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# "Shakespeare and Science": A Critical Assessment

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- 1 This panel was led by Prof. Sophie Chiari and Dr. Mickael Popelard and featured the following papers:
1. Frank Lestringant (University of Paris-Sorbonne), "*La Tempête* de Shakespeare, ou le témoignage de la cartographie renaissante"
  2. Pierre Iselin (University of Paris-Sorbonne), "La musique: science ou pratique?"
  3. Carla Mazzio (University at Buffalo, State University of New York), "The Drama of Mathematics in the Age of Shakespeare"
  4. Pascal Briost (François Rabelais University, Tours), "L'école de la nuit revue et corrigée"
  5. Anne-Valérie Dulac (University of Paris 13 Nord) "Shakespeare's Alhazen: *Love's Labour's Lost* and the History of Optics"
  6. Margaret Jones-Davies (University of Paris-Sorbonne), "Les énigmes abstraites ('abstract riddles') de l'alchimie (Ben Jonson, *The Alchemist*, 2.1.104)"
  7. Jonathan Pollock (University of Perpignan-Via Domitia), "Shakespeare and Atomism"
  8. Liliane Campos (University of Paris 3-Sorbonne Nouvelle), "'Wheels have been set in motion': Geocentrism and Relativity in Stoppard's *Rosencrantz and Guildenstern are Dead*".

## Science in Early Modern England

- 2 As early as 1566, in a small book focused on the conduct of physicians and apothecaries, the physician John Securis defined science as "an habite (that is) a ready, prompt, and bent disposition to do any thyng, confirmed and gotten by long study, exercise and use [...]" (B4v).<sup>1</sup> Such a positive view of science, however, was not universally shared. The following year, Arthur Golding's translation of *De scandalis* notably publicized Calvin's denunciation of Cornelius Agrippa as an atheist. More generally, the widespread association with atheism of such men as the mathematician Thomas Harriot, the courtier

and explorer Walter Raleigh, the mariner and explorer Lawrence Keymis, the poet Matthew Roydon,<sup>2</sup> or the 'wizard earl' Henry Percy serves as a reminder that natural philosophy was still widely regarded as a dangerous pursuit and, in particular, as a threat against traditional religious beliefs.

- 3 Yet, Giordano Bruno's visit to Elizabethan England in the 1580s<sup>3</sup> left its imprint on many fields of contemporary culture, ranging from the newly developing natural philosophy to the flowering of Elizabethan literature. Unsurprisingly, more and more poets and playwrights started exploring the tricky relationship of sensory experience to moral and scientific reason. Shakespeare's own interest in science, as well as his literary and dramatic use of natural phenomena, has now been clearly established. Like Roger Bacon and his talking brass head in Greene's *Friar Bacon and Friar Bungay* or Marlowe's damned Doctor Faustus, Shakespeare's great man of science, Prospero, is "for the liberal arts / without a parallel" (1.2.73)<sup>4</sup> and yet he is also a flawed human being who practices a magic deeply linked to his imagination. Ultimately, he can also be regarded as a practitioner of occult arts, like Dr Dee, who determined the most propitious day for the coronation of Queen Elizabeth. Dee also believed he could communicate with angels and was renowned for his mirror, a polished disk of black obsidian from Mexico which testified to the Elizabethan fascination with cosmology and astrology.

