study in Mathematical Beauty*. New York: Dover, 1970, p.xiii.

Man Who Loved Only Numbers.¹⁰ From a literary perspective the entire sonnet is a frequent inclusion in poetry anthologies and sonnet collections, and it has the honour of being the first text presented in Denis Donoghue's appendix on notable quotations on beauty in *Speaking of Beauty*.¹¹ Finally, the poem is frequently cited in online sources related to both mathematics and literary studies.

The sonnet's first line is often isolated as some sort of definitive statement about the relationship between science and beauty. The phrase "beauty bare," in particular, seems to resonate within different reading communities, but the meaning of this phrase is not really unpacked. The word "bare" seems to be uncomplicatedly self-evident and accessible. An indicator of plainness, it is apparently resistant to exegesis. This ironically produces a barrenness of meaning; the word is unanalysable because of its apparent semantic obviousness. This initiates a series of contradictory attributes concerning the nature of beauty. The light imagery that Millay attaches to the idea of Beauty, for example (Beauty is "luminous air" and "light anatomized" that "shone" for Euclid, in a "blinding hour") does not illuminate, but obscures – endarkens – our understanding. The repetition of the light images without specific detail as to *what* is shining results in an impenetrable glare of imagery: an interpretive snow-blindness. The impenetrability of Millay's imagery provoked a protracted debate in *Explicator* from 1942 to 1948 over whether or not the poem referred to Euclid's theory of optics; no satisfactory conclusions were reached, and the matter was quietly dropped after 1948.¹² Similarly, Euclid's "bare" vision is a "shifting lineage" that is "intricately drawn", yet is also "nothing," "nowhere." It is "massive": it is physically huge, cosmic, and beyond the scope of human grasp, but it also *possesses mass*, in that it is the indefinite and intangible embodied. It is obvious and overt, but also intimate; "bare" in the sense of naked and revealed, which places Euclid in the role of both a lover and a voyeur. Even syntactically, the word "bare" performs double duty; it could modify either Beauty herself or Euclid's own vision: "bare Beauty" or "looked upon . . . bare," as in a gaze undertaken without mediation.

Despite the abstraction and impenetrability of the central adjective of the first line, the *idea* of beauty in this sonnet retains its association with transparency, crispness and clarity. These qualities are connected to the study of geometry, which is probably the discipline that most readers imagine as the subject of the poem. The reader who first raised the problem of the sonnet's subject matter in *Explicator* noted that "generally the sonnet is read as if concerned with geometrical discoveries."¹³ The geometric principles of the "small square poem" are especially clear in Millay's text; the rhyme is simple and rigorous; a perfect, four-rhyme Petrarchan (or Italian) sonnet, with an octave and a sestet that can be further subdivided into quatrains and tercets. Therefore the idea of three and four pointed figures – triangles and squares – is implied in the structure of the poem. Like Euclid's ideal geometric figures, however, they are without dimension – they are not "real" aside from the quadrangle of the single stanza itself.

¹⁰ Paul Hoffman, *The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth*. New York: Hyperion, 1998, p.33.

¹¹ Denis Donoghue, *Speaking of Beauty*. New Haven: Yale University Press, 2003, p.179. All subsequent references are to this edition and are given in the text.

¹² See the first entry in this exchange: 'Q9: Millay's 'Euclid Alone has Looked on Beauty Bare',' *Explicator* 1.1 (1942) n. pag. The ensuing debate can be followed by consulting the index of subsequent volumes of the journal.

¹³ See: 'Q9: Millay's 'Euclid,' n. pag.

True beauty, Millay suggests, belongs to the intangible absolutes of the mathematical visionary; the rest of us can only "gabble and hiss" about beauty. But reading a poetic text on the subject of mathematical beauty begs the question as to what extent mathematical beauty transfers to literary beauty? Certainly, the readership of this poem indicates that the text is meaningful to both scientists and literary scholars alike. But how strong is the relationship between scientific and poetic beauty generally, and is that relationship embodied in this poem? Beyond that, to what extent can we see scientific and poetic aesthetics sharing an interpretative space in other poems or in poetry generally?

Gillian Beer has noted that "stories of culture" tend to "go largely *undescribed*: symmetry, simplicity, development, hierarchy, chance, provide models, ideals, and implied narratives in science as much as literature." We might regard symmetry and simplicity as "ideals of scientific elegance," Beer observes, but the underlying aesthetic narratives or models of symmetry and simplicity – the idea of elegance itself – for example, tend to be "sequestered" from debate.¹⁴ Elegance, or beauty, simply *is*: it is just *bare*. Yet there are a number of important studies on the subject of science and aesthetic theory.¹⁵ For example, mathematicians and scientists like Paul Dirac, Roger Penrose, Jacques Mandelbrojt and Steven Weinberg have meditated on beauty in their professions. Commentaries on mathematical biographies and testimonies of particular scientific experiences frequently segue to meditations on beauty, as seen in G.H. Hardy's *A Mathematician's Apology* (1941), Henri Poincaré *Science and Method* (1952), Werner Heisenberg's *Across the Frontiers* (1974), and J.W.N. Sullivan's *The Limitation of Science* (1933).¹⁶ More general studies of aesthetics occasionally engage the issue of beauty in science; an early example is Francis Hutcheson's 1725 analysis *An Inquiry Concerning Beauty, Order, Harmony, Design*. In the twentieth century, Roger Fry's canonical *Vision and Design* (1920) also considered scientific aesthetics.

Ideas of mathematical and scientific beauty are frequently collapsed in these studies; indeed, mathematical aesthetics are frequently read as a foundation for scientific aesthetics, especially in our mathematically-determined scientific methods of today. For the mathematically inclined the idea of mathematical beauty is so self-evident as to be irreducible to analysis, and for the non-mathematically inclined it is so distant as to be almost incomprehensible: heard "once only and then but far away." While Millay's poem seems to be as much about the inexpressibility of aesthetic visions as it is about aesthetics – we are not permitted to see what precisely it is that Euclid is seeing, for example – it is still clearly meaningful to mathematicians, readers of literature and others. As an aesthetic object, the poem is self-reflective; embedded

¹⁴ Gillian Beer, *Open Fields: Science in Cultural Encounter*. Oxford: Clarendon, 1996, p.161.

¹⁵ The fullest treatments are found in the following book-length studies: Subramanyan Chandrasekhar, *Truth and Beauty: Aesthetic Motivations in Science*. Chicago: University of Chicago Press, 1987; Ernst Peter Fischer, *Beauty and the Beast: The Aesthetic Moment in Science*. trans. Elizabeth Oehlkers. New York: Plenum, 1999; James McAllister, *Beauty and Revolution in Science*. Ithaca: Cornell University Press, 1996; Arthur I. Miller, *Insights of Genius: Imagery and Creativity in Science and Art*. New York: Springer, 1996, as well as the proceedings of the 1980 Nobel Conference edited by Deane W. Curtin: Deane W. Curtin, ed. *The Aesthetic Dimension of Science: 1980 Nobel Conference*. New York: Philosophical Library, 1982.

