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Introduction

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Focussing upon the interactions between science and literature/ film in the modern era, the articles presented in this volume engage with a diverse range of cultural contexts and artistic genres, including the Victorian periodical, the twentieth-century novel, postcolonial film and literature, and contemporary fiction informed by the natural sciences. Over the course of the late nineteenth, twentieth, and early twenty-first centuries, the terms 'science' and 'literature' have come to denote particular media, praxes and worldviews, as analysed in this issue of the *Working Papers in the Humanities*. Specific connotations of these terms and a potential conflict between them do seem to crystallise in this post-1850 period, however such a situation does not emerge *ex nihilo*. The question of the relationship between empiricism and nature on the one hand, and imagination, culture and language on the other is one that dates back to antiquity. Its evolution over the subsequent millennia is a complex and fascinating story and in this introduction we offer a brief historical overview that, it is hoped, will provide some important background to the pieces that follow. We then provide a short introduction to the diverse and enlightening articles by Caroline Verdier, William Tattersdill, Rachel Crossland and Sura Qadiri that make up the remainder of this collection.

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Science fiction is one of the central preoccupations of the present volume, and the question of where it begins is hotly contested amongst critics of the genre, with opinions ranging from those who see it as a product of nineteenth- or even twentieth-century culture, to those who view its emergence as co-terminous with the dawn of literature itself (perhaps with the *Epic of Gilgamesh*, c. 2000 BC). As Adam Roberts notes, taking a position on the issue of chronology means taking a stance on the very issue of what one considers science fiction to be (a thorny issue which William Tattersdill engages with later in this volume):

> Stress the relative youth of the mode, and you are arguing that SF is a specific artistic response to a very particular set of historical and cultural phenomena: for instance, that SF could only have arisen in a culture experiencing the Industrial Revolution [...] Stress the antiquity of SF, and you are arguing instead that SF is a common factor across a wide range of different histories and cultures, that it speaks to something more durable, perhaps something fundamental in the human make-up, some human desire to imagine worlds other than the one we actually inhabit.[1]

Aside from *Gilgamesh*, in which the hero's fantastical encounters with the unknown Other might be read as a form of proto-science fiction, other contenders for the first science-fictional text include Homer's *Iliad* (c. 8th century B.C.), whose eighteenth book features the first known literary example of automata,[2] or the writings of the Syrian Lucian (2nd century B.C.), which include several substantial accounts of space travel.[3]

Alongside the question of how science, technology, and cosmic exploration find themselves represented in literature, however, we must look at the way in which ancient science was presented in poetic form. This is particularly striking in the case of the Pre-Socratics (6th century B.C.), many of whose cosmological conjectures, for example, were presented using the same dactylic hexameters that were Homer's chosen vehicle for his epic poetry.[4] The potential truth-status of poetry is implied through the use of such forms, but that status did not go uncontested for long. The tenth book of Plato's *Republic* (598d-608b)[5] famously discusses poetry as an imitation and corruption of the truth, concluding with Socrates' declaration that poets would be expelled from the ideal state (608b).[6] This is not to suggest, however, that Plato rejected poetry, rhetoric and imagination in favour of some kind of modern scientific empiricism. In fact, quite the reverse.

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[1] Adam Roberts, *Science Fiction* (London and New York: Routledge, 2000), pp. 47-48.
[2] Homer, *Iliad*, ed. and trans. by A.T. Murray, rev. by William F. Wyatt, Loeb Classical Library 170-171, 2nd edn, 2 vols (Cambridge, MA: Harvard University Press, 1999), vol. II, Book XVIII, lines 372-379.
[3] See Lucian, *A True Story*, in *Lucian in Eight Volumes*, ed. and trans. by A.M. Harmon, K. Kilburn and M.D. Macleod, Loeb Classical Library (Cambridge, MA: Harvard University Press, 1913-1967), I (1913, repr. 1961), pp. 248-357 (pp. 258-285); Lucian, *Icaromennipus, or The Sky Man*, in *Lucian in Eight Volumes*, II, 267-323. For Jacques Sadoul, *Icaromennipus* was the 'premier texte indiscutable' in the history of science fiction (Jacques Sadoul, *Histoire de la science-fiction moderne [1911-1975]*, 2 vols [Paris: Albin Michel, 1973], I, 13).
[4] For a good introduction to the Pre-Socratics, see Edward Hussey, *The Presocratics* (London: Duckworth, 1972) (on the Presocratics' use of verse and prose see especially pp. 78-81).
[5] Plato, *Republic*, ed. and trans. by Paul Shorey, Loeb Classical Library, 2 vols (Cambridge, MA: Harvard University Press, 1930-1935, repr. 1963), II, 432-469.
[6] Plato, *Republic*, II, 464-465.

