

spectral narratives:
Art-Science Objects Unveiling Scientific Protocols for
Detecting Petroleum Hydrocarbons in Urban Soils in Montreal

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Abstract

spectral narratives: Art-Science Objects Unveiling Scientific Protocols for Detecting Petroleum Hydrocarbons in Urban Soils in Montreal

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This research–creation project explores the intersection of art, design, and environmental chemistry by reinterpreting an analytical environmental chemistry protocol used to detect petroleum contamination in urban soils. *spectral narratives* investigates how artistic practice can bridge the material culture of the organic chemistry laboratory and the art studio to question the aesthetic, epistemological, and political dimensions of contamination.

Through a series of sculptural modules, each corresponding to a step in the analytical process, the project mobilizes laboratory glassware, and solvents as both scientific and aesthetic materials. The work proposes to recontextualize these elements within four installations that translate the gestures and temporality of laboratory work into perceptual and affective experiences.

Situated at the crossroads of critical design (Antonelli, 2017), environmental communication (Merskin, 2020; Schuppli, 2020), and the history and philosophy of chemistry (Bachelard, 1953; Warner, 1990; Baird, 1993; Levere, 2001; Bensaude-Vincent & Stengers, 2019), *spectral narratives* examines how scientific visualization contributes to the formation of environmental knowledge. The term “spectral” operates on multiple registers, referring simultaneously to optical phenomena, to analytical instrument, and to the invisible traces of industrial and ecological histories. By transforming the chemistry protocol into an installation-based narrative, the project proposes an alternative mode of representing contamination.

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List of Abbreviations and Acronyms

ACDP	Amis du Champ des possibles
ASTS	Art-Science and Technology Studies
Cdp	Champ des possibles
CP	Canadian Pacific
DRs	Diagnostic ratios
GC	Gas Chromatography
GC-MS	Gas chromatography-Mass spectrometer
LED	Light-emitting diode
MELCCFP	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
MS	Mass spectrometer
PAHs	Polycyclic aromatic hydrocarbons
PHCs	Petroleum hydrocarbons
R-C	Research-creation
RML	Ray Mont Logistiques
STS	Science and Technology Studies

Chapter 1: Introduction

Urban soils are considered “anthroposols,” indicating that they are extensively shaped by human activities, arguably more so than soils formed under forests, marshlands, permafrost, or agricultural lands (Naeth et al., 2023). Urban areas concentrate industrial activities, high-density transportation streams, and soil sealing through asphalted streets, alongside urban agriculture and gardening, while supporting diverse infrastructures such as building foundations, wastewater systems, and more (Morel et al., 2005). Consequently, urban soils act as sinks for a wide range of residual compounds and materials, influencing the beneficial functions of primordial soil bacteria and altering the very consistency of soil matrices. These changes, in turn, affect the capacity to nurture biodiversity and the soil’s buffering and filtering abilities against pollutants and contaminants, which may propagate into groundwater and air (McBratney et al., 2014). Contaminants in soil can become bioavailable, infiltrating ecosystems and food chains, and disrupting metabolic processes (McBratney et al., 2014).

Several artists and designers have engaged with the materiality of soil and its significance in urban landscapes (Feller et al., 2015). Alexandra Regan Toland’s *Rubble Mapping* (2010) is an installation that reconsiders urban topography by revealing the buried construction materials of post-war Berlin. By highlighting the environmental challenges posed by the “slow leaching of sulphate from tons of buried mortar into the groundwater system” (Toland, 2010) and the potential loss of lively public parks, Toland invites the public to view soil as both a repository of cultural memory and a functional infrastructure for resilient urban landscapes. Similarly, Urbaniahoeve, a social lab for urban agriculture in the Netherlands, has developed the ongoing land art installation *Food Forest DemoTuinNoord* (2011–ongoing), which explores the production and placement of soil composed of organic waste materials, also known as anthropedogenic topsoils, to create thriving urban gardens. This project demonstrates “how a change in the perception and management of urban soil can directly and positively affect the city” (Solomon & Nevejan, 2019, p. 616). Both works contribute to a broader discourse that positions soil as a vital element in fostering resilient and flourishing urban environments.

Practitioners also draw on scientific methodologies to investigate soil contamination. The London-based research group Forensic Architecture (2019) identified pesticides and other toxic agents historically used for colonial purposes, developing an interactive application that traced the provenance and movements of these contaminants through human populations and ecosystems. Similarly, *Working with Soil* (2019), an art project by the Finnish research group Traces from the Anthropocene, translates contaminated soils into aesthetic expressions through ceramics. Bridging laboratory and studio practices, the project raises awareness of both historical and ongoing industrial soil pollution, working with materials that “not only offer a contemplative practice to reflect our relationship with soil,” but also present opportunities for envisioning better futures (Latva-Somppi et al., 2020, p. 17). Collectively, these projects critically explore soil contamination through interdisciplinary approaches that integrate scientific, artistic, and social perspectives. By

intertwining methodologies from science, art, and social analysis, they contribute to a nuanced discourse on soil-related challenges while fostering reflection and dialogue on pressing environmental issues.

These practices resonate with Science and Technology Studies (STS) scholars, who have also examined soil contamination through critical art-science approaches. María Puig de la Bellacasa (2017) has emphasized the alternative temporalities inherent in soil cycles and the infrastructural care required for resilient human-soil relations, while Jennifer Gabrys (2009) has highlighted how soil contamination is a dynamic process that escapes technological containment, demanding new frameworks for understanding complex and hybrid ecologies. Other STS scholars conceptualize toxicity as a mechanism of control and perpetuation of harm. Max Liboiron et al. (2018) investigate “toxic politics,” wherein toxicant thresholds are leveraged to justify land dispossession, environmental degradation, and economic status quos that legitimize polluting technologies. Anthropologists have similarly drawn on ecotoxicological protocols to examine socio-cultural dynamics within contaminated environments. Simone M. Müller (2021) introduced the concept of the “toxic commons” to underscore the pervasive and uneven impacts of contamination. She deconstructs the notion of “environmental safe havens” and traces the flows of contaminants to reveal environmental privileges.

From a critical design perspective, these insights underscore the need to reconsider hegemonic design practices and explore experimental alternatives that address contamination differently. They collectively deepen our understanding of the complex dynamics of soil cycles, infrastructural care, and the multifaceted implications of contamination.

1.1 Contaminated Soils: A Local Problem

A significant portion of the Island of Montreal is contaminated due to various anthropogenic activities, leaving large unstructured spaces that affect mobility, the appropriation of public areas, and exacerbate social inequalities related to the proximity of contaminants or processes of environmental gentrification (MELCCFP, 2021). One notable example is the *Champ des possibles* (Cdp), a vacant green lot located in the Mile-End neighbourhood between Gaspé and Henri-Julien streets. This site has received considerable media attention in recent years, particularly regarding its toxicity and citizen mobilization. The Cdp is known to be contaminated with petroleum products and heavy metals (ACDP, 2015).

The site’s industrial history dates back to the mid-19th century, when it was initially used for farming before being converted into grey limestone quarries. Following abandonment, many of these quarries filled with rainwater and runoff, and numerous areas, including the Cdp, were used as dumping grounds. In 1906, the Canadian Pacific Railway acquired the land and constructed a rail yard to store wagons and serve local businesses in the asphalt, coal, scrap metal, and junk yard industries. CP gradually phased out its activities at this location and abandoned the site by the

1980s. In 2007, the City of Montreal acquired the Cdp, which has since been protected by a citizen group called *Les Amis du Champ des possibles* (ACDP).

The Cdp exemplifies the long-term consequences of environmental degradation resulting from harmful industrial practices, particularly in the energy and transportation sectors. The spilling and elemental dispersion of polycyclic aromatic hydrocarbons (PAHs), molecules naturally present in coal, crude oil, and gasoline, and primarily produced through incomplete combustion, represent an inevitable byproduct of the fossil fuel industry and everyday urban life, leaving a significant territorial imprint on Montreal.

1.2 An Emerging and Ongoing Artistic Preoccupation

I first became interested in the issue of soil contamination during my undergraduate studies in Intermedia Cyber Arts (2018-2022). In the fall of 2020, I witnessed the demolition of a cinema near my apartment in Montreal, which marked the beginning of preparations for a large condominium project. As I began researching the site's history, I discovered that it required decontamination due to oil spills originating from a former gas station. This investigation led to my first art installation specifically addressing soil contamination by petroleum hydrocarbons: *saturation by accumulation* (fig. 1.1), a prototype exploring the fluorescent properties of hydrocarbons, presented at the Milieux Institute's *In the Middle, a Chimera* end-of-year exhibition (Eastern Bloc, Montreal, 2022).

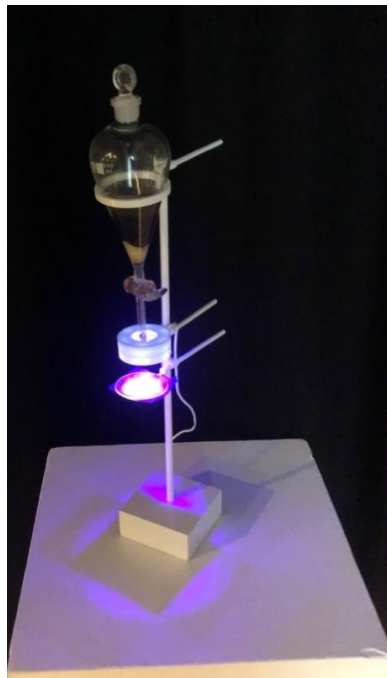


Figure 1.1 *saturation by accumulation*. *In the Middle, A Chimera*, Eastern Bloc, Philippe Vandal, 2022.
Montreal, Canada. Photo: Philippe Vandal

In October 2022, I also participated in organizing *Écotones*, a series of artistic interventions held at the *Champ des possibles* (Cdp), where I presented two additional prototypes exploring the specific properties of hydrocarbons¹. The event combined a public walking roundtable and an outdoor exhibition that fostered aesthetic, creative, critical, and social reflections on local soil pollution in Montreal. Two modules were presented: *rotary assistant* (fig. 1.2), a solar-powered device that gently scrapes the topsoil in a circular motion while illuminating it with a blacklight LED strip; and *chromatically witnessing*, a reinterpretation of a common solar-powered garden lamp, in which four LED strips illuminate laboratory plastic test tubes containing contaminated soil, water, or acetone. Together, these two early modules proposed a speculative representation of an analytical chemistry protocol for detecting soil contaminants, one that is typically confined within the laboratory space.



Figure 1.2 *Écotones*, Cdp, Montreal, 2022. Left: *rotary assistant* in which a broom can be seen attached on the right side of the device and a blacklight LED on the left side. Right: *chromatically witnessing*.

Plastic test tubes can be seen in the middle of the contraption. On the right side, a blacklight is illuminating the acetone wash of a soil extraction, on the left side, a water wash illuminated by a bright white light. Photo: Philippe Vandal

Écotones (2022) led to the discovery of a detailed map of the *Champ des possibles* (Cdp), documenting the nature, location, and depth of its contaminants (ACDP, 2015). These include petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals such as arsenic, copper, tin, and lead (ACDP, 2015, p. 6). Such contaminants, commonly found throughout the Island of Montreal and other urban areas (MELCCFP, 2023), have a wide range of

¹ *Écotone* was organized in collaboration with PhD candidate Brice Ammar-Khodja and realized in partnership with the Association Les Amis du Champ des Possibles. It was supported by the Canada Excellence Research Chair (CERC) on Smart, Sustainable and Resilient Communities and Cities at Concordia University, the Haute École des Arts du Rhin (France), the Sustainability Action Fund (SAF), Hexagram, the Milieux Institute, and the Concordia University Research Chair in Critical Practices in Materials and Materiality. The artistic objects were realized across the Milieux Institute Speculative Life Biolab (dir. Dr. Alice Jarry) and the Topological Media Lab (co-dir. Dr. Alice Jarry and Prof. Michael Montanaro).

environmental and health impacts, from groundwater contamination and food chain disruption to reduced air quality caused by the release of volatile compounds, and decreased soil fertility that impacts plant growth and biodiversity (McBratney et al., 2014).

Another exploration in artistically appropriating scientific laboratory aesthetics and objects was *module 2: non-esg chaotic behavior* (2023, fig. 1.3), exhibited during Milieux's *The Commons* exhibition (4th Space, 2023). The prototype explored the fluorescent properties of various vegetable oils while connecting the speed and direction of two custom magnetic stirrers with the fluctuations of the stocks of Canadian banks. Also known as the “Big Fives,” these institutions are heavily investing in the petroleum industrial complex (Greenpeace Canada, 2021). The speed of the stirrer would vary the distance of the vegetable oils by pulling them slowly closer to the bottom of the vessel, displaying colourful gradients induced by the ultraviolet LED lights.



Figure 1.3 *module2 non-esg chaotic behavior*. The various colours can be seen depending on the distance of the oil and the blacklight source. *The Commons*, 4th Space, Philippe Vandal, 2023. Montreal, Canada. Photo: Philippe Vandal

To deepen my understanding of the nature and the repercussions of petroleum contaminants, I conducted a Directed Study under the supervision of committee member Dr. Yves Gélinas (Department of Biology and Chemistry, director of the Organic Geochemistry Environmental Laboratory, Concordia University). We followed a scientific protocol for detecting soil contamination (see Appendix A) and selected three soil samples from the *Champ des possibles*

(Cdp) to analyze for the presence of polycyclic aromatic hydrocarbons (PAHs), compounds found in crude oil and produced through incomplete combustion processes.

Following this protocol provided insight into specific laboratory practices, such as solvent extraction and sample analysis using gas chromatography–mass spectrometry (GC-MS), to visualize soil contamination that is typically hidden from the public due to limited access to laboratory facilities. It also offered an opportunity to understand how contamination detection is formally produced through quantitative scientific methods that are essential for informing political action, environmental policy, and public awareness (MELCCFP, 2023).

Beyond the social imagination of soil contamination as vacant lots, abandoned gas stations, wastelands, or bright iridescent colors scattered through greenery, the Directed Study revealed a different perspective on the visibility of contamination through the molecular detection of pollutants using scientific instruments and equipment.

1.3 Research Problematic: A Matter of Visibility and Accessibility

Environmental analytical chemistry protocols function as institutionalized frameworks for recognizing and officially acknowledging soil contamination. Through their standardized procedures and methodologies, these protocols not only provide a systematic means of identifying pollutants but also shape how contamination is perceived and understood within institutional contexts. In Quebec, any soil sample collected as part of a site characterization study must be analyzed in a laboratory accredited by the MELCCFP (MELCCFP, 2023). However, these controlled environments are not accessible to the public, which contributes to the obscuring of the legal and official processes involved in detecting soil contamination.

This underscores the importance of bridging the gap between laboratory and public spaces, where artistic representation and scientific mediation can make laboratory procedures more accessible and emphasize the need to address contamination in urban environments (Solomon & Nevejan, 2019).

Several contemporary artists have worked to bridge the divide between the laboratory and public space by appropriating scientific instruments and protocols. Agnes Meyer-Brandis's *Tea Cup* (2014) explores the infusion and tasting of environmental atmospheres through an art-science collaboration that reinterprets the aesthetics of scientific instrumentation. Eve André Laramée's *Apparatus for the Distillation of Vague 24 Intuitions* (1998) reflects on the history of borosilicate glass and the craft of glassblowing in chemistry laboratories, emphasizing the material's role in shaping scientific knowledge through reproducibility and controlled micro-environments. Dr. Simon F. Park's *The Exemplary Life of Soil* (n.d.) visualizes how soil properties affect the movement and growth of bioluminescent bacteria through microscopic photography and collaborative laboratory practices. Similarly, Gilberto Esparza's collaborations with biologists, engineers, and roboticists translate laboratory research into public engagement. His projects *Autophotosynthetic Plants* (2013–2014) and *Nomadic Plant* (2008–2014) use microbial fuel cell

modules to generate energy from the metabolic activity of microorganisms present in polluted water.

Despite these initiatives and methodological alliances, a gap remains in artistic exploration specifically focused on the tools and instruments central to analytical environmental chemistry protocols for addressing soil contamination. This absence of representation prompted the following research questions:

How can speculative scientific tools and instruments, inspired by environmental analytical chemistry protocols, enhance visualization and generate new perceptions of soil contamination?

How can these speculative narratives reframe discussions around the ecological and social impacts of petroleum extraction, production, and pollution?

By examining these scientific implements through an art-science practice, this research aims to reveal the often overlooked visual and material dimensions of contamination detection. Within this context, an artistic approach can illuminate the political implications embedded in scientific protocols, their aesthetics, and dissemination within society and culture.

1.4 Outcomes, Contribution, and Limitations of the Research

To address these research questions, the research-creation (R-C) materialized into an installation consisting of four art-science objects that represent each step of an analytical chemistry protocol for detecting the presence of hydrocarbons in urban soil samples (fig. 1.4 to fig. 1.7). Each object represents a tool or an instrument used for a specific manipulation, magnifying its aesthetic qualities while exploring speculative and critical engagement with organic chemistry's material culture (Harré, 2003). This artistic proposition presented at EISODE (January 16th to February 27th, 2025) informed public mediation activities (January 28th and February 15th, 2025).

This R-C thesis contributes methods to the fields of Critical Design and Art-Science and Technology Studies (ASTS) by exploring the convergence of artistic practices and scientific methodologies in the context of soil contamination analysis. It provides a unique perspective on contamination, which is often obscured due to limited access to laboratory space, costly instruments, and prerequisite scientific knowledge. The thesis also examines the interconnection between the organic chemistry laboratory and the fossil fuel industry, revealing how contamination detection is produced through scientific quantitative practices that shape, and are informed by, political actions, environmental policies, and public awareness.

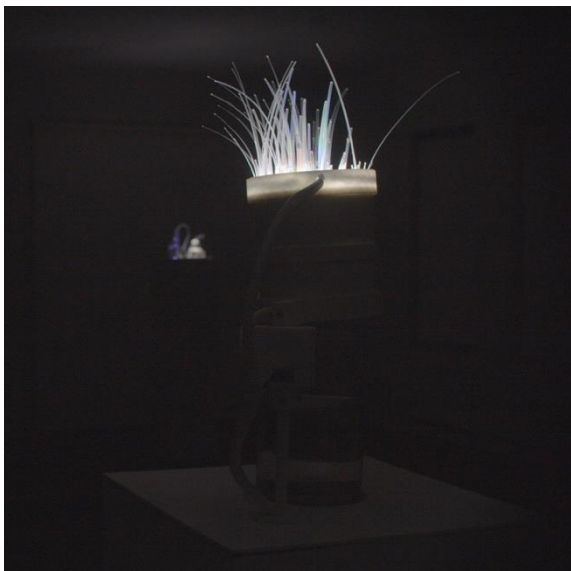


Figure 1.4 *module0. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

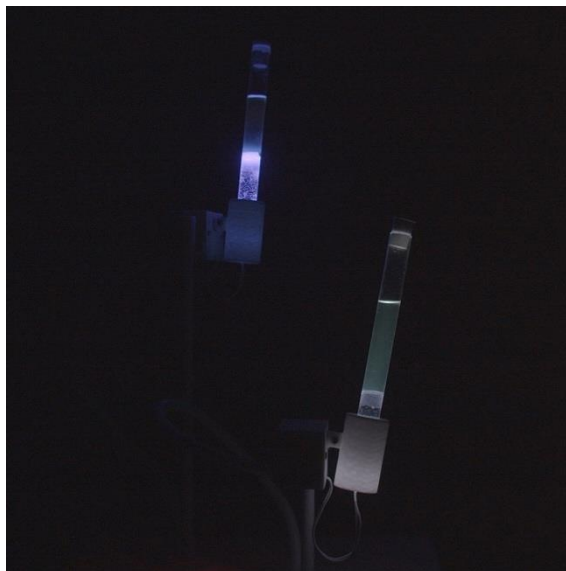


Figure 1.5 *module1. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal



Figure 1.6 *module2. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal



Figure 1.7 *module3. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

However, the instruments and tools derived from analytical protocols are not intended to be scientifically accurate, but rather act as conceptually functional material artifacts. The technical complexity of fabricating instruments restricts the precision and functionality of their representations, especially given challenges in acquiring materials such as helium tanks, GC-MS columns, or accurate sensors. As an artist-researcher, my limited knowledge of organic chemistry

also restricts the use of technical terminology and requires caution to avoid false conclusions. Therefore, *spectral narratives* acts as an exploration in convening environmental preoccupations, petroleum-derived materials, and artistic interpretations of a scientific protocol; it performs a speculation that helps discuss and visualize contamination and processes rather than formal detection.

1.5 Chapters Overview

Chapter 2 will situate the R-C within its theoretical and methodological framework (Chapman & Sawchuk, 2012; Loveless, 2019; Rogers et al., 2023). More specifically, it will present the benzene ring as the operational principle for the interdisciplinary exploration of *spectral narratives*. Lastly, it will describe the analytical environmental protocol that inspired the creation and the sequence of the artistic objects.

Chapter 3 will delve into some of the materials that were used in the *spectral narratives*' *module1*, *module2* and *module3*, highlighting the connections of their different usage within the laboratory and the art gallery space. It will present some artworks that inspired the use of glassware in the modules, such as Eve Andrée Laramée's *Apparatus for the Distillation of Vague Intuitions* (2008) and Hicham Berrada's *Présages Series* (2007 –), and contextualize its usage in a chemistry laboratory (Jackson, 2015). Additionally, the mobilization of light phenomena, such as fluorescence, phosphorescence, and iridescence, will be explored and compared with HeHe's *When the Future was about Fracking* (2016).

Chapter 4 will introduce the philosophy and aesthetics of scientific instruments and objects, and how the R-C artistic interpretations explored some of the key questions of this field (Warner, 1990; Baird, 2002; Taub, 2018). Specifically, it will look into the concept of “functionless object,” or how scientific instruments presented in museums might eschew how they are used and in which context (Gauvin, 2016; Ivanova, 2021). It will specifically look at *module3*, an artistic interpretation of the GC-MS, and compare it with Agnes Meyer-Brandis's *Teacup Tools* (2014-) and *Tealemetree Station* (2014-) to present the limits of the aestheticization of science.

The last chapter will define *spectral narratives* and put it in resonance with the mediation activities during the final exhibition. Specifically, it will look into how the project was inspired by concepts such as ecohauntology (Henriksen, 2021), spectralities (Derrida, 1994), and prismatic ecology (Cohen, 2014). It will also explore the mobilization of the concept and the practice of maintenance in the arts and in the philosophy of scientific instrumentation.

Chapter 2: Theoretical, Artistic, and Methodological Foundations

My R-C is situated within the theoretical and artistic framework of Art Science and Technology Studies (ASTS). It encompasses the interdisciplinary practice of formulating art-science propositions by bridging the realms of sciences, social sciences, humanities, and arts (Rogers et al., 2023). Where the interdisciplinary STS contextualizes art–science within the histories, sociologies, philosophies, and anthropologies of the arts and the sciences, ASTS integrates arts practice and cultural studies not only for their methodological and theoretical content but also for their epistemological and ontological perspectives (*ibid.*). This chapter will first present the operational principle of this R-C, an interpretation of the benzene ring interconnecting the theoretical framework of the project. The chapter will conclude with the description of the methodological framework inspired by the environmental analytical chemistry protocol made during the Directed Study (2023).