## Shakespeare and Science

- 4 This fascination is everywhere present in early modern drama. Indeed, as already noted by Adam Max Cohen, "[t]he theatre seems a natural place to seek out representations of technologies because of the cross-fertilization between technological and theatrical imagery" which was clearly at work in the numerous scientific treatises issued in the 16<sup>th</sup> century.<sup>5</sup> Shakespeare's plays, in particular, raise nagging questions related to the (mis)use of science and are permeated with the disturbing themes of nothingness and epistemological uncertainty. On the one hand, many characters seem to display an awareness of Epicurean philosophy—one thinks of Hamlet, Lear, or the Duke in *Measure for Measure*. According to Jonathan Pollock, Shakespeare had probably read Lucretius at first hand and he was not the only one. Indeed, it is now "possible to class the reception of Lucretius in England up to the time of Shakespeare into three distinct categories, depending on whether the native writers allude to the poetry, ethics or physics of *De rerum natura*."<sup>6</sup> On the other hand, the underlying presence of several aspects of Francis Bacon's philosophical interests in Shakespeare's texts makes us realize that the playwright was perfectly aware of the 'scientific revolution' of his time—a time when magic, religion and science were just beginning to separate.
- 5 Yet, and as is usual with Shakespeare, it is difficult to assert what the playwright's position on the subject exactly was. On the one hand, in *Romeo and Juliet*, he presents us with "[a] pair of star-crossed lovers" (Prologue, l.6) while on the other, in *King Lear*, he has the bastard define astrology as an act of deception.<sup>7</sup> Shakespeare's frequent use of optics is similarly disconcerting. Whereas the arch-villain Richard III intends to be "at charges for a looking-glass" (1.2.259) in order to "adorn" his deformed body (261), the poet of Sonnet 62 looks at himself in the mirror only to underline the discrepancy between his supposedly perfect face and his real features ("But when my glass shows me myself indeed, / Beated and chopped with tanned antiquity, / Mine own self-love quite contrary I read;" l. 9-11). Other examples are less clear-cut. Is the playwright serious when, in *As*

*You Like It*, he has Touchstone describe Corin, a man whose wisdom is merely composed of proverbs, as a "natural philosopher" (3.2.30), or does he give pride of place to contemplative life in the countryside? Does Shakespeare really think that "some prescriptions / of rare and proved effects" can allow female doctors such as Helen, in *All's Well that Ends Well*, to heal the "desperate languishings" of a sovereign (1.3.221-230), and does he seriously endorse the medical theories of his time when Cordelia, in *King Lear*, proposes music as a cure for her "child-changed father" (4.7.17)?

- 6 Informed by new developments in the history of science and science studies, our two sessions on Shakespeare and science proposed to expand our understanding of the interactions between Shakespeare's drama and science by focusing on a variety of scientific pursuits, ranging from astrology to cartography to music. Following in the footsteps of Carla Mazzio's seminal study on Shakespeare and science, while also drawing upon the groundbreaking work of scholars like Denise Albanese, Anthony Grafton, Stephen Shapin and others, this two-part panel aimed at exploring the complex interactions between science and drama as seen through the prism of Shakespeare's plays. But rather than delineating the various imprints which individual scientific disciplines, activities or thought processes left on Shakespeare's plays, we proposed to explore the dynamic and dialectical relationship between art and science as it is reflected in the Shakespearean corpus. To quote Carla Mazzio, we concentrated neither on "thematic traces" nor on "linguistic reflections"<sup>8</sup> of particular scientific disciplines but rather on "thought processes",<sup>9</sup> bringing together contributions on cartography, music, alchemy, mathematics, atomism, or optics. Moving beyond the mere catalogue of scientific allusions, metaphors or indeed conceptual borrowings, the participants were keen to show that literature and science were part of the same early modern mindscape which they informed in their own specific ways.
- 7 Theatrical issues were also at the heart of discussions. For much as 'science' can be said to have shaped at least part of Shakespeare's dramatic writing, conversely, the Elizabethan stage was also a place of knowledge as well as entertainment, an arena where science suffered a sea-change by being turned into an art. In the process it was also discussed and questioned. Thus, it is perhaps not exaggerated to consider the stage as a laboratory of sorts, in which, if science was not actually produced, it was at least problematized, while also being transformed into "something rich and strange" (*The Tempest*, 1.2.404).

