

# Introducing a third culture: Carl Djerassi and Roald Hoffmann in theatre

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*More than a century-old gap of mutual incomprehension between social scientists and humanities scholars, famously pointed out by C. P. Snow in 1961, has resulted in the formation of two cultures – the sciences and the arts – which have ceased to communicate over a period of time. In the late 1980s, however, Carl Djerassi's invention of a new literary genre called science-in-theatre paved the way for the development of a 'third culture'. In focusing on this interface between scientific knowledge and humanistic enquiry, the present article outlines several conversations that take place among the areas of history, gender, theatre, and science, all of which find their place in the thematic landscape of Carl Djerassi and Roald Hoffmann's play Oxygen (2001).*

**Keywords:** Discovery of *Oxygen*, gender, science-in-theatre, third culture.

In the late 1980s Carl Djerassi, recipient of the National Medal of Science and the National Medal of Technology, sought a unique way to integrate the sciences with the arts. Thus, he ushered in a curious genre called 'science-in-theatre'. Among all existing literary genres, Djerassi chose 'theatre' as his medium because of its dramaturgic appeal. It is in the interstice between the sciences and arts that one should situate Djerassi and Roald Hoffmann's *Oxygen: A Play in Two Acts*. In exploring scientific sensibilities through literary lens, *Oxygen* addresses several issues which lie at the heart of scientific research but often remain marginalized in, or are outrightly expunged from, its discourse, including the history of discovery and the processes involved in it, and also the gender dynamics surrounding scientific research. Moreover, in focusing on a series of dialogues between the sciences and the arts through the rubric of science-in-theatre, this article also draws attention to the well-known 'two culture' debate that Snow<sup>2</sup> triggered in the 1960s. Through an analysis of *Oxygen*, we argue that a renewed conversation between the sciences and the arts could open up a third culture, which the science-in-theatre initiated by Djerassi presently epitomizes.

## What is science-in-theatre?

In his essay on contemporary science-in-theatre, Djerassi<sup>1</sup> notes that there exists a yawning gap between the scientific community and the scientifically untrained: 'I want

to use fiction to smuggle scientific facts into the consciousness of a scientifically illiterate public – a pedagogic activity I consider intellectually and socially beneficial, because the majority of scientifically untrained persons are afraid of science'<sup>1</sup>. According to him, if a scientist begins with the preamble 'Let me tell you about my science', the non-scientists might immediately raise a mental shield, but if the conversation opens in a different way, 'Let me tell you a story', one could perhaps ignite the audiences' interest. Djerassi firmly believes that science-in-theatre might be a space where the two cultures – the sciences and the arts – could possibly meet and give rise to a third culture. This argument is very much in line with Snow's<sup>2</sup> affirmation that 'the clashing point of two subjects, two disciplines, two cultures – of two galaxies, so far as that goes – ought to produce creative chances.' The creativity involved in science-in-theatre, therefore, not only serves to make scientific reflections more intelligible to the community unaccustomed to science, but also keeps alive the classical kinship between the sciences and the arts.

## Snow's *The Two Cultures* and critical responses

During his annual Rede lecture on 7 May 1959 in the Senate House of the University of Cambridge, Snow<sup>2</sup>, former research chemist and best-selling author, observed 'a gulf of mutual incomprehension' between literary intellectuals and natural scientists. He noted that one of the reasons for the two-culture divide is the attitude of literary intellectuals towards the impact of the Industrial Revolution. For them, the developments in science and technology boosted the lifestyle in industrial society, but the Industrial Revolution also gave rise to a mechanized

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outlook. However, humanistic scholars' critique of industrialization seems to have taken into account only the counterproductive side of the Industrial Revolution. As a result, in the academic circles two 'polar groups' emerged, the intellectuals in the arts and the scientists, and both ceased to communicate more or less completely over a period of time<sup>2</sup>.

Critical opinions remained divided over Snow's standpoint. F. R. Leavis, a British literary critic who taught at Cambridge and later at the University of New York, USA, reproached Snow in an infamous Richmond lecture<sup>3</sup>. In declaring Leavis' response to Snow's *The Two Cultures* as 'too personal, too rude, too dismissive, too Leavis', the American critic Lionel Trilling<sup>4</sup> in turn criticized Snow.