2.1 The Benzene Ring as an Operational Principle

This research’s theoretical and artistic framework is inspired by the unique chemical structure of the benzene ring (fig. 2.1), the foundational unit of PAHs and a key molecule in organic chemistry (Graham et al., 2023). Specifically, its hexagonal carbon–carbon bonding and the delocalization of some of its electrons, or more specifically its *aromaticity*, confer strong stability and persistence (*ibid.*), which motivates this R-C to explore six topics or areas of interest that circulate and assemble in different configurations throughout the chapters: 1) speculative and critical design, 2) environmental communication, 3) organic and analytical environmental chemistry, 4) scientific instruments, 5) history, and 6) philosophy of chemistry (fig. 2.2). Together, these topics allow to properly contextualize and situate *spectral narratives* within a historical, artistic, and conceptual milieu.

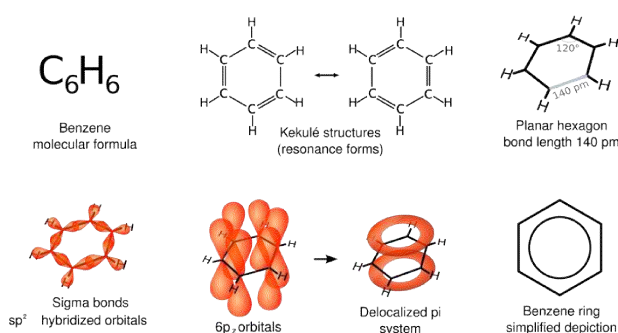


Figure 2.1 Various representations of benzene, Vladsinger, 2009. License CC BY-SA 3.0

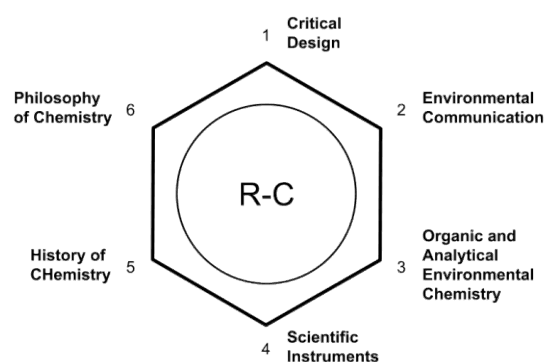


Figure 2.2 The Benzene Ring as the operational principle for the theoretical and artistic framework, 2025. Design: Philippe Vandal

2.1.1 Speculative and Critical Design

This research engages with socio-cultural and environmental urgencies and creates connections between scientific laboratory practices and aesthetic experimentation. One key area is the field of Speculative and Critical Design, which focuses on “the impact and possible consequences of new technologies and policies, and of worldwide social and environmental trends, as well as on outlining new goals and areas of interest for designers” (Antonelli, 2017). In other words, Speculative and Critical Design provides a way to imagine a “preferable” world within the current state of affairs (*ibid.*). Accordingly, it serves as a conceptual tool to situate and critique the environmental, socio-cultural, and geopolitical contexts surrounding a material culture of interest. A Critical Design ethos is evident in the extensive art-historical catalogue *Oil: Beauty and Horror in the Petrol Age* (Beitin, Klose, & Steininger, 2021), which examines a wide array of artists, scientists, photographers, painters, and new media practitioners working within the geopolitical and socio-cultural implications of the petroleum industry. Within this thesis, the artists and practitioners discussed and adopting this genre include Eve André Laramée, Agnes Meyer-Brandis, Susan Schuppli and Hicham Berrada.

2.1.2 Environmental Communication toward Artistic Mediation

Environmental communication encompasses both the dissemination of information and the application of communication strategies related to environmental issues (Merskin, 2020). It also includes research and practices that examine the interactions among diverse entities, such as institutions, states, and individuals, in relation to environmental topics (*ibid.*). Furthermore, it considers how cultural products shape societal perspectives on environmental matters. Artists such as Susan Schuppli and the collective Center for Land Use Interpretation have addressed environmental issues through distinct creative practices. Schuppli, for instance, engages with the concept of environmental forensics and the idea of the material witness, treating matter as bearing legitimate testimony of an incident, as exemplified in her *Nature Represent Itself* installation (Schuppli, 2018). The Center for Land Use Interpretation, on the other hand, organizes public tours that interpret cultural inscriptions in the landscape, critically analyzing anthropogenic contamination and fostering dialogue (2018). This approach will be central to discussing the *Maintenance* mediation activities (2025) during the exhibition aspects of *spectral narratives*’ process.

2.1.3 Organic and Environmental Analytical Chemistry

The field of organic chemistry investigates the structure, properties, composition, reactions, and synthesis of compounds primarily composed of carbon. While most organic compounds contain carbon and hydrogen, they may also include a variety of other elements (Graham et al., 2023). Environmental analytical chemistry, by contrast, can be understood both as a subset of analytical chemistry and as a branch of environmental chemistry. Whereas analytical chemistry focuses on the separation, identification, and quantification of chemical components from natural and

synthetic sources, environmental analytical chemistry specifically examines the separation, identification, and quantification of chemical components of environmental relevance (Zhang, 2007). A basic understanding of organic chemistry, along with the principles and operation of instruments used in environmental analytical chemistry, informed the development of the artistic representations. Although this thesis does not engage with these fields from a strictly scientific perspective, their inclusion is essential because they provide a conceptual and methodological framework that shapes the work's exploration of various materials, chemical processes and aesthetics of scientific objects and instruments.

2.1.4 Scientific Instruments

Defining and conceptualizing scientific instruments is essential to situate this research's artistic representation of the material culture of science. Scientific instruments have been examined from multiple perspectives, including museum curation, anthropology and ethnography, philosophy, the arts, and instrument making. Deborah Jean Warner's (1990) genealogy of the concept and expression of the scientific instrument, considered in relation to its social and cultural historicity, informs the conceptual framework within which the project's intentions developed. Furthermore, Davis Baird's notion of "thing knowledge" (2004, p. xii), a "materialist epistemology for instrumentation" (*ibid.*, p. 39), which examines scientific instruments, laboratory tinkering, and the arts and crafts as bearers of human knowledge, situates the R-C project within the broader context of representation and science communication.

2.1.5 History of Chemistry

The historical study of chemistry involves tracing the discipline's evolution over time. This inquiry encompasses the development of chemical knowledge, major discoveries, shifting theories, and technological advancements. Within this historical context, research questions often address prominent figures, pivotal experiments, paradigm shifts, and the societal and cultural forces that have shaped both the practice and perception of chemistry. Numerous historians of science have critically examined the genealogy of the discipline and its practices, including Trevor Harvey Levere (2001), Bernadette Bensaude-Vincent and Isabelle Stengers (2019), and Davis Baird (1993). Engaging with the history of chemistry was essential for this project, as it allowed the artistic representations of instruments and tools to be situated within their historical context, to be connected to the contemporary state of analytical chemistry, and to better engage with the philosophical and social complexities of the discipline.

2.1.6 Philosophy of Chemistry

While the history of chemistry traces the discipline's chronological development, the philosophy of chemistry examines its foundational concepts, theories, and methodologies. This field explores the nature of chemical entities, the epistemology of chemical knowledge, and the philosophical dimensions of chemistry as a science. Philosophical investigations within this domain may

encompass debates on the ontology of chemical substances, the characteristics of chemical laws, the interplay between chemistry and physics, and the epistemic standing of chemical explanations. Philosophers of chemistry employ conceptual analysis, logical reasoning, and critical examination of theoretical frameworks to delve into the core principles that underlie the discipline. Bensaude-Vincent (2008, 2014) and Klein (2005) have written extensively on the philosophical implications of chemistry and its relationship to industry from a Science and Technology Studies (STS) perspective. Moreover, the French philosopher and chemist Gaston Bachelard reflects on the “factitious” understanding of purified chemicals as “highly civilized” (1953, p. 31) materials, subject to rigorous inspection and purity standards imposed by regulatory systems. These authors and thinkers will guide how the R-C artistic modules were thought and contextualized within STS and ASTS.

2.2 Methodological Framework

R-C is a research approach that integrates creative, reflexive, and theoretical practices, fostering the advancement of knowledge and innovation through a blend of artistic expression, scholarly investigation, and experimentation (Loveless, 2019). Most importantly, R-C involves addressing the theoretical, technical, and creative aspects of a research project simultaneously (Chapman & Sawchuk, 2012). It is an intervention into current knowledge production paradigms and, “combined with new ways of developing and disseminating that knowledge, R-C helps reveal different contexts and methods for cultural analysis” (*ibid.*, p. 12). It allows for the crossing of disciplinary boundaries through practice-based reflection situated within diverse creative spaces and theoretical frameworks.

Scholars Sarah E. Truman and Stephanie Springgay, specialists in contemporary art practices at the University of Toronto (Canada), argue that R-C is a speculative and future-oriented practice that invents novel ways of doing, one which embraces the rejection of predetermined frameworks and the creation of novel concepts (Truman & Springgay, 2016). Additionally, they emphasize the importance of a continuous and iterative re-examination of the practice itself, which gives rise to ethico-political concerns that are always situated (*ibid.*; Jarry, 2019).

Informed by an interdisciplinary literature review spanning land art, scientific protocols for soil contaminants, fieldwork, STS, anthropology, urban ecology, and Montreal’s environmental policies, my iterative methodology began with a presentation with Brice Ammar-Khodja during the in.site Conference (4th Space, Concordia University, 2022), where I showed some early prototypes shaped by critical reflections, art-science techniques, and aesthetics. Engaging in public conferences and exhibitions fostered self-reflexivity and critical reflection on technical and scientific knowledge (Born & Barry, 2010). As Hannula et al. (2014) argue, these preliminary public aspects of the research were inseparable from the process, continuously shaping and challenging it. Leading to *saturation by accumulation*, a project exploring hydrocarbons’ fluorescent properties (*In the Middle, a Chimera*, Eastern Bloc, 2022; fig. 1.1), this process informed new spectral analysis experiments and culminated in the fluorescent forensics series

Écotones (Champs des possibles, Montreal, 2022), as well as a Hexagram online publication (Ammar-Khodja & Vandal, 2022).

2.2.1 How a Scientific Protocol informs a Research-Creation Process

Drawing on the work conducted during the Summer 2023 Directed Study with Dr. Gélinas (Organic Geochemistry Environmental Laboratory, Concordia University, Montréal) the various phases of the R-C were informed by the steps involved in an analytical chemistry protocol designed to detect PAHs in urban soil samples from the Cdp (see Appendix A for the full protocol). The main anthropogenic sources of PAHs are vehicle exhaust and industrial processes, making them ubiquitous in urban and industrial areas throughout the country (Canadian Council of Ministers of the Environment, 2010). Their exposures have been linked to cancers in animals and humans, and their non-carcinogenic effects are irritation and redness of the eyes, skin, and breathing passages. PAHs have a strong tendency to bind with particulate matter, facilitating their scattering through air and water (O'Halloran, 2006). The impact of PAHs contamination on soil properties is due to their chemical stability, hydrophobicity, and resilience to microbial breakdown, implying that high concentrations can potentially harm both biological and physicochemical characteristics of soil matrix (Daâssi & Almaghribi, 2022). This scouting experiment, conceived as a compromise between scientific rigour, limited time frame, and restricted access to equipment, included the following steps:

2.2.1.1 Sample Preparation

Sample preparation was the first step and included: 1) *in situ* soil sampling at the Cdp, 2) dry/wet weighing, and 3) sifting. Supported by the Carte des Contaminants (ref), a literature review on the historical and in use of the selected site (the Cdp) was conducted beforehand to guide the sampling process.

2.2.1.2 Organic Matter Extraction

The second step was the extraction of organic matter, which involved combining organic solvents with the prepared samples, followed by centrifugation and stirring. The solvents dissolved the organic compounds from the inorganic ones, and an additional separation was achieved by adding water. Consequently, the hydrophobic PAH molecules were extracted from the floating layer in the test tubes.

2.2.1.3 Separation and Purification of Selected Contaminants

The third step involved selecting PAH molecules by passing the extracted sample through a glass column filled with silica, which acted as a buffer or filter, followed by the near-complete evaporation of the combined solvents containing the selected molecules for analysis.

2.2.1.4 Instrument Analysis

The fourth step, instrumental analysis, involved introducing the prepared soil sample into a GC-MS (fig. 4.6). GC-MS refers to the combination of gas chromatography (GC) and mass spectrometry (MS). A GC separates and detects the chemical components within a sample mixture to determine their presence or absence and, when relevant, quantify their amounts. An MS identifies unknown compounds by determining their molecular weight, quantifies known compounds, and elucidates the structure and chemical properties of molecules (Turner, 2022).

2.2.1.5 Interpretation and Communication of Results

The final step of the protocol was the interpretation and communication of results. It involved critically analyzing the data obtained from the analytical instruments while reflecting on the protocol's limitations in comparison with those described in the scientific literature. Additionally, it included writing and sharing a lab report to disseminate the findings (see Appendix A).

2.2.2 *spectral narratives* Informed by Scientific Protocol

The final artistic intervention, *spectral narratives*, and its public mediation (EISODE, Montréal, 2025) were informed by the five aforementioned phases involving the manipulation of scientific measuring instruments and tools. Performing and interpreting a scientific protocol from an artistic and critical perspective provided an opportunity to situate the lab's tools and instruments (e.g., test vials, burettes, GC-MS) and techniques (e.g., solvent separation, purification, analysis of the structure and effects of PAHs) in relation to one another. This creative process created a space to better understand their epistemic function within specific narratives of knowledge production (Hannah, 2013; Taub, 2018, p. 8). As Liba Taub argues, referring to Jutta Schickore's work in the history and philosophy of science:

“knowledge of things – of instruments – cannot be gained fully by considering the thing on its own; instruments must be studied within the context and setting of their use. Individual instruments are often used alongside other things, including other instruments, tools and devices, as well as specimens.” (Taub, 2018, p.8)

This protocol engaged in the isolation of a specific kind of chemical compound. Preparing for substance characterization outlines the necessity of a substantial workforce, including technicians, scientific instrument manufacturers, analytical chemists, physicists, and political environmental agencies. Moreover, it necessitates the expertise of specialized professionals and regulatory bodies responsible for establishing purity standards. Additionally, it requires inspectors to ensure compliance with these standards, particularly in the context of using scientific measurement instruments. Resonating with Taub (2018), the goal of *spectral narratives*' modules was to situate the instrumental sequence of the protocol to contextualize and gain the “knowledge of things.” Following this specific protocol thus aimed to reveal the political, scientific, and cultural dispositions of PAHs, or their various modes of existence (Bensaude-Vincent, 2014), as embodied

in the contextualization of the work within the gallery space and through mediation activities. The artistic depiction of the instruments and tools used in the protocol was not intended to be scientifically precise in a quantitative sense; rather, these elements served as tangible artefacts offering a meaningful avenue for exploring topics related to science, the history of scientific practices, and the effective and affective communication of scientific concepts and environmental issues linked to PAH contamination.

The following chapters reflect on this methodology through a tangible and embodied artistic practice, where material explorations, through various artistic and scientific manoeuvres, inform both the potentials and limitations of the research, thereby continually reorienting the prototyping process.

Chapter 3: Glass and Solvents: Discovering Artistic Materials in the Chemistry Lab

In the final installation at EISODE (2025, fig. 3.1), four modules representing consecutive stages of the protocol were partially made of glass, both hand-crafted and industrial, and some utilized various solvents. The modules were placed in the darkness of the gallery space, and automatically sequenced using Ossia Score to artistically reproduce the four different steps of the protocol (Ossia, n.d.).

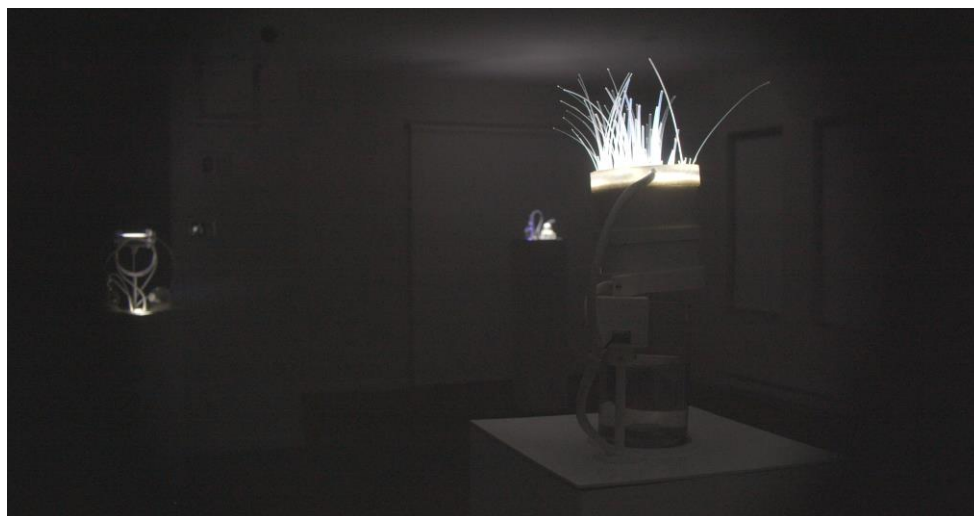


Figure 3.1 *spectral narratives*, exhibition view, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

Focusing on *module1*, *module2*, and *module3* of the installation, this chapter examines the intertwined histories of materials used in both art studios and science laboratories, focusing specifically on glass and solvents. From the invention of iconic laboratory vessels such as the Erlenmeyer flask (1860) and the test tube (early 19th century) to the evolution of scientific glassblowing and the emergence of solvents as essential components in both artistic and chemical practices, these materials have profoundly influenced how we see, represent, and manipulate the world. By tracing key moments in the historical development of glassware and solvents, this chapter investigates how material culture bridges disciplines, revealing unexpected continuities between artistic experimentation and scientific inquiry. The chapter draws on three conceptual nodes derived from the operational principle of the benzene ring: critical design, and the history and philosophy of chemistry (fig. 3.2), and will start with a description of *module1* and *module2*, followed by a short history of glass in the sciences and how it has been utilized in the arts. After a section on the implicated glass manipulation in materializing the modules, and a short summary of the implications of solvents, in scientific and artistic practices, the chapter closes with the various light properties of solvents involved in *spectral narratives*.

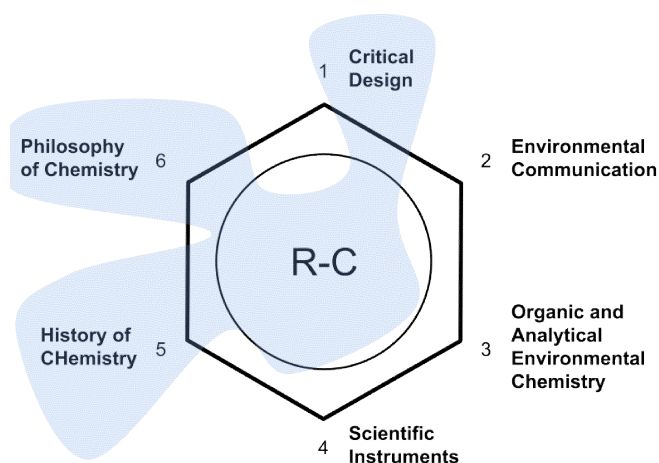


Figure 3.2 Mobilization of Critical design, history, and philosophy of chemistry in the Benzene Ring for Chapter 3, 2025. Design: Philippe Vandal

3.1 Description of *spectral narratives' module1* and *module2*

module1 (fig. 3.3) is a diptych placed onto a white plinth. Two glass test tubes are attached to servo motors mounted on white steel rods. They are filled with petroleum-based products, such as kerosene, mineral spirit engine oil, and water, illuminated with a white and blacklight LED. *module1* is a material exploration of the density and miscibility of pure chemicals, such as petroleum-derived products, acetone, and water. It artistically represents the second step of the Directed Study's protocol (2023), "*Organic Matter Extraction*."

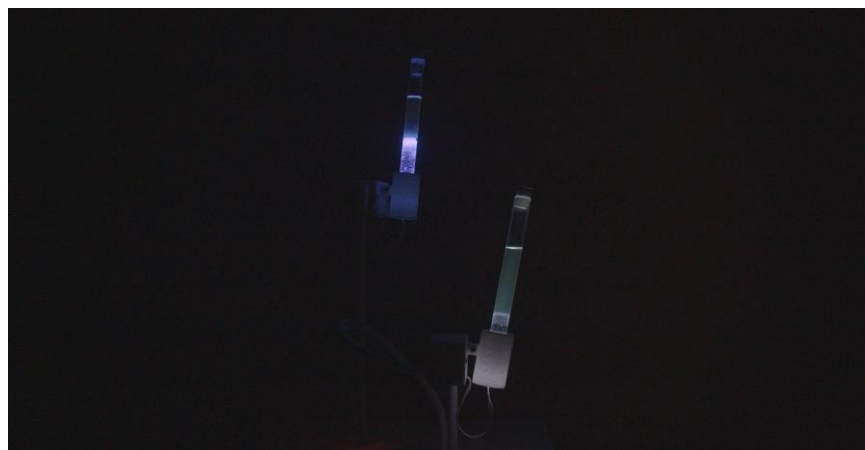


Figure 3.3 *module1*. Two test tubes are secured within 3D printed holders and illuminated with blacklight and white LEDs. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal.

A double choreographed sequence juxtaposed the intensities of the LEDs and the angles of the motors onto which the test tubes are attached. The dramatic change caused by the fluorescent properties of organic chemicals under blacklight allegedly helps the interpretation of *module1* as containing two very different samples undergoing an identical manipulation or processual step. The jittering circular arc movements are a slowed-down and chaotic representation of the centrifuge spinning, used to separate the liquid from solids in the organic extraction step. Automated soft rocking the test tubes while simultaneously adjusting the LEDs' intensities allowed the viewer to inspect the various chemical layers in the test tubes.

module2 (fig. 3.4) expands on this diptych assemblage. It displays a round-bottom flask and a glass-blown version made during Summer 2024, my first attempt at blowing glass. It represents the separation and “*Purification of Selected Contaminants*” step from the protocol. It is the process of selecting the PAH molecules of interest by passing them through a glass column filled with silica with a specific solvent combination. Subsequently, the eluent is evaporated through nitrogen evaporation. *module2* embodies the artistic interpretation of nitrogen evaporation to drastically reduce the content of solvents before their analysis.



Figure 3.4 *module2*. The left blown glass vessel represents an interpretation of a round bottom flask whereas the right one is an exploration of the materiality of glass. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

The two glass vessels are placed onto a white plinth, filled with various vegetable oils, liquid paraffin, and water. Small air bubbles are introduced into the liquids via silicone tubes. The glass

compressed blown vessel is placed onto a large white light (fig. 3.5) and the interpretation of a round bottom flask is illuminated by an array of blacklight LEDs (fig. 3.6). The illumination of the former vessel shows the intricacy of its materiality and odd shape; the bottom is textured, reminiscent of the soil from which the sample was taken from. The introduction of bubbles softly moves the green and yellow-tinted vegetable oils.