## Frank Lestringant, "*La Tempête de Shakespeare, ou le témoignage de la cartographie renaissante*"

- 8 We started our two-part session with Frank Lestringant's intervention<sup>10</sup> on Shakespeare's use of maps and geometry, which was part of the medieval quadrivium. In *The Tempest*, Lestringant reminded us that Shakespeare skilfully relied on Montaigne's *Essays*. Indeed, Gonzalo's famous tirade, act 2, scene 1, is drawn from Montaigne's chapter on Cannibals, translated by John Florio in 1603. Commenting on this almost literal and well-known borrowing, Lestringant showed how Shakespeare managed to dramatize Montaigne's observations and how he lionized the old Gonzalo thanks to his indirect quote. Doing so, he reassessed Gonzalo's role in *The Tempest* and rehabilitated his science and his humanist education.

## Pierre Iselin, "La musique : science ou pratique ?"

- 9 If maps and geometry are woven into the very fabric of *The Tempest*, so is music, and it is difficult not to associate the play with Caliban's famous pronouncement that the "isle is full of noises, / Sounds and sweet airs, that give delight but hurt not" (3.2.138-139). Considering music's place in the quadrivium of mathematical sciences, Pierre Iselin then wondered if music was truly a science or rather a practice. This question, he told us, was not new at the time and it had been theorized several times. But it became particularly relevant towards the end of the 16th century, not just because of the heated debate surrounding religious music performed in the English churches, but also because an important distinction, first introduced by Boethius in around 500, gradually appeared between two different categories of music, namely between the "musicus" (i.e. the professional musician) and the "cantor" (who was then responsible for liturgical performance), or, to put it differently, between the theoretically-inclined "musician" and the more practically-minded "minstrel". At the same time, what Morley defined as "plain and easy practical music"<sup>11</sup> became increasingly successful. Iselin showed that in Shakespeare's drama, echoes of such issues could be detected. Strikingly enough, these echoes emphasize the importance of science on the early modern stage.

## Carla Mazzio, "The Drama of Mathematics in the Age of Shakespeare"

- 10 Carla Mazzio's contribution was part of a book in progress, *The Drama of Mathematics in the Age of Shakespeare*, under advance contract with the University of Chicago Press. She examined relationships between the history of mathematics and accounting, the history of rhetoric and humanism, and the history of drama in the late 16<sup>th</sup>- and early 17<sup>th</sup>-century London that open up new points of entry into Shakespearean drama. In doing so, Mazzio aimed at revising some dominant theories about the relationship between humanism and accounting, mathematics and rationalism, and literature and science before the mid-17<sup>th</sup> century. In the second half of the 16<sup>th</sup> century, as mathematics began to emerge as a newly validated field of knowledge practices in England, so too, Mazzio argued, did discourses of potential catastrophe or embarrassment for those persons and communities unable to seriously engage in practices of calculation newly understood to be necessary for everything from determining the worth of an estate to mobilizing military power. The stakes and tensional dimensions of mathematics as a newly necessary and validated field became heightened — for a variety of reasons — during the very period in which Shakespeare was composing his plays and poems.
- 11 Drawing on a range of vernacular mathematical texts and discourses, Mazzio set the stage for the highly dramatic powers of number not simply in poetic but also in dramatic texts of the period. As mathematics books drew on forms of dialogue, metaphor, and the structure of the counterfactual, they did not simply mine humanism for authority or validation but they in fact challenged fundamental forms of humanism — in England in particular — that elevated word over number, rhetoric over calculation, *trivium* over *quadrivium*.<sup>12</sup> This challenge drives a series of central tensions in Shakespearean drama. Mazzio focused on a play perhaps least associated with "the drama of mathematics", *Hamlet*. Here she argued for the play as a meditation on the relationship between

humanism and calculation, opening up a new avenue for scholars to think about what it might mean to make *Hamlet*, or Shakespeare more broadly, count.