Firstly, Plato was not opposed to poetry *per se*, but rather to a certain kind of poetry, as embodied by Homer, which he saw as distorting reality. For Plato, the poet *might* attain truth if, as Gerald Else writes 'he is willing to go to school with Plato and learn philosophy': from Plato's perspective, good poetry had the potential to facilitate a deep communication between souls.[7] Moreover, Plato's philosophy was rarely *natural* philosophy and was profoundly characterised by its insistence upon inner reflection and upon sensible forms' inability to disclose the universe's full truths. The *Timaeus*, which marks Plato's most significant entry into the natural philosophical realm, is the exception which proves this rule. For in the *Timaeus*, despite its apparently natural philosophical preoccupation with the creation and nature of the universe, the opposition between superficial appearances and a more profound world soul lies at the very heart of its cosmology.[8] It is intriguing to note that the *Timaeus* fuses the myth of Atlantis (related to the importance of writing history) with natural philosophy, thus emphasising the importance of the text, and of narrative, to the study of the universe. Thus, whilst Plato's rejection of the poets is firm but not absolute, his understanding of nature is at once proto-scientific and philosophico-poetic.

Aristotle's relative empiricism in natural philosophical matters and his rigid, formalist conception of poetry provide an obvious contrast to Plato's emphasis upon the invisible world soul, and the communication of truth between souls which Plato thought an ideal poetry might achieve.[9] Yet it is not Aristotle, but Plato's teacher and mouthpiece Socrates who comes in for what is perhaps one of the earliest literary attacks upon the proto-scientist's reductive, rationalist agenda: Aristophanes' *Clouds* (late 5th century B.C.) ridicules Socrates (one of the play's chief protagonists), and portrays him as overly materialistic.[10] Socrates' *Apology* (as reconstructed by Plato) indicates that his depiction in this play was one of the factors which shaped his public image in the period leading up to his execution.[11] Similar

[7] Gerald F. Else, *Plato and Aristotle on Poetry*, ed. by Peter Burian (Chapel Hill and London: University of North Carolina Press, 1987), p. 46 and p. 196.
[8] For Plato's most concise statement of this doctrine, see Plato, *Timaeus*, in Plato, *Timaeus, Critias, Cleitophon, Menexenus, Epistles*, ed. and trans. by R. G. Bury, Loeb Classical Library (Cambridge, MA: Harvard University Press, 1929, repr. 1966), pp. 1-253 (pp. 72-73 [36D-37A]).
[9] On these aspects of Aristotle, see Else, 67-203; also Raymond Barfield, *The Ancient Quarrel Between Philosophy and Poetry* (Cambridge: Cambridge University Press, 2011), pp. 32-51.
[10] Aristophanes, *Clouds*, in Aristophanes, *Clouds, Wasps, Peace*, ed. and trans. by Jeffrey Henderson, Loeb Classical Library 488 (Cambridge, MA: Harvard University Press, 1998), pp. 1-211.
[11] Plato, *The Apology*, in Plato, *Euthyphro, Apology, Crito, Phaedo, Phaedrus*, ed. and trans. by Harold North Fowler, Loeb Classical Library (Cambridge, MA: Harvard University Press, 1914, repr. 1966), pp. 68-145 (p. 73).

accusations of science's materialism and soulless demystification of the universe recur throughout the centuries.

It is in Roman times that we see the emergence of the classical divisions of knowledge that would become so influential in the medieval curricula of learning. Though no longer extant, Varro's *Disciplinarium* (1st century B.C.) divided knowledge into nine categories: Grammar, Rhetoric, Logic, Geometry, Arithmetic, Music, Astronomy, Medicine and Architecture.[12] It was under the influence of Varro that Martianus Capella would write his *De Nuptiis Philologiae et Mercurii* (c. 410-c. 429 A.D.), in which he dropped Medicine and Architecture from the curriculum on the basis of their mundane nature. Martianus's text contained two implicit groupings — Grammar, Rhetoric and Logic on the one hand, and Arithmetic, Geometry, Music and Astronomy on the other, which together comprised the seven liberal arts. This text was by the far the most important work on divisions of learning for the Middle Ages (Christianised by later writers, most notably Alcuin), and its importance endured undiminished until the final centuries of the medieval period. The division between the two groupings referred to above would become formalised following Boethius' dubbing of the second group as the *quadrivium* in the 6th century A.D.. Isidore of Seville's prolifically-distributed *Etymologiae* further reinforced the division in the 7th century, dividing its first three books into *Rhetorica; Grammatica et Dialectica*; and *Quattuor disciplinis mathematicis* respectively. Finally, Rhetoric, Grammar and Logic came to acquire their own group-label in the Carolingian era, in which they became known as the *trivium*. Whilst early medieval erudition typically emphasised the unity of all learning, the division between the *trivium* (based on the verbal disciplines) and the *quadrivium* (based on the numerical disciplines) can clearly be seen to foreshadow the division between literature and natural science that is typically considered to be the product of the modern era. Moreover, hints of the later tensions between these fields can certainly be detected in other early medieval writers, such as Johannes Scotus Eriugena (9th century A.D.). In the *Periphyseon*, Eriugena claims that the arts of grammar and rhetoric are not based on nature like the other arts, a point which he reiterates in his commentary on Priscian.[13]

[12] On Varro and the other Latin classifiers discussed in this paragraph, see George Ovitt, *The Restoration of Perfection: Labor and Technology in Medieval Culture* (New Brunswick and London: Rutgers University Press, 1987), pp. 111-117.