Figure 3.5 *module2*. Illumination of the vegetable oils under white light. Textures can be seen through the bottom of the illuminated vessel. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

The disruption of the vegetable oil in the latter vessels can be observed when the visitor's sight is specifically at the height of the transparent layer of liquid paraffin. As the blacklight slowly

intensifies, the various vegetable oils reflect a very different spectrum: green, bright blue, yellow, and even red. This time, the disturbance of the vegetable oils by the air bubbles softly induces color changes caused by the shifting distance from the light source (fig. 3.6). The sequence of *module2* lets the visitor see the different effects of the lights on the liquid.

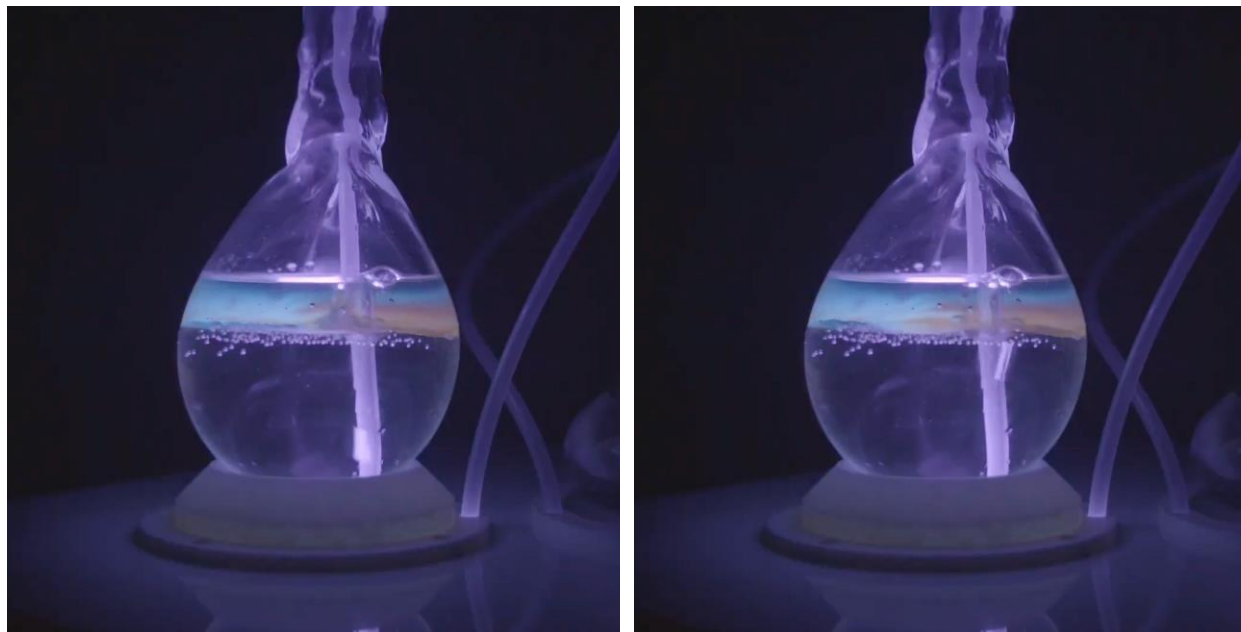


Figure 3.6 *module2*. Introduction of air bubbles disturbing the vegetable oils interface. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

module1 and *module2* situate the use of glass within an art-science practice, yet this intention has a strong historical pertinence and philosophical relevance in chemistry, and in the overall project. The next section will historically situate glass usage in scientific laboratories.

3.2 The Scientific “Glassware” Revolution

One of the most iconic objects of the chemistry laboratory in the mainstream imagination is the Erlenmeyer flask (fig. 3.7). Invented in 1861 by German chemist Emil Erlenmeyer, this flask was designed for mixing, heating, and storing liquids, with its conical shape facilitating swirling while reducing the risk of spills. Another one would be the test tube (fig. 3.8), attributed to two renowned chemists, Jöns Jacob Berzelius (1779–1848) and Michael Faraday (1791–1867).



Figure 3.7 Erlenmeyer narrow neck conical flask made by Silberrad Research Laboratories, n.d. Essex, England. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0



Figure 3.8 Set of six test tubes with stand, used by Joseph Lister, unknown maker, 1877. England. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0

In an 1814 article, Berzelius described the boiling tube, a sturdier variant of the test tube, while Faraday, in his 1827 book *Chemical Manipulation*, suggested that small glass tubes would serve as effective vessels for test reactions. Regardless of the precise origin, the test tube likely emerged in the early 19th century, as it does not appear in 18th-century chemistry sets. Instead, earlier texts indicate that test reactions were often conducted in wine glasses. Science historian and synthetic organic chemist Catherine Jackson (2015) is interested in the early 19th century, in which chemistry manuals were pointing at the importance of glass apparatus and glassblowing to chemistry practices. More importantly, she argues that there was a “glassware revolution,” illustrated by Justus Liebig’s development of the Kaliapparat (fig. 3.9), a pioneering piece of chemical glassware designed for organic analysis, which reshaped not only the material culture of chemistry but also, as she asserts, its geographical landscape and educational practices (Jackson, 2015, p. 46).



Figure 3.9 The Kaliapparat, invented by Justus von Liebig, 1831.
Photo: Eberhard Theophel. License CC BY-SA 3.0 DE

In a section entitled “Bending, Blowing, and Cutting of Glass” found in *Chemical Manipulation* (1827), Faraday recommended that chemists and students learn glass blowing to become more independent from large towns and instrument makers (Jackson, 2015, p. 49). What Jackson reminds us of is a moment in the scientific revolution of the 19th century where scientists had to make their apparatus on their own, following the side notes and guidelines attached to published articles to reproduce the experiments and thus facilitate the dissemination of new knowledge throughout Europe.

Science historian Sven Dupré mentions how it was only in the second half of the 19th century, with the rise of scientific experimentation emphasizing precision and purity, that the physico-chemical functionality between glass containers and laboratory substances was recognized as a potential source of error (Espahangizi, 2015; Dupré, 2023). This realization spurred efforts to standardize glass materials and develop specialized glass for scientific applications. Later in the 1880s, the German chemist and entrepreneur Otto Schott invented borosilicate glass. However, due to the interruption of borax extraction and production caused by World War I, which was dependent on global supply chains, it is Corning Glass Works, a research facility in the United States, that acquired the market with its Pyrex brand, now ubiquitous in scientific laboratories and first and foremost in kitchen dishwares (Dupré, 2023).

It is in the Interwar Period that the techniques and equipment used in scientific glassblowing, or more specifically, lampworking, drastically changed. Charles V. Litton, Sr., an engineer and inventor, designed and built the first practical glass-blowing lathe in 1924, transforming the vacuum tube industry. In 1932, he established Litton Engineering Laboratories in Redwood City (United States of America). During World War II, he relocated to San Carlos (United States of America), expanding production to support the war effort by manufacturing microwave tubes for communications and radar. Following the war, he went on to found Litton Industries. The glass

lathe changed how glass blowers manipulated the material to follow the needs of scientists with precision and intricate reproducibility.

Another important discovery through an invention made with a glass-blown component in the early 1900s was the first instrument capable of producing mass spectra similar to modern examples, developed by Sir J. J. Thomson at the Cavendish Laboratories in Cambridge (Dronsfield, 2023; Sutton, 2024). Trained as a physicist and mathematician, Thomson recognized the significant potential of his chemistry method. His plots of ion intensity against relative mass, first published in 1913, were the world's first mass spectra (fig. 3.10).

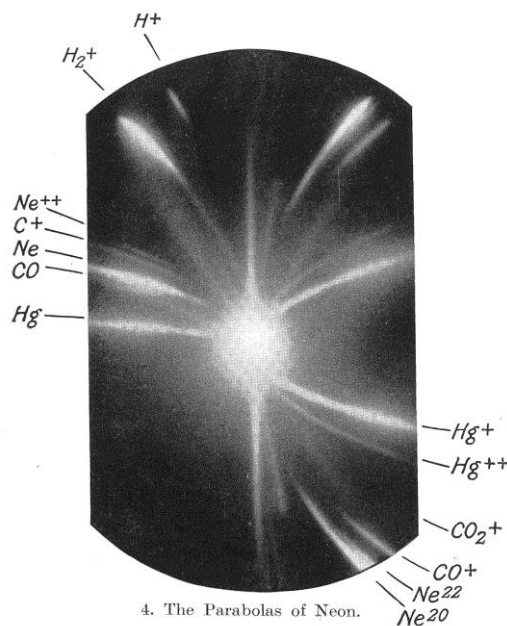


Figure 3.10 Discovery of neon isotopes by J.J. Thomson, 1913. The light curves found in bottom right of the image are the different parabolas of deflection of neon, proving its different atomic masses. London, England. In public domain.

Thomson's early mass spectrograph depended on glass for maintaining a vacuum, enabling ionization, and insulating electrodes, ensuring precise ion movement. Hand-blown glass tubes sustained the low-pressure conditions required for ion travel, while their chemical stability prevented contamination. Additionally, glass functioned as an electrical insulator, reducing charge interference, and housed the photographic plates that recorded ion traces. Its transparency, durability, and insulating properties made glass indispensable in the advancement of early mass spectrometry.

Glass' properties praised by the scientific communities are also of interest to the artists and designers. Its plasticity and transparency helped practitioners in advancing intricate aesthetic experiments while separating the public from their speculative microenvironments. The next section will contextualize the use of glass in *module1* and *module2* through an analysis of Eve Andrée Laramée's *Apparatus for the Distillation of Vague Intuitions* (2008) and Hicham Berrada's *Présages Series* (2007 –).

3.3 Glass in Speculative Practices

Eve Andrée Laramée's installation *Apparatus for the Distillation of Vague Intuitions* (2008) features a collection of tall metal stands, clamps, PVC tubing, and an assortment of glass beakers, flasks, and vials (fig. 3.11). While the setup resembles standard laboratory equipment at first glance, the artwork functions as a surreal and non-functional laboratory, emphasizing the often-overlooked subjectivity embedded in scientific inquiry (Yu, 2013). Most of the glassware found through the vast installation is hand-blown with various opacities, cobalt blue solutions, and large exotic flowers attached to copper wires. After meticulous examination, the visitor discovers etched phrases on some of the glass vessels, such as "HANDFULS", "LEAP IN THE DARK", and "UNNECESSARY EXPLANATORY PRINCIPLES", which arguably expose "a sense of insecurity and imprecision behind the process of science" (*ibid.*).



Figure 3.11 *Apparatus for the Distillation of Vague Intuitions*, MASSMoCA, Eve Andrée Laramée, 2008. North Adams, MA, USA.
Photo: Eve Andrée Laramée. License CC BY-SA 3.0

Another important aspect of the installation is its various iterations contextualized through exhibitions and different spaces, through which the glasswares were attached, disposed of, and configured. The material states of the installation also changed through the exhibition setting, where water would evaporate, and metals would react with their chemical environments, a “double temporality mirrors the fluidity of science and the obsolescence of new technologies” (Yu, 2013). In her artistic statement, Laramée mentions how she is interested in how science and art are used as “devices or maps,” or ways of constructing and representing the natural world through belief systems. She draws attention to the overlapping and interconnecting slipperiness of human subjectivity that underlies both the artistic exploration and the scientific investigation (Yu, 2013).

Another artist who inspired the use of glass as containers was Hicham Berrada, specifically his *Présages Series* (2007 – ongoing, fig. 3.12), which are short movies shown on large-scale hyperbolic screens, engulfing the panoramic view of the visitors while bringing them within the speculative landscapes.



Figure 3.12 *Présages, Avant l'orage*, Fondation Pinault, Hicham Berrada, 2018. Paris, France. Photo: Jean-Pierre Dalbéra.
License CC BY 2.0

While he did not utilize glass-blown vessels in this series, Berrada is interested in using an off-the-shelf aquarium as a microcosm for exploring speculative aquatic landscapes activated by chemical reactions. Little worlds are produced by introducing metal oxides of various colours in an aqueous solution, through which emerge coral and rock-like figures at various reaction speeds. Whereas Eve Andrée Laramée’s interests in using glass are to depict a sense of imprecision in the process of science onto the surface of the vessels, Berrada arguably plays with what can and could be contained within the new spatial and functional possibilities brought by borosilicate glassware, the material that changed the philosophy of experiments in the middle of the 19th century. His work

resonates with how “the objects of research were enclosed and studied, turned from a handcrafted technical object into an epistemically relevant and technologically controlled boundary, forming the envelope of the material nucleus of experimentation” (Espahangizi, 2015, p. 403). The *Présage Series* is spatially and temporally unfolding, colourful, and uncannily organic generative sculptures.

These two artists resonate with what science historian Kijan Espahangizi (2015) distinguishes as the topos and oikos of glass in science, or the “idea of an ideal place of the experiment, surgically removed from the actual, complex textures of research environments” and the laboratory itself (*ibid.*, p. 400). This “ideal place of experiment,” made possible with borosilicate glass, was materialized in two ways. Firstly, the incorporation of off-the-shelf glassware in the modules was a way to utilize the transparent properties of modern borosilicate glass to make the vessel invisible to the visitors while prioritizing the various liquids and their visual reactions under different light spectra. The goal was to translate Espahangizi’s topos/oikos distinction by abstracting the research environments, or the artist’s studio, the science laboratory, and the gallery space, by emphasizing the experimental materialized by the work itself. Secondly, and resonating with the use of glass-blown vessels in Eve Andrée Laramée’s installation, the distortions brought by manipulating and blowing molten glass show a depiction of a scientific protocol that is fabricated, specifically by an artist who explored glass for the very first time, and that has a rudimentary knowledge of organic chemistry (fig. 3.13).

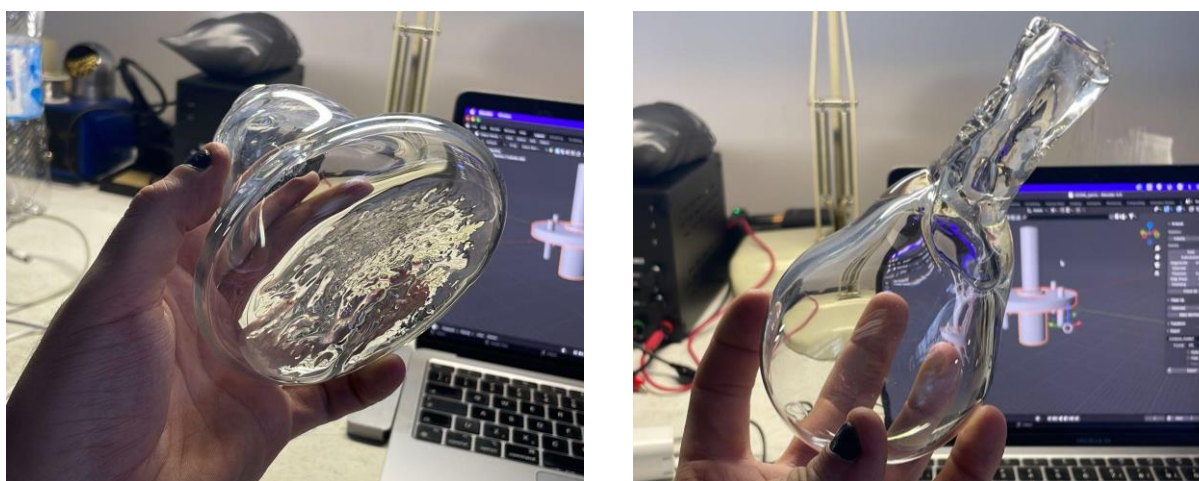


Figure 3.13 Left: The first blown glass vessel used in *module 2*, in which the bottom is textured by the ground of the glass studio. Right: The second blown glass vessel used in *module 2*, showing a distorted neck, 2024. Montreal, Canada. Photo: Philippe Vandal

Exploring and displaying glass was, through a unique material exploration, a humble exercise in understanding my position as an artist interested in science and the material culture of laboratories. The incorporation of historical manipulation of glass that revolutionized 19th-century chemistry into a contemporary material practice was to specifically integrate chemistry aesthetics, laboratory gestures, while looking for novel ways of visualizing the process of detecting contamination.

3.4 Glass Intentions across *module1*, *module2*, and *module3*

The material connection of glass across the histories of art and science was a major factor that led me to incorporate it into my installations. More specifically, it became important for me to make some of the vessels that would be integrated into the modules myself, resonating with the 19th century chemist who made their own glass apparatus to reproduce experiments found in papers. I was interested in thinking with and through glass, its historical significance, its material potential, and the gestures required to shape it. Due to limited access to workshops and technical spaces in Montreal, and the inherent complexity of manipulating glass for the first time, I traveled to Cap-Chat in Gaspésie, accompanied by a friend and experienced glassblower. The technique used was the traditional furnace method with soda-lime glass, the same type used by Venetian and Murano artisans, rather than the propane-oxygen lampworking typically employed in scientific glassblowing, which uses borosilicate glass (Dupré, 2023).

This research stay's objectives were to : 1) create a round-bottom flask with a collar and 2) produce a flask deformed by the texture of the ground of the glass studio space that would both be integrated to *module2*; and 3) improvise a form intended to be juxtaposed with a manufactured round-bottom flask, evoking an early predecessor of the mass spectrometer, the mass spectrograph (McLafferty, 2011). The first two intentions were linked to the third step of the protocol, specifically regarding the nitrogen evaporation while resonating with *module2*, forming a continuity between what is seen and unseen in both contaminated and uncontaminated soil samples. One vessel, rough and irregular, barely resembles a manufactured round-bottom flask, while the other bears an imprint that metaphorically connects to the ground; its distorted surface acts as a kind of mold of the topsoil from which the sample was taken (fig. 3.14). The third and last vessel was to be incorporated in *module3*, representing the GC-MS in the "*Instrument Analysis*" step of the protocol (Chapter 4).

Every piece began by rotating the blowpipe over the surface of the molten glass to gather material. A first breath was blown into the pipe and sealed with the thumb, forming a hollow core. A second gather was then performed to add more material. After reheating, the glass was rolled on a smooth steel surface to form a cylindrical shape, followed by a longer blow to achieve roughly half the desired diameter of the round-bottom form.

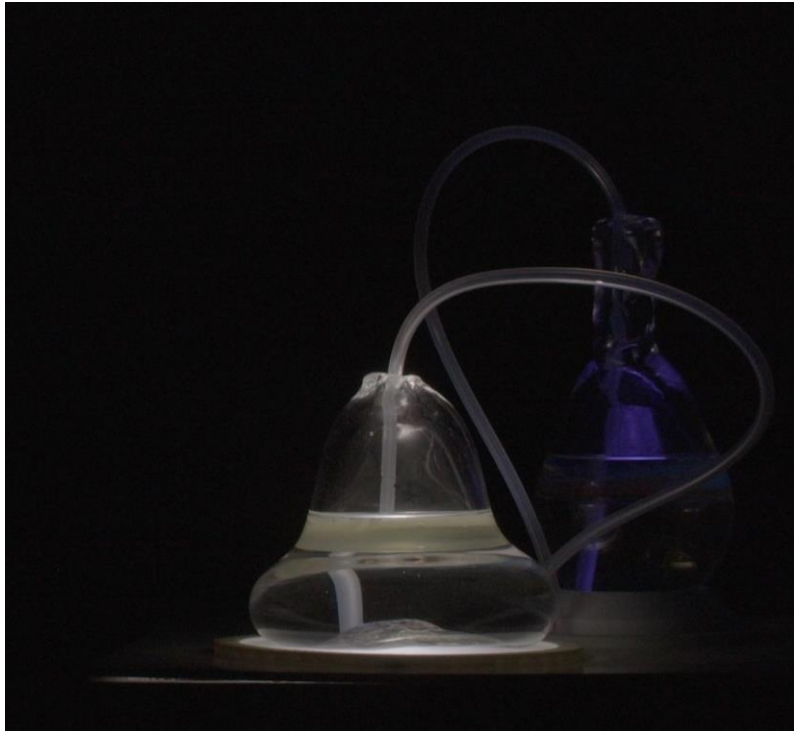


Figure 3.14 *module2*. The studio's ground imprint can be seen at the bottom of the blown glass vessel. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

The next step was pulling a collar using jacks, a steel tool invented by Venetian glass blowers in the 16th century. The jacks were squeezed onto the hot glass and dragged toward the tip of the bubble, pulling a collar at the neck (fig. 3.15). This proved difficult: as the glass cooled in contact with the jacks, it became harder to keep the blowpipe turning evenly, causing slight twisting distortions. After the collar was formed, a final reheat allowed for the rounded bottom to be shaped. The object was then placed in the annealer to cool gradually and relieve internal stress. Irregularities in the shape of the collar and the body of the flask raised a few concerns. First, the inside diameter of the collar was quite narrow, and I wasn't sure if the silicone tubing would fit properly. Second, I worried about the ability to clean the glass thoroughly, especially given the presence of oils, solvents, or pigments. This raised questions about the longevity of the piece. Third, I was concerned about how optical distortions in the glass might affect the experience of viewing or photographing the piece. Lastly, I considered how best to secure the glass to the rest of the module, given the irregularities in its base.



Figure 3.15 Jacklining a bubble, Philippe Vandal, 2024. Matane, Canada. Photo: Philippe Vandal



Figure 3.16 Finalizing the bubble before annealing, Philippe Vandal, 2024. Matane, Canada. Photo: Philippe Vandal

The second flask (fig. 3.16), imprinted with the texture of the ground, began similarly. I opted not to pull a collar due to the technical difficulty. After a second gather, a larger bubble was formed, I stood on a short stool and pointed the blowpipe vertically downward, using gravity to elongate the shape. The hot glass was gently pressed against the floor to imprint the ground's texture while air was blown in. As the glass cooled and began to harden, the piece was lifted and reheated to relieve stress. Finally, it was placed in the annealer for controlled cooling. This second piece also had its imperfections—namely, inconsistent glass thickness and a narrow opening. Fortunately, it survived the annealing process. The silicone tubing did fit snugly into the neck, which turned out not to be an issue.

The third and final blown glass vessel was made for *module3* and is directly inspired by Thomson's mass spectrograph (fig. 3.17), specifically, the chamber that receives the ions and visualizes their deflected paths.