¹⁶ See also chapters by Poincaré and Morse in Raymond G. Ayoub, ed. *Musings of the Masters: An Anthology of Mathematical Reflections*. Washington, DC: Mathematical Association of America, 2004, pp.17-30, 81-96; and Paul Hoffman's biography of Paul Erdős: Paul Hoffman, *The Man Who Loved Only Numbers*.

in its meditation on mathematical beauty is an interrogation of poetic beauty, and the relationship between the two. It asks us to consider if the text can possess the same transcendent aesthetic qualities that the mathematical visionary engages in, and, more subtly, it interrogates the aesthetics of the sonnet form specifically – arguably, the most significant single poetic form in our literary inheritance in English, which acts as an archetype for the idea of poetic form generally.¹⁷

So how does this sonnet – “Euclid Alone has Looked on Beauty Bare” – work as a link between literary and mathematical aesthetics? The meaning of the poem is found not in its literal applications, but in its actions, which are experienced through its form of the English-language version of the Petrarchan, or Italian, sonnet form. The form of the sonnet itself is inherently mathematical, and the aesthetic functions of the mathematical elements of the sonnet are responsible for much of the form’s beauty, as well as its deeper meanings.

Shifting Lineages: Sonnet Form and Mathematics

Previous scholarship has explored numbers and numeric symbolism in poetic forms, including sonnets, within the broader context of numerical mysticism of classical, medieval and early modern cultures. S.K. Heninger and Alastair Fowler have contributed substantial studies of Platonic and Pythagorean numerology in English literature.¹⁸ More recently, Marcia Birken and Anne C. Coon’s *Discovering Patterns in Mathematics and Poetry* established a broad range of connections between the two fields, with a special focus on using these common grounds as a productive teaching strategy. There has even been a single-author study on the subject: William Goldbloom Bloch’s *The Unimaginable Mathematics of Borges’ Library of Babel*.

The sonnet form is usually of interest in such studies of mathematical-literary relationships, but many of their engagements are under-theorized; Birken and Coon provide several examples of the various patterning of the fourteen-line stanza (including “Euclid Alone has Looked on Beauty Bare”) although they do not extend their discussion to mathematical formulae or theories. Fowler’s detailed analysis of numerology and Elizabethan poetry includes a chapter on the sonnet sequence, although he does not discuss the sonnet as a single stanza. Paul Oppenheimer and Don Paterson have provided the most sophisticated analyses of the aesthetic relationship between mathematics and poetry; both discuss the sonnet’s relationship to the proportions of the Golden Section, and Paterson has also drawn connections to the Fibonacci sequence. In order to make these theories work, however, both Oppenheimer and Paterson have to tweak the sonnet structure slightly. To reconstruct the Golden Ratio, for example, Oppenheimer suggests that the last two lines of the stanza be seen as connected to, but distinct from, the previous twelve (302-3). This constructs a numerical idea within the core of the sonnet of 6:8:12, which is the harmonic proportion in the Renaissance architecture of rooms (303). Similarly, Paterson also explores the sonnet’s connection to the Fibonacci sequence

¹⁷ Obviously this may be challenged, but insofar as the sonnet has remained emblematic of poetry generally, and it has not, like the verse romance, merged with prose forms over the last 500 years, it is a fair assessment of the form’s importance. One is hard pressed, for example, to find significant numbers of whole print collections devoted only to other single poetic forms.

¹⁸ See: S.K. Heninger Jr., *Touches of Sweet Harmony: Pythagorean Cosmology and Renaissance Poetics*. San Marino, California: Huntington Library, 1974; Alastair Fowler, *Triumphal Forms: Structural Patterns in Elizabethan Poetry*. Cambridge: Cambridge University Press, 1970. See also Marianne Shapiro’s study of number symbolism in the sestina form: Marianne Shapiro, *Hieroglyph of Time: The Petrarchan Sestina*. Minneapolis, MN: University of Minnesota Press, 1980, pp.10-13.

(1,1,2,3,5,8,13, 21, etc), which itself is related to the Golden Mean and which is patterned in the sonnet up to 13; the extra 1, he suggests should be taken in the mathematical equation from the repeated 1 that starts the sequence, so the sonnet form adds to 14 (xviii-xix).

Both of these theories are workable and probably accurate in a general respect; there is no question that the Golden Ratio was a dominant force in Renaissance aesthetics and that it would have been read into poetic forms including the sonnet.¹⁹ Furthermore, the Fibonacci numbers and the Golden Ratio have mathematical connections to each other, so it makes sense that they can both be seen in the sonnet.²⁰ But although creative, both Oppenheimer's and Paterson's theories lack a certain mathematical elegance, since they require us to rework the basic fourteen line form in some respect – with the result that the mathematical figures are more *alluded to* than *represented in* the text. While these allusions are important to the meaning of the sonnet form, the significance of numbers and their behaviours is more than allusive in relation to mathematical constructs in the sonnet form (and in Millay's sonnet specifically). The sonnet form contains within it a mathematical theorem that is very beautiful – and quite literal: the Petrarchan English sonnet, with the octave/sestet/iambic pentameter stanza, embodies two geometrical constructs exactly: the Pythagorean Theorem and the Primitive Pythagorean Triple.

We can construct the Pythagorean Theorem out of the three primary numeric components of the sonnet; 8 (the octave), 6 (the sestet) and 10 (the number of syllables in each line): $8^2+6^2=10^2$; $64+36=100$. In this respect, the sonnet form does not merely *represent* the Pythagorean Theorem, it both *is* it and it *does* it. The form is symbolic but it also *enacts* the elegant mathematical form. But not only does the Italian sonnet form embody – or perform – one of the classically beautiful mathematical theorems, but it divides down to another essential mathematical beauty: the Primitive Pythagorean Triple.

If we take any triangle and multiply all of its sides by 2, we arrive at a scaled-up version of the original triangle; it has all of the same angles as the original triangle and looks exactly the same (except enlarged). In mathematics, these triangles are called "similar triangles." The 6, 8, and 10 triangle of the Italian sonnet is simply a scaled up version of 3, 4 and 5; this is also true for 9, 12, and 15; 12, 16 and 20, as well as 15, 20, and 25. In this sense, 3, 4, and 5 is the parent to all of these other triples and it is the most primitive of all of them since it cannot be subdivided any further, as long as we want to work in integers.

This idea of the Primitive Pythagorean Triple is analogous to irreducible fractions; mathematicians always write fractions in their lowest terms (instead of writing 12/8 or 6/4 they would write 3/2). Therefore, the sequence 3, 4, and 5 has special significance in this respect, since it characterizes an entire family of solutions to the Pythagorean Theorem. While the 3/4/5 triple isn't the only Primitive Pythagorean Triple,²¹ it is significant that all Primitive Pythagorean Triples can be generated from the 3/4/5 triangle by use of three relatively simple algorithms. This

¹⁹ On the cultural influence of the Golden Ratio see: H. E. Huntley, *The Divine Proportion*; and Mario Livio, *The Golden Ratio: The Story of Phi, the World's Most Astonishing Number*. New York: Broadway, 2002.

²⁰ Richard Dunlap explores these connections extensively. See: Richard A. Dunlap, *The Golden Ratio and the Fibonacci Numbers*. New Jersey: World Scientific, 1997.