[13] See Anneli Luhtala, 'On Early Medieval Divisions of Knowledge', in *Carolingian Scholarship and Martianus Cappella: Ninth-Century Commentary Traditions on 'De Nuptiis' in Context*, ed. by Mariken Teuwen and Sinead O'Sullivan (Turnhout: Brepols, 2011), pp. 75-98 (p.94).

The eleventh and twelfth centuries mark the most fundamental change in education's institutional structures since the end of the classical period. Learning gradually moved, via the transitional institution of the Cathedral School, out of the monastery and into more secular learning environments, ultimately culminating in the emergence of the first European universities at Paris and Oxford c. 1200. As well as these universities, schools dedicated to particular learned but vocationally-oriented practices also began to emerge (in particular Bologna for law, and Salerno and Montpellier for medicine). This renewed intellectual vigour was stimulated to a very great extent by new Latin translations of Greco-Arabic scientific texts moving north from Italy and Spain. The twelfth-century scientific renaissance was not, however, without its opponents. Gerbert of Cremona's travels to Spain to learn astronomy and mathematics resulted in proto-Faustian legends about his supposed engagement with diabolical magic[14] whilst John of Salisbury's championing of the importance of the *trivium*, and of logic in particular, did so at the expense of other fashionable disciplines, including medicine:

> Alii autem suum in philosophia intuentes defectum, Salernum uel ad Montem Pessulanum profecti, facti sunt clientuli medicorum [...] Fallacibus enim referti experimentis in breui redeunt, sedulo exercentes quod didicerunt. Hipocratem ostentant aut Galienum, uerba proferunt inaudita, ad omnia suos loquuntur afforismos [...][15]

> Others, becoming cognizant of their inadequate grounding in philosophy, have departed to Salerno or Montpellier, where they have become medical students [...] Stocked with fallacious empirical rules they return after a brief interval to practice with sedulity what they have learned. Ostentatiously they quote Hippocrates and Galen, pronounce mysterious words, and have aphorisms ready to apply to all cases [...][16]

The twelfth century also marks the emergence of literature in many of the vernaculars of Western Europe, in particular in Occitan, French and German. Some of these works clearly conceive of an ideal union between the quadrivial arts and the literary enterprise (c.f. Erec's

[14] See Edward Peters, *The Magician, the Witch and the Law* (Philadelphia: University of Pennsylvania Press, 1978), p. 28.
[15] John of Salisbury, *Metalogicon*, ed. by J.B. Hall and K.S.B. Keats-Rohan, Corpus Christianorum (Continuatio Mediaevalis) 98 (Turnhout: Brepols, 1991), p. 18.
[16] Translation from: John of Salisbury, *The Metalogicon of John of Salisbury: A Twelfth-Century Defense of the Verbal and Logical Arts of the Trivium*, trans. by Daniel D. McGarry (Berkley and Los Angeles: University of California Press, 1955), pp. 17-18.

donning of his coronation robe, adorned with representations of these disciplines in Chrétien de Troyes's *Erec et Enide*).[17] Others, however, portray an unequivocal hostility to the rise of medicine and astrology (Chrétien's *Cligès*, for example, depicts three physicians from Salerno brutally torturing the romance's heroine, whilst Béroul's *Tristan* presents the reader with a malicious astrologer-dwarf, Frocin, who schemes to bring about the downfall of Tristan and Iseut).[18]

The great literary monuments of the later Middle Ages also gave the natural sciences a mixed reception: Chaucer — who, we should remember, was himself the author of a *Treatise on the Astrolabe* — presents his astronomically-informed 'Doctour of Phisik' in decisively equivocal terms. On the one hand, we are told that 'In al this world ne was ther noon hym lik, | To speke of phisik and surgerye, | For he was grounded in astronomye'.[19] On the other, he is avaricious and religiously suspect: 'His studie was but litel on the Bible', whilst 'he lovede gold in special'.[20] Meanwhile, the influence of science on Dante's writings was particularly strong.[21] Though the problem of incorporating specialist and technical concepts into poetry was already an important one for the Italian twelfth century, as Zygmunt Baránski argues, Dante's attempt to forge a natural philosophical poetry (in which scientific doctrines were fully incorporated into his literary enterprise) still remained relatively novel in the late thirteenth century.[22] However, as Baránski also notes, Dante was not chiefly interested in philosophy (natural or otherwise) for its own sake, but insofar as it illuminated the relationship between the mortal and divine spheres.[23] Indeed, Dante's treatment of his