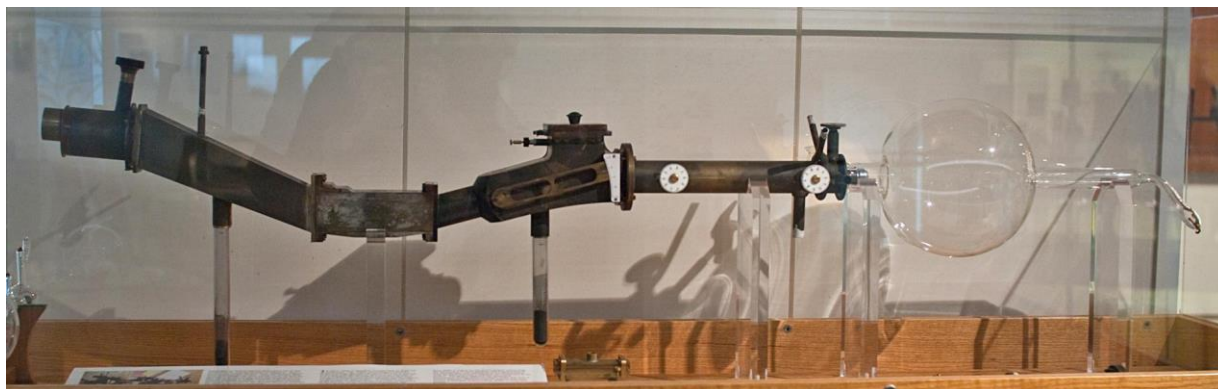


Figure 3.17 Replica of Francis William Aston's third mass spectrometer. The glass chamber can be seen at the very right end of the instrument Replica of Francis William Aston's third mass spectrometer, 2009. Photo: Jeff Dahl. License CC BY-SA 3.0

Instead of blowing a spherical vessel, I chose to expand the section closest to the blowpipe, creating a form that more closely resembles an inverted round-bottom flask (fig. 3.18). A large interior surface was necessary to accommodate a magnetic stirrer, which helps disperse phosphorescent pigments in the water and mitigates the traces left by evaporation and prolonged stillness of the liquid. The resulting shape was quite unusual, diverging significantly from my initial intentions. This presented a challenge when integrating the vessel into *module3*. After several trials and errors in modeling the part that would hold the vessel horizontally, positioned above the motor and aligned with the section containing the magnetic stirrer, the vessel's tail ultimately had to extend beyond the dimensions of the plinth.



Figure 3.18 *module3*. The blown glass vessel on the right extends over the surface of the plinth. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

The material and conceptual bridge between the artistic and scientific was also explored through the use of solvents for *module1*, representing the “*Organic Matter Extraction*” step. It was a way to think about assembling various liquids, with different densities and miscibility, as a sculptural endeavour rather than a functioning assemblage for chemical reactions.

3.5 Solvents in the Laboratory and Art Studio

Solvents are a primordial component of oil painting, and their first use arguably dates back to approximately 650 AD and are found in Buddhist murals within the rock-cut chambers of Afghanistan's Bamiyan Valley (Orsi, 2022). These artworks employed an early type of oil-based paint, likely derived from walnuts or poppies, centuries before oil painting became common practice in Europe (Orsi, 2022). Small quantities of solvents such as alcohol, one of the earliest, and later turpentine, derived from pine resin and now substituted by mineral spirits, began to be accessible. The predominant drying oil in use was linseed oil, abundant across northern Europe (Hoakley, 2016). These solvents were also used as cleaning agents for brushes.

Solvents are used in ceramics for suspending oxides for glazing, cleaning tools for lithographic work, in numerous textile processes such as dyeing, printing, cleaning, and bonding, and extracting pigments from plants. One of the key consequences of the Industrial Revolution was the rise of large-scale chemical production, fundamentally transforming how humans interacted with and modified the planet (Crown, 2022).

Organic chemists and alchemists largely relied on water as a solvent up until the Industrial Revolution (1760–1830), despite the earlier peak of interest in a universal solvent during the height of Renaissance alchemy between the 14th and 17th centuries. One notable figure, Philippus Aureolus Theophrastus Bombastus von Hohenheim (1493–1541), sought to bridge the gap between medicine and chemistry. He dedicated considerable effort to the elusive search for Alkahest, the mythical universal solvent believed to dissolve any substance, including metals, without altering the essential properties of the dissolved matter (Mainkar et al., 2024). Acetone, a solvent commonly found in nail polish removers, paints, and varnishes, was originally known to alchemists as the “Spirit of Saturn,” as it was produced through the dry distillation of lead(II) acetate. In 1832, Jean-Baptiste Dumas and Justus von Liebig determined its empirical formula, and Dumas gave it the name acetone. Johann Josef Loschmidt proposed its molecular structure in 1861, which was later refined in 1865 when August Kekulé presented its structural formula (Mainkar et al., 2024).

Organic solvents are the result of a long chain of processes, from the extraction of crude oil, passing through pipelines or transported in barrels, to the distillation fractions and further refined to achieve specific properties. The resulting chemicals materially withhold that chain of process, embodying the whole extractive and refining maneuvers. These are the same solvents used to extract the organic phase of soil samples, specifically in the goal of detecting petroleum contamination. Organic solvents, like hexane or toluene used at the Organic Geochemistry Environmental Laboratory (dir. Dr Yves Gélinas, Concordia University), are highly hazardous due to their

flammability and their potential to cause serious health effects, ranging from neurological harm and reproductive problems to fatal outcomes, particularly with prolonged or high-level exposure (Government of Canada, 2023; Committee on Acute Exposure Guideline Levels et al., 2013, April 26; U.S. National Library of Medicine, 2017). They are also expensive because their production requires precise distillation to isolate them from other hydrocarbons with similar boiling points.

Their use in artistic painting for thinning oil paints resonates with English and environmental humanities scholar Stephanie LeMenager, stating that “oil itself is a medium that fundamentally supports all modern media forms concerned with what counts as culture” (2016, p. 6). *spectral narratives* substantially rely on oil as medium, through preliminary research in the field of environmental forensics and the environmental history of the Cdp, presented through *Écotones* (Cdp, Montréal, 2022), the exhibition proposition during the Milieux’ *In the middle, a chimera* (Eastern Bloc, Spring 2022), and *The Commons* (Milieux, 2023). Each and every proposition is about oil, made from or facilitated by petroleum-based products, bridging their environmental repercussions while paradoxically celebrating their artistic potential.

The goal of experimenting with and incorporating solvents in the installations was to create a material connection between their specific use in laboratory protocols, the artworld, and their environmental repercussions on soil matrices. Additionally, it was a way to highlight their petroleum provenance, ubiquity, and accessibility, and most importantly, their fundamental presence in the artworld. *spectral narratives* incorporates oil, or more specifically, its derived products, as a medium, for their chemical, physical, and aesthetic potentials (Davis, 2021). More specifically, they are utilized for their physical density, turning them into sculptural materials, and their various effects under different light frequencies.

3.6 Fluorescence, Iridescence, and Liquid Sculptures

module1 (fig. 3.19) is an iteration of *saturation by accumulation* (2022, fig. 1.1), presented during the Milieux Institute’s *In the middle, a chimera* end of year exhibition (Montreal, Spring 2022). *saturation by accumulation* was the first installation that specifically explored and addressed the visualization of soil contamination by petroleum hydrocarbons through fluorescence. Subsequently, I participated in the organization of *Écotones*, a series of artistic interventions in Cdp (fig. 1.2), in which I proposed three other prototypes exploring the fluorescent properties of hydrocarbons (October 2022).

The use of fluorescence in *spectral narratives* was partially inspired by HeHe, an artist duo consisting of Helen Evans and Heiko Hansen, who have explored the utilization of fluorescent materials to highlight social, industrial, and ecological repercussions induced by contemporary technological landscapes (HeHe, 2024). Their use of a very specific green, strongly associated with radioactivity, polluting chemicals, dangerous technologies, or their environmental consequences, is reminiscent of an uncanny and frightening atmosphere around their gallery or public artworks (Alcalde, 2021). *When the Future was about Fracking* (2016) is a re-enactment of a post-

apocalyptic abandoned excavation site, where large purple pipes with pressure valves seemed to be leaking and slowly submerged by a fluorescent green substance. The sculpture is a play on the miniaturisation of potential and actual global disasters that can be felt within the gallery space rather than on a contaminated and abandoned excavation site. The ultraviolet light fixture creates an eerie and hazardous feeling around the piece, while augmenting the colour contrast and saturation. While not using the “radioactive” green in *spectral narratives*, the effect of contrasting a fluorescent and non-fluorescent mixture by simply changing the lighting creates a dramatic diptych that might evoke in the visitor the presence of a contaminated and uncontaminated sample.

Due to the high cost of the laboratory solvents, I relied on off-the-shelf products, such as kerosene, mineral spirits, paraffin, and acetone. Kerosene is commonly used for heating oil, fuel for cooking, and jet fuel; mineral spirits, as previously stated, is a substitute to turpentine used as oil paint thinner; acetone dissolves nail polish, allowing it to be lifted and removed from the surface of the nail plate, and a cleaning and disinfecting agent; paraffin is used as a soft solid wax for candles, crayons, and electrical insulation, and is found in cosmetics, pharmaceuticals, and as a lubricant when in a refined mineral oil (Hoakley, 2016a; Hoakley, 2016b). Additionally, engine oil was introduced in the sculptural experiments as a blue coloured chemical, while delimiting the water from the other products.

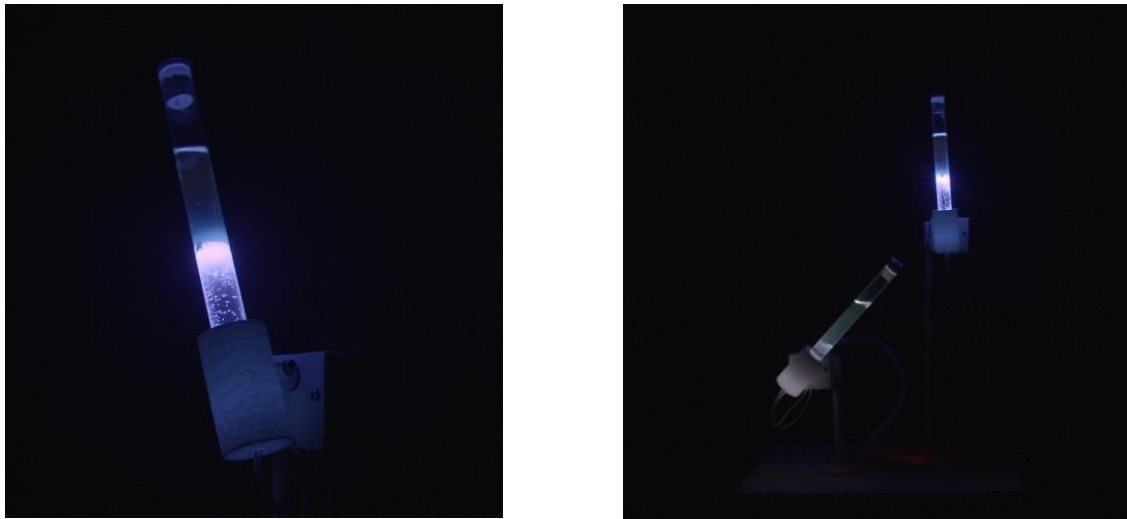


Figure 3.19 *module1. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada.
Photo: Philippe Vandal

With all the products miscible and insoluble besides acetone, the water sets the height of the sculpture and, as such, its distance from the light source. The distance directly affects the light intensity through the liquids. An initial sequence for stacking and “sculpting” the various chemicals in the test tube was experimented with during July 2024. The final sequence for depositing the

various liquids within the test tubes was as follows: water, blue coloured engine oil, kerosene, mineral spirits, paraffin (fig. 3.20).

This sequence resulted in water at the bottom of the test, engine oil floating on top, while separating the rest of the chemicals. As a way to introduce and materially connect the protocol within the test tube, an organic matter extraction from a Cdp soil sample was done with pure acetone, tuning the colourless chemical with a dark translucent yellow tint. Several experiments were made regarding the ideal introduction of organic extraction within the liquid sculpture: Whereas the introduction of the organic matter extraction in the water created a cloudy white layer trapped right under the engine oil, irregular masses were able to be shaped by softly introducing it within the kerosene, mineral spirits, and paraffin section. The possibility of shaping and inserting the organic matter extraction within this section can derive from the fact that it is not yet homogeneous, which creates localized density disparities.



Figure 3.20 Solvent experiments. The various density layers through the test tube starting from the bottom: water, blue coloured engine oil, kerosene, mineral spirits, paraffin. 2024. Montreal, Canada.
Photo: Philippe Vandal

module1's diptych was a convenient way to imagine a common motorized and light-based double device that could speculatively represent a contaminated and uncontaminated sample by simply changing the wavelength of the LEDs. Where one has a cold temperature white light, the other was closer to the ultraviolet band, around 395 nm wavelength (see fig. 3.3). With the direct contact of the test tubes with the LEDs, the whole glass and its content were illuminated. The dramatic change caused by the fluorescent properties of organic chemicals under blacklight allegedly helps the

interpretation of *module1* as containing two very different samples undergoing an identical manipulation or processual step.

module2 (fig. 3.21) expands on the diptych assemblage of the previous module by displaying drastically different glass-blown vessels while utilizing other off-the-shelf products. It represents the “*Separation and Purification of Selected Contaminants*” step in the protocol. This process is followed by the near-complete evaporation of the solvent mixture containing the selected molecules before analysis. More specifically, the installation translates the nitrogen evaporation process into an artistic form, emphasizing the drastic reduction of solvent content in samples before their examination.



Figure 3.21 *module2*. The glass vessels illuminated by a white light is inspired by an Erlenmeyer, whereas the one illuminated by blacklight is inspired by a round bottom flask. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

Just like *module1*, both of *module2*'s vessels contained the same products illuminated with white and blacklight LEDs. However, the use of solvents or petroleum-derived products would have shortened the lasting quality due to the introduction of air bubbles through peristaltic pumps, accelerating the evaporation of their content. Vegetable oils, such as canola, sesame, olive, and peanut, were used instead (fig. 3.22). This exploration was first proposed as *module 2: non-esg chaotic behavior* (2023 fig. 1.3) during Milieux's *The Commons*, (4th Space Montreal).



Figure 3.22 Vegetable oils experiments with liquid paraffin for *module2*, 2023. Montreal, Canada.
Photo: Philippe Vandal

These experiments aimed at exploring the typical iridescence of petroleum oil by combining different fluorescent liquids. This was inspired by artist, researcher, and former member of the Forensic Architecture Group Suzan Schuppli's *Nature Represents Itself* (2018). This artwork is a video loop featuring the simulation of the oil film from both the surface slick and deep subsurface plumes caused by the Deepwater Horizon spill (Schuppli, 2018). The work was exhibited alongside audio from a lawsuit filed against BP by nature. The installation also features satellite imagery, kite photography kits made by Public Lab (Giaimo, 2017), animation, and underwater video footage. The work explores the “proto-cinematic properties” of oil films, the result of industrial-scale petroleum infrastructure’s spilling and environmental repercussions (Schuppli, 2015, p. 431). As she argues,

“the image-making capacity of the oil film isn’t simply a question of its ability to mirror or project some kind of image-like event back at us—abstracted and lurid patterns of reflected light—but is a cinematic feature of its very ontology, its molecular structure and behavior. It is not a representation of an oil spill, but an oily picture, or what I call a slick image” (Schuppli 2015, p. 435).

Schuppli’s video reproduces the iridescence of oil through simulated fluid dynamics and 3D modeled surface reflective properties. The simulation aspect of this work resonated with my concerns about unsustainably using large quantities of various petroleum products in order to arrive at satisfying results. Additionally, it would have brought environmental concerns during the

maintenance of *spectral narratives*' modules, specifically regarding the accumulation and eventual discard of these toxic products.

Conclusion

This chapter summarizes the history and importance of glass in chemistry labs, specifically regarding iconic flasks, the invention of the glass lathe to reproduce precise and complex shapes, and its material incorporation in revolutionizing instruments. Eve Andrée Laramée's and Hicham Berrada's works were then put in resonance with the use of glass in *spectral narratives* (*module1*, *module2*, and *module3*), in which a simulation and representation of a chemistry protocol for detecting hydrocarbon contamination in a soil sample is performed within store-bought and hand-blown glass vessels. A short history of the use of solvents in science and in the arts was then followed by a description of *module1* and *module2*. Put in resonance with the works of HeHe and Suzan Schuppli, these modules turned chemicals used in the laboratory into iridescent and fluorescent sculptures by playing with the mainstream "fluorescent green" and "oily iridescent film" toxic and hazardous connotations. By mobilizing these visual and sensory codes of contamination, *spectral narratives* strive to explore the affective conditions of hazardousness. Luminous phenomena became a way to follow the contaminants in the artistic rendering of the detection and characterization process, translating the microscopic into an expanded spectrum. The iridescence and fluorescence act as spectral mediations between soil, petroleum contaminants, solvents, and their environmental and social repercussions. Chemical and optical processes became a way to bind these various materials into an aesthetic language that underlines the importance of ever expanding how we conceive and discuss contamination. The mobilization of solvents and blown glass in *spectral narratives* was a possibility of bridging the laboratory and the gallery space through thoughtful artistic manipulations informed by shared materials and processes. Their integration within the modules depicting scientific objects was a way to augment the materials' legitimacy and connection with *spectral narratives*' aesthetic exploration. The next chapter will look into how *spectral narratives*' modules play with the aesthetics of the scientific object, encompassing tools and instruments, through their spatial arrangements and built details.

Chapter 4: Mobilizing Scientific Objects and Instruments' Aesthetics in the Arts

This chapter explores the evolving roles, definitions, and aesthetics of scientific objects and instruments, situating them both historically and within the contemporary framework of *spectral narratives* (EISODE, Montréal, 2025). Through the detailed artistic interpretation of the gas chromatograph–mass spectrometer (GC-MS) module within the installation, titled *module3*, it examines how artistic representations can embody the operational and epistemic logic of scientific devices. Three nodes of the operational principle of the Benzene Ring will be utilized in framing the analysis of the artwork and their intentions: critical design, organic and analytical environmental chemistry, and scientific instruments (fig. 4.1).

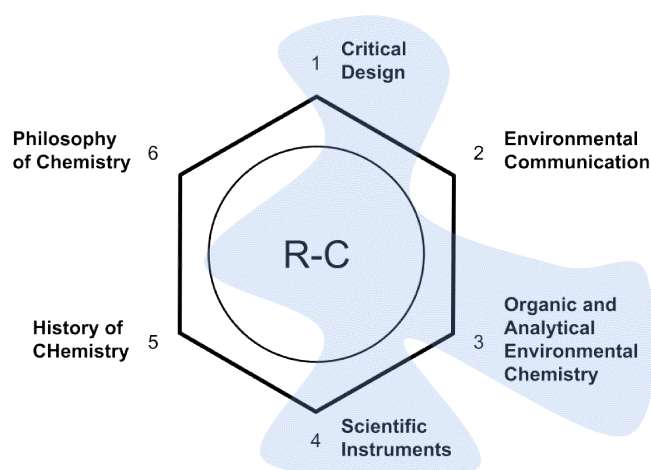


Figure 4.1 Mobilization of Critical design, organic and analytical environmental chemistry, and scientific instruments in the Benzene Ring for Chapter 4, 2025.

Design: Philippe Vandal

The chapter starts with a description of *module3*, followed by a definition of scientific objects and instruments and how their design aesthetics have always reflected broader social, political, and technological shifts. Additionally, a thorough description of German artist Agnes Meyer-Brandis's *Teacup Tools* (2014-) and *Tealemetree Station* (2014-) will contextualize *spectral narratives*' visual choices through what can be termed the aestheticization of science. The chapter will conclude by situating *spectral narratives*' interpretation of the GC-MS within the gallery space and through environmental sciences, while reflecting on the concept of artistic "Functionless Object" (Gauvin, 2016).

4.1 Description of *spectral narratives*' *module3*

The fourth and last module of *spectral narrative* is an artistic interpretation of the GC-MS (fig. 4.2), the instrument used in the "Instrument Analysis" step of the protocol. Its two main

components, the gas chromatograph and mass spectrometer, exposed on a plinth, are interconnected with silicone tubing. Due to potential technical and security issues within the public settings, the artistic interpretation used water instead of compressed gas as a way to represent the flow of the sample through the instrument. For representing the molecules travelling through the instrument, insoluble phosphorescent pigment was used, guiding the visitor's gaze within the modules with a dim green and blue glow.



Figure 4.2 *module3. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

The gas chromatograph separates chemical compounds of a mixture by vaporizing and pressuring the sample through a column, a long, narrow tube that contains a thin film applied to its inner surface, called the stationary phase (Bud & Warner, 1998). Separation occurs based on differences in the chemical and physical properties of the organic compounds found in the sample and their interactions with the column. The compounds with the greatest affinity for the stationary phase are the last to exit the GC.

At EISODE (2025), the interpreted autosampler, found in modern GC, is represented as a manufactured 250 mL round-bottom flask placed onto a hidden magnetic stirrer. When the peristaltic pump and the magnetic stirrer get activated, the water flows right under the cover of the plinth, and a bright white LED illuminates the pigment, representing the vaporization of the organic phase extracted from a contaminated soil sample. The phosphorescent water then emerges out of the plinth, continuing its course through the sculpture (fig. 4.3). It then goes up into the column, loops of silicone tube held by an actual column holder. During this process, the visitor can already see some phosphorescent particles getting stuck at the bottom of various loops, representing the heavier, and thus slower, molecules running through the GC part of the sculpture.



Figure 4.3 *module3*. Phosphorescent pigments flowing through the silicone tubing. *spectral narratives*, EISODE, Philippe Vandal, 2025 Montreal, Canada. Photo: Philippe Vandal

The mass spectrometer utilized in laboratories receives the sequence of separated chemical compounds from the GC and positively charges them through electron bombardment (Reinhardt, 2002). These positive ions and their fragments are then accelerated in an electric field produced by four metal rods, called a quadrupole, deflecting their trajectories. The goal of varying the electric and magnetic fields is to collect the ions with the same mass-to-charge ratio at the detector, a funnel-shaped device called an electron multiplier, which receives and amplifies the signals. The resulting mass spectrum is a recording of each received ion based on its mass.

At EISODE (2025), the few phosphorescent particles that traverse the loop in *module3* are then introduced into the first component of the MS, the quadrupole mass analyzer, interpreted as four stainless steel tubes aligned by two 3D printed circular holders, with LED strips glued and facing the silicone tubing (fig. 4.4). The first pair of opposing stainless steel tubes illuminates a bright white, while the other pair a blacklight, both representing the AC and DC currents passing through the quadrupole to influence the magnetic trajectory of the introduced particles, turned into ions. The exiting phosphorescent particles, excited again by the LED strips, flow into a glass-blown conical vessel, placed over another magnetic stirrer, representing the detector of the instrument. After all the water has been received in the vessel, the peristaltic pump reverses its pull, reinitializing the sculpture for the next visitor (fig. 4.5). The artistic interpretation of the analysis is then completed, and in the gallery, all the modules' lights softly pulse, indicating the end of the protocol.