In his defence, Trilling sought recourse to the 19th century debate between Matthew Arnold and Thomas H. Huxley, which deliberated on the importance of liberal education in an industrialized world. While Arnold<sup>5</sup> argues that a balance should be struck between scientific knowledge and literary scholarship, Huxley<sup>6</sup> emphasizes the need for education in natural sciences in isolation. In tackling the two-culture problem, Trilling's view unmistakably approximates that of Djerassi. While Trilling suggests that education should be based on equitable grounds, Djerassi reckons that a perfect conversation should be and could be created between the sciences and the arts, and he hopes to do so through science-in-theatre. Djerassi's intervention through establishing a new genre assumes tremendous significance in this context.

### Djerassi and Hoffmann's *Oxygen*: an analysis

The play *Oxygen* is the cornerstone of the genre science-in-theatre. Known as 'the father of the pill' and the founder of Djerassi Resident Artists Program, Djerassi's contributions to the advancement of the sciences and the arts were unparalleled. Correspondingly, Hoffmann, the 1981 Nobel laureate in Chemistry and currently Frank H. T. Rhodes Emeritus Professor of Humane Letters at Cornell University, USA, tried to enrich the combined field of the sciences and the arts in hosting a monthly programme called 'Entertaining Science' from 2001, a platform for exploring the common areas in the sciences and the arts. In *Oxygen*, these playwrights explore the conflicts in the lives of three scientists – Joseph Priestley, Carl Wilhelm Scheele and Antoine Laurent Lavoisier. *Oxygen* presents two time-frames, 1777 and 2001, and the story alternates between these periods. In juxtaposing the research environments, the playwrights investigate the relation of the two periods to the phases before and after the institution of the Nobel Prize. The play deals with the fictive subject of awarding a retro-Nobel to a scientist whose contribution had brought about a revolution in science. It is on the occasion of the centenary year celebration of the Prize

(time span 2001) that the Nobel Committee explores the idea of awarding such a Nobel Prize. Thus, a four-member Committee of the Royal Swedish Academy of Sciences assembles to zero in on a suitable candidate for the Prize. Three 'male' members – Bengt Hjalmarsson, Sune Kallstenius, Ulf Svanholm – and a 'female' member, Astrid Rosenqvist constitute the Committee. Apart from them, Ulla Zorn, a graduate student in the history of science serves as an amanuensis to this Committee. Involving a historian gives this play a distinctive direction, which eventually becomes crucial for the development of the plot. After a drawn-out discussion, the Committee decides that the retro-Nobel should be awarded for the discovery of oxygen as it was the harbinger of the chemical revolution. However, the Committee members differ among themselves on the claimants for the discovery.

At this juncture in *Oxygen*, the playwrights set out to address two fundamental questions about scientific inquiry in general: 'what is a discovery?' and 'why is it so important to be first?' The playwrights call attention to the preoccupation with priority prevalent in the scientific community, which they call 'the Nobel Syndrome: who did what first'<sup>7</sup>. In the context of the discovery of oxygen, Kallstenius asks 'But we [members of the Royal Swedish Academy of Sciences] still haven't agreed what "being first" means: Is it the initial discovery ... the first publication ... or full understanding?' In a fictive scenario, the play gives each candidate a chance to advance arguments in favour of the priority of his research finding, that is, the discovery of oxygen. Scheele claimed that he initially discovered oxygen in 1771 during his experiment in a pharmacy at Uppsala, Sweden, but the discovery was neither reported nor published. In 1774, Priestley professed that he discovered oxygen even before that, though he published about it only later. On the other hand, Lavoisier in 1770–80 remarked that since he fully understood the properties of burning, rusting and respiration (oxygen being crucial for all these processes), he spearheaded modern chemistry. Given this situation, the Committee finds it challenging to converge on a potential candidate for the retro-Nobel.