²¹ 5, 12, and 13; 7, 24, and 25, etc. are also primitive solutions. In fact, there are infinitely many Primitive Pythagorean triples, each characterizing their own separate family of solutions to the Pythagorean Theorem. See Eves 45-6 and 80-2.

means that 3, 4, and 5 is the *most* primitive of all Primitive Pythagorean Triples; it can be used to generate all of the others. The 3/4/5/ triple may be regarded, therefore, as the mother of all solutions, which captures perfectly both the centrality and the generative function of the sequence. Furthermore, in addition to being the smallest Primitive Pythagorean Triple that can generate all other Primitive Pythagorean Triples by a simple application, it also has the important feature that 3, 4, and 5 are consecutive numbers. For these reasons the 3/4/5 Primitive Pythagorean Triple holds much mathematical fascination, and is considered especially elegant. The Italian sonnet in English possesses this same reduction: sestet, octet and iambic pentameter can be subdivided into tercet, quatrain and pentameter.

One circumstance of the historical context of the invention of the sonnet is that it coincided with an era of mathematical innovation. The sonnet was invented in the court of Emperor Frederick II, probably by a courtier and notary named Giacomo da Lentino (or Lentini), whose fellow courtiers included Leonardo "Fibonacci" Pisano himself.²² Shortly before that time, Euclid's *Elements* was translated from Arabic into Latin by Gherardo of Cremona, making it available to European scholars at the end of the twelfth century.²³ It was this text that contained the first widely circulated formal statement and proof of the Pythagorean Theorem (Proposition 47 of Book 1). Therefore, the poetic innovators of the early thirteenth century that produced the sonnet, as well as other number-based forms like the sestina, the strambotto, and terza rima forms, were working within a mathematical renaissance of sorts, alongside mathematicians like Fibonacci who were interrogating the very nature of number, and therefore the very nature of space, time, nature and beauty.²⁴ The circulation history of Euclid's *Elements* corresponds with important moments in English literary history as well; it was first printed in 1482, just before the start of the Tudor dynasty that would produce the first English sonneteers.²⁵ Although manuscript evidence of the direct mathematical influence on literature is lost to history and must remain speculative, it would be reasonable to expect that the *Elements* would have contributed to the intellectual milieu of the Tudor court as it did in the court of Frederick II, and that it may have reinforced the links between mathematics and poetry as Sir Thomas Wyatt and the Earl of Surrey continued to experiment with number and pattern in the sonnet.

²² See: Paul Oppenheimer, 'The Origin of the Sonnet,' p.289; Don Paterson, 'Introduction,' p.xiii; Michael R. G. Spiller, *The Development of the Sonnet: An Introduction*. London: Twayne, 1992, p. 13; Ernest H. Wilkins, 'The Invention of the Sonnet.' *Modern Philology* 13 (1915), 463-94., p.463. While Paterson points out the connection between the Fibonacci sequence and the Golden Mean, which he feels is a significant aspect of the sonnet's construction, he fails to note the historical connection between Fibonacci and da Lentino (xviii). Regarding Fibonacci's name, see: Alfred S. Posamentier, and Ingmar Lehmann, *The Fabulous Fibonacci Numbers*. Amherst: NY: Prometheus, 2007, pp.17-18. On Da Lentino's poetry see: Ernest F. Langley, *The Poetry of Giacomo da Lentino: Sicilian Poet of the Thirteenth Century*. Cambridge, M: Harvard University Press, 1915.

²³ Howard Eves, *An Introduction to the History of Mathematics*. 6th edn. Philadelphia: Saunders College, 1990, p.261.

²⁴ On mathematicians and poets in the court of Frederick II see: David Abulafia, *Frederick II: A Medieval Emperor*. 1988. New York: Oxford, 1992, pp.251-89; Paul Oppenheimer, 'The Origin of the Sonnet,' pp.300-1; Michael R. G. Spiller, *The Development of the Sonnet*, pp.1-27; Georgina Masson, *Frederick II of Hohenstaufen: A Life*. 1957. London: Secker and Warburg, 1973, pp.112, 223-43.

²⁵ Eli Maor, *The Pythagorean Theorem: A 4,000 Year History*. Princeton: Princeton University Press, 2007, pp.72-3.

Beauty, Meaning, and the Sonnet's Mathematics

Both the Pythagorean Theorem and the Primitive Pythagorean Triple embedded in the English Petrarchan sonnet form are considered beautiful by mathematicians for several reasons. Most obviously, they both express ideas of symmetry and proportion. Of the Pythagorean Theorem, Johannes Kepler said: "Geometry has two great treasures: one is the theorem of Pythagoras, the other [the Golden Ratio]. The first we may compare to a measure of gold; the second to a precious jewel".²⁶ Centuries later, the mathematician and writer Charles Dodgson (Lewis Carroll) insisted the Theorem was "as dazzlingly beautiful now as it was in the day when Pythagoras first discovered it".²⁷ But there are two aesthetic qualities of the Pythagorean Theorem and Pythagorean Triples that should be of special interest to readers of the sonnet: both theorems are *generative* and *spatial* in nature: they are generative in the sense that they are procreative and prolific, and they are spatial in the sense that they interrogate the meaning of physical and intellectual space.

The Primitive Pythagorean Triple of 3/4/5 produces replicas of itself by being scaled up. The generative aspect of the Pythagorean Theorem is its applicability and connectivity to other ideas, mathematical and otherwise. In fact, Francis Hutcheson used the Pythagorean Theorem as his ideal example of beauty in theorems generally, which he defined as possessing "uniformity in variety", wherein the theorem offers a model that demonstrates the essence of a thing, which can in turn be generalized to express a multitude of examples, however various they may seem (such as right-angled triangles of different sizes).²⁸ Hutcheson's requirement is fulfilled by the Pythagorean Theorem in that it reveals a universal truth of every possible manifestation of right-angled triangles according to the axioms of Euclidean geometry. Its application to a theoretical infinity of examples makes it especially beautiful. More recently, in his definition of mathematical aesthetics, G.H. Hardy required "significance" of an elegant or beautiful mathematical statement. The significant (or "serious") theorem connects in a "natural and illuminating way" to things outside itself, so as to shed light on our larger understanding of the nature of number, and perhaps on human understanding in general (29).

These qualities of the Theorem and the Triple can be seen to share functions with the sonnet form, which itself is generative. Sonnet experimentation and innovation produced new forms and new understandings of the nature of literary form, especially in English. Wyatt's import into the young English literary culture put new demands on the artistic possibilities of the language.²⁹ Not only were new literary forms spawned through the experimental energy of such project, but the language itself flexed and grew to accommodate the structural rigour of the form. Commentators have noted that the sonnet, while providing a structural model that is rigorous enough to determine the form, is nevertheless wondrously adaptable, and is thus both beautiful and enduring. As Wordsworth reflected, the sonnet, though

²⁶ Quoted in Eli Maor, *The Pythagorean Theorem*, p.47.

²⁷ Charles L. Dodgson, *Curiosa Mathematica: Part 1, A New Theory of Parallels*. London: MacMillan, 1888, p.x.