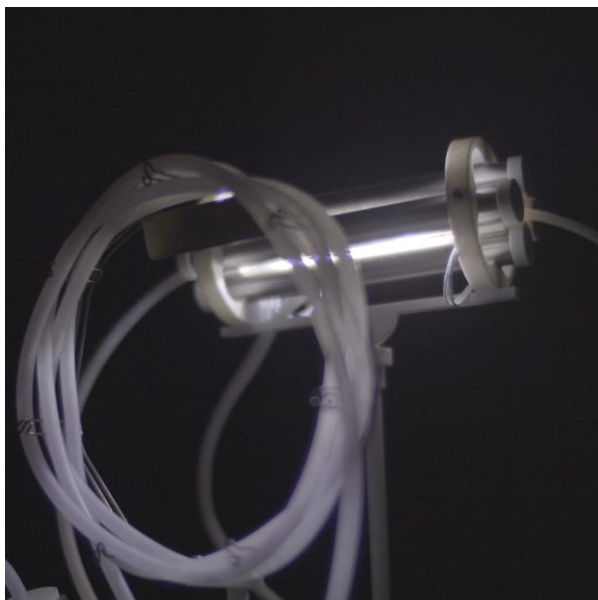


Figure 4.4 *module3*. In front, the separation column, interpreted with a transparent silicone tube. At the back: the quadrupole mass analyzer, interpreted as four LED strips attached to stainless steel tubes. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal



Figure 4.5 *module3*. Reinitialization of the sculpture, through which the liquid containing the phosphorescent pigments is brought back to the initial round bottom flask. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

The GC-MS is one of the many scientific instruments that are extremely complex, intricate, and costly, which raises the possibility and limits of truly depicting its functioning from an artistic and low-cost perspective. The goal of this exercise was to primarily portray its main components by playing with liquid flows and components inspired by the assemblage and visual cues. Additionally, it correlates with the desire to extend soil aesthetics from a visualisation of contamination found in the environment to an interpretation of how this contamination is detected within the laboratory space. Assembling a speculative GC-MS to be displayed in a gallery space expands the possibilities of representation, interpretation, and dissemination of the hazardous consequences of contaminants (further discussed in Chapter 5). Historical definitions of what scientific instruments and objects are surprisingly aligned with *spectral narratives*' modules in how they have knowledge-sharing capabilities with embedded intricate manufacturing and craft.

4.2 Defining Socio-Historical Scientific Instruments

The definition of what a scientific instrument is has shifted historically, and only coined in the English language in the mid-19th century. Many of these objects were referred to as 'mathematical', 'optical', or 'philosophical' throughout the 17th and 18th centuries (Taub, 2018). In the 17th century, "philosophical" instruments, mostly related to optics such as telescopes and microscopes, were related to the natural philosophers' endeavours to understand the world. They were specifically

interested in the environment in which the human was part of, through observations, measurements, and experiments, distancing themselves from mathematicians' and mechanics' intentions of using their instruments for practical purposes (Warner, 1990). In the 18th century, as Science Museum curator and historian Deborah Jean Warner (1990) points out, these instruments proliferated due to a high demand from researchers in need of precision in their results. This arguably started with French Chemist Antoine-Laurent Lavoisier, who hired the most meticulous instrument maker in Europe to construct apparatus, such as volumetric flasks, scales, barometers, and thermometers, that were sometimes outstripping the scientist's accuracy needs (Levere, 2010). A considerable difference between precision and accuracy can be found in Lavoisier and other scientists' manipulations and results, and where the pursuit for precision often arose from the instrument makers' perfectionism (Levere, 2010). Whereas the 19th century was the "Glassware Revolution" (see Chapter 2), the increasing awareness of the role of instruments in experiments and results found through the 20th century's chemistry was dealing with science historian Peter J.T. Morris' "Instrumental Revolution" (Baird, 2002). In other words, "the history of physical science is largely the history of instruments and their intelligent use" (Müller, 1940).

Historical examples reveal that the category of objects labeled as 'scientific instruments' was neither fixed nor universally agreed upon (Warner, 1990; Taub, 2018). The designation of an object as 'scientific' often depended on the context in which it was used; in certain situations, industrial or educational devices, such as microscopes, telescopes, and chemistry molecular model kits, were also classified as scientific instruments (Warner, 1990; Taub, 2018). As such, the four artistic modules of *spectral narratives* play within what was once termed as "scientific instruments," since they embody scientific knowledge that has been interpreted through an artistic and material exploration. They bear the knowledge found through the sequence of the protocol, encompassing specific materials, mechanical gestures, and linear unfolding. Nevertheless, they are not scientific in the sense that they have not been accepted as such by the scientific community. The modules are first and foremost aesthetic explorations, artistic interpretations of objects and instruments found within the realms of an environmental analytical chemistry laboratory. They metaphorically interpret working scientific instruments used in the process of detecting soil contaminants. They become philosophical in a way that the visitors will think with them, and how they can become vectors of conversations in mediation activities (further discussed in Chapter 5).

Specifically regarding measuring instruments, science historian Davis Baird (2004) argues that they perform to reproduce model representations and, in doing so, combine the "working" and "model" knowledge. Acting as hybrids, measuring instruments encapsulate accurate or spatiotemporal understanding of model representations while effectively acting on or with the material of interest; they "bear knowledge of a kind of material agency" (Baird 2004, p. 15). In order to accurately measure and relate to the theoretical and model representation, samples have to be prepared for measurements, and as such, measuring instruments are part of a sequence of manipulations encompassing a multitude of tools, devices, other instruments, or even specimens (Maxwell, 1876). Professor of History and Philosophy of Science Jutta Schickore thus points to

the importance of studying instruments within their context and setting of their use, and that displaying an individual instrument does not offer the experimental context (Schickore, 2013). For the contextualisation of an instrument within a science museum's collection, the reproduction of a laboratory table or even the whole space of experimentation proposes the conditions within which the use of these apparatus are recognized and productive from a scientific standpoint (Taub, 2018).

The GC-MS interpretation proposed in *spectral narratives* is in line with Schickore's experimental context: the linearity of the protocol's sequence, embodied in the contextualisation of the soil samples, the initial extraction and further separation of the organic phase containing the contaminants, offers an artistic rendering of the material preparation for properly utilizing the measuring instrument. The distant placement of the plinths within the gallery space, while dictating the specific movement of the visitor within *spectral narratives'* speculative and dramatic laboratory, resonates with the various rooms visited in the Organic Geochemistry Environmental Laboratory (dir. Dr Yves Gélinas, Concordia University, fig. 4.6).

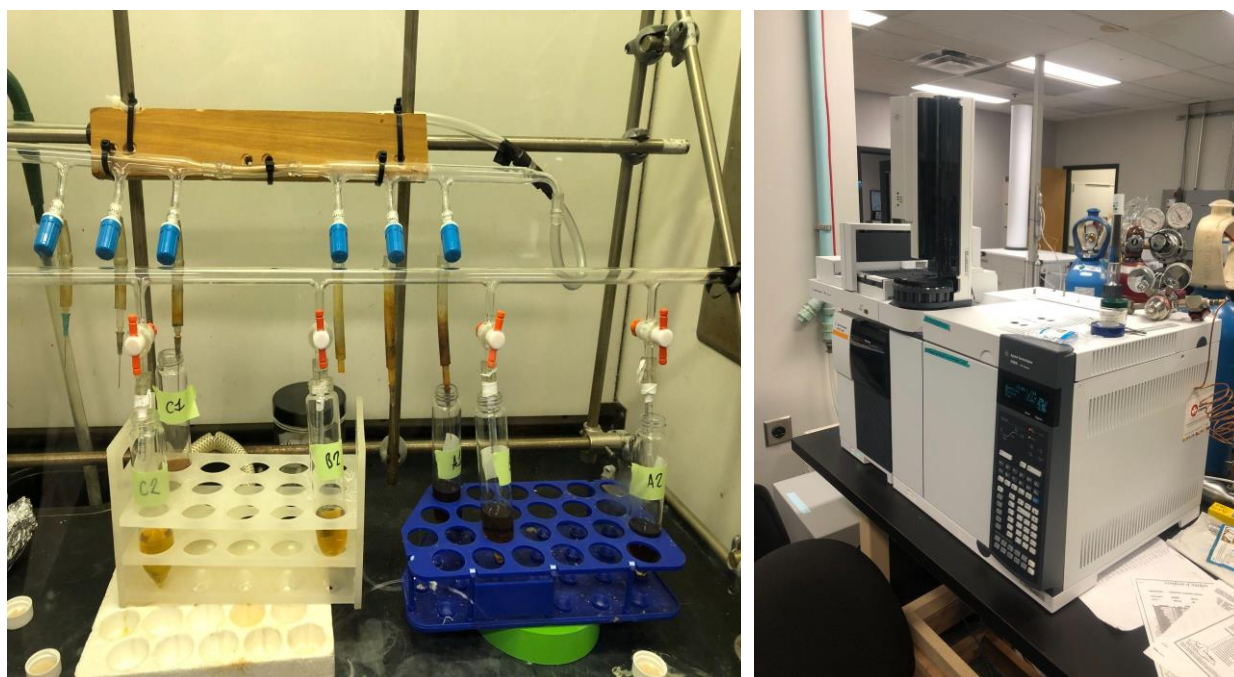


Figure 4.6 Left: Nitrogen evaporation setup. Right: GC-MS. These pictures were taken in different rooms of Concordia's Geochemistry Environmental Laboratory. Each room facilitates different manipulations due to their layout and ventilation system. 2023. Montreal, Canada. Photo: Philippe Vandal

Each and every module has a single function within the sequence of the protocol, and the dramaturgy of the installation view reflects on the "instrumentarium," or what the laboratory holds as actual and available equipment (Harré, 2003). More importantly, it is the intention and outcome of the chosen protocol, the sequence of the available instrument-inspired modules, that expands the instrumentarium. The *spectral narratives'* modules can also be understood as both functional and performative, in the sense that an "instrumentarium" can be interpreted not only as a scientific

possibility, but also as a narrative and affective one. This alternative and expanded definition now turns the whole gallery space into a device for making the invisible dimensions of detection of soil contamination in the laboratory perceptible. While not quite combining Baird's "model" or "working" knowledge per se (2004), the modules found through *spectral narratives* play with the shifting definition of scientific instruments, while hinting at the historical trends of the scientific instrument's aesthetics.

4.3 Aesthetics of the Historical and Modern Scientific Instruments

The aesthetics of scientific objects, here encompassing instruments, tools, and devices meant for experiments or science education, have historically shifted through the materials, manufacturing capabilities, and technical expertise of the instrument makers. Many of the historical objects were imbued with extravagant ornaments, situating them within geopolitical and sometimes religious intentions. As discussed by science historian Johannes Graves (2007), King George III's lodestone (fig. 4.7), created by the instrument maker George Adams, was an enclosed piece of natural magnetite within a silver casing, adorned with a small lion's head that functioned as a handle. The underlying purpose of materializing an invisible force while making it measurable and comparable resonated with the ideals of the Enlightenment, but more importantly, and as argued:

"the entire composition of the powerful stone, the lion's head and the silver box makes reference to King George III, whose coat of arms decorates the central part of the casket. Obviously, this coat of arms is not only a mere indication of the lodestone's possessor, but links a natural force with a social and political authority" (Graves, 2007, p. 38)



Figure 4.7 King George III's lodestone by Georges Adams. The lodestone is full of details that go beyond the simple display of magnetism and closer to the King's power over natural forces. 1762. London, United Kingdom. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0

What Graves points at is the importance of considering the aesthetic qualities of scientific objects as deliberate decisions and political markers within their historical contexts, or that the “object’s socio-cultural context determines its aesthetic features” (Graves, 2007, p. 39). Referring to Roland Barthes' semiology, scientific objects are not “pure”, devoid of signification or connotation, and act as complex and obscured signifiers (Graves, 2007). The sociological aspects of these objects are always characterized by an anthropomorphic “contamination,” or as Bruno Latour puts it, “things do not exist without being full of people” (Latour, 2000). This contamination can be found through the optical instruments (fig. 4.8), navigational devices (fig. 4.9), and glassware (fig. 4.10) of the 18th and 19th centuries, where functionality and intricate ornaments coexist.



Figure 4.8 Modified form of John Marshall's Compound microscope. Intricate gold ornaments can be seen on the microscope's main body. unknown maker, 1730. England. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0



Figure 4.9 Main part of three-foot geodetic theodolite made by Jesse Ramsden. Carved columns can be seen on the base of the instruments. 1791. London, United Kingdom. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0



Figure 4.10 Medicine glass. Carved ornaments and golden details can be seen all over the vessel. unknown maker, possibly 18th century. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0

A major shift in scientific instrument building and aesthetic traditions occurred during the second half of the 19th century, where science was no longer practiced by individual aristocrats and the manufacturing of the equipment became a business of mass production (Resnick et al., 2000). Newly invented electrical technologies integrated in novel scientific instruments made their production involve specialized piecework combined with assembly-line methods (Johnston, 2007). Another cultural outcome of the Scientific Revolution was the close collaboration of scientists-inventors and instrument manufacturers, which turned a historical craft into a lucrative business through the 20th century. The Second World War burst the “research” environment into a “production” environment, altering the scale of production of instruments (Johnston, 2007;

Mukhopadhyay, 2008). A major shift occurred in their aesthetics as they turned from highly priced commodities to more affordable and streamlined pieces of equipment for governmental or academic research laboratories (Resnick et al., 2000). Ergonomic, efficient control interfaces and operational convenience became the major design qualities that were considered in a new, highly competitive market of manufactured scientific equipment (fig. 4.11 and 4.12). As argued by designer R.H. Litherland (1960), “all scientific instruments which are directly used by human beings can only be judged efficient in performance if they work well in conjunction with the people who have to use them—the aesthetic aspect of design aims to contribute precisely in that direction” (p. 140).



Figure 4.11 Photograph of Beckman Model DB Spectrophotometer. The case is made with plastic injection molding for efficient production. 1960. United States. In public domain.



Figure 4.12 Various gas analyzers, monitors and recorders made by Beckman. Their various formats and metal attachments implies efficient placement in the laboratory. 1960. United States. In public domain.

By focusing on efficiency of control and design, instruments turned into “black boxes,” highly effective in producing measurements and collecting data while dissimulating their inner workings to facilitate their manipulations. Blackboxing is, for Latour (1999), the way scientific and technical work is made invisible by its own success. When a machine runs efficiently, one needs to focus only on its inputs and outputs and not on its internal complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become. The wartime production rate and increased market demands for efficiency also motivated the development and integration of automation within instruments, which allowed greater precision in laboratory routines (Noble, 1984; Graves, 2007).

Latour’s definition of blackboxing and the integration of automation in instruments were embedded and technically celebrated within *spectral narratives*’ modules. The white plinths were an efficient

way of concealing the microcontrollers and the electronic circuitry, while the use of wireless communication to narrate the protocol gave the impression that the visitors' manipulation were unneeded in this automated sequence. The intentions were to evoke some of the new realities in modern laboratories by employing new media art tactics like automated kinetics and wireless communication, while *unblackboxing* the process of detecting soil contamination.

Late 20th century scientific instrument's material aesthetics encompass injection molded or aluminium casing, mostly monochromatic colors, computer aided interfaces, interlocking components for modularity and efficiency; a merge between the rise of cybernetics and industrial manufacturing design (fig. 4.13, fig. 4.14; Randall & Strong, 1931; Bennett, 1992; Johnston, 2007; McMahon, 2007; Carvalho, 2013). Another standardized industrially manufactured component that is highly regarded for its modularity is the aluminium extrusion, easily adaptable for many laboratory needs. Philosopher of Science specialising in the aesthetics of Science, Dr Milena Ivanova (2021; 2022) argued that the development of these new instruments, laboratory techniques, and methods signified a shift in the aesthetic evaluation of experiments towards the design of the experiments, or how apparatus and instruments are assembled for particular intentions. This resonates with the "instrumentarium" of *spectral narratives*, in which the design of the exhibition space has the particular intention of displaying the detection of contamination.



Figure 4.13 Nicolet Avatar 360 FT-IR Spectrometer, by Nicolet Instrument Corp. The plastic injection molding techniques are now very well known, with intricate assembly and a small handle. 1997. United States. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0



Figure 4.14 Gas Chromatograph HP 5890 by Hewlett-Packard. Computer aided interfaces are now ubiquitous in instruments. 1995. United States. Photo: Science Museum Group. License CC0 1.0 and CC BY 4.0

The aesthetics of scientific objects morphed through geopolitical, socio-cultural, and manufacturing capabilities. The independent instrument makers with their artisanal gestures elaborated through wooden structures, strict with intricate ornaments, rapidly became streamlined, and large-scale manufacturing processes were shared through instrument companies brought by

new industrial and wartime needs. Late 20th-century scientific instruments brought a novel way of encapsulating complex processes through blackboxing and automation, signifying a shift in the aesthetic evaluation of experiments towards the design of the experiments.

The next section will look into contemporary artists who investigated apparatus and instruments, and the various ways of unboxing processes, knowledge production, and aestheticizing science.

4.4 Science Aesthetics or Aestheticization of Science

Ivanova's aesthetic evaluation of experiments (2021; 2022) can be found in artists' interests to explore and display installations that resonate with these new aesthetic modes of engagement, such as German artist Agnes Meyer-Brandis's *Teacup Tools* (2014-...). Based on a conversation she had with a Swiss cloud scientist who told her how the clean, aerosol-free Antarctic air did not allow steam from tea to produce cloud droplets, Meyer-Brandis initially developed a permanent participatory installation at the Station for Measuring Ecosystem Atmosphere Relations in Finland. *Tealemetree Station* (2014-...) consisted of tea cups on a white table carved out to receive the trunk of a tree. The installation's goal was to "invite people for tea and remind passers-by of the importance of an adequate ambience when searching for a fruitful dialogue between human and non-human disciplines" (Meyer-Brandis & Taipale, 2022). These exchanges aimed at correlating the social and environmental spheres of Science and the perception of their intricate connections within our understanding of pollution. After conversations with various scientists, they came up with *Teacup Tools* (2014-...), an elaborate outdoor installation inspired by weather station equipment. In this work, tea cups were attached with laser pointers and various sensors and mounted on linear actuators in order to reach the height of various atmospheric sensors. Filled with hot tea, the steam gets illuminated by the lasers, visualizing the presence of microscopic atmospheric particles. After retracting the linear actuators, the tea cups are shared with visitors as a way to speculatively taste their environment. A web server, integrated within the manufactured atmospheric instruments, is accessible to the visitors around the world to view and associate the various scientific measurements with the height and atmospheric conditions of the tea cups.

All scientific apparatus and instruments are used in many contexts/protocols: a sifter simply filters a sample by its particles' sizes, a centrifuge separates particles based on their weight, a chromatography column is used to filter molecules based on their electrical polarity, and a measuring instrument quantifies a presence or a state. What is of interest in Meyer-Brandis' proposition is the incorporation of ubiquitous tea cups within a network of manufactured scientific instruments and custom parts displayed as an in-situ artistic installation; actuators mounted on aluminium extrusions, aluminium rods holding various sensors next to the tea cups, reminiscent of chemistry lab stands, and "off the shelf" weather stations. The familiar and underwhelming steam coming from a hot tea is meshed within Ivanova's argument of aesthetic evaluation of the design of the experiments rather than its individual components (Ivanova, 2021). More specifically, and referring to philosophers of Science Glenn Parsons and Alexander Reuger's (2000) research on the epistemic significance of aesthetics in experiments, many experiments regarded as beautiful are

valued for their simplicity, efficiency, and elegance. Parsons and Reuger even suggest that an aesthetically pleasing experiment produces the most significant results with the minimal possible use of materials.

The simplicity of Meyer-Brandis' proposition of the tea cup and the tactics utilized to enhance the visual presence of atmospheric particles resonates with some of *spectral narratives'* lighting, sculptural simplicity, and kinetic motions (see fig. 3.1). Each and every module, placed on a simple white plinth with embedded electronics under the top white acrylic surface, incorporates just a few eye-catching details. The modules almost disappear in plain sight by letting the phosphorescence and various light and kinetic movements attract the attention of the visitor. The disappearance of the modules, or in other words, of the scientific objects, contradicts the desire to attend to their design and aesthetic choices while referring to the very point mentioned by Litherland (1960): modern scientific instruments are utilitarian, and their usage does not require intricate ornaments. The modules highlight the modern manufacturing of scientific instruments at its industrial scale. Their disappearance in the gallery space draws attention to the processes rather than the forms, foregrounding the operational and ephemeral qualities of each gesture, or their "operational simplicity" towards the particular goal of speculatively displaying the process of soil contaminants detection (Parsons & Reuger, 2000, p. 431). This approach echoes certain strategies in both scientific display and media art practices, where what matters is less the object and more what it enables or reveals: making visible through minimal, almost disappearing interventions (see fig. 3.3). The goal of elongating their individual sequences within the orchestration of *spectral narratives'* totality was to finally offer the visitor the opportunity to examine their efficient and undecorated details after adapting to the various intensity of lights within the dark gallery. The end of each module's sequence highlights its utilitarian nature; the lights turn off to notify the visitor of the end of its use in the very specific intentional context of the protocol.

Ivanova's aesthetic evaluation of the design of experiments rather than their results inspired the overall gallery display and each and every module of *spectral narratives*. The new aesthetic modes of engagement with scientific instruments and their incorporations in experimental setups offered the possibility to lay out the modules of *spectral narratives* in a minimal yet inviting way. Resonating with Parson and Reuger's (2000) research on the epistemic significance of aesthetics in experiments, the modules are simple, efficient, and arguably elegant in their design and placements. The simplicity in the kinetic programming, visual design, and materials used for *spectral narratives'* modules aligns with Parson and Reuger's statement, while the historical and political complexities of the tools and instruments have yet to be deciphered through their artistic interpretations.

The last module, *module3*, of *spectral narratives* represents the GC-MS, an instrument that had a major impact in the petroleum industry while becoming, years later, the preferred instrument to detect the environmental impact of that very same industry. The next section will contextualize the

module3 within the history of the GC-MS and explore the conceptual tensions arising from the gallery space.

4.5 Contextualizing the GC-MS: An Artistic “Functionless Object” within the Petroleum Industry and Environmental Applications

The separate and combined uses of the GC and MS were extremely productive for the organic chemical analysis of petroleum and petrochemical products at the beginning of the 20th century and increasingly since the First World War (Camin & Raymond, 1973; Reinhardt, 2002; McLafferty, 2011; Smoluch & Silberring, 2019). For example, many of the first spectra and fragmentation patterns that were obtained by MS and published mainly emerged from the efforts of the Hydrocarbon Research Group of the American Petroleum Institute (Reinhardt, 2002). The first combination of GC and MS was done by the chemists Roland S. Gohlke and Fred W. McLafferty in 1956 at the Spectroscopy Laboratory of the Dow Chemical Company (Gohlke & McLafferty, 1993).

The advanced knowledge of discrete solid-state electronics between the end of the Second World War and the mid 1960s, and its integration in analytical chemistry instruments, accelerated and facilitated the analytical techniques and algorithms for identifying molecules. This integration was indispensable due to a reduction in the workforce available for analytical tasks, combined with a rise in the volume of analytical work needed to manage and monitor new industrial facilities, and finally, a significant increase in the complexity of analytical challenges, particularly due to the emergence of new products in the field of organic chemistry (Stanley, 1984). Analysis and identification were streamlined by mass spectrum interpreter programs using a massive database maintained by the National Institute of Standards and Technology (NIST) under the National Institutes of Health (NIH) and the U.S. Environmental Protection Agency (EPA) (Heller, 1999). Automated operations drastically improved the quality of observations, reproducibility of results, working conditions, safety, and the productivity of research (Guette et al., 1988; Heller, 1999).