[17] Chrétien de Troyes, *Erec et Enide*, ed. and trans. by Jean-Marie Fritz, in Chrétien de Troyes, *Romans suivis des Chansons avec, en appendice, Philomena*, ed. by Michel Zink (Paris: Librairie Générale Française, 1994), pp. 55-283 (lines 6726-6785).
[18] Chrétien de Troyes, *Cligès*, ed. and trans. by Charles Méla and Olivier Collet, in Chrétien de Troyes, *Romans suivis des Chansons avec, en appendice, Philomena*, ed. by Michel Zink (Paris: Librairie Générale Française, 1994), pp. 285-494 (lines 5882-5934); Béroul, *Le Roman de Tristan*, ed. and trans. by Philippe Walter, in *Tristan et Iseut: les poèmes français, la saga norroise*, ed. by Daniel Lacroix and Philippe Walter, Livre de Poche 4521 (Paris: Librairie Générale Française, 1989), pp. 23-227 (lines 320-334, 635-843, 1306-1350).
[19] Geoffrey Chaucer, *Canterbury Tales*, ed. by A.C. Cawley, Everyman Library 74, 2nd edn (New York: Random House, 1992), p. 13 (General Prologue, lines 412-414).
[20] Chaucer, *Canterbury Tales*, p. 14 (General Prologue, lines 438 and 444).
[21] Giorgio Stabile, *Dante e la filosofia della natura: Percezioni, linguaggi, cosmologie* (Florence: Sismel, 2007) includes analysis of the role of many scientific fields (including optics, astronomy and cosmology) in Dante's work. For an introduction to more specific elements, see Romano Pasi's brief *Dante, i medici e la medicina* (Ravenna: Essegi, 1996) and (on astronomy/ cosmology) Alison Cornish, *Reading Dante's Stars* (London and New Haven: Yale University Press, 2000).
[22] Zygmunt G. Baránski, '"Per similitudine di abito scientifico": Dante, Calvacanti and the Sources of Medieval 'Philosophical' Poetry', in *Science and Literature in Italian Culture from Dante to Calvino: A Festschrift for Patrick Boyde*, ed. by Pierpaolo Antonello and Simon A. Gilson (Oxford: MHRA and Maney, 2004), pp. 14-52 (pp. 17-18).
[23] Baránski, 32.

encyclopaedist-teacher, Brunetto Latini, is notoriously ambivalent: he places him in the Seventh Circle of the Inferno along with the sodomites, yet his treatment of him in other respects is relatively positive (Dante wishes that Brunetto was not 'de l'umana natura posto in bando' ['exiled [...] from human nature'] and recalls 'la cara e buona imagine paterna | di voi quando [...] m'insegnavate come l'uom s'etterna' ['the dear, kind, paternal image of you, when [...] you taught me how man makes himself immortal']).[24]

As is well known, the humanism of the fifteenth and early sixteenth centuries led to the Latin translation of a vast corpus of classical Greek texts which were previously unavailable to scholars in the West of Europe, including not only literary and philosophical works, but also those of a more mathematical or scientific nature.[25] The 1440 invention of the printing press was also a crucial moment in the dissemination of all forms of *scienza*. It was the printed word that would allow literature to find a worldwide audience, and provide for a corresponding increase in access to natural philosophy. This was by no means an immediate effect: it would be centuries until mass literacy was common in Europe. Nonetheless, the ability for knowledge to circulate outside privileged academic communities was the first step in making this knowledge accessible to the general public; a process that would continue with the first printed publications in the vernacular, including Descartes' *Discours de la méthode* (1637),[26] and culminate in the modern trend for popular science. The form and medium of these vehicles of dissemination were of greater importance than ever before, reminding us of the extent to which language is essential to scientific communication (for the practical discoveries of science can only exist to its audience, and particularly to the lay reader, through representation). Thus, argues Charlotte Sleigh, metaphor is often at the heart of scientific communication, especially when it is aimed at those outside the scientific community. Richard Dawkins' *Selfish Gene*[27] is an example of the application of a recognisable human experience (selfishness) to scientific fact. Science has to persuade, and language is the art of persuasion: scientists must therefore be masters of language, just as much as their literary counterparts.[28]

[24] Dante Alighieri, *Inferno*, <http://www.danteonline.it/italiano/opere.asp?idope=1&idlang=OR> [accessed 24 January 2013], Canto XV, lines 80-85. Our translation.
[25] On which see William Caferro, *Contesting the Renaissance* (Oxford and Malden, MA: Wiley-Blackwell, 2011), pp. 195-199.
[26] René Descartes, *Discours de la méthode* (Paris: Flammarion, 2000).
[27] Richard Dawkins, *The Selfish Gene* (Oxford: OUP, 1976).
[28] Charlotte Sleigh, *Literature and Science* (London: Palgrave Macmillan, 2011), p.5.