### Theatre in science

*Oxygen* advances the proposition that the history behind a discovery is no less important than the discovery itself. The playwrights include a 'masque' in the play, an art form that involves music, dance, song and action. Since the masque flourished during the 16th and 17th century in the courtly circles, it undoubtedly suits the time-frame in *Oxygen*. Thus in the masque titled 'The Victory of Vital Air over Phlogiston', Lavoisier and his wife Mme. Lavoisier enact how the discovery of oxygen replaced the theory of phlogiston: 'A revolution is about to dawn, in chemistry, as Oxygen is born. Phlogiston is a notion of

the past, disproved and set aside, indeed, surpassed<sup>7</sup>. Perhaps the playwrights want to emphasize that the theory of phlogiston is important to the discovery of oxygen. Noticeably, the playwrights underscore the notion that the understanding of a discovery and the history behind it need to co-exist.

In a fictitious context, the characters enact the revolutionary discovery of oxygen using an engaging literary technique, that is, a play-within-a-play. In *Oxygen*, accordingly, King Gustavus III invites the scientists to perform (time-frame 1777) their respective experiments on stage. For the King, these experiments are decisive for selecting the architect of oxygen. Thus, in the play, the stage becomes a space for experiments, and the reenactment of the discovery turns out to be a crucial factor for deciding the retro-Nobel laureate.

(a) During the performance, Scheele claims that he first discovered ‘the air’ (in the play, the scientists refer to ‘oxygen’ as ‘the air’) and named it *eldsluft*, a Swedish word for ‘fire air’. Scheele invites Lavoisier to perform his experiment: ‘Dissolve silver in acid of nitre and precipitate it with alkali of tartar. Wash the precipitate, dry it, and reduce it by means of a burning lens... . A mixture of two airs will be emitted. And pure silver left behind<sup>7</sup>.’ As mentioned earlier, Scheele claims that he performed this experiment long back in 1771 at a pharmacy in Uppsala.

(b) In his turn Priestley claims that he first performed the experiment in 1774. To validate his findings, he invites Scheele to conduct the experiment: ‘In August of 1774, I exposed *mercurius calcinatus* ... the red crust that forms as mercury is heated in air ... in my laboratory to the light of my burning lens. As the red solid is heated, an air will be emitted, while dark mercury globules will condense on the walls of the vessel. You will collect the air by bubbling it through water<sup>7</sup>.’ During his experiments, Priestley demonstrates the actual use of ‘the air’ (for respiration). He adds, ‘We have here two chambers ... one with ordinary air ... the other with my new dephlogisticated one. Mr. Scheele, now take a mouse ...<sup>7</sup>.’ Through this experiment Priestley proves that ‘the air’ is a ‘dephlogisticated vital air’.

(c) Lavoisier’s experiment begins with a reference to his use of *mercurius calcinatus* in 1774 and to the development of the new gas, *oxygène*. He invites both Scheele and Priestley to perform his experiment. Lavoisier, in order to prove his experiment, brings a rubber suit to be put on by the volunteer who happens to be Scheele. Lavoisier says, ‘Not only must you weigh Apothecary Scheele ... you must weigh his suit. The measurements will take several hours<sup>7</sup>. Lavoisier proves his experiment and states that the theory of phlogiston is no longer relevant because he was able to explain the theory behind ‘rusting, burning and respiration’<sup>7</sup>. The three scientists perform their experiments on stage, thereby symbolically converting the stage into a laboratory.

Here one needs to note that neither Priestley, Scheele, nor Lavoisier carry out their own experiment, instead they ask someone else to repeat it. They seem to assert that each discovery needs to be verified and confirmed. As Scheele says, ‘Once reproduced by another, claims become facts’<sup>7</sup>. This scene draws our attention to Djerassi’s own path-breaking novel *Cantor’s Dilemma*<sup>8</sup>, in which a molecular biologist named Professor Isidore Cantor encounters a series of challenges until the Nobel Committee awards the Prize jointly to Cantor and his postdoctoral fellow Jeremiah Stafford. Cantor believes that his hypothesis, if proved, would be a landmark achievement in the research on tumorigenesis. Cantor asks Kurt Krauss, an authority in cancer research at Harvard, USA, to verify his hypothesis. However, Krauss’ postdoc Ohashi is unable to replicate the Cantor–Stafford experiment because of a missing entry in Stafford’s notebook. Yet when Ohashi repeats the experiment for the third time he could verify the hypothesis. Krauss, while speaking to Cantor, says, ‘Ohashi only succeeded a couple of weeks ago ... The explanation turned out to be ridiculously simple: apparently, Ohashi had been using a brand-new scintillation counter whose calibration hadn’t been checked. You know how it is, some piddling detail ...<sup>8</sup>.’ Here Krauss observes that while reconstructing an experiment, a minor change can lead to an incommensurable difference in the results. The novel unveils how the use of scientific equipments and the measurement values modifies an experiment and affects the results thus obtained.