It was only in the 1970s that the first environmental applications of GC-MS were published (Hites & Biemann, 1972). With the rise of the American environmental movement of the 1960s, initiated by Rachel Carlson’s *Silent Spring*, a growing awareness of the impact of industrial chemicals on ecosystems brought environmental chemistry laboratories around the United States to utilize commercially available and reasonably priced GC-MS (Eisenreich & Simonich, 2015). Ronald A. Hites, a young assistant professor in the Department of Chemistry at MIT, published research on the presence of PAHs in the sediments of the Charles and Merrimack Rivers as well as in stormwater runoff from the city of Boston. Concentrations correlated with sources ranging from biological matter to automobile exhaust condensates (Hites & Biemann, 1972).

These findings mark an instrumental tension between the growing use of the GC-MS in the petroleum industry for quality and, later, for detecting arguably the same compounds in the

environment that either should not be present or exist in concerning quantities (Eisenreich & Simonich, 2015).

spectral narratives' GC-MS interpretation found in *module3* does not resolve this dual operational tension. Rather, this duality complicates any straightforward artistic and public interpretation of the instrument left within the automated exhibition that is, first and foremost, an aesthetic exploration of an environmental analytical chemistry protocol. The visitor, briefed by a concise description that contextualises the modules and their specific usage within the protocol for detecting urban soil contamination, does not mention the technical or contingent histories of their usage. Additionally, no labels are placed within the gallery space, leaving the visitor in a dark space, spasmodically enlightened by four sculptures. The exhibition's presentation, with its minimal and elementary description and protocol-specific contextualization, does not exactly hold any ethical or political position regarding the use of the actual artistically interpreted scientific instruments and tools, more specifically, the dual measuring capabilities of the GC-MS in the petroleum-based product production and detection of its environmental repercussions (fig. 4.15). This tension arguably resolves through the *Maintenance* mediation activities, representing the "*Interpretation and Communication of Results*" step of the protocol, further discussed in Chapter 5.

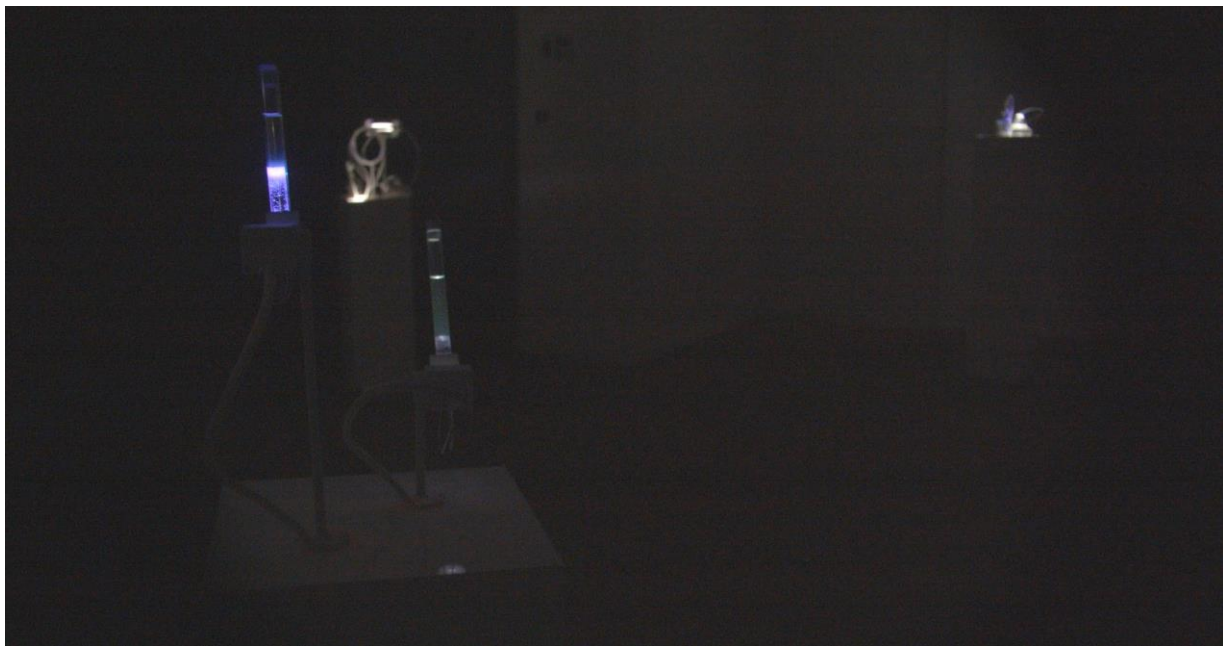


Figure 4.15 The darkness only allows the visitors to see the lights emerging from the modules. *spectral narratives* at EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal.

This intention of partially presenting the instrument's function resonates with science historian and curator Dr Jean-François Gauvin's critique of the "functionless" scientific instruments displayed in the museum (2016). Extending French philosopher Jean Baudrillard's concept of the "pure

object,” or “an object pushed onto an aesthetic plane that no longer belongs to the practical and tangible space of functionality,” Gauvin argues that unfamiliar and unreachable objects leave the Science Museum visitor to admire beauty and aesthetic details, while stripping the function from the form (2016). The tangible proximity and power of things brought between scientists and their tools and instruments is lost in the visit to the museum (Bertoloni Meli, 2006). Even worse,

A good exhibition does not simply let visitors marvel at the beauty of objects, tuned in to their own idiosyncratic knowledge; it should provide instead the ‘contexts and resources that enable audiences to choose to reorganize their knowledge’ (Karp, 1991, pp 22–23, as cited in Gauvin, 2016).

The specific, untouchable, contextualized, and aestheticized *spectral narratives*’ modules are not reorganizing the visitor’s knowledge of environmental chemistry’s instrumental history and various usages, and more specifically, industrial funding and geopolitical implications. The installation acts as a partial representation of the instrumental potential employment found within a single protocol, leaning towards a visualization of detection practices rather than industrial production, quality assurance, and a critique of environmental extraction and its socio-cultural repercussions. Rather than attempting to reconcile this contradiction, the exhibition of *spectral narratives* acts as an artistic exploration inspired by scientific visual culture, protocol interpretation, and dramatic material experimentation, which arguably can be criticized as an “aesthetization of the world” (Lipovetsky & Serroy, 2013). The modules are not produced and presented solely as a “visual shock” that emphasizes form over functionality, but to artistically narrate a procedure that changed the material world since its instrumental inception. This context requires a mediation, activated by the artist within the space.

Conclusion

This chapter explored the shifting definitions and aesthetics of scientific objects and instruments, situating them both historically and within the contemporary framework of *spectral narratives*. From highly ornate to manufactured and advertised in scientific magazines as high-end yet accessible products, scientific objects and instruments resonate within their manufacturing, historical, and political times. High throughput demands during the First and Second World Wars shifted the manufacturing and thus their aesthetics, focusing on efficient ergonomics and blackboxing the devices. *spectral narratives*’ proposition was to reflect on these histories by acknowledging Ivanova’s aesthetics of scientific experiments while extrapolating Gauvin’s “functionless” objects. In doing so, the gallery served as a space for presenting the laboratory’s “instrumentarium” through automated and sequenced sculptures, leaving ethical or political positions regarding the multifaceted usage of the interpreted objects. By following the phosphorescence and fluorescence mobilized within the modules, the *unblackboxing* of the intricacy of the objects and the protocol offered to the visitors a slow unfolding and intimate encounter with the process of *aesthetizing* contaminants through speculative scientific apparatuses.

They become “functionless” objects to the extent that they solely explore artistic extrapolations and conceptual metaphors of detection to shed light on the process of detection.

The exhibition only addresses the initial four steps in a five-part protocol, encompassing “*Sample preparation,*” “*Organic Matter extraction,*” “*Separation and Purification of Selected Contaminants,*” and “*Instrument Analysis.*” The next and last chapter will specifically look at the fifth and last step of the protocol, “*Interpretation and Communication of Results,*” and how the contextualization of the research and science and environmental communication embedded within the exhibition was done through EISODE gallery’s mandate of organizing mediation activities to reach out to and collaborate with its surrounding communities.

Chapter 5: Spectral Storytelling and Contaminated Narratives

This chapter situates the project within an environmental communication perspective, more specifically, the last step of the protocol, which is “*Interpretation and Communication of Results.*” The first part of the chapter starts with a description of *module0*, embodying the first step of the protocol, “*Sample Preparation,*” and simultaneously the very graphical results produced by the GC-MS. The next section defines the terms “spectral narratives,” how they have mobilized in philosophy and in the arts, and how their combination is productive for comprehending the overarching conceptual framework of the project. The chapter ends by exploring the mobilization of maintenance in the arts, and how the concept was put into practice throughout the exhibition and in the mediation activities at EISODE (January 28th and February 15th, 2025). Three nodes of the operational principle of the Benzene Ring will be used: critical design, environmental communication, and scientific instruments (fig. 5.1).

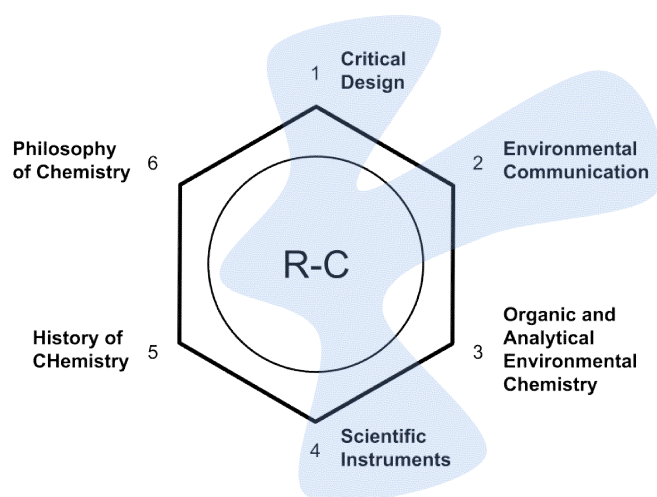


Figure 5.1 Mobilization of Critical design, environmental communication, and scientific instruments in the Benzene Ring for Chapter 5. Design: Philippe Vandal

5.1 Description of *spectral narratives'* *module0*

module0 is the first object in the *spectral narratives'* sequence, representing the sifting of the dried soil sample (fig. 5.2). The separation of large conglomerate, rocks, and organic materials such as twigs and insects, from small soil particles homogenizes the samples and facilitates the solvent extraction of its organic phase. In the artwork, a large glass cylindrical vessel is placed onto a sandblasted acrylic sheet, hiding a motor with magnets under the plinth's top. Next to the vessel is a steel rod that holds a large stepper motor to which is attached a large PVC container. The container has two chambers: the top part holds a soil sample from the Cdp, and in which iridescent acetate sheets are cut and curled into a concentric sculpture, reminiscent of the long grass of the

site; the bottom chamber has a small contraption that holds more soil sample mixed with phosphorescent pigments, a stainless steel mesh specifically used for sifting small particulates, and two bright LEDs.

When the *module0* is activated, the top part of the container illuminates and shines through the multicoloured hues of the acetate grass (fig. 5.3). The stepper motor starts a pulsed sequence synchronized with the activation of the bright LEDs, sifting and shining on small particles dropping in the water (fig. 5.4). A magnetic stirrer slowly speeds up while the bright LEDs fade off, leaving the viewer in a pitch dark environment. Slowly, the phosphorescent pigments appear, swirling in the glass vessel (fig. 5.5). The stirrer stops right before the phosphorescence decay time, and every module of spectral narrative lights again, announcing the beginning of a new activation.

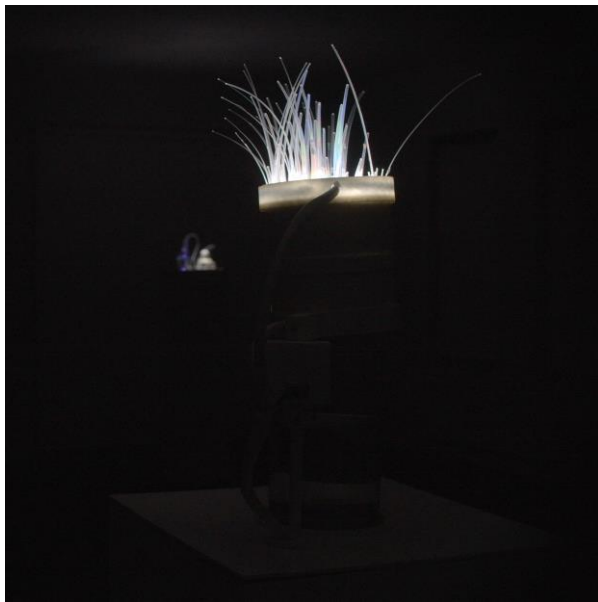


Figure 5.2 *module0. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal.

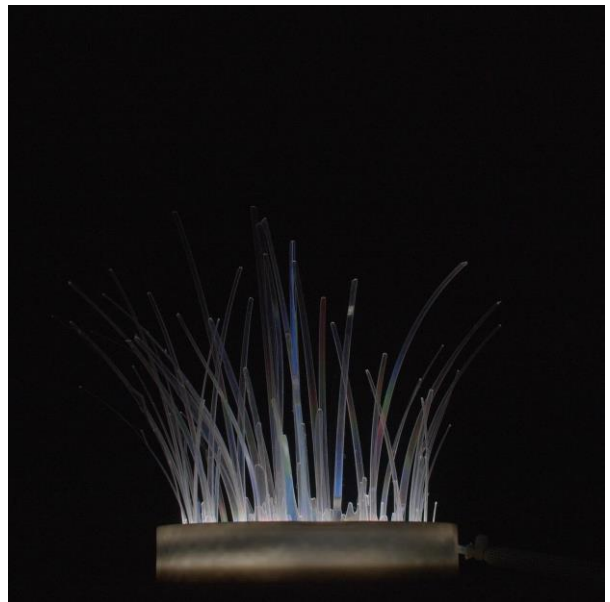


Figure 5.3 *module0. Iridescent vinyl cut acetate sheets. spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal.



Figure 5.4 *module0*. Activation of the stepper motor and LEDs. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal.

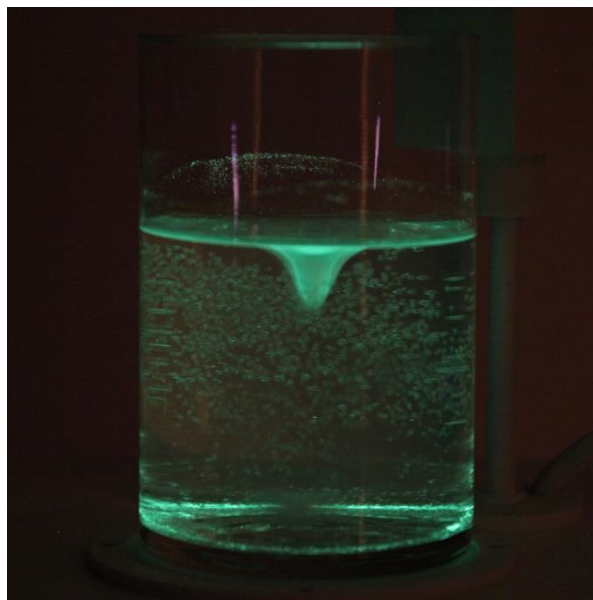


Figure 5.5 *module0*. Magnetic stirrer swirling the phosphorescent pigments. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada. Photo: Philippe Vandal

module0 is as much embodying the first step of the protocol and the visual results of the protocol. The shape of the acetate sheets is not simply adding colourful movements to its sequence and reminiscent of the Cdp's long grass; the acetate sheets are shaped and cut into the graphs produced by the GC-MS, the result of the molecular analysis of the soil sample taken from Cdp during the Directed Study with Dr. Gélinas (fig. 5.6, in comparison with fig. 5.3).

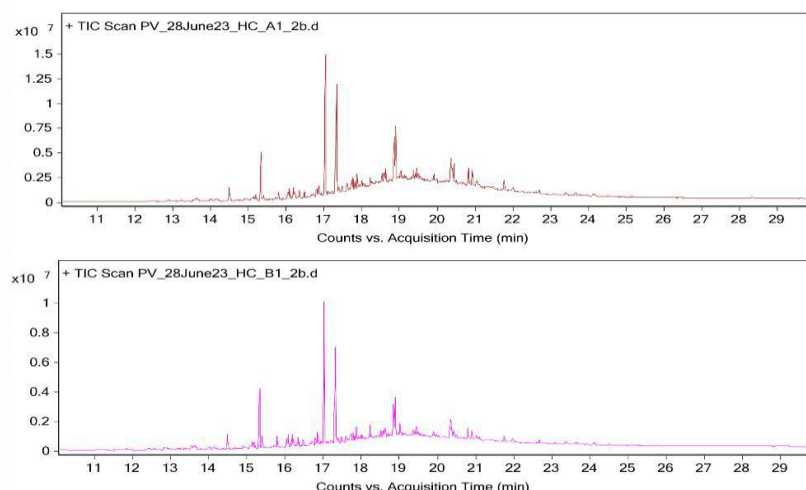


Figure 5.6 Graphs produced by the GC-MS, representing the compounds present in two soil samples taken from Cdp, 2024. Montreal, Canada. Photo: Philippe Vandal.

module0 embodies the very conceptual core of the *spectral narratives*' storytelling, in which Cdp's historical contamination is not shared through personal memories, on-site walks, nor solely relying on common environmental art aesthetics. *spectral narratives* plays with the more-than-green hues that are shining through the protocol and petroleum materiality. The next section will specifically define the title of the project and situate its theoretical framework within the visual and philosophical spectrums.

5.2 Defining *spectral narratives*

A narrative is first and foremost something that is narrated, a story or an account that is told. According to the Merriam-Webster dictionary, it is additionally “a way of presenting or understanding a situation or series of events that reflects and promotes a particular point of view or set of values”, the very practice of narration, or an artistic representation of an event (Merriam-Webster, n.d. a). The narrative is at the core of every story; it is felt by the reader or listener and engages them through psychological realism (Hsu, 2008). Stories, with the narrative's emotional and cognitive effects, can affect our ways of relating in and to the world. Regarding science communication, researchers found that readers are more engaged through storytelling than the ‘traditional, logical scientific communication’ (Dahlstrom, 2014, p. 13614). The narrative is also the intention within the programmed sequence of *spectral narratives*' modules; a long, softly pulsing light environment welcomes the viewer in the gallery-laboratory space, followed by pitch black, and finally *module0* illuminating the acetated grass and soil (fig. 5.7).

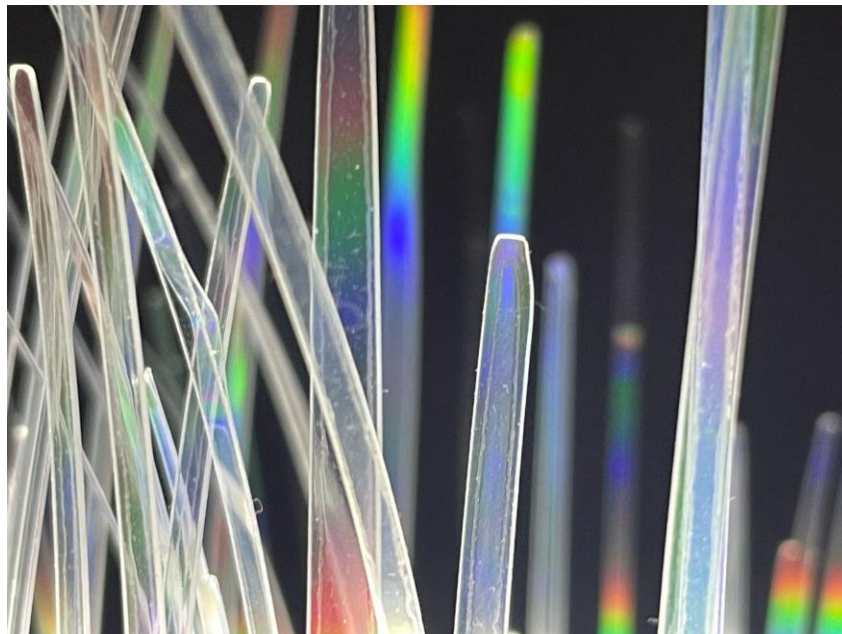


Figure 5.7 *module0*. Closeup of the illumination of the laminated acetates. *spectral narratives*, EISODE, Philippe Vandal, 2025. Montreal, Canada.
Photo: Philippe Vandal

Spectral can refer to a specter, a ghostly presence, while also something made by a spectrum, especially the electromagnetic spectrum of visible light (Merriam-Webster, n.d. ab). The use of this adjective in this project first refers to the mass spectrum, the graph produced by the GC-MS, which plots the relative abundance of ions against their mass-to-charge ratio (Garg & Zubair, 2024). The graph represents and acts as an environmental signature, encompassing past interactions within present molecular connections, a highly detailed graphical trail of a specific location. The definition of the mass spectrum depends on the processing time within the GC, where individual molecules are counted through their vaporization phase.

Spectral also refers to French Algerian philosopher Jacques Derrida's concept of hauntology, specifically the "spectralities" that came from the "spectral turn" (Derrida, 1994). In *Specters of Marx* (1994), Derrida is interested in exploring ethics as justice beyond the present moment and the self by thinking through the figure of the spectre, something that comes into being via a haunting relationality (Henriksen, 2021). This figure embodies the co-constitution of the self vis-à-vis the absent Others, the "one's others, those yet to come, those that have been, those that do not exist as such" (Henriksen, 2021). He thus concluded that to be just implies a responsibility "beyond the living present," an always incomplete relation that is through an ethics of debt to the ghostly other (Derrida, 1994, p. xviii). Line Henriksen, Senior Lecturer in Literature and Creative Writing at the School of Arts and Communication, Malmö University, coined "ecohauntology" as the ethics of debt to past, present, and future environmental connections (Henriksen, 2021). Spectral is also hinting at what author Jeffrey Jerome Cohen coined "Prismatic Ecology" (Cohen, 2014). Cohen argues that green became synonymous with sustainability, a mainstream association with ecological sciences, and has long been the favorite color of ecocriticism, arguably dismissing other ways of perceiving, relating with, and acting on our surroundings. He asks for an extended ecological discourse beyond monochrome, and in his own words,

"The spectrum is an unfinishable totality, an open expanse that gathers for a while a range of possible relations, always in excess of what a human perceives (ultraviolet and beyond, infrared and beyond). No Green Eden here, but a restless expanse of multihued contaminations, impurities, hybridity, monstrosity, contagion, interruption, hesitation, enmeshment, refraction, unexpected relations, and wonder. A swirl of colors, a torrent, a muddy river" (Cohen, 2014, p.xxiii)

"Making the invisible visible" is a common artistic undertaking through various materials, techniques, and contexts. Many artists interested in environmental arts, specifically concerned about contamination and its complex repercussions, have been exploring various ways of materializing or visualizing what slipped through perceptual cracks and histories. A playful take on the deadly, ubiquitous, and highly productive chemicals that emerged from the petrochemical industry can be found in Kuwaiti visual artist Monira Al Qadiri's *Benzene Float* (2023). This piece encompasses five ridiculously large inflatables of scientific drawings of petrochemical molecular structures, known as the "space-filling model" (Al Qadiri, 2023; fig. 5.8).