²⁸ Francis Hutcheson, *An Inquiry into the Origin of Our Ideas of Beauty and Virtue in Two Treaties*. ed. Wolfgang Leidhold. Indianapolis, IN: Liberty Fund, 2004, p.36.

²⁹ See: Michael R. G. Spiller, *The Development of the Sonnet*, pp.83-101; Elizabeth Heale, *Wyatt, Surrey and Early Tudor Poetry*. London: Longman, 1998, p.118; F. W. Bateson, *English Poetry and English Language*. New York: Russell, 1961, pp.26-34.

structured, is not a restrictive "narrow room."³⁰ Instead, the fact that the sonnet is "adept at daring escapes and covert crossings" of its own form is integral to that form.³¹ In such work, the sonnet form fulfills Hardy's requirement of being significant and illuminating, and, as Wordsworth's metaphor suggests, the form is implicitly interrogating physical space itself, and this is where it connects most directly with mathematics.

Spatially, both the sonnet and the Pythagorean Theorem also have something to teach us, and their engagement with physical space contributes directly to the mathematical aesthetics that underlie their respective forms. The fact that the Pythagorean Theorem extends beyond any specific example to illustrate the nature of all Euclidean right angles connects us to the issue of space. Jacob Bronowski called the Pythagorean Theorem "the most important single theorem in the whole of mathematics," noting that "what Pythagoras established is a fundamental characterisation of the space in which we move".³² This is true most especially in the architectural applications of the theorem: "the Pythagorean Theorem," Michio Kaku writes, "is the foundation of all architecture; every structure built on this planet is based on it".³³ The relationship between the Pythagorean Theorem and the Primitive Pythagorean Triple is part of architectural history; ancient builders knew that ropes composing the 3/4/5 triangle could be used to form right angles long before mathematicians like Pythagoras stated the more general theorem that characterized *all* right-angled triangles. In other words, the builders knew that 3/4/5 was an extremely useful and beautiful relationship, but they did not actually know *why* that was the case until the theorem.

The Pythagorean Theorem articulates spatial integrity; its essential beauty is its articulation of the relationships of wholes and parts, and its demonstration of how they are unified: "the result is magical and of immense usefulness" Bryon E. Wall concludes.³⁴ This spatial significance of Euclid's visionary mathematics is captured by Millay in the phrase "light anatomized", which constructs light as a physical body that can be dissected, deconstructed and even reshaped by the geometer. The true resonance of Millay's meaning is actually a sort of "active pun": breaking the word "anatomized" into its semantic parts – anatomizing it – releases "atom", which is Greek for "indivisible", implicitly, then, a whole. While we associate anatomy with dissection, its more general meaning is simply to divide the indivisible, and the mystical associations with this idea play into our feelings about the human body, the earth, and light itself. Dividing the indivisible (anatomy literally means "un-dividing"³⁵) is what a geometer (earth-measurer) does, and what Euclid could do to an extent that was impossible for average thinkers: his dimensionless lines and points divided the entirety of light.

³⁰ William Wordsworth, 'Nuns Fret Not at their Convent's Narrow Room' in *Wordsworth: Poetical Works*. ed. Thomas Hutchinson. Oxford: Oxford University Press, 1973, p.199.

³¹ Zachariah Wells, *Jailbreaks*, p.11.

³² Jacob Bronowski, *The Ascent of Man*. London: BBC, 1974, pp.160-1.

³³ Michio Kaku, *Hyperspace, A Scientific Odyssey through Parallel Universes, Time Warps, and the 10th Dimension*. New York: Oxford University Press, 1994, p.37.

³⁴ Byron E. Wall, 'Proposition I.47 of Euclid: The Pythagorean Theorem,' in *Science in Society: Classical and Contemporary Readings*. ed. Byron E. Wall. Toronto: Wall and Thompson, 1989, 55-8., p58. On the study of parts and whole – or "mereology" – in literature see: Amanda Jernigan, 'Wholes and Parts (All Puns Intended): The Mereological Vision of Richard Outram's Poetic Sequences.' MA thesis. Memorial University of Newfoundland, 2007. Especially pp.1-14.

³⁵ StevenConner, *Fly*. London: Reaktion Books, 2006, p.90.

Similarly, the beauty of the sonnet is often read as the way in which it provides form for another indivisible space – mental space: the sonnet is, according to Paterson, “one of the most characteristic shapes human thought can take” (xxvii). Wells writes that sonnets “are built the way that people think and speak and argue” (11); the containment on thinking imposed by the rigour of the form, particularly the octave-sestet construction, imparts a holism of identity. In Millay’s text the subject (Euclid) and the object (Beauty) of the poem are joined as the mathematician “seeks release” in the “luminous air” of Beauty’s light, which in turn penetrates his vision with “light anatomized.” In his history of the form, Oppenheimer reads its structure as possessing a similar type of investment in the unification of psychological spaces that have previously been perceived as discrete. The sonnet form, specifically the way in which the octave and sestet sections are distinct but also irrevocably part of the sonnet unit, is meant to reconcile the split between the poet and his conventional courtly-lover personae that had been the dominant model for lyric poetry into the 13th century. It is one of the sonnet’s marks of modernity, he suggests, that the form “will solve the problem” of the “*persona* split into rival *personae*” (299). This is what he calls the psychological work of the sonnet; the poet, he writes, “addresses himself not to any outsider but to the form itself” (299). The sestet (6) and the octave (8) are like the two perpendicular legs of the right angled triangle, representing the distinct poetic split or fork. The thing that structurally binds them and reconciles the split is the iambic pentameter (10), which persists through the entire poem and would represent the hypotenuse of a right-angled triangle; ultimately, the hypotenuse completes the triangle and makes it a closed geometrical figure.

The ultimate experience of Millay’s sonnet is, then, the experience of meditating on the relationship between its parts and the whole. Just as Euclid meditated on dimensionless lines of anatomized light and saw their relationship to each other, the reader of this sonnet – and of sonnets in general – experiences a beauty of the “conformity of the parts to one another, and to the whole,” which Werner Heisenberg declares to be the best definition of mathematical beauty.³⁶ The Pythagorean Theorem articulates an underlying structure or relationship that hitherto had gone unexpressed, except in discrete, disconnected instances: like the ancient builders, the mystical persistence of the sonnet indicates that we recognize the usefulness and beauty of the sonnet form without really understanding *why* it is so. There is an underlying structure or relationship that has gone unnoticed (in both cases, the Pythagorean Theorem). The unveiling of this structure may be the “bare beauty” experienced by visionaries like Pythagoras or Euclid; it is the difference between “prating” about a single instance or physical example of beauty – like a single 3/4/5 triangle – and knowing the pure and basic form of that beauty that cannot be intricately drawn.

The closed form of the right-angled triangle determined by its own dimensions mimics the psychological, meditative work of the form, which is to demonstrate its own integrity. Perhaps this is the psychological and aesthetic law, equation, or archetype that Oppenheimer senses as the mystery of the sonnet form (290). For Paterson, the sonnet presents a “unity of meaning”:

³⁶ Werner Heisenberg, *Across the Frontiers*. trans. Peter Heath. New York: Harper, 1974, p.167.

something that is impossible to represent in any sustained, linear, complex utterance – but it's crazily, what our human poetry tries to do. So a sonnet is a paradox, a little squared circle, a mandala that invites our meditation." (xvi).