In addition, Djerassi systematically describes the steps towards a discovery, beginning with the evolving of a hypothesis to the process of verification. As Krauss in *Cantor’s Dilemma* remarks, ‘a hypothesis without proof is sometimes worse than useless – it can be dangerous. A man can spend the rest of his experimental life chasing after a rainbow<sup>8</sup>.’ Correspondingly, Stafford in his conversation with a reporter named Ulf Lundholm comments ‘A hypothesis, in any field, is a sleeping beauty. She needs a prince to wake her up. With this sleeping beauty, the prince is the experimental test<sup>8</sup>.’ The eminent sociologists Latour and Woolgar<sup>9</sup> claim that ‘A fact only becomes such when it loses all temporal qualifications and becomes incorporated into a large body of knowledge drawn upon by others.’ According to Stafford, a hypothesis can only be confirmed when it is put through an experimental test: ‘An experiment is only meaningful if it can be repeated by someone else. You need at least two princes to convert a hypothesis into fact<sup>8</sup>.’ Djerassi and Hoffmann also address from a third-culture perspective the verifiability approach in sciences, which postulates that a theory can be demonstratively true only if it can be corroborated several times. The observations of the playwrights could lead one to yet another field of inquiry, i.e. the philosophy of science in which the concepts of verifiability and falsification in science are discussed at length.

Djerassi in the afterword to *Cantor's Dilemma*<sup>8</sup> draws the readers' attention to the different stages of discovery: hypothesis, experiment designs, datasets, reference papers, etc. He invokes the philosopher of science Thomas Kuhn's phrase 'paradigmatic science' to explain the 'construction of a working hypothesis which must then be substantiated experimentally'<sup>8</sup>. Besides, the process of corroborating scientific data, Djerassi maintains, is liable to 'statistical aberration' as well<sup>8</sup>. Accordingly, the multifaceted phases of discovery that Scheele, Priestley and Lavoisier unfold in *Oxygen* are made comprehensible to the audience through a third culture, science-in-theatre.

### Science and gender

The 'history of discovery' and the 'history of women involved in the process of discovery' are seldom mentioned in science education. Djerassi and Hoffmann advance the view that the history of discovery is vital to a clear understanding of discovery itself. The play presents a situation in such a way that the roles of wives in the lives of 18th century chemists grab the limelight. The playwrights emphasize the worthwhile feat that women accomplished in science way back in the 18th century. For instance, Mme. Lavoisier in time-frame 1777 mentions:

'There was chemistry to study. Art too. I took lessons with Jacques-Louis David ... all to help my husband. Each day in the laboratory, I made a list of what experiments were to be done. Antoine [Lavoisier] called out the numbers, I wrote them down. I drew plates for his books ... I etched them ... I corrected them. There was Latin to learn, and English too. It is I, Mrs. Priestley, who translated Dr. Priestley's *Experiments on Different Kinds of Airs* ... and his writings on phlogiston<sup>7</sup>.'

This scene calls to mind the historian of science Londa Schiebinger's<sup>10</sup> claim that in 'the prioritization of science' and 'the professionalization of science'<sup>8</sup>, the efforts of women in science are scarcely recognized. As Mme. Lavoisier states in *Oxygen*, 'The product of science is knowledge ... but the product of scientists is reputation. Reputation is important to him ... and when I married him, it also became important to me. Especially when he asked me to assist him in his endeavors<sup>7</sup>.' The authors resorted to a distinctive way of accentuating the characters' dialogues using ellipses, underlining, and italicizing specific words. This pattern serves a greater purpose than merely emphasizing dialogues. For instance, ellipses are used to refer to things which are unsaid and, therefore, to invite the audience to contemplate on the unstated, likely events. In one of the scenes from 1777, Priestley convinces his wife Mary: 'You help me in other ways ... you take splendid care of house and family ...<sup>7</sup>'. Ellipses here,