## Pascal Brioist, "L'école de la nuit revue et corrigée"

- 12 From *Hamlet*, the historian Pascal Brioist turned to *Love's Labour's Lost* to usefully complete Mazzi's argument. While he refuted the existence of the controversial 'school of night', he studied in detail the historical context of *Love's Labour's Lost* and analysed the scientific interests of Henry Percy's circle in Syon House and in Petworth. Brioist notably demonstrated that the polymath Thomas Harriot, his assistant Christopher Tooke, his pupils Thomas Aylesbury and William Lowern, together with the physician Walter Warner and his assistant John Pell, the astronomers Nicholas Hill and Nathaniel Torporley, and the cosmographers Robert Hues and Emery Molyneux, were all part of a "little academe" (*Love's Labour's Lost*, 1.1.13) of sorts which famously contributed to the advent of early modern science in Shakespeare's time. Natural philosophy thus gradually emerged from such English aristocratic circles whose bold members not only contradicted the *doxa* defended by more traditional scholars, but also made discoveries likely to reinforce the military powers of the time.

## Anne-Valérie Dulac, "Shakespeare's Alhazen: *Love's Labour's Lost* and the History of Optics"

- 13 Anne-Valérie Dulac also explored science in *Love's Labour's Lost* and like Pascal Brioist, she first reminded us that in her *Study of Love's Labour's Lost*, first published in 1936, Frances Yates repeatedly mentions the importance of Alhazen's optical theory in grasping the play's many references to light, eyes, and vision. What Yates saw in this play, which, as she writes, is "full of eyes", was a dramatization of the 9<sup>th</sup> Earl of Northumberland's attempt at curbing his sensual appetites to channel and deviate them into a desire for knowledge, including optical and astronomical knowledge, that would occupy his mind and senses more compellingly and with more intensity than any mistress. Yates's line of argument starts with the idea that "the theme of Northumberland's essay on the pursuit of learning is the theme of Shakespeare's play, reversed"<sup>13</sup> which then progressively leads her to conclude that Alhazen's optical theory—a crucial reference in Northumberland's text—is the key to the play's numerous references to optics. Yet *A Study of Love's Labour's Lost* never tackles Alhazen's optics as such, and the reader is left wondering about the major development of optics he is associated with.
- 14 Dulac's paper thus addressed Yates's claim from different angles. In a first part, Dulac dealt with two mistakes made by Yates in her rather short description of the 1572 edition of the *Opticae Thesaurus*, a compendium including a truncated Latin version of Alhazen's treatise along with Witelo's *Perspectiva*.<sup>14</sup> By presenting this edition as a translation and its frontispiece as a visual summary of Alhazen's optics, Yates forgets to mention the missing passages and to notice that the frontispiece offers an illustration for questions much closer to Witelo's own text than Alhazen's. In a second part, Dulac convincingly showed that this was due to the fact that at the time Yates was writing, historians of science had not yet shown as forcefully as they now have how different the translations of the *Kitab al-Manazir* (*The Books of Optics*) are, or, in other words, how different Alhazen is

from "Alhacen" and "Ibn al-Haytam". In the final part of her paper, Dulac looked into the Latinised version of Alhazen's optical theory to enquire into whether it could shed light on some of the most intricate metaphorical networks of the play. Dulac's conclusion was that although it was impossible to substantiate Yates's erroneous claim, we now know that Alhazen's views were well and truly woven within the Latin tradition which allowed his model to become fully compatible with competing theories, making him one of the dominant sources of western optics and, as such, a source as plausible as any when looking into Shakespeare's eyes.

## Margaret Jones-Davies, "Les énigmes abstraites ('abstract riddles') de l'alchimie (Ben Jonson, *The Alchemist*, 2.1.104)"