This experience of integrity (from the Latin wholeness, soundness, uprightness, honesty, as well as "integer" – untouched) may fulfil a deeper psychological desire: "The urge to understand is the urge to embrace the world as a unity," the mathematician Marston Morse wrote, "to be a man of integrity in the Latin meaning of the word".³⁷ This extends the meaning of the Pythagorean form of the sonnet beyond the original Renaissance interest in Platonic ideals that may have motivated the mathematical experimentation with poetic forms. We do not have to subscribe to archaic philosophical perspectives to appreciate the beauty, however contingent, of expressions of integrity. The sonnet, with its Pythagorean structure, allows us to experience even briefly Virginia Woolf's "triumph" and "consolation" of seeing the "perfect dwelling-place" of ideas: "The structure is now visible; what is inchoate is here stated; we are not so various or so mean".³⁸ We may still have some cultural nostalgia for such an integral form of Beauty, even if culturally it is "but far away," that brings us back to the sonnet form again and again.

Conclusion

It is sensible to assume that Edna St. Vincent Millay was aware of the Pythagorean perfection of her favoured poetic form, and that "Euclid Alone has Looked on Beauty Bare" is her meditation on the synthesis between mathematical and literary aesthetics. She was, after all, a consummate sonneteer and had an intimacy with the form that few others would understand.³⁹ Similarly, the early Renaissance poets – and perhaps many who came later – likely recognized the mathematical structures within the form as being so obvious as to not merit comment; such structures were endemic to their intellectual and artistic worlds, and as such, they became one of those undescribed stories of culture that we have since forgotten. In rediscovering them we can gain knowledge about the original creative impulses of our poetic inheritances, as well as finding new significance for these structures in our own literary worlds.

Employing Millay's sonnet as a case study illuminates larger conclusions that go beyond the issue of the mathematical significance within this one poem, or even within the tradition of one poetic form. Mathematical forms – numbers and number theorems – are not inert, passive or purely descriptive structures. Literary form, in that it has a spatial and temporal presence in poetry (it takes up space on the page, it involves measurements of time in language) is not merely symbolic – representation is not its only level of participation. Denis Donoghue considers form to be intrinsic to

³⁷ Marston Morse, 'Mathematics and the Arts' in *Musings of the Masters: An Anthology of Mathematical Reflections*. ed. Raymond G. Ayoub. Washington, DC: Mathematical Association of America, 2004, 81-96., p.90.

³⁸ Virginia Woolf, *The Waves*. ed. Gillian Beer. Oxford: Oxford University Press, 1992, p.134.

³⁹ On Millay's sonnets see: Cedric Barfoot, 'Edna St. Vincent Millay's Sonnets: Putting 'Chaos into Fourteen Lines,' in *Uneasy Alliance: Twentieth Century American Literature, Culture and Biography*. ed. Hans Bak. Costerus New Series 150. Ropodi: Amsterdam, 2004, 81-100; Judith Farr, 'Elinor Wylie, Edna St. Vincent Millay, and the Elizabethan Sonnet Tradition,' in *Poetic Traditions of the English Renaissance*. ed. Maynard Mack and George de Forest Lord. New Haven: Yale University Press, 1982, 287-305; Debra Fried, 'Andromeda Unbound: Gender and Genre in Millay's Sonnets.' *Twentieth Century Literature* 32 (1986), 1-22; Michael R. G. Spiller, *The Development of the Sonnet: An Introduction*. London: Twayne, 1992 68-76.

and inseparable from the meaning of the text ("meaning" as opposed to "content" or even "subject"); "Form is the achieved, purposed deployment of energy, energy available on need and not there till looked for" (123). The idea of the text's *meaning*, which is additional to its subject, might be aligned with Hardy's idea of mathematical *significance*. In its *meaning* the text is active, it performs its own subject in a way that pushes the reader beyond the literal interpretation to a more emotional and aesthetic experience. It connects to things (readers, other texts, larger ideas) outside of itself that were not consciously built into its narrative – hence it can connect to a future. Michael Wood has discussed this as the inherent knowledge of form, placing an autonomous interpretative level within form that precedes the reader's interpretation, which we experience emotively, sensually, physically, as well as intellectually.⁴⁰ We recognise this formal knowledge in our experience of reading the poems, and we respond emotionally and aesthetically. A keystone form like a Primitive Pythagorean Triple, or a sonnet, can support whole new systems of knowledge, and contain a generative energy that ripples outward from its core, seeking "release / From dusty bondage into luminous air". Of course, not all sonnets discuss mathematical or scientific subjects directly: very few of them do, in fact. But certainly all sonnets engage aesthetics generally and an aesthetics of form specifically, and on both those levels they are connected historically and structurally to principles of mathematical and scientific beauty, and so on those levels it is fair to say that the *meaning* of the sonnet form can be connected to scientific aesthetics. In an era where science is profoundly mathematical, and mathematics is a language that most non-scientists don't speak, it is a beautiful idea that poetics may have the capacity to silently and covertly "speak" beauty mathematically, bringing us back to the shared intellectual heritage of science and literature.

Mathematics in poetry is always a creative application, and therefore any sort of absolutist assertion of a mathematical "formula" for the sonnet runs counter to the poetic impulse from *any* era. Poets, early or late, who would pick up such a project must do it with the spirit of experimentation and play. In this case of the mathematics in the sonnet, the synthesis of form and formula must be opened up to the more extended meanings of both the sonnet form and the Pythagorean structures. Ultimately, their true common ground (and true common beauty) is what they mean to us *beyond* their rote formulations: and these ideas (space, integrity, generation) could be transferred to other ideas and forms, poetic and mathematic, far beyond those examined in this essay. We can recognize, without being reductive, that mathematical and poetic forms sometimes come from very similar intellectual and creative places. Our reconnections of these shared heritages between the disciplines must always be modest, however; mathematics and poetry must retain their distinct qualities; words and numbers have a different resonance, and these differences must also be recognized.

These differences are acknowledged in Millay's sonnet through her handling of the gender conventions of the sonnet tradition, especially in relation to the traditional lyric subjectivity of the sonneteers. Constructing Beauty as female retains the convention of the chilly erotic power of the courtly lady (such as the hind – *noli me tangere* – in Wyatt's "Whoso List to Hunt"). But in Beauty's "massive" size and dominance over the lover-mathematician we also see a loosely Freudian maternity; Beauty is the mother of all solutions in an expanded sense, a sort of sandaled lover-

⁴⁰ See: Michael Wood, *Literature and the Taste of Knowledge*. Cambridge: Cambridge University Press, 2005, p.136.

mother goddess of the classical pantheon, like Juno. Beauty holds the mathematician in thrall from all her sources of feminine power. Similarly, the conventional poet-lover-first person subject of the traditional sonneteer is loosened by Millay's division between the (male) mathematician and the (female) poet; they remain analogous, but not identical. As a woman writing about a man, and in eschewing the first-person lyric voice of the traditional courtly sonneteer, Millay puts distance between herself and the poetic subject, Euclid. She lives in the realm of those who never really connect with the level of beauty that Euclid does. Euclid's singularity – his aloneness – adds a modern dimension to the alienation of the conventional courtly lover from the beloved; the subject of the poem is also separated from the poet and the expected total identification between the audience and the speaker is frustrated; we can hear Beauty, but we cannot see her.