Meanwhile, the sixteenth century marked the beginning of a separation between the divine, the cosmological and the human that, as Kathryn Banks has argued, may have been influenced not only by scientific developments, but also by imagistic poetry.[29] It is easy to see how this more fragmented conception of the universe might have contributed towards the process by which academic disciplines became increasingly separate. If microcosmos and macrocosmos no longer fully reflected one another, this opened the way for the conception of theology, natural science and rhetorical/ humanistic studies as isolable fields of enquiry. Indeed, it was in the seventeenth century that philosophy and natural science first began to be distinguished from one another. This was not an immediate clean break: scientists largely still held religious convictions, and thus the search for truth by observation was often still bound up in the search for Truth from the mystic realms.[30] Marlowe's *Dr Faustus*, written in 1604, portrayed a search for knowledge that traversed the earthly and heavenly kingdoms, its protagonist's thirst for scientific truth bound up with his foolhardy challenge to an all-powerful God.[31] Galileo's 1633 trial over his theory of heliocentrism is an indication of the threat science was perceived as posing to the religious establishment in the real world, and the on-going power of that establishment to impose limits on scientific enterprise.

The role of written texts remained important in this climate, as the supporters of the 'Ancients' venerated them both as safer sources of truth and knowledge and as literary models. From mid-century, however, there was a clear movement towards an appreciation of the merits of empirically-acquired knowledge, which culminated in France in the Quarrel of the Ancients and the Moderns.[32] In Britain, where the quarrel had been taken less seriously, 1660 nonetheless saw the founding of the Royal Society of London for the Improving of Natural Knowledge, created by Christopher Wren and his colleagues as 'a Colledge for the Promoting of Physico-Mathematicall Experimentall Learning'. Five years later, the first peer-reviewed scientific journal was published: the Philosophical Transactions of the Royal Society. Far from the foolhardy overreaching of a Faustian individual filled with hubris, scientific enquiry was transformed into an officially-sanctioned collective endeavour. No longer did authority rest with the named 'I'; instead it was the anonymous collectivity of the

[29] Kathryn Banks, *Cosmos and Image in the Renaissance: French Love Lyric and Natural-Philosophical Poetry* (London: MHRA and Maney, 2008), pp.189-191.
[30] Stephen J. Gould, *The Hedgehog, the Fox, and the Magister's Pox* (Cambridge, MA: Harvard University Press, 2003), p. 29.
[31] Christopher Marlowe, *Dr Faustus*, ed. by Edwin Morgan (Edinburgh: Canongate, 1999).
[32] Joan DeJean, *Ancients against Moderns: Culture Wars and the Making of a Fin de Siecle* (Chicago: University Of Chicago Press, 1997).

scientific body that guaranteed the veracity of its claims. And this shift happened just as the opposite movement was beginning to take place in literature, with an increasing focus upon the glory of individual authorship (a trend that would eventually culminate in the Romantic cult of the author). As literature cemented its subjectivity, objectivity became the tool that science used to emphasise its authority.

The eighteenth century saw the explosion of the quest to know and to classify through experience (a hallmark of scientific activity which continues to this day, and which, later in this volume, Sura Qadiri analyses in Amin Maalouf's *Le Premier siècle après Béatrice*). The French *philosophes* rejected a reliance on wisdom contained in ancient texts in favour of their own direct knowledge of the world. In this enterprise, science and literature were still tightly bound up with one another, serving a single purpose as writers attempted to make sense of humanity's place in the world without having recourse to divine explanations. Voltaire the author and dramatist engaged with Newton's *Principia mathematica* in his *Lettres philosophiques*; Diderot moved between anatomy and philosophy in his examinations of materialist theories in *Le Rêve de d'Alembert*; Condillac addressed how the senses filtered human beings' experience of the world, whilst Swift, Montesquieu, Rousseau and others interrogated the origins and development of their own societies through anthropologically-oriented considerations of alternative worlds.[33] Many of these texts represented a different form of scientific enquiry, which tested hypotheses through their realisation in fictional environments. Rousseau's *Discours sur l'inégalité*, for example, is a thought experiment that harks back to a mythical state of natural man, not in order to fight for a return to this state (which in any case did not exist), but to allow for an anthropological investigation of modern society.