- 15 According to György E. Szönyi, the "double nature of optics can be compared to the Janus face of alchemy, which included practical procedures with chemical matter on the one hand and, on the other, spiritual transformation, that is, ascent from base existence to supernatural understanding."<sup>15</sup> So the next paper was naturally devoted to the "abstract riddles" of alchemy (Ben Jonson, *The Alchemist*, 2.1.104).<sup>16</sup> Margaret Jones-Davies convincingly demonstrated that Shakespeare uses the poetics of alchemy precisely as it begins to be on the wane as a science. The history of alchemy is parallel to the history of the concept of "perfection". But now, as H. Wölfflin noted, the absolute is no longer perfection but the infinite.<sup>17</sup> So, for Jones-Davies, the study of the process of secularization shows the importance of nominalist philosophy which was famous for the way it distinguished between faith and reason. The 14<sup>th</sup>-century philosopher William of Ockham separated ethics from metaphysics and thereby questioned the notion that man could reach perfection. The notion of perfection was thereby limited to the domain of faith and transcendence. Contrary to what happens in other forms of skepticism like Epicureanism, nominalism allowed the language of faith to go on living a life of its own. And so as in the case of Shakespeare, the images of alchemy went on expressing concepts and values that were no longer valid in objective reasoning, without questioning the process of secularization.
- 16 Jones-Davies contended that, in Shakespeare's plays, alchemy becomes a reservoir of metaphors, carrying with them the notion of perfectibility. Alchemical images thus turn into "abstract riddles" severed from any ambition of working on Nature itself; the alchemical project of "rectifying Nature to what it was"<sup>18</sup> is no longer valid now that all coherence is gone from the universe. The intertextual study of *All's Well that Ends Well* shows that the only case when the "art" seems to have a literal power of healing, is ironic. A study of Shakespeare's constant use of alchemy shows its conservative consequences on his political analysis of kingship for instance but his approach to the literal effects of alchemy on the laws of Nature is reassuringly modern.

## Jonathan Pollock, "Shakespeare and Atomism"

- 17 Equally, if not more modern, perhaps, was Shakespeare's approach to atomism. Judging from the derogatory use of the term *Epicurean* in Shakespeare's plays, one might be inclined to think that he shared Ben Jonson's disregard for this philosophical sect.



However, as Jonathan Pollock explained in his compelling paper, closer analysis shows that the term is invariably employed by unsavoury or downright evil characters about those whom the playwright portrays in a more positive light. Might it not be that Shakespeare had a far greater knowledge of Epicurean science than is usually recognised? Even if he had no access to writings by Epicurus, there is a strong likelihood that he knew the *De rerum natura* by Lucretius, were it only via the numerous extracts contained in Montaigne's *Essays* (duly translated and annotated by John Florio).

- 18 It was Pollock's contention that the prevalence of weather images in Shakespeare's later plays is a result not only of his propensity for cloud-gazing but also of his interest in Lucretius's use of meteorological models in order to explain the creation and disintegration of material objects and living beings. Close readings of these plays reveal so many textual parallels with the original Latin that it is hard to believe in pure coincidence. Beside Shakespeare's Ovid and Shakespeare's Vergil, there is then Shakespeare's Lucretius. But what are we to make of such an interest on the part of a (supposedly) Christian author? Epicurean science recognises only (atomic) matter and void, it denies the reality of a spiritual "substance" (God or an immortal soul).
- 19 It would seem that Shakespeare uses Lucretian doctrine as a means of establishing dialectical oppositions: set against Lear's naive paganism or Cordelia's redemptive figure, atomism portrays a world without Divine Providence of any sort, prey to purely material forces; Antony's experience of his own dissolution contrasts with Cleopatra's vision of a cosmic Antony whose figure becomes immortalised in the stars; Prospero predicts the dissolution of the globe, while exerting his authority on spirits whose powers are denied by Epicurean rationalism. Shakespeare uses atomist ethics and physics in order to multiply perspectives and do justice to the complexity of human experience. Without rejecting Christian dogma he places religious belief in a world where it is challenged by other systems of thought. Such metaphysical conflicts are rarely foregrounded (*Lear* is an exception) but it is this dimension which contributes to making Shakespeare one of the most emblematic artists of the late European Renaissance.