Our limited access to Euclid's experience is due to our dependence on language itself. In Millay's sonnet, Beauty is a feminized version of the common mathematical expression "God is a mathematician". This formulation is more philosophical than theological in its meaning; the divinity of mathematics is usually presented (although not always) as a shorthand for the issue of mathematical realism or Platonism. This idea of an ultimate mathematical reality and/or divinity has a long tradition and is still in play today.⁴¹ The issue of whether or not mathematics should be considered the basis of reality is contentious, and probably irresolvable. What is important is that Millay, the early sonneteers, and many other poets, are interested in the aesthetic possibilities of mathematical realism. Obviously, for a poet working in words, this is a challenge. Millay seems to want to address the issue from the mathematician's perspective, which reserves the ultimate aesthetic experience for the geometer, but to represent that experience in language. This is an enterprise that is obviously doomed to fail. Her use of the blinding light imagery calls our attention to this problem, and she instead locates the idea of the beauty of the poem – which is the object of inquiry here – in the form, not the descriptive language. It reminds us that poetry works on levels beyond language, and that something like form may be more connected to other levels of meaning – in this case mathematics – than linguistic meaning.

Thinking about science and literary form in this way involves two complementary methodologies: the investigation of the direct, causal relationship between literature and science, and a second approach, which examines indirect and non-casual relationships between the two disciplines. In this study, the first method is found in the historical linkages between mathematical and poetic innovators like Fibonacci and da Lentino, as well as the cultural context of Pythagorean principles of Renaissance poetics. But the true resonances in thinking about relationships between science, literature, form and aesthetics are not found in the causal arguments, but in a more fluid realm of ideas, where we may obtain a "sense of the movement of ideas from context to context" in order to "emphasize the accidental, the partial, and the metaphorical".⁴² Recognizing the aesthetic function of the sonnet form in relation to the Pythagorean Theorem is part of the expanded mandate of science and literature studies, as determined by scholars like Gillian Beer and N. Katherine Hayles, who challenge us to "avoid stabilizing the argument so that one form of knowledge

⁴¹ A recent and very accessible history of mathematical realism is found in Mario Livio's *Is God a Mathematician?*.

⁴² Alice Jenkins, *Space and the "March of the Mind": Literature and the Physical Sciences in Britain 1815-1850*. Oxford: Oxford University Press, 2007, p.142.

becomes again the origin of all others".⁴³ We can recognize the influence of Pythagorean numerology on poetics, but we should avoid viewing this as a strictly causal and static relationship. In the realm of aesthetics, the mathematical and literary forms work together and in fact exemplify ideas of unity and integrity in space and consciousness. This is not an issue of precedence of knowledge: the Pythagorean Theorem and the Primitive Pythagorean Triple do not tell the sonnet what to think. Rather, they are part of the shared knowledge of beauty in form. The knowledge that is shared between the Pythagorean Theorem and the sonnet is the idea of integral quality of the forms themselves – the principle of unification that is transmitted by the structural qualities and their attendant meanings.

⁴³ See: Gillian Beer, *Open Fields*, p.177. See also Hayles, who poses the challenges the dominant methodology of establishing scientific knowledge as the casual force on literary knowledge: Katherine N. Hayles, 'Turbulence in Literature and Science: Questions of Influence,' in *American Literature and Science*. ed. Robert J. Scholnick. Lexington, KT: University of Kentucky Press, 1992, 299-50., p.229.

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Laura Vorachek, ‘Mesmerists and Other Meddlers: Social Darwinism, Degeneration, and Eugenics in *Trilby*.’ *Victorian Literature and Culture* 37 (2009): 197-215

Scholarly criticism of George Du Maurier’s *Trilby* (1894) has tended to focus on the novel’s depiction of women, Jews, aestheticism, and mesmerism. Although some critics have explored the ideas of racial degeneration that inform Du Maurier’s anti-Semitic characterisation of Svengali – including Daniel Pick’s detailed analysis in *Svengali’s Web: The Alien Enchanter in Modern Culture* (2000) – the importance of other Darwinian-inspired social theories in the novel has often been overlooked. Shifting the primary focus of investigation to Du Maurier’s representation of scientific and pseudoscientific ideas in *Trilby*, Laura Vorachek’s article takes a wider view of the novel to suggest that it sits at the very heart of the Darwinian and eugenicist debates of the late Victorian period.

Du Maurier’s fascination with Darwin’s work had a profound effect on his writing; indeed, as Vorachek points out in her opening passage, Du Maurier spends seventeen pages of *Trilby* ruminating about *On the Origin of Species* (1859). Rather than adhering to the pessimistic outlook of many proponents of degeneration and eugenics in the 1890s, Du Maurier identified with Darwin’s more optimistic view that evolution was a progressive movement toward perfection. However, he does not simply reproduce evolutionary theories in *Trilby*; instead, he manipulates them in order to reveal their inherent tensions and conflicts. Indeed, one of Vorachek’s central points is that *Trilby* warns its readers that evolutionary progress could be hindered by the suppression of individualism in favour of social conformity. Vorachek presents a convincing case that *Trilby*’s ability to adapt to her environment can be read in positive evolutionary terms and that her moral degeneracy is not due to biological factors or heredity, but rather to the social constraints generated by middle-class codes of conduct. Through the careful accumulation of such evidence from the text, Vorachek argues persuasively that *Trilby* advances the notion that evolutionary progress can be achieved only when sexual selection is determined by individual choice rather than by social strictures.

Vorachek’s article is both a significant contribution to the study of the scientific resonances in late Victorian fiction and a highly suggestive analysis of how popular culture is shaped by exchanges between science and literature. Her title ‘Mesmerists and Other Meddlers’ refers to the connections between mesmerism and meddling that she traces throughout *Trilby* and that forms the principle source of tension in the narrative between individual freedom and collective dogma. In particular, the social regulation of marriage (or sexual selection) is shown to have destructive results for many of the major characters in the novel. Vorachek demonstrates that Du Maurier’s portrayal of meddling in *Trilby* – whether it is caused by the intrusive Mrs. Bagot who promotes middle-class values above her son’s happiness, or by the aristocratic Zouzou who marries for social status rather than for love – is consistently pessimistic. Arguing that Du Maurier’s novel is highly critical of those who sacrifice individual liberty for collectivist principles, she claims that Svengali’s mesmeric ability “stands in for and amplifies other means by which an individual forfeits his or her will to a collective force, be it middle-class mores or eugenic programs” (205). Read in this way, those who meddle in the lives of

individuals in order to uphold prescriptive middle-class values – meddling mothers, eugenicists, and social regulators alike – are all cast as manipulators resembling the malevolent Svengali. In the compelling final section of her essay, Vorachek draws together these seemingly disparate ideas – mesmerism, meddling, eugenics, and evolution – in intriguing and highly convincing ways.