The greatest publication of this period, which best typifies the on-going symbiosis of science and literature, is the *Encyclopédie*, published between 1751 and 1771 by Diderot, D'Alembert and dozens of contributors. The tree of knowledge, given at the start of the first volume, divides all entries into Memory / History, Reason / Philosophy and Imagination / Poetry. That all of these elements are included in this *Dictionnaire raisonné* in itself

[33] Voltaire, *Lettres philosophiques* [1734], ed. by Gustave Lanson (Paris, Marcel Didier, 1964); Denis Diderot, *Le Rêve de d'Alembert* [authored 1769, published 1830] (Paris: Flammarion, 2002); Étienne Bonnot de Condillac, *Traité de sensations* [1754] (Paris: Fayard, 1984); Jonathan Swift, *Gulliver's Travels* [1726] (London: OUP, 1951); Montesquieu *Lettres persanes* [1721] (Geneva: Droz, 1954); Jean-Jacques Rousseau, *Discours sur l'inégalité* [1754] (Paris: Garnier-Flammarion, 1992).

demonstrates how its creators saw them as occupying equally important places in the encyclopaedic enterprise, whilst the system of references (*renvoies*) linking the articles is evidence of their interconnectedness. The article *Lettres* exposes the extent to which science and literature, though now recognised as separate entities in the public consciousness, are still very much necessary to one another. 'Les principes des sciences seraient trop rebutants, si les *lettres* ne leur prêtaient des charmes ['scientific principles would seem too unpleasant without letters to lend them their charm'], but at the same time science is necessary to literature to provide content and to bring it to life, for otherwise: '[les Lettres] ne feraient que bégayer dans une nation où les connaissances sublimes n'auraient aucun accès' ['[literature] would merely stutter uselessly in a nation to which sublime knowledge would have no access'].[34]

Over the course of the nineteenth century, eclectic journal culture followed in the footsteps of the encyclopaedists by ensuring the coexistence of different types of knowledge within the same pages, which were destined for mass public consumption. The publications that William Tattersdill analyses in his article in this volume appeared in one such periodical (*The Idler*). However, as well as this intermingling of popular science and literature, the nineteenth century also bore witness to the increasing professionalisation of science. In 1833, Coleridge prompted the Cambridge fellow William Whewell to coin the term 'scientist' as equivalent to the 'artist', denoting someone who took science seriously. It was perhaps this clearer division that provoked the first modern public debate related to the place of science and literature in academic institutions; a debate that returned to the very questions Martianus Capella had grappled with in the 5th century AD. In 1880, the same year that Mary Shelley published *Frankenstein*, Thomas Huxley spoke about the need to differentiate between scientific and literary curricula. He fought to demonstrate the important role a scientific education could play, as opposed to a syllabus based largely on literature, and particularly the literature of Greek and Roman antiquity.[35] In opposition, Matthew Arnold argued that Huxley's definition of literature extended only to *belles lettres*, when in fact:

[34] Jaucourt, Art. 'Lettres' in Diderot, d'Alembert et. al., *Dictionnaire raisonné des arts et des sciences* (Geneva, Paris, Neufchatel: Chez Briasson, 1754-72) vol. IX, pp.405-33. Our translation.
[35] Thomas Huxley, 'Science and Culture', in *The Major Prose of Thomas Henry Huxley*, ed. by Alan P. Barr (Athens: University of Georgia Press, 1997), pp. 224-8.

> Literature is a large word; it may mean everything written with letters or printed in a book. Euclid's *Elements* and Newton's *Principia* are thus literature. All knowledge that reaches us through books is literature.[36]

Huxley's viewpoint makes a striking contrast to the twenty-first-century debate, in which it is literature, and not science, that suffers from a lack of interest, and must be bolstered.

The clash between Arnold and Huxley would not be the last time that tensions between science and literature took centre-stage in Britain's intellectual life. Their confrontation was the precursor to the more famous debate between C.P. Snow and F.R. Leavis in the 1950s and 60s, in which Snow made his pronouncement about the existence of 'Two Cultures'.[37] Nonetheless, these controversies did not prevent the continued production of texts that trod the fine line between the two disciplines: the trained biologist H.G. Wells wrote a popularised world history as well as his infamous science fiction *War of the Worlds*,[38] whilst George Orwell and Aldous Huxley (who would later write theoretical texts on the links between science and literature) projected scientific and technological breakthroughs forward into a dystopian (and disturbingly prescient) future.[39] If the quasi-scientific texts of the eighteenth century had introduced scientific thought into philosophical considerations of man's origins and his place in the world, these texts instead warned of a world in which science had taken over, and its philosophical implications were no longer being considered.