## Liliane Campos, "Wheels have been set in motion': Geocentrism and Relativity in Stoppard's *Rosencrantz and Guildenstern are Dead*"

- 20 To conclude our session, Liliane Campos bridged the gap between early modern and 20-century representations of science in a thought-provoking paper. By de-centering our reading of *Hamlet*, she argued, Tom Stoppard's *Rosencrantz and Guildenstern are Dead*<sup>19</sup> questions the legitimacy of centres and of stable frames of reference. His characters' comical attempts at understanding their position suggest both a postmodern view of the canon and a scientific paradigm of indeterminacy. Critics have often described Stoppard's taste for instability and relativity as an Einsteinian worldview, in which there is no point of rest, yet the tropes he chooses to express this contemporary epistemology are images of instability borrowed from Shakespeare. Although his *Rosencrantz and Guildenstern* experience the uncertainties of 20<sup>th</sup>-century science, he frames their doubts within early 17<sup>th</sup>-century knowledge.
- 21 Campos examined how Stoppard plays with the physical and cosmological models he finds in *Hamlet*, particularly those of the wheel and the compass, and gives a new

scientific depth to the fear that time is 'out of joint'. In both his playtext (1967) and his own film adaptation (1990), Stoppard's rewriting gives a 20<sup>th</sup>-century twist to these metaphors, through references to relativity, indeterminacy, and the role of the observer. When they refer to the uncontrollable wheels of their fate, his characters no longer describe the destruction of order, but uncertainty about which order is at work, whether heliocentric or geocentric, random or tragic. When they express their loss of bearings, they do so through the thought experiments of Galilean relativity, drawing our attention to shifting frames of reference. Much like Schrödinger's cat in quantum physics, Stoppard's Rosencrantz and Guildenstern are both dead and alive. According to Campos, as we observe their predicament, we are thus placed in the paradoxical position of the observer in 20<sup>th</sup>-century physics, and constantly reminded that our time-specific relation to the canon inevitably determines our interpretation.

## Science and Literature: A Reassessment

- 22 When dealing with the relationship between science and literature, there is always a risk of one treating the two notions as if they were two separate and stable entities or, in the words of Stefan Collini, "two proud kingdoms lying alongside in chaste self-sufficiency."<sup>20</sup> But it is worth remembering that such a divide is very much a social and historical construct. What has come to be known as "the two cultures debate", in the wake of C.P. Snow's influential, if somewhat outdated 1959 Rede lecture, would have been utterly incomprehensible in Shakespeare's times. As the *OED* usefully reminds us, the word "scientist" did not enter the English language until the 1830s.<sup>21</sup> Neither the Middle Ages nor the Renaissance recognized that there existed such a clear-cut separation between science and literature. By an interesting swing of the intellectual pendulum, however, for the past thirty years or so, literary academics and scientists alike have become increasingly interested in bridging the gap between science and literature, paying more and more attention to the manifold interconnections and similarities between their respective practices and discourses. In so doing, they have helped to blur the boundaries between two cultural systems, two sets of norms and practices that have much more in common than was once recognized.
- 23 Yet, in a way, this is less a new development than a restoring of *the status quo ante*. As Steven Shapin rightly points out, "the man of science" was not a "natural" feature of the early modern cultural and social landscape: "one uses the term *faute de mieux*, aware of its impropriety in principle, yet confident that no mortal historical sins inhere in the term itself."<sup>22</sup> In other words, in Shakespeare's times, there was no such thing as a 'two cultures' divide. By focusing on a wide range of subjects, from natural philosophy to optics to cartography, it is our hope that these two panels have gone some way towards illustrating and exploring the fruitful dialogue between Shakespeare's creative imagination and some of the most intellectually stimulating discourses and practices of his time.
- 24 For not only was Shakespeare influenced by a variety of 'scientific'—for lack of a better term—activities and discourses, from alchemy to mathematics, as the speakers on these two panels have shown. By seizing on a host of rapidly developing subjects and treating them as dramatic material, it is most likely that he, too, was instrumental in shaping the thought processes at work during the early stages of what is—somewhat inaccurately—often still referred to as the 'scientific revolution'. If, to paraphrase Sonnet 111,