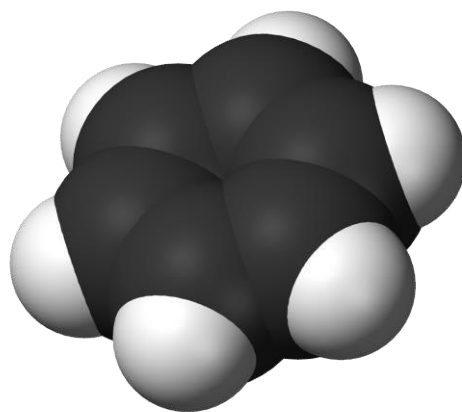


Figure 5.8 Space-filling model of benzene, which inspired the shapes of Al Qadiri's *Benzene Float* (2023), 2009. Design: Benjah-bmm27. In public domain.

Their disproportionate size and vibrant colours accentuate their ubiquitous presence and paramount importance in shaping our current geopolitical, environmental, and energy reliance on petroleum and its derivatives. It is a whimsical way of reminding us that “[t]hese chemicals are so integrated into our day-to-day lives that they remain invisible to us, hovering in the background of our immediate field of vision, secretly fueling our activities like magical spirits or ghosts” (Al Qadiri, 2023). With some measuring over six meters in length with shiny fabrics, they engage the visitor’s sight, forcing them to recognize their aesthetic and chemical exposure within the gallery and everyday life. Additionally, Al Qadiri’s inflated depiction of petroleum-derived molecules highlights the importance of considering them as “agents of both convenience and destruction,” resonating with writer Heather Davis’ statement that the ubiquity of fossil fuel changed what and how we perceive and sense our surroundings (Al Qadiri, 2023; Davis, 2021, p.342). Quoting English and environmental humanities scholar Stephanie LeMenager, “[o]il itself is a medium,” stating its importance to understand current politics or economy, as much as cultures and aesthetics (cited in Davis 2021, p.342). Art and oil are interconnected through materials, processes, infrastructures; museums, as Davis argues, are “energy-intensive systems” and through which fossil fuels percolate through the cooling, heating, humidity, and media player systems (Davis 2021, p.342). Petroleum could be the lubricant of the art world (Davis 2021). Al Qadiri’s piece inflates this lubrication characteristic through its placement, material, and iridescent colours; it is as much a spectral celebration as a shimmering deflation.

Combining the terms “spectral” and “narratives” implies a consideration of merging and opening to multiple temporalities, materials, and mediums, perceptions, and mediation tactics. Al Qadiri’s *Benzene Float* is a good example in that it does not solely depict petrochemical products as “bad,” yet that this contemporary emancipatory energy and material regime has its political and environmental consequences. In the context of this R-C project, *spectral narratives* specifically

relates to the desire of fusing organic chemistry's tools and instruments within an artistic practice that explores novel ways of representing and disseminating environmental interactions. Contamination permanently imposes new arrangements within an ecological system, and for which its repercussions are deployed and felt chaotically. Spectral, as ghostly, residues of industrial malpractices, and scientific, charting molecular masses, it signals the lingering presence of invisible petroleum contamination. Narratives as storytelling, deployed through the artistic interpretation and disposition of a scientific protocol within the gallery space, acknowledge the impossibility of an objective totalizing rendering of a situation while suggesting the importance of subjective points of view within the larger conversation regarding urban soil contamination. It becomes a mode of science-communication-through art, foregrounding ambiguity and haunting, rather than scientific closure and clarity. The use of various hues, brought by the fluorescence of oils (see fig. 3.3), the phosphorescent pigments (see fig. 5.4), and the iridescent acetate lamination (see fig. 5.6), explores and expands on what was not seen and heard through the scientific protocol. It implies a bifurcation from a direct representation to an interpretation. Additionally, *spectral narratives* enhances the importance of communicating alternate points of view to arrive at a just materialization of socio-environmental ethics.

In the context of the project, two mediation activities were organized at EISODE gallery, titled *Maintenance*, with the goal to clarify the project's intentions, the history of the Cdp, and open conversations on the importance and advantages of healthy urban environments.

5.3 Maintenance, in the Arts and Sciences

Maintenance is as much the process of preserving something or attending to someone. In the context of a tool, instrument, mechanical object, or even computer systems, it usually refers to a proactive effort to prevent malfunctioning or failure through routine activities (Karakas, 2025). These routine cleanings were necessary due to the use of miscible products, like the various petroleum-derived products used in *module1* and the vegetable oils and liquid paraffin for *module2*, which would blend and lose their visual demarcations, or phosphorescent pigments in *module0* and *module3*, causing stains due to their settlement in the glass vessels. The unfortunate dirtying and staining of the glass vessels, added to the fast mixing of the various liquids, required recurrent personal attendance to restore liquid demarcation and translucent receptacles. In other words, the fragile equilibrium of the installations was disrupted by their own functioning and activation.

Maintenance also hints at the interdisciplinary field of art conservation, specifically in art museums. The incorporation of chemistry into art conservation emerged in late nineteenth century Europe, whereas the first conservation research center in America dates back to 1928 with the establishment of Harvard University's Fogg Art Museum (Provost, 2022). The interest of the center was to "develop science-based conservation and studies of materiality with the use of scientific techniques that supported conservation and art-historical research," turning the art museum into a laboratory (Provost, 2022). Environmental analysis and the study of material behaviours and deterioration mechanisms were implemented in every museum by the end of the 1930s (Provost,

2022). Preventive conservation chemists were responsible for applying specific analytical chemistry protocols, physical and chemical techniques to understand the structure of art objects or the nature of pigments and binders. Gas chromatography has been used in art conservation to investigate organic materials since the 1970s, and its pairing with a mass spectrometer has become the most frequently employed technique (Geddes da Filicaia et al., 2023).

For Science Philosopher and STS scholar Alexandra Karakas, “maintenance centers around the relation between actual or possible failure and an expectation and description of function,” for which she argues, opens the possibility of understanding functioning and malfunctioning objects as a spectrum rather than a binary state (Karakas, 2025, p.278). The expected function fulfilled by a technical artefact is solely known by its operator or maker, yet as Karakas (2025) points out, a subtle or partial malfunction can stay unnoticed during its operation. She concludes that “knowing the function of an artifact does not necessarily explain the malfunction of the artifact” (p.281). Additionally, she reminds us that technicians are the ones maintaining, operating, conducting, and recording the instruments, and are thus laying the very functional foundations for scientific knowledge production (Barley & Bechky, 1994).

Maintenance in the arts was popularized, theorized, and practiced by Mierle Laderman Ukeles, an American artist who wrote *Maintenance Art Manifesto 1969! Proposal for an exhibition "CARE"* (1969). Her work ties feminism, environmentalism, and participatory art practice, and is most known for her performance at the Wadsworth Atheneum Museum in 1973, Connecticut, in which she cleaned and scrubbed its entrance to bring attention to the invisible and unacknowledged labor made by the museum’s maintenance workers. She famously wrote,

Maintenance is a drag; it takes all the fucking time (lit.)

The mind boggles and chafes at the boredom. The

culture confers lousy status on maintenance jobs=

minimum wages, housewives=no pay. (Ukeles, 1969, p.2)

She is also the first artist-in-residence at New York City’s Department of Sanitation, and has been involved since 1977. One of her performances, *Touch Sanitation Performance: “Handshake and Thanking Ritual”* (1979-1980), was to give handshakes to every sanitary worker as a way to thank them for the invisible work of maintaining the city’s metabolic functions.

Maintenance is a process of preserving, conserving, or attending to something or someone. It becomes a productive term and conceptual framework to bridge the recurring manipulations needed to clean *spectral narratives’* modules by attending to the mediation activities of participants. The *Maintenance* series at EISODE became a crucial turning point in discussing the creative process behind the work and the importance of attending to urban soil contaminations before potential environmental and socio-cultural malfunctioning.

5.4 Maintenance, Mediation Activities

EISODE, a word invented by Michael Faraday meaning “gate by which the power comes in,” is a unique exhibition space that privileges an intimate relationship between a single artwork and a limited number of visitors (EISODE, n.d. a). Their curatorial mandate is to exhibit generative artworks, deploying spatially and temporally through the visit, and that “require increased and meticulous attention and therefore a significant time of experience” (*ibid*). Guided and autonomous experiences are proposed through their online interface, lasting exactly an hour. A link provided in the confirmation email facilitates the visitor’s autonomy, unlocking the main door of the gallery space and triggering the beginning of the artwork’s sequence. Additionally, EISODE advocates for artworks that consciously position themselves within the visitors’ course, suggesting initiatives to organize mediation activities before, during, or after visits (EISODE, n.d. b).

Two mediation activities (January 28th and February 15th, 2025) were proposed during the time of the exhibition to present the conceptual and artistic framework, the aesthetic decisions, and contextualise the current urban soil contamination in Montreal, specifically in the Cdp. They also represented the very last step of any scientific protocol, “*Interpretation and Communication of Results*.” They could be loosely described as performative lectures, combining liquid manipulations, explanations, and opening for conversations with the participants. The modules were maintained and presented sequentially.

During the mediation events, I was sitting on a plastic storage bin in which I would grab equipment or compounds to replenish the modules, and in front of a small table with a black light, a small fan, laboratory gloves, glass test tubes, tissues, and other tools to prepare the manipulation safely. The participants were sitting around the table on cushions, surrounded by the four modules. While the first module’s maintenance was to simply put additional phosphorescent pigments in its top container, the second had a more spectacular take, where I would announce, while turning the fan on, and opening and grabbing plastic containers from the bin, the implication of off-the-shelf, inflammable, toxic products for arriving at the desired multi-phasic liquid sculptures contained in the test tubes. The third module, while not involving any dangerous substances, had a few surprising effects. The first would be the combination of various vegetable oils over water, the addition of liquid paraffin, and their illumination under black light in the furnace-worked glassblown vessels. The second would be to pull a hand torch attached to a gas canister of methylacetylene (propyne), propadiene, and propane, also known as MAPP gas. While igniting the torch and pulling a borosilicate glass test tube plugged with a silicone tube connected to perforated rubber stopper, I take out the on the importance of blown glass in the history of organic chemistry, or its implication in what was previously referred to as the “glassware revolution,” and how 18th century’s chemists needed to practice glass lampworking in order reproduce the experiments in scientific papers. Heating the glass evenly till it reached a working temperature, I would softly blow into the silicone tube to inflate the test tube. After disposing of the previous tools and materials, I took the glass vessels of the fourth module, or the GC-MS interpretation, and talked about the history of the instrument, its implication in the petroleum industry, and its later usage in

environmental science for detecting petroleum contamination. The *Maintenance* done, I would start the sequence of the exhibition and ask the visitors to experience *spectral narratives*, and open up for questions.

The *Maintenance* mediation activities within the *spectral narratives*' exhibition are a certain continuation of what was presented and addressed during the *Écotones* propositions at Cdp (2022). As mentioned in the introduction, a dynamic walking round table, including students, artists, scholars, teachers, and community members, ended with an *in-situ* exhibition (Ammar-Khodja & Vandal, 2022). The speculative tools and instruments, *rotary assistant* and *chromatically witnessing* (see fig. 1.2), incorporating blacklights, solvents, and aesthetization of laboratory material culture, are the very first propositions that would become foundational for *spectral narratives*' research. They were mobilized to visualize the process of detecting contamination on the very ground of Cdp, occupying space while casting a preoccupying atmosphere to people unaware that an art exhibition on contamination was occurring. The mediation portion of *Écotones* had quite an impressive attendance, facilitated by the availability and openness of Cdp and an effective communication through Hexagram, Milieux Institute, Speculative Biolab, and ACDP's websites and newsletters. *spectral narratives*' *Maintenance* worked on a whole different scale and environment; ten to fifteen people assisted each activity in the gallery, welcomed with warm tea during the Winter 2025 semester. The subjects and conversations suggested a faraway and unreachable contaminated site, from which samples were taken and brought into the exhibition space. The objects that were facilitating the mediation were extrapolating the Cdp samples into a different material process, which turned EISODE into an artistically performed laboratory for environmental communication. The fact that soil samples were not highlighted within the modules reframed conversations around the process and aesthetics of detection rather than contamination itself. In other words, it was an opportunity to explore other ways of engaging the public with urban ecology, historical use of vacant lots, their social and cultural implications, and most importantly, how contamination is framed in laboratories.

The *Maintenance* mediation activities were also a way to publicly perform what has been indispensable throughout the exhibition: cleaning glass vessels, replenishing the modules with various liquids and pigments, fixing misaligned stepper motors, replacing burned LEDs, and fixing network miscommunications. Between the art conservation tactics, repairing and fixing art-science objects, and maintenance as an artistic performance, these activities were an opportunity to explain my intentions, aesthetically and functionally. They were, above all, an opportunity to reinitialise the modules to my preferred state of aesthetic encounter. Some visitors most likely experienced *spectral narratives* in their most unclear and blurred state throughout the time of the exhibition, specifically referring here to the fast mixing of the various miscible liquids. Yet, as Karakas (2025) argued above, the intentional concealment of modular descriptions and their expected functioning state opened a spectrum of encounters through partial malfunction, unknown to the visitors.

Conclusion

This chapter traced how *spectral narratives* positioned itself as an interdisciplinary project encompassing environmental communication and artistic practice. By situating *module0* as the first and last step of the analytical protocol, it points to the essential role of mediation and artistic narration in art-science endeavours.

Through the conceptual articulation and artistic appropriation of the terms spectral and narratives, the project embodies the multiplicity of meanings and temporalities found in visualizing and speaking of environmental contamination. Whereas the spectral evokes the GC-MS mass spectrum and the remnants of petroleum contamination, narrative combines the communicative and affective power of artistic narration into an ethical mode of engagement. Their combination opens a conceptual and aesthetic field in which environmental data are turned into phosphorescent, fluorescent, and iridescent materials for artistic narration. Inspired by (eco)hauntology and prismatic ecology, *spectral narratives* expands on the “green” imagery of environmentalism, insisting on the importance of considering multilateral understandings of the contemporary ecological realities.

The *Maintenance* mediation activities at EISODE ground the conceptual explorations in practice. Maintenance was mobilized not solely as a technical necessity, but additionally as a performative and ethical gesture, through which a continual act of tending to the work kept it properly functioning throughout the exhibition. Echoing Ukeles’ manifesto, specifically regarding the often invisible labour sustaining both artistic and scientific systems, and extending Karakas’ view of understanding functioning and malfunctioning as a spectrum, the *Maintenance* mediation activities were a way of tending to work while communicating the importance of urban soils, while historically situating environmental analytical chemistry and its aesthetic potential in an artistic practice.

Chapter 6: Conclusion

spectral narratives bridges the material, aesthetic, and epistemological between art and environmental analytical chemistry. The project explored how scientific objects and instruments, and materials of scientific inquiry, could be reimagined through artistic speculation that visualizes the realities of urban soil contamination. Rooted in both the historical change in laboratory material cultures and a contemporary concern for petroleum residues in the urban landscape, *spectral narratives* offers an artistic interpretation of a scientific protocol as a poetic, sensory, and critical form of mediation.

The project was guided by two overarching preoccupations or provocations; on the one hand, the possibility of enhancing visualization and creating new ways of perceiving soil contamination through the materialization of art science objects guided by an environmental analytical chemistry protocol; on the other hand, affording new discussions around petroleum culture and its environmental and social impacts through the mediation of these art-science objects. The methodological and theoretical framework of the project was inspired by the chemical structure of benzene. It became a productive way to contextualize and situate *spectral narratives* within an artistic, philosophical, and embodied preoccupation for dwelling in urban soil contamination and its detection, spanning through interests in critical design, environmental and scientific communication, organic chemistry, scientific instruments exhibited and utilized, and finally, the history and philosophy of chemistry. More specifically, the reappropriation of benzene's aromatic characteristics within the framework points to the importance and necessity of thinking of *spectral narratives* as an interdisciplinary project. *Aromaticity* is thus understood here as both the fundamental importance of each and every subject involved in understanding and structuring the project, and the guiding principles, methods, and explorations brought by R-C, embodied through the circling and hybridization of the various subjects of interest within an art-science practice.

The first aromatic combination of the benzene ring framework (critical design, and the history and philosophy of chemistry) explored was to examine *module1*, *module2*, and *module3*, and more specifically, how they embody the intertwined histories of materials used in both the art studio and the chemistry laboratory. The materials were specifically blown glass, for its immense importance in the chemistry revolution of the 18th century, and solvents, historically used in the arts and science. The three modules sequentially represented “*Organic Matter extraction*,” “*Separation and Purification of Selected Contaminants*,” and “*Instrument Analysis*.” From the history and importance of glass in chemistry labs, to Eve Andrée Laramée's and Hicham Berrada's works, the use of glass in *spectral narratives* was to mobilize its transparency and materiality in order to illuminate the vessels' content under various light phenomena. The use of solvents in science and in the arts was specifically relevant for *module1* and *module2*. In resonance with the works of HeHe (2016) and Suzan Schuppli (2018), the goal of these modules was to explore the aesthetics of hazardous chemicals through iridescent and fluorescent materials. Mobilizing these visual and sensory codes of contamination brought *spectral narratives* into an experiment for affective

conditions of hazardousness. The use of solvents was also a way to highlight their petroleum provenance, ubiquity, and accessibility, and their primordial importance in the arts, as a medium and a subject. The mobilization of solvents and blown glass in *spectral narratives* was a possibility of bridging the laboratory and the gallery space through artistic manipulations informed by shared materials and processes. More importantly, these materials allowed a metaphorical and practical continuation between the in-situ contamination and its visualization or detection within the art-science objects. It made possible an extended aesthetics of environmental contaminants through the interpretation of the protocol.

spectral narratives also explored the historical and conceptual understanding, evolving roles, definitions, and aesthetics of scientific objects and instruments, and how they were reappropriated in various artistic intentions. This interest mobilized the second aromatic combination of the benzene ring framework found in the thesis: critical design, organic and analytical environmental chemistry, and scientific instruments. Put in resonance with Agnes Meyer-Brandis's *Teacup Tools* (2014-) and *Tealemetree Station* (2014-), *module3*'s artistic interpretation of the GC-MS explored the aestheticization of science while mobilizing the concept of artistic "functionless object," more specifically the display of untouchable, artistic and speculative instruments that arguably lose their practical, and situated, tangible proximity (Bertoloni Meli, 2006; Gauvin, 2016). It was also an opportunity to explore what science historian Davis Baird (2004) refers to as measuring instruments as bearing some knowledge of material agency, between theory and practice. Resonating with Schickore's statement about the importance of studying instruments within their context and setting of usage and Ivanova's aesthetics of scientific experiment, *spectral narratives* changed the EISODE gallery into a speculative "instrumentarium." The exhibition space also allowed an *unblackboxing* of the process of detecting soil contamination, through which the visitors had to follow the phosphorescent and fluorescent particles through a slow unfolding and intimate encounter with the process of *aesthetizing* contaminants. The white plinths became an efficient way of concealing the microcontrollers and the electronic circuitry, while celebrating the history of automation in the chemistry laboratory by fully sequencing *spectral narratives*' unfolding for the visitor, triggering its beginning by unlocking the gallery's door. The exhibition context of EISODE allowed for an exploration of the new realities of modern laboratories by employing new media art tactics, and by doing so, enhanced visualization and a new perception of soil contamination.

"*Interpretation and Communication of Results*," the final step of the protocol, was paradoxically embedded within the very first module of the sequence, *module0*. While representing the first step of the protocol, "*Sample Preparation*," *module0* also has the particularity of displaying the results of analysis made by the measuring instrument, the GC-MS, which can be seen in the acetate sheets. Their shape is a vectorial representation of the graphical results produced by the GC-MS. This dual function embedded within *module0* points at the essential role of interpretation, mediation, and artistic narration of the project. This had to mobilize a third and last aromatic combination of the

benzene ring framework: critical design, environmental communication, and scientific instruments. Inspired by (eco)hauntology, prismatic ecology, and Derrida's spectralities, the goal of *spectral narratives* was to expand on the common colour spectrum found through environmentalism and environmental art with the intention of artistically materializing and mediating contamination in novel ways. This was possible by mobilizing the conceptual articulation and artistic appropriation of the terms "spectral" and "narratives," allowing the project to explore the multiplicity of meanings and temporalities found in environmental artistic narration. While "spectral" evokes the GC-MS mass spectrum and some of the light phenomena possible through petroleum products or contaminants, "narrative" works through the communicative and affective power of artistic narration for an enhanced mode of engagement. Their combination becomes a conceptual and aesthetic field to follow phosphorescent, fluorescent, and iridescent materials into scientific and speculative tales of contaminants. Another aspect of the combination of the terms was the *Maintenance* mediation activities at EISODE, echoing Ukeles' manifesto and extending Karakas' view of understanding functioning and malfunctioning as a spectrum. They became a way of tending to the modules while talking about the project's conceptual framework of artistically interpreting the protocol, and the importance of urban soils for socio-cultural unfoldings.

Following a protocol and interpreting each and every step of it to materialize art-science objects brought an interesting method of creative inquiry, hybridizing analytical interpretation and speculative fabrication. *spectral narratives* introduced a methodology where scientific protocol sequences became conceptual and aesthetic frameworks for artistic creation. This procedural translation was not only metaphorical but also performed, embodied through materials and spatial compositions. The project proposed an experimental mode of research-creation through the logic inherited from the laboratory and articulated with critical design and environmental aesthetics' sensibilities. The integration of the aromaticity of the benzene ring within the theoretical and conceptual framework of the project became a powerful model to efficiently explore the relational dynamics of its components. The persistence and chemical stability of aromatic compounds worked as metaphors for interdisciplinarity and legitimized a framework to hybridize artistic, scientific, and theoretical concerns. This chemical analogy guided the structure of the thesis, facilitating each chapter and artistic objects to become an "aromatic node" within a broader molecular and conceptual network. Interdisciplinarity was not treated as a juxtaposition of fields but as a chemical-like bonding process: reactive, continuous, and materially grounded.

Within the field of critical design, *spectral narratives* contributes a material and conceptual approach that resists functional resolution. These "functionless instruments" reinterpret the aesthetics of scientific apparatuses and processes to explore and reveal some of their cultural, political, and affective dimensions. The project expands the critical design discourse by extrapolating and appropriating the aesthetic codes of analytical chemistry into speculative artworks toward environmental inquiry and material ecology. In the context of research-creation, *spectral narratives* establishes a methodological contribution by demonstrating how scientific protocols can serve as narrative and structural frameworks for artistic research. Not simply

appropriating scientific imagery, *spectral narratives* mobilizes laboratory material culture and aesthetics as sites of epistemological reflection. This methodological gesture offers a productive way to navigate interdisciplinary projects by legitimizing the integration of multiple fields, a shared commitment to process and material specificity. This approach contributes to the broader field of arts-based research by articulating contamination as both an aesthetic and epistemic problem. *spectral narratives* proposes that the visualization and the process of detecting pollution can emerge through affective, sensorial, and material engagements. The project offers an alternative form of environmental communication that supplements discursive awareness by inviting viewers to experience contamination as lights, temporalities, and material gestures.