By contextualising *Trilby* within these debates about mesmerism, degeneration, and eugenics, Vorachek illuminates the reciprocal relationship between the text and the scientific and pseudoscientific theories of the late nineteenth century. Her article not only traces the influences of social Darwinism, degeneration, and eugenics in the novel, but it also offers a persuasive argument that Du Maurier was actively engaged in questioning many of the precepts of these theories. Clearly and cogently bringing such wide-ranging concepts into sharp focus, ‘Mesmerists and Other Meddlers’ marks an important contribution to studies in late Victorian science and popular culture.

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Anna Henschman, 'Hardy's Stargazers and the Astronomy of Other Minds.' *Victorian Studies* 51:1 (2008): 37-64

Hardy scholars have long concerned themselves with the writer's themes of human desperation and isolation, those psychological states provoked and then exacerbated by a profound inability to understand and, in turn, to be understood by others. Hardy's characters frequently inhabit a physical landscape inadequate for optimal vision, imprisoned in a body and a mind incapable of empathy. Anna Henschman complicates the oft-invoked argument by examining this challenge of vision in relation to Hardy's complementary interest in the stars, the solar system, the universe, and beyond. She considers the late Victorian astronomical advancements that were shedding light on the mysterious cosmos, and notes the sea of celestial bodies and massive empty spaces that appear as frequent guests on the hills and heaths of Hardy's Dorset. Henschman successfully combines her study of "Hardy's preoccupation with our capacity to register the inner loves of others," with "his lifelong fascination with astronomy and the hundreds of references to celestial phenomena in his literary works," (38) enriching the dense tome of Hardy scholarship with a thoughtful consideration of the skies beyond the reach of humanity, and the interiority of the character's psyches that the heavens mirror in Hardy's writing.

Henschman begins by outlining the developments in astronomy that Hardy witnessed, claiming that Hardy "incorporating astronomy into his literary works," to an extent "second, perhaps, only to Tennyson" (39). Henschman considers Hardy's emphasis on "the emptiness of the universe," pointing out that this new knowledge of the cosmos astounded scores of interested stargazers, including Hardy himself (40). She notes how Hardy uses this new information in his novels to underscore the fallibility of human perception and examines the subsequent obstacle this places in terms of discerning another's reality. The senses can hardly be trusted if one keeps in mind the "perceptual challenges" that Hardy invokes and Henschman documents (42). She posits that this new information suggests the following conclusions:

First, at great distances, almost all the techniques we use to perceive relative distance break down...Second, without external indicators, we find it impossible to distinguish between our own motion and the motion of the object we are observing...[and] Finally, our vision is organized in such a way that the observer always appears to be at the center of things, with the rest of the world extending out from him or her (42-43).

Henschman suggests that it is this faulty perspective that allows Alec to rape Tess, while her fellow town-goers contemplate the depth of their shadows just steps away, ignoring Tess, resulting in her eventual murder of Alec and her subsequent hanging. These "deathly lapses of attention" also occur in *The Return of the Native* (1878), as inhabitants of Egdon Heath can "see across large distances" marveling at bonfires far away, while Hardy positions them as powerless to process the suffering of the figures beside them (45). The implications of optical illusions, evidenced when observing the outer universe, are pivotal to the plot structures of Hardy's novels.

Henschman's most valuable contribution to Hardy scholarship springs from her observation that:

While even the most ardent stargazer can only obtain a momentary perception of the stars, that inability is usually seen as an intellectual problem rather than a moral one. The inability to attend to another person, however, is often thought of as a moral failure. For Hardy, then the stars provide a morally neutral example of the perpetual reasons behind the fact that a person can take up one's entire universe one week and fade into irrelevance the next (49).

According to Henchman, stars not only "express the failure of one person to register another," but they provide an excuse for the behaviour. The limitations of humans are such that we cannot be held responsible for our ocular frailties, which traject into omissions of awareness and often culminate in actual moral transgressions. Still, we live in a world where egocentricity is not without consequence, and the state of "being unable to transcend [one's] own perceptual standpoint" necessarily carries "moral implications" (51). Henchman rightly discerns that "even as Hardy creates a moral divide between the narrator and the pedestrians, he lets us feel how persistent and vivid the pedestrians' impression of their own centrality is," (52) underscoring humanity's moral ambiguousness.

Henchman could have mentioned that Hardy's interest in psychological distance and the inability to connect with one's fellow humans evidenced itself most strongly within the author himself. J. Hillis Miller's landmark *Distance and Desire* (1970) brilliantly maps Hardy's own limitations as a man: he was so often hyperaware of the people around him, a keen observer of their experiences, and yet cold to the struggles of those closest to him. Hardy often processed and experienced emotional moments at his leisure, at a later time, as documented in his "Poems of 1912-13," written in response to his wife's death. Then, he expressed all of his pent up love, although during her life, her pain and their strained relations apparently left him cold. The emptiness of the cosmos echoed his own vacuity, as the brilliant streaks of light in the heavens mimicked his powerful awareness of existence, empathy, understanding – magnificent but fleeting. All of the capabilities and limitations of humankind marked Hardy's own experience.

Finally, Henchman sets out to prove that "by looking at the ways in which Hardy's characters oscillate back and forth between different types of knowledge in the contemplation of celestial objects, we can better understand the techniques he uses to wrest his readers out of their bodies and into mental journeys of their own" (39). Although a somewhat reductive claim, to her credit, Henchman resists simply making the assertion and linking it to stargazing. Instead, she extends her rich analysis of Hardy's authorial methods, providing proofs that suggest that "[Hardy's] narrative experiments illustrate the ways in which the imagination can move quickly between vastly different standpoints, inducing a kind of productive perplexity rather than epistemological breakdown" (61). This last assertion, which includes the reader in Hardy's cosmic consideration, distracts from the crucial preceding arguments of the article, but is still consistent with the clear, methodical approach employed in this important addition to Hardy studies.

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Mandy Reid, 'Racial Profiling: Visualizing Racial Science on the Covers of *Uncle Tom's Cabin*.' *Nineteenth-Century Contexts* 30.4 (2008): 369-387

Perhaps the similarities between the disciplines of art and science are made no clearer than when the seemingly objective facade of science is exposed as facade, something that is especially apparent when we examine the discourses of science in the past. The peculiar institution of nineteenth-century racial science, for instance, which encouraged the visualization of race via the practices of phrenology, evolutionary theory, and the articulation of eugenics, was perhaps most dangerously influential when presented in the popular literature and illustrations of the period that reached mass audiences. As Mandy Reid's article demonstrates, even the book covers (in this instance, of *Uncle Tom's Cabin* (1852)) were influential in "disseminating and normalizing" (370) the progress of racial science and in codifying the ways in which race was pictured and hence reinforced.

Reid begins by establishing the increasing literacy of the American public and the importance of images at the time, noting Stowe's own figuration of her text as a painting that functions (in Stowe's own words) to paint in as "lifelike and graphic manner possible slavery" (371). Reid focuses on American covers only and on those that depicted Tom and Eve in scenes involving literacy. These covers are examined as evidence of her assertion that (not exclusive to Stowe's text alone) book packaging often enforced racial difference visually, despite the work to the contrary that the abolitionist books themselves set out to do.