Developments in this debate since the late twentieth century have largely been in the application of scientific knowledge to literary study, rather than literary creation. In 1983, Gillian Beer influentially argued for how Darwinism had inspired a revolution in plot-construction, creating a narrative of the struggle for life that now underpins our culture, and encouraging a search for origins in a variety of fields.[40] The increasing interest in applying cognitive psychology, neuroscience, linguistics, evolutionary biology, artificial intelligence, and the philosophy of mind to literary criticism was recognised in 1998 with the creation of

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[36] Matthew Arnold, *Literature and Science*, Rede Lecture, Cambridge, 1882 in *The Nineteenth Century* (August 1882).
[37] C.P. Snow, *The Two Cultures* (London: CUP, 1959).
[38] H.G. Wells, *The Outline of History* (London: Newnes, 1919) and *The War of the Worlds* (London: Heinemann, 1898).
[39] George Orwell, *1984* (London: Secker & Warburg, 1949) and Aldous Huxley, *Brave New World* (London: Chatto, 1932).
[40] Gillian Beer, *Darwin's Plots*, 3rd edn (Cambridge: CUP, 2009).

the MLA's Cognitive Science and Literature discussion group, and this strand of research continues to grow.[41] Perhaps the most significant new development in recent decades, however, is the digital humanities: from the digitising of texts,[42] to the creation of searchable databases, to the application of tools such as data mining and statistical analysis to reveal trends and even uncover hidden authors.[43] Literary scholars are increasingly required to engage with these technologies, and consider the contribution they can make to traditional critical analysis. A particularly problematic issue is the extent to which literature can be treated as data, and described in quantitative terms.[44]

Whilst the question of literature-as-data is currently controversial, an earlier challenge to literary studies' appropriation of scientific discourse was made in 1997 by the physicist Alain Sokal, whose *Impostures intellectuelles* condemned postmodernists' abusive employment of terms taken from maths and physics.[45] His damning analysis of what he viewed as the false erudition of figures including Derrida and Deleuze was not all that different to the assessment made over a century early by Henri Bergson in his *Essai sur les données immédiates de la conscience*, which includes pseudo-mathematical, parodic explanations of man's experience of the world.[46] Whilst literary techniques have long been appropriated to assist in the communication of science, it seems that the precision of scientific terminology prevents its easy assimilation into literary explanations of the world.

And yet this fractious relationship between the two elements has also served as a stimulus for literary creation. Rachel Crossland's article in this volume explores the richly provocative

[41] Cf. the Balzan project on 'Literature as an Object of Knowledge' currently being undertaken by Terence Cave and a team of researchers from Oxford: <http://www.sjc.ox.ac.uk/3122/The-Balzan-Project.html> [accessed 11 January 2013].
[42] Cf. the ARTFL project (American and French Research of the Treasury of the French Language, <http://artfl-project.uchicago.edu/>, inaugurated in 1982 [accessed 11 January 2013]) which provides its members with access to North America's largest collection of digitized French resources, and EEBO (Early English Books Online, <http://eebo.chadwyck.com/home>, inaugurated in 1999 [accessed 11 January 2013]) which contains more than 125,000 titles published between 1475 and 1700.
[43] Author attribution had begun in in the nineteenth century with Mendenhall's work on the plays of Shakespeare (see C. Williams, 'Mendenhall's Studies of Word-Length Distribution in the Works of Shakespeare and Bacon' in *Biometrika*, 62.1 [1975], 207–212), whilst Yule and Zipf applied statistical methods in the first half of the twentieth century (George Yule, *The Statistical Study of Literary Vocabulary* (Cambridge: CUP, 1944). It was not until the 1990s, however, that automated methods began to be applied.
[44] See Franco Moretti, *Graphs, Maps, Trees: Abstract Models For A Literary History* (London: Verso, 2005) and Charles Cooney, Glenn Roe, and Mark Olsen, 'The Notion of the Textbase: Design and Use of Textbases in the Humanities', in *Literary Studies in the Digital Age: An Evolving Anthology*, ed. by Kenneth Price and Ray Siemens, Modern Language Association (forthcoming).
[45] Alain Sokal, *Impostures intellectuelles* (Paris: Jacob, 1997).
[46] Henri Bergson, *Essai sur les données immédiates de la conscience* (Paris: Alcan, 1889).

questions posed by D.H. Lawrence's complex engagement with both scientific and human relativity. Meanwhile, Caroline Verdier's analysis of Elisa Brune's novels investigates the Belgian novelist's attempts to disseminate scientific concepts in literary form. Furthermore, in academia, 'literature and science' as an entity has become a widespread object of study. John Brockman's *The Third Culture* encouraged a move beyond the traditional divide to consider how influential scientists were using language to communicate their ideas to the general public, and thus harked back to the *Encyclopédie's* attempt to embellish science through literary techniques.[47] A decade later, Stephen J. Gould argued for a confederation of the sciences and the humanities, encouraging a focus on their commonalities rather than their differences.[48] The British Society for Literature and Science was founded in 2005, two decades after its American counterpart, the Society for Literature, Science and the Arts. In the UK, Liverpool, Salford and Glamorgan Universities run research groups for Literature and Science, whilst international journals such as Johns Hopkins' *Configurations* provide a space for published discussion. It seems that Brockman's third culture is coming into being: a discipline in its own right.