Shakespeare's "nature [was] subdued / To what it worked in, like the dyer's hand" (l. 6-7), the reverse also probably holds true, for Shakespeare's stage was a place of knowledge as well as entertainment, an arena where science—among many other things—was discussed, questioned and finally transformed. In the words of Carla Mazzio, a play could therefore become "a meditation on the relationship between humanism and calculation,"<sup>23</sup> or, more generally, science and literature. It is our hope that this two-part session has contributed, in however small a way, to further exploring what constitutes a very promising research field for scholars and students of the early modern period.

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## NOTES

1. John Securis, *A Detection and Querimonie of the Daily Enormities and Abuses Committed in Physick*, London, 1566, B4v. The book was reprinted in 1651.
2. Interestingly enough, George Chapman dedicated "The Shadow of Night" (1594), to his "deare and most worthy friend Master Matthew Roydon" (George Chapman, *George Chapman, Plays and Poems*, ed. J. Hudston, London, Penguin, 1998, p. 223-224). B.J. Sokol reminds us that in his dedication, Chapman indicates that "he was cheered to learn from 'his good Mat.' of the studiousness of the earls of Derby and Northumberland and 'the heir of Hunsdon'. This suggests that Roydon introduced Chapman to the circle of Northumberland and Sir Walter Raleigh, which included Harriot and Lawrence Keymis"(B.J. Sokol, "Roydon, Matthew [fl. 1583-1622]", *Oxford Dictionary of National Biography*, Oxford, Oxford University Press, 2004; online edition, January 2008 [<http://www.oxforddnb.com/index/24/101024238/>, accessed 7 April 2015]).
3. For further details on this particular topic, see Hilary Gatti, *The Renaissance Drama of Knowledge: Giordano Bruno in England*, London, Routledge, 1989.
4. Quotes from Shakespeare are drawn from Stanley Wells, Gary Taylor, John Jowett and William Montgomery, eds. *The Complete Works*, Oxford, Oxford Clarendon Press, 1986, 2005.
5. Adam Max Cohen, "Science and Technology" in *The Oxford Handbook of Shakespeare*, ed. Arthur F. Kinney, Oxford, Oxford University Press, 2012, 2014, p. 705 (p. 702-718).
6. See Jonathan Pollock, "Shakespeare and the Atomist Heritage" in *The Circulation of Early Modern English Literature*, ed. Sophie Chiari, Farnham, Ashgate, 2015, p. 48 (p. 47-56).
7. See *King Lear*, 1.2.118-126: "EDMUND. This is the excellent foppery of the world, that when we are sick in fortune, often the surfeits of our own behaviour, we make guilty of our disasters the sun, the moon and the stars, as if we were villains on necessity, fools by heavenly compulsion, knaves, thieves and treachers by spherical predominance; drunkards, liars and adulterers by an enforced obedience of planetary influence; and all that we are evil in by a divine thrusting on."
8. Carla Mazzio, "Shakespeare and Science, c. 1600", *South Central Review* 26/1 & 2 (Winter & Spring 2009), 1-23, p. 6.
9. *Ibid.*, p. 13.
10. Lestringant's contribution was actually a follow-up paper on a previous study already devoted to *The Tempest*. See Frank Lestringant, "'Gonzalo's books': La république des Cannibales, de Montaigne à Shakespeare" in *Shakespeare et Montaigne. Vers un nouvel humanisme*, eds. Pierre Kapitaniak and Jean-Marie Maguin, Paris, Société Française Shakespeare, 2003, p. 175-193.
11. See Thomas Morley, *A Plain and Easy Introduction to Practical Music*, London, Peter Short, 1597.