perhaps, denote the hesitation in Priestley's tone to acknowledge the fact that his wife assists him in his laboratory, while he never forgets to mention her responsibility in handling household chores. Likewise, in the 2001 time-frame women play a crucial part. Ulla Zorn, a Ph D student, works on the topic 'Women in the lives of some 18th century chemists' at Lund University, Sweden. According to Zorn, all candidates for the retro-Nobel had wives who were always around them. She says, 'The wives. That's where I would look. Aren't they usually expected to clean up the dirt?'<sup>7</sup>. Zorn's stance on this issue further highlights the non-appearance of women in scientific discourse: 'Wives. Most men around that time (1777) had wives. Why not look for what they had to say?' (emphasis in the original)<sup>7</sup>. The playwrights suggest that knowledge about the history of women in the lives of the scientists would indeed be an acknowledgment of their labours in support of scientific research.

### History and science

The importance of digging into history is revealed in *Oxygen* when Rosenqvist says, 'I am referring to Scheele's letter to Lavoisier ... in which he outlined his own experiments with oxygen, which he called *Feuerluft* ... Did Lavoisier get that letter and if so, when?'<sup>7</sup>. The Committee from this point onwards concentrates more on the historical aspect rather than the scientific one. And this historical aspect further provides more detailed insights into the life of Lavoisier. Bengt Hjalmarsson assures that Lavoisier did receive and read Scheele's letter. During his research Hjalmarsson finds an evidence while reading through Lavoisier's biography. He learns from Edouard Grimaux, a French chemist, historian and Lavoisier's biographer, that Grimaux found Scheele's letter in 1890 'hidden among Lavoisier's papers for over one hundred years'<sup>7</sup>. He further quotes from the letter, 'There is nothing I desire more eagerly than to be able to show you my discovery' (61).<sup>7</sup> He says that the letter lies in the archives of the French Academy of Sciences. The Academy, founded in 1666, publishes a volume each year, which includes information about the entire work done by its members.

Similarly, Zorn visits the library of Cornell University, where she finds an object resembling a book. Interestingly, the object happens to be a travel chest disguised as a book titled *Histoire des Théâtre*. She finds a hidden compartment wherein lies a letter. She states: 'A letter ... this is a photocopy, of course ... a letter apparently never sent. From Madame Lavoisier ... to her husband<sup>7</sup>.' Mme. Lavoisier in her letter mentions, 'My dear husband. In these difficult times, in the separation forced upon us by the Revolution, I reflect on the past. I return time and again to Apothecary Scheele's 1774 letter ...<sup>7</sup>.' She also confesses that she indeed received a letter from Scheele

but she kept it hidden. She says ‘I ask you now to forgive me. I could not show Apothecary Scheele’s letter to you, my dear husband. It would have taken the wind out of your sails, you, who were so close ... And I told you why I felt incapable of destroying it. Our priority rested on my hiding it<sup>7</sup>.’ From the events in the play one could conclude that a historical angle would enhance one’s understanding of scientific events, since science has a dynamic historical direction. A historical approach, further, lends current science a background to understand the minute processes involved in a discovery. The playwrights, thus, by highlighting the historical side of the discovery aspired to create space for a robust interaction between history and science.

### Conclusion

The emerging ‘third culture’ could erode the mutual gap of incomprehension between the sciences and the arts, and science-in theatre is a product of such an outlook. This article addresses the two-culture impasse by analysing *Oxygen*, a monumental work in science-in-theatre. The playwrights draw on theatre as a potent medium to convey their understanding of the subtle relationships between the sciences and the objects of humanistic inquiry. In so doing, this article discusses the confluence of theatre, science, gender and history. Moreover, in maintaining a non-conclusive ending, the playwrights seem to voice

for an analogous, open-ended approach to the procedures involved in any discovery. Such issues are rendered visible only because these authors are able to locate themselves in the interstice of the sciences and the arts.

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