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A knowledge of literary tropes and techniques provided early natural philosophers with a way to communicate their findings to one another and to the public.[49] But as science became professionalised, and distinguished itself from literature as a separate and coherent discourse, so it became less accessible to those outside this privileged circle. The human aspect of an individual author was lost behind faceless institutions, which provided authority, but removed the tools for direct communication. It is perhaps this shift that is to blame for the situation of crisis described by contemporary activists such as Ben Goldacre, who fight for the importance of normalising the scientific approach, and deplore the fact that, for example, the UK Parliament is made up largely of Humanities graduates.[50] The implication of this situation is that an understanding of people and societies lies on one side of the coin, and science on the other. Yet this ignores the self-evident truth that humanity and its place in the world sit at the very heart of scientific enterprise: there is little that is more human than the

[47] John Brockman, *The Third Culture* (New York: Simon & Schuster, 1995).
[48] Stephen J Gould, *The Hedgehog, the Fox, and the Magister's Pox* (Cambridge, MA: Harvard University Press, 2003).
[49] *Literature and Science in the Nineteenth Century, an Anthology*, ed. by Laura Otis (Oxford: OUP, 2002), pp. xvii-xx.
[50] Ben Goldacre, *Bad Science* (London: Fourth Estate, 2009).

quest to define oneself in relation to one's surroundings. The sentiment that science should not be a rarefied world, understood by the learned few, is at the centre of the modern drive towards popular science, which uses language and literary techniques to re-assert its relevance to our lives, just as so many writers have done across the centuries. These books are not written by nameless institutions, but by individuals, whose own humanity is part of their writings' success as objects of communication. Science invites us to question, to consider, to understand; and so does literature. And when they are brought together, it is in the context of communication from one human to another that they function most effectively.

In Caroline Verdier's article on contemporary Belgian novelist Elisa Brune we see an analysis of precisely this sort of communication, as Brune strives to incorporate (astro)physical concepts and language into her fictional accounts of the scientific community. However, as Verdier suggests in her examination of *Petite révision du ciel* (1999) and *Les Jupiters chauds* (2002), Brune's success in providing insights into scientific ideas and practices through the medium of the novel is rather open to question. This in turn is linked to the question of Brune's intended/ implied/ actual readership, and whether or not these works are in fact being digested by the wider novel-reading public or are being appreciated mainly by those with a formal scientific training.

The problem of incorporating 'hard' science into the novelistic genre is also central to Rachel Crossland's analysis of the role of Einstein's relativity theories in D.H. Lawrence's fictions. Focussing upon *Fantasia of the Unconscious* (1922) and *Kangaroo* (1923), Crossland emphasises the importance which Einstein's theories had for Lawrence, who not only sought to include allusions to the ideas which they propose, but actively engaged with them in his consideration of the relationship between scientific relativity and human relationships. As Crossland shows, such considerations are closely connected to other very problematic questions, including relativity's status as an absolute principle: is relativity relative, and does the relativity of relativity paradoxically make it more absolute?

The questions concerning literary form which are generated by such examinations of the role of scientific concepts in fictional works resonate very strongly with the issues explored by William Tattersdill in his article on Victorian periodical culture. The content of the illustrated magazines that emerged in the 1890s was astoundingly diverse, with popular science sharing their pages with fictional pieces (and much else besides). Tattersdill examines two stories by

Israel Zangwill that appeared in one such magazine and questions both works' status in relation to science fiction. As Tattersdill argues, when generic labels such as 'science fiction' are used retrospectively, they tend to make inappropriately sharp distinctions between writings which in reality have a great deal in common. The fluid boundary between science-fictional and non-science-fictional texts is closely linked to the more general (and equally hazy) relationship between literature and science, as Tattersdill also emphasises.

Finally, Sura Qadiri's piece shows how two works in different genres and media can be read comparatively to throw light upon their joint explorations of science's relationship with colonialism. Through an analysis of Chris Marker's science-fiction film *La Jetée* (1962) and Amin Maalouf's postcolonial novel *Le Premier siècle après Béatrice* (1992), Qadiri argues that science is deeply implicated in the troubling of colonial and postcolonial identities. In Marker, scientists seek to control and experiment upon an individual whose confused identity troubles distinctions between coloniser and colonised, whilst in Maalouf the postcolonial scientist embodies the troubled status of the coloniser in a postcolonial world.

As Qadiri's piece shows, the relationship between literature/ film and science goes to the very heart of our comprehension of ourselves and of our relationship to otherness. It thus emphasises that an analysis of the interactions between literature and science not only casts light upon the status of these two fields, but also serves as a lens through which we are able to explore much broader political and ontological questions: the troubled relationship between literature and science is one which demands our urgent attention.