12. Together, the *quadrivium* and the *trivium* formed what was known as "the liberal arts". The *trivium* consisted of grammar, logic and rhetoric, whereas the *quadrivium* was comprised of the more mathematical subjects, namely arithmetic, geometry, music and astronomy.
13. Frances A. Yates, *A Study of Love's Labour's Lost*, Cambridge, Cambridge University Press, 1936, p. 147.
14. Witelo probably wrote his *Perspectiva* or *Opticae libri decem* in 1270 or soon afterwards.
15. György E. Szönyi, "John Dee as Cultural, Scientific, Apocalyptic Go-Between" in *Renaissance Go-Betweens: Cultural Exchange in Early Modern Europe*, ed. Andreas Hofele and Werner von Koppenfels, Berlin, Walter de Gruyter, 2005, p. 97-98 (p. 88-103).
16. See the Cambridge edition of the works of Ben Jonson online: <http://universitypublishingonline.org/cambridge/benjonson/> (date accessed: 7 April 2015).
17. H. Wölfflin, "Introduction" in *Les Principes fondamentaux de l'histoire de l'art* (1915), translated from the German by C. and M. Raymond, Plon, Paris, 1952, p. 10: "Au lieu du parfait et de l'achevé, [le baroque] recherche le mouvement, le changement [...] l'illimité et le colossal" (See also the English version of the same passage by M D Hottinger, Dover Publications, New York 1932: "Baroque uses the same system of forms, but in place of the perfect, the completed, gives the restless, the becoming, in place of the limited, the conceivable, gives the limitless, the colossal").
18. John Donne, "To Sir Edward Herbert at Julyers" (1610), ed. W. Milgate (1967), l. 33-34, in John Donne: The Satires, Epigrams and Verse Letters, Oxford Scholarly Editions Online, Website: <http://www.oxfordscholarlyeditions.com/view/10.1093/actrade/9780198118428.book.1/actrade-9780198118428-book-1> (date accessed: 7 September 2015).
19. Tom Stoppard, *Rosencrantz and Guildenstern Are Dead*, London, Samuel French, 1967.
20. Stefan Collini, "Introduction" in C.P. Snow, *The Two Cultures*, Cambridge, Cambridge University Press, 1993, p. liii.
21. See the following quotation from the 1834 article about the absence of a proper term to describe "the students of the knowledge of the material world". The author proposed that "by analogy with artist, they might form "scientist"", though, according to the same author, "this was not generally palatable". See *OED*, s.v. 'science' sense 5, quoted by Collini in Snow, *op. cit.*, p. xii.
22. Steven Shapin, "The Man of Science" in *The Cambridge History of Science*, vol. 3, "Early Modern Science", eds. K. Park and L. Daston, Cambridge, Cambridge University Press, 2006, p. 180.
23. This quote is excerpted from Carla Mazzio's intervention in our two-part panel.

## ABSTRACTS

This paper examines Shakespeare's works and ideas in light of early modern knowledge, theories and techniques. Focusing on the scientific practises of the time, it intends to explain the rationale behind the chosen topic of early modern science and to summarize as faithfully as possible the debates that occurred during a two-part session exclusively devoted to Shakespeare and Science, and led by Sophie Chiari and Mickael Popelard. This session included eight participants and took place during the Shakespeare 450 Congress.

Cette synthèse se propose d'analyser les idées et les pièces de Shakespeare à la lumière du savoir, des théories et des techniques caractéristiques de l'Angleterre de la première modernité. En mettant en avant les pratiques scientifiques des XVIe et XVIIe siècles, elle revient sur la

pertinence de la thématique explorée par notre double panel « Shakespeare et la science » et résume aussi fidèlement que possible les débats qui s'y sont tenus. Ces deux sessions, animées par Sophie Chiari et Mickael Popelard, ont rassemblé huit participants et ont eu lieu lors du congrès Shakespeare 450 organisé par la SFS en avril 2014.

## INDEX

**Mots-clés:** alchimie, atomisme, épistémologie, géographie, mathématiques, musique, optique, philosophie naturelle, quadrivium, science, trivium

**Keywords:** alchemy, atomism, epistemology, geography, mathematics, music, natural philosophy, optics

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