The project also revealed several limitations. A deeper engagement with the functioning and material specificities of the GC-MS would have enriched its artistic interpretation understanding, and a sustained laboratory collaboration would have allowed for more interesting chemical effects. This points at the gap between conceptual speculation and technical implementation, being a productive tension but also one that invites future investigation. Methodologically and participatorily, while the *Maintenance* mediation activities were successful in presenting the project and conversing around soil contamination and its repercussions, their documentation and the analysis of these exchanges could have deepened the understanding and reflected on the limits of the project from a mediation standpoint. These exchanges would have strengthened the participatory dimension by enriching the reflexive understanding of how artistic practices communicate environmental knowledge within and beyond academic contexts.

This research has catalyzed an enduring transformation in both my conceptual and material practice. The immersion into the material culture of the laboratory evolved into a sustained artistic exploration of borosilicate glass flameworking, the very technique of fabrication of modern scientific apparatuses. What started as an interpretive engagement with laboratory aesthetics has become a technical obsession that reshaped my studio practice. The thesis's focus on combining scientific and artistic materialities has exceeded its academic intention, and led to new technical and formal directions. *spectral narratives* now serves as the conceptual foundation for a new series of installations, titled *para-instrumentarium*, which was accepted by Perte de Signal and Molior to be part of the Projet émergent mentorship program (2025–2026). This series extends Rom Harré's notion of the "instrumentarium" by exploring the material and aesthetic tensions of scientific glassblowing through artistic sculpture. Using biphasic liquid systems by combining water, solvents, and pigments, revisits and expands the material findings of *spectral narratives*. *para-instrumentarium* turns to the embodied and technical dimensions of its making. It addresses one of the material limitations of the project, the inaccessibility of specialized equipment for glass flameworking. This shift represents deeper material and technical explorations, through which conceptual translates to material manipulation, strengthening my artistic language.

APPENDIX A

INDI 698: Le Champ des possibles: A Scouting experiment for assessing polycyclic aromatic hydrocarbon contamination in a Montreal vacant lot

Abstract

This paper's context emerges from an immersive and intensive course within a scientific laboratory, where, as an artist with an interest in better understanding the methods, I delved into a comprehensive exploration of the techniques and instruments used for detecting soil contamination caused by petroleum polycyclic aromatic hydrocarbons. This paper is the result of a scouting experiment for addressing the current contamination levels found at the Champ des possibles in Montreal, Quebec. GC-MS analyses show that there are important concentrations of PAHs in the chosen polygon. The diagnostic ratios for fluoranthene with pyrene and benzo[a]anthracene with chrysene based on the GC-MS counts are 0.47 and 0.37, respectively. These results would imply that the emission source is most likely from vehicles. The Carbon Preference Index is approximated to 1, suggesting that there is no distinct preference between anthropogenic contributions from petroleum products and byproducts or inputs from microorganisms and recycled organic matter. Considering previous research on the field, It is highly probable that deeper soil is more contaminated by PAHs.

Introduction

The Champ des possibles (Cdp) is a vacant green lot situated in the Mile-End neighbourhood in Montreal, between Gaspé and Henri-Julien streets. Cdp has an industrial past that can be traced back to the middle of the 19th century and was first utilized as farming land. A majority of the sector was bought and turned into grey limestone quarries, used to build most of Montreal's public buildings and middle-class residences throughout the century. Once abandoned, many quarries became ponds due to rainwater and runoff, but above all, many have been turned into dumping grounds (1), including the Cdp. In 1906, Canadian Pacific (CP) acquired and built the rail yard to store its wagons and serve local businesses in the asphalt, coal, scrap metal and junk yard industries. The sector has become a major industrial hub, thanks to its proximity to railway facilities. CP is gradually phasing out its activities at this location and abandoned the space by the 1980s. It is only in 2007 that the Cdp is acquired by the city and since protected by a group of citizens called les Amis du Champ des possibles (ACDP), and since the official signing of the Champ des Possibles co-management agreement between the ACDP and the borough of Plateau-Mont-Royal in 2013, a co-management committee has been set up to oversee the project's development. According to their 2014-2015 Activity Report (ACDP, 2015), ACDP produced a map of contaminants in the Cdp (nature, location and depth) that was submitted to the Ministère de l'Environnement et de la Lutte contre les changements climatiques in spring 2016. The contaminants include petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals such as arsenic, copper, tin, and lead (ACDP, 2015, 6).

This scouting experiment focused on PAHs. They represent a group of complex hydrocarbons formed by the combination of two or more benzene rings, composed of six carbon atoms joined in a ring with a hydrogen atom attached to each. They occur naturally in coal, crude oil and gasoline, and are the primary byproduct of incomplete combustion processes. The main anthropogenic sources of PAHs are vehicle exhaust and industrial processes, making them ubiquitous in urban and industrial areas throughout the country (Canadian Council of Ministers of the Environment, 2010). Out of the numerous PAHs known, the Environmental Protection Agency (EPA) has identified sixteen as High Priority Pollutants, including naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, benzo[g,h,i]perylene, indeno[1,2,3-c,d]pyrene, and dibenz[a,h]anthracene. These specific 16 PAHs are a matter of environmental concern due to their potential harm to humans and other organisms, as well as their widespread and persistent presence in the environment. Their exposures, including ingestion, inhalation, and contact with the skin, have been linked to skin, lung, bladder, liver, and stomach cancers in animals and humans. Among PAHs, benzo(a)pyrene is the most prevalent carcinogenic agent. Non-carcinogenic effects are irritation and redness of the eyes, skin, and breathing passages. The impact of PAHs contamination on soil properties is due to their chemical stability, hydrophobicity, and resilience to microbial breakdown, implying that high concentrations can potentially harm both biological and physicochemical characteristics of soil matrix (Daâssi and Almaghribi, 2022).

Materials and methods

This independent study was done through a “scouting experiment” method, understood as a compromise between scientific rigour, limited time frame, and thus, limited accessibility to equipment. Accordingly, only one sample (A1) was analyzed and matched through the EPA’s NIST Bank in order to better understand the method for assessing PAHs contamination.

Sampling locations and collection

A grid sampling morphed into a *purpose sampling technique* was used, consisting of choosing sample locations in regions recognized for their high contamination levels based on the site's historical data (Malherbe, 2001). According to the map produced by the ACDP in their 2014-2015 Activities Report (2016, p. 6; see Figure A.1), two samples were taken within a delimited polygon contaminated by PHCs and PAHs, in the blue circle, and a third, at the green dot, outside any contaminated polygon (see Figure C.2). A small shovel and sealable plastic bags were used to store the soil samples until their preparation in the laboratory. The samples were taken at a depth of 20 centimetres.

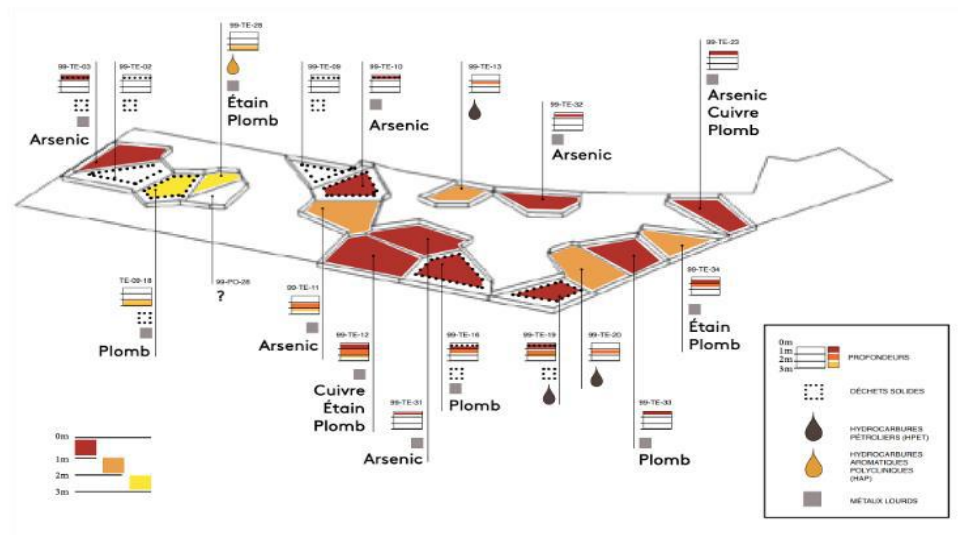


Figure A.1 Map produced by the ACDP containing information on the nature and the depth of the contaminants found in the delimited polygons of Cdp, 2016. Montreal, Canada

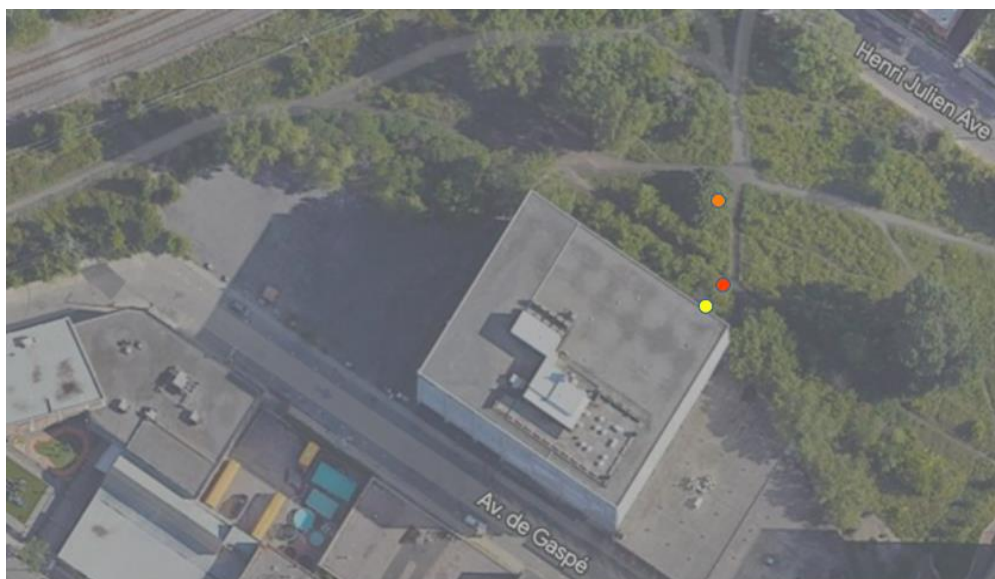


Figure A.2 Satellite imagery of the Cdp with the three sampling locations (Google Maps). A (red): 45.528495, -73.597596; B (yellow): 45.528446, -73.597621; C (orange): 45.528627, -73.597597. Montreal, Canada. Design: Philippe Vandal

Solvent Extraction

The samples were sifted in order to eliminate large particles and homogenize them. Two replicates for each samples were made (15 g per replicate). An organic extraction was then applied with an organic solvent mixture, 1:1 v:v acetone:hexane. This specific ratio is needed to reach a low polar solvent system. After sonication, 7mL of distilled water was added to the samples. After centrifuge, the organic phase was isolated in hexane through a liquid-liquid extraction. This isolation happens because water separates both solvent due to acetone's miscibility, creating a biphasic system in which the hexane holds the least polar and hydrophobic compounds. Following the hexane recovery step, 5ml of hexane was added to the samples and then centrifuged once again, aiming to maximize the recuperation of substances from the soil samples. The final hexane extraction was then reduced to 1mL by nitrogen evaporation. Nitrogen evaporation is a technic in which a syringe feeds a constant stream of nitrogen gas on the surface of a solvent in order to lower the vapour pressure and increase the surface area, accelerating the process and thus lowering the chance of losing semi-volatile compounds. After the evaporation, the aliphatic, such as alkanes and alkenes, and aromatic fractions, such as polycyclic aromatic hydrocarbons (PAHs), were separated on a silica gel column with a 25% v:v toluene:hexane. The columns were made with silica gel (SiO₂) and sodium sulphate (Na₂SO₄). The silica gel acts as a polar buffer and the sodium sulphate as a water absorbent. The final extract was evaporated to 500 µL and stored in a GC vial until the time of analysis.

Determining the Soil Sample's Moisture Content

Concurrently with the solvent extraction process, approximately 1g of soil was placed in glass jars for each sample, weighed, and left uncovered to allow water evaporate (see Table A.1). This step is essential to enable accurate comparisons between the samples themselves or with the findings from other studies.

Table A.1 Water content for each sample, Philippe Vandal, 2023.

Sample	Wet Weight (g)	Dry Weight (g)	Water Content (%)
A	1.172	1.009	13.87
B	1.081	0.910	15.84
C	1.093	0.943	13.75

Sample Analysis

Gas Chromatography and Mass Spectrometry

Samples were analyzed through a Agilent 7890 N gas chromatograph with a flame ionization detector (GC-FID) with a constant flow of helium as a carrier gas and coupled to an Agilent 5977B mass spectrometer (GC-MS). The separation of the PAHs was done through an Agilent J&W DB-5ms capillary column (25 m × 0.25 mm × 0.25 µm). The flow rate was 1 ml/min. The initial temperature was kept at 120°C for 10 minutes, then ramped to 300°C with incrementation of 20°C/min, and kept at 300°C for 11 minutes, totalizing a run time of 30 minutes for each sample. The identification of the compounds was based on their retention times, matched through the NIST bank produced by the Environmental Protection Agency (EPA).

Diagnostic Ratios

Diagnostic ratios (DRs) are extensively employed to discern the primary sources of PAHs (petrogenic or pyrogenic) in air, water, sediment, and soil samples (Tobiszewski and Namieśnik, 2012). The pyrolysis process is responsible for generating PAHs with a diverse range of molecular weights, whereas petrogenic sources mainly contribute to the presence of lower molecular weight compounds (Abdel-Shafy and Mansour, 2016; Tobiszewski and Namieśnik, 2012).

Results

The PAHs identified in sample A1 are shown in Table A.2, with their respective acquisition times and counts. Figure xx are the chromatograms for samples A1, B1, and C1. Table A.3 shows the diagnostic ratios used in this study, with their PAH compound quotients and defined value ranges indicating their respective emission sources (Chaber and Gworek, 2020). Accordingly, the DRs for fluoranthene with pyrene and benzo[a]anthracene with chrysene based on the GC-MS counts of sample A1 are 0.47 and 0.37, respectively

Table A.2 Identified compounds with their respective acquisition times and count,
Philippe Vandal, 2023. Montreal, Canada.

Compounds	Acquisition times (min)	Counts
Anthracene (or phenanthrene)	15.335	9388696
1-methyl Anthracene	16.04	650000
1-methyl Anthracene	16.09	1315727
1-methyl phenanthrene	16.2	1155569
1-methyl phenanthrene	16.25	500000
fluoranthene	17.04	14629709
pyrene	17.332	16728288
benzo[a]anthracene	18.854	5895958
chrysene	18.9	9906261
benzo[b]fluoranthene	20.364	11413453
benzo[k]fluoranthene	20.827	3472644
benzo[a]pyrene	20.924	3135870
benzo[g,h,i]perylene	23.396	910882
dibenz[a,h]anthracene	24.139	1000237

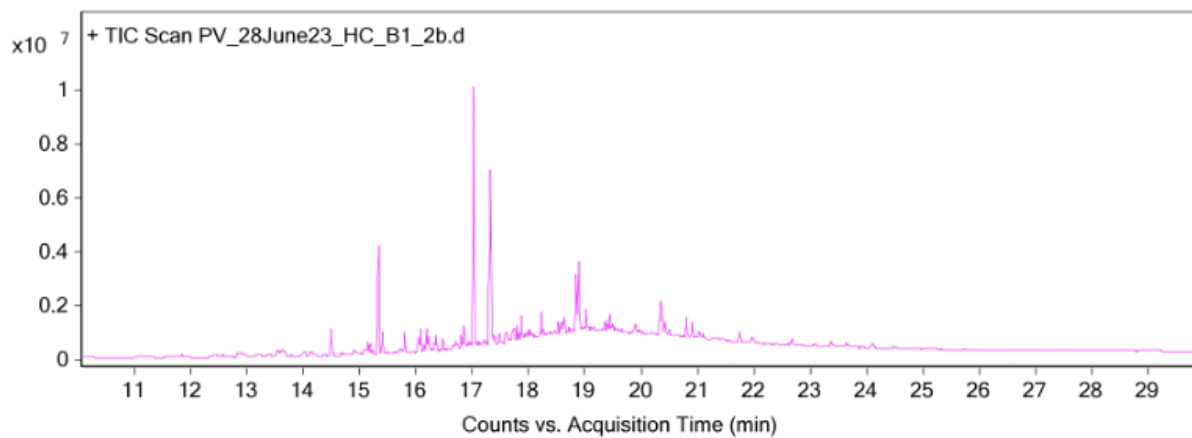
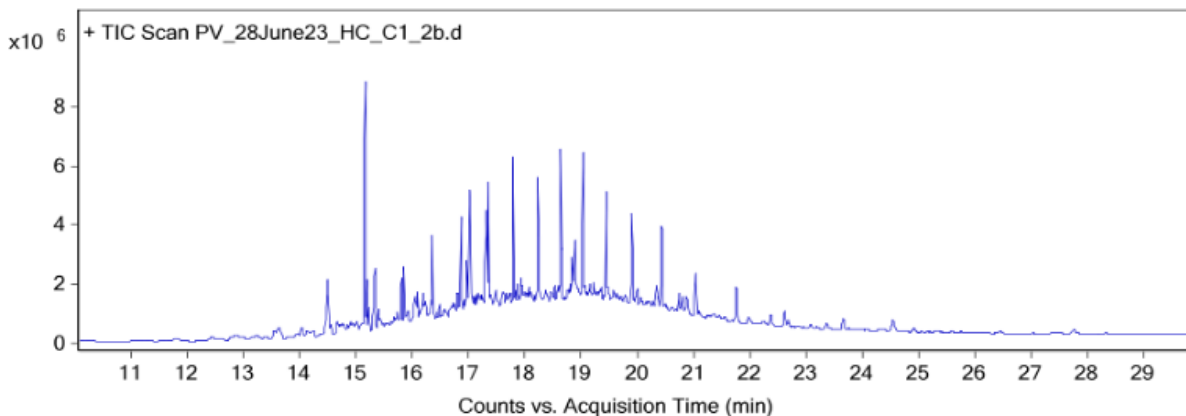
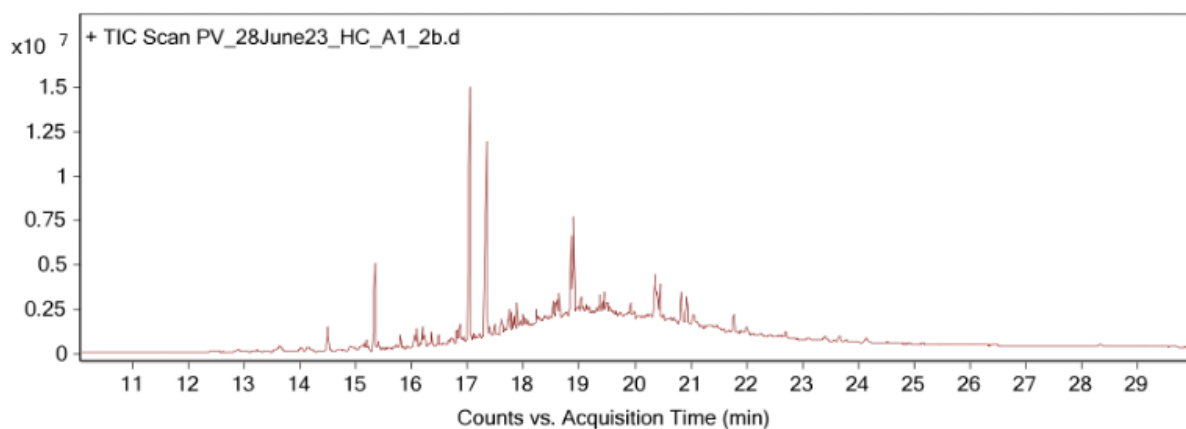


Figure A.3 Chromatograms of samples A1, B1, and C1, Philippe Vandal, 2023. Montreal, Canada.

Table A.3 DRs used in this study, with their value range and associated emission sources (PYR, Pyrene; FLT, Fluoranthene; BaA, Benzo[a]anthracene, CHR, Chrysene), Philippe Vandal, 2023. Montreal, Canada.

PAHs ratio	Value range	Identification of emission source
FLT/(FLT+PYR)	< 0.4	Petrogenic
	0.4–0.5	Vehicular emissions
	> 0.5	Grass, wood and coal combustion
BaA/(BaA+CHR)	< 0.2	Petrogenic
	0.2–0.35	Coal combustions
	> 0.35	Vehicular emissions

Discussion

Considering table C.3, these results would imply that the emission source is most likely from vehicles. Additionally, and considering there is a very small water content difference between the samples (see Table C.1), we can infer that sample A1's PAHs relative abundance with sample B1 is threefold and sixfold with sample C1, implying that samples A and B were taken within the perimeter of a contaminated polygon. Considering the samples's coordinates and the map produced by the ACDP, It is highly probable that deeper soil is more contaminated by PAHs.

Many adjustments would have been needed in order to properly address the analysis of the contamination in the Cdp. A rigorous grid sampling method throughout the premise would have been needed for a content and spatial distribution of the various contaminants and a proper result comparison with other studies. In order to better identify the PAHs in the 200-250 molecular mass range, a separation on a silica gel column for the n-alkenes would have been necessary. Regarding the GS-MS analysis, the aliphatic fraction was eschewed, restricting the possibility of calculating the Carbon Preference Index (CPI), a frequently employed molecular ratio for determining the biological source and maturity of organic matter (Bray and Evans, 1961). Fortunately, the CPI was approximated to 1 by the supervisor during the GS-MS analysis session, suggesting that there is no distinct preference between anthropogenic contributions from petroleum products and byproducts or inputs from microorganisms and recycled organic matter. A longer analysis in the GC-MS would have helped better differentiate and detect additional compounds. For example, a differentiation

between anthracene and phenanthrene would have allowed the possibility of identifying petroleum input from combustion processes with the diagnostic ratio anthracene/(anthracene+phenanthrene) (Budzinski et al., 1997; Yunker et al., 2002). Other diagnostic ratios, such as natural n-alkane ratio (NAR) and average chain length (ACL), would have helped better characterize the origin of organic matter (Imfeld et al., 2022). The calculation of Benzo[a]pyrene Total Potency Equivalents (B[a]P TPE) and the Index of Additive Cancer Risk (IACR) would have ensured that the current PAHs concentrations are not dangerous for human health, where B[a]P TPE address direct contact with contaminated soils and the IACR looks at the potability of water; both are based on the carcinogenic effects of PAHs (Canadian Council of Ministers of the Environment, 2010).

There were several manipulation mistakes that happened in the lab: 5mL of the C2 replicate were lost before the evaporation prior to the column chromatography; the Na₂SO₄ layer was added too quickly to B2's column chromatography and did not coagulate properly; phthalates, which are a group of chemicals used to enhance plastics' durability, were found in C2; B1 and C1 were physically interchanged before the GS-MS analysis, which resulted in pairing mismatch in the GS-MS report.

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