The book covers are examined for their evolving representations of race and their visualization of influential contemporary theories such as Nott and Gliddon's polygenesis, Darwin's *Descent of Man* (1871), and Davenport's understanding of eugenics in terms of heredity. Specifically, she argues that they manifest over the period from 1852 to 1928 as ever-more explicit racial profilings that ultimately mirror the imperative of racial science that (black) bodies need to be read by Americans. While an 1885 cover depicts Tom's features in a manner typical to "Negro physiognomy", (377) for instance, a 1928 cover presents a threateningly large Tom that visualizes the figuration of the Negro as "biologically inferior" (381) and in need of control via eugenics.

While the changing representations of Tom are considered in light of contemporary theories, Reid suggests that these changes are also reflective of improvements in printing technology. The more crude and generic figures of Tom and other characters in an 1852 cover, for instance, are due to the use of block engravings and would be replaced with more detailed illustrations as refined printing processes were in place.

Overlooked in her analysis, however, is the powerful and persuasive effect photography had, not only on the illustrations used in books but also on the ways in which race was visualized and understood by the very theories of racial science she highlights. Abolitionists, for instance, relied on photographs as irrefutable evidence of the effects of slavery; the most notable instance being the circulation of Mathew Brady's famous and much-reproduced 1863 photograph of Gordon, the whipped slave whose scarred back was described as "tell[ing] the story [of slavery] in a way that even Mrs. Stowe can not approach, because it tells the story to the eye."¹ More disturbingly, also in circulation were the numerous "scientific" photographic studies or catalogues that purported to make visual (and also irrefutable) the claims that the inferiority of the black race was visually evident or

¹ Anonymous, *New York Independent*, 1863 (Quoted in the *National Antislavery Standard*, June 20, 1863).

written on the bodies of those photographed. Both opposing visualizations of the race were not only widely disseminated as photographs themselves, but also circulated as visual types produced in illustrations in advertisements, magazines, and book covers. A consideration of the ways in which photography informed this reading of race and its manifestations in the book packaging of *Uncle Tom's Cabin* would expand and strengthen an already-strong examination of how "the science of race" (383) was visually coded. The ways in which both types of photographs, despite their opposing ideological perspectives, were undeniably attractive to the viewer in encouraging the visual consumption of the black body, for instance, would reinforce Reid's brief mention of the interesting notion of the reader's role as a speculator who, in purchasing *Uncle Tom's Cabin*, participated in the "trade in 'black' bodies" (373).

Overall, the analysis Reid undertakes in her article presents a fruitful approach for interdisciplinary scholars of the arts and sciences, particularly as visual and material studies are increasingly being regarded as new and important ways to interrogate both literary and scientific texts.

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**Danielle Coriale, 'Gaskell's Naturalist', *Nineteenth-Century Literature* 63:3
(2008): 346-375**

The development of naturalist science in the Victorian period provided an intellectual framework for classifying and interpreting change in the life of discrete organisms. But it also initiated a diverse cultural movement in English society that was thoroughly ensnared in economic matters. In her recent discussion of Elizabeth Gaskell's first novel *Mary Barton* (1848), Danielle Coriale reminds readers of the important function naturalism served in providing certain working-class men with a modicum of social mobility and respect. Coriale's objective in drawing attention to *Mary Barton's* careful manipulation of naturalist science is to identify the multiple – and often paradoxical – ways in which naturalism restructured the period's class relations and literature. Working through her analysis of Gaskell's novel alongside contemporary materials such as self-help guides, newspaper reports, and poetry, she provides a more complete impression of *Mary Barton's* politics than that which is otherwise available to Gaskell's readers upon first examination.

Part of the difficulty readers find in their attempt to interpret Gaskell's work stems from the problem of recreating her novels' historical context. Contemporary critics generally agree that Gaskell was mindful of Victorian public debates. Where this agreement usually ends, however, is in the question of specifics. In the first half of her study, Coriale is pragmatic; she sees the creation of Gaskell's naturalist Job Legh serving a dual purpose in, first, allowing Gaskell the opportunity to undertake "the risky project of representing working-class suffering to middle-class readers" and, second, permitting "the seamless integration of working-class characters into a legal plot" (351, 353). By establishing an important link between the novel's depiction of Legh and evidence of a fully formed working-class movement in the sciences, Coriale effectively repositions the novel in the midst of an ongoing debate on the use of science for social reform. In her view, because Legh draws upon his familiarity with science to act as a conduit between working-class and professional communities, Gaskell can explore the complex relationship between classes under socially acceptable circumstances.

Having suggested that Gaskell could not avoid naturalism's political influence in turning her readers' attention away from the radical Chartist discourse that runs throughout the rest of her novel, Coriale moves on in the second half of her article to historicize naturalism's influence on Gaskell's style. Here Coriale seems eager to avoid committing an intentional fallacy – perhaps too eager given her otherwise convincing claims for naturalism's impact on Gaskell's worldview. Yet while there is no doubt that some readers will look at this section of her article with regret that Coriale does not take her analysis further in "hinting at the deep interconnections" that existed between novel writing and natural history, most will likely accept her decision to avoid testing the limits of biographical truth and alternatively pursue a metaphorical link between Legh's negotiation of class and Gaskell's own negotiations as author given the otherwise circumstantial evidence she is forced to corroborate with in making her claims (349). Clearly, Coriale does not seek radically to alter our interpretation of *Mary Barton* and its content, instead, to add an informative, well-supported footnote to Gaskell's legacy.

Despite the article's limited scope, readers will find themselves impressed with its implications for future work in the history of science. In a significant attempt to situate her claims within the tangled web of cross-class communication, Coriale notes that while supporters of naturalism frequently cited its social function as a productive way to better

the lives of working-class men, their discussions often overlooked the importance of unequal access to knowledge within working-class communities as well as the tenuous relationship between intellectual and economic reform. In other words, while naturalism offered its supporters the illusion of social mobility, it ignored material conditions; a trend Coriale describes as “traveling in one place” (351). Rival reform movements, in contrast, while not necessarily more inclusive, were typically more conscious of material questions. From their potential hostility towards proposals that threatened to dilute more substantive social and economic change, it can be inferred that the value of working-class scholarship as a productive alternative to political action was not universally accepted among nineteenth-century reformers. Rather, it represented a partial though intellectually significant development in the mid-Victorian debate on social and economic issues.

Whatever one makes of *Mary Barton*, it is indisputable that Legh and the other working-class naturalists found in Coriale’s article were the byproduct of a Victorian class hierarchy in a state of flux. ‘Gaskell’s Naturalist’ thus deserves attention from scholars interested in Victorian studies for its ability to provoke important questions related to cultural capital, the history of science, and the Chartist reform movement of the 1830s and 40s. For while naturalism’s importance to nineteenth-century culture has long been self-evident, Coriale demonstrates its ability to assume unique forms in social practice – an observation of which any scholar would be advised to take note.

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