FROM CAFE TO COLOURANT:

NATURALLY DERIVED COLOURANT FOR SCENIC ART APPLICATION

MATTEA STEPHANIE KENNEDY

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Abstract

This thesis project playfully intertwines the concept of a hypothetical theatre café menu and naturally derived colourant. The remnants or same ingredients that come from the recipes are made into naturally derived colourant, for scenic art surface applications, that would be utilised in live performance. I add to the global conversation around more sustainable colourants in reference to the climate crisis. I have chosen this lighthearted interconnection to foster engagement within the core concept. I assert that by drawing people together amidst the pleasure and comfort of a café environment, we move closer to achieving the 3 Cs of Ecoscenography: Co-creation, Celebration, Circulation. Co-creation in the duality of both café items and resultant colourant, celebration in the community aspect of meeting to eat and drink and experience live performance, and circulation towards engendering a closed loop mindset in the creation of theatrical scenery.

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Chapter One: Introduction

In late 2022, UN secretary-general Antonio Guterres uttered his exigent pronouncement in an article published by The Guardian Newspaper regarding COP 27: “The world is ‘on the highway to climate hell with our foot still on the accelerator’, UN secretary-general Antonio Guterres has warned” (The Guardian 2022).

My thesis aims to add naturally derived colourant, sourced from ingredients shared by a hypothetical café menu, into the global conversation around climate action. I explore buy-in regarding sustainability and welcome organic change as a necessary shift in thinking about more ecological surface treatments. The United Nations Sustainable Development Goals, (sub-section 9.4,) targets policy to “upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.” (United Nations Environment Program 2023). Theatre, Film and Television production are a positive force in the Canadian economy that supports employment in every province, generating a GDP of over $12.2 billion dollars. (Motion Picture Association 2023). As a scenic artist professional for over thirty years, I am sorry to report that not enough has been done to comprehensively entrench sustainability into the scenic art department. An imperative exists to paint scenery in a more ecological way.

I have a fierce passion for theatre and joy in the collective instruments of its creation, yet all of it belies the abject vulnerability of our Earth. I remain optimistic in contemplating a future that creates art, without destroying, our planet’s dwindling resources. My concept serves as a framework for adding naturally derived colourant, into the global conversation around

sustainable design for theatre. “A colourant is a substance that is used to impart colour to matter. Dyes and pigments are the main forms of colourant. The main difference between them is that dyes are soluble, and pigments are insoluble and are suspended in a medium or binder.” (Winsor & Newton 2023). I have envisioned an artistic synergy created between delicious, nutritious café items and the naturally derived colourant sourced from them. I aim to engender buy-in, regarding the concept of naturally derived colourant, as welcome organic change. For this Thesis, I have created a recipe booklet that offers typical café fayre that might reasonably be found at an onsite theatre café, and provocatively invite the cook to use the same base ingredients, and repurpose the by-products, or waste generated, into colourant for painting. This is conceived of in order to draw attention to the subject of colourant, in relation to our current practices in terms of the climate crisis and expand the idea of organic change. I forefront the concept of naturally derived colourant that emanates from a café source because I want it to be easily graspable, in a tangible way in terms of instant gratification, that I hope enthuses people to embrace more ecological thinking. My hope is that through the combined medium of food and drink, that is consumed for pleasure, the naturally derived colourant that is generated from the remnants begins to exist in an intellectual space that is not a resigned deflating acceptance of climate change necessity, but rather something expansive and creative with opportunity for not steely determination but pleasure.

As far back as I can remember I have always expressed myself through the medium of paint. I distinctly remember enjoying theatre in my early teens when musical theatre experienced somewhat of a renaissance in London, U.K., my hometown. In the early 1980s, *CATS*, *Starlight Express*, *Sunset Boulevard*, *Phantom of the Opera*, *Les Misérables*, and *Follies* are just a few of the productions that I remember attending. I fell in love with the surface treatments and in

particular the scenic painting that was applied to the sets. Painting then came to a way for me to channel emotions into a physical manifestation as art, and I became a scenic artist.

Scenery starts life as a concept that is agreed upon between the scenographer, (also known as the set designer,) and stage director. Scale drawings are generated that give construction information to the builders, carpenters, welders, fabricators, sculptors, amongst other disciplines. The physical environment created as the setting for a theatrical piece is known as the 'set.' A scenic artist is the person responsible for executing the surface treatments for that set, which may be applied to hard scenery, such as theatre walls known as 'flats' which were historically canvas but are now most often wooden; and 'soft goods' which are textile backdrops. The painting and surface treatments are executed in reference to the scenographer's specifications. As the head scenic artist for a theatrical production, one is almost always invited to meet with the designer in person. Here we look at their scale model, (maquette) which is a miniature replica of their design. They may share paint elevations, which are a view of the set from a front-on perspective, communicating an artistic vision of the surface treatments required. They may also provide renderings, which are drawings. "The use of renderings and models of the set design has long established the role of the set designer as the "author," the creative worker responsible for the conception of the scenography." (Hambleton 2017). Over the last decade or so almost all renderings are computer generated and sent by PDF in an email to be viewed onscreen. Hambleton makes note of this, "The experiences of the scenic artist when faced with interpreting digital images of set designs are telling of the occupational identities of those who practice this craft, and current struggles to adapt" (Hambleton 2017). This challenge is a topic of investigation unto itself, and I will touch upon it in Chapter Two: Colour Space and Colour Theory. I include a description of Isaac Newton's theory of light and primary colours,

the additive and subtractive spectrum, colour space and the artists' palette. I outline some of the aspects presented by digital media representation that is generated for colourant painted interpretation.

As a professional scenic artist, my job in terms of scenic painting and surface treatments is a direct response to connect, interpret, or replicate the material conceived of by the scenographer. I find it very fulfilling, however I cannot deny the environmental lackadaisy in the regular course of painting in terms of the impact of the colourants used in my department. I crave what I have since learned is Ecoscenography, a term originated by Tanja Beer. In her ground-breaking book she describes it as "Ecoscenography—a neologism to encapsulate the integration of an ecological ethic with performance design." (Beer 2021). Although Beer may have coined this term in 2014, this concept has been ignored for a long time. Chaudhuri points out almost 30 years ago:

> "The great debates raging today between the adherents of deep vs. shallow ecology, of conservation vs. preservation, may seem rather remote from the concerns of theatre studies, but they are the appropriate framework for any attempted search for a useful ecological theater. Moreover, such an investigation is not merely desirable in terms of the theater's own standards of social seriousness and political relevance: it is also crucial to the future of the ecological movement itself, and hence to the future as such." (Chaudhuri 1994).

In Chapter Three, Problematic and Other Disciplines, I will explain how scenic paint may seem to be quite an innocuous substance because it is a water-based product with few cautions described for its use on the label. As opposed to other specialized and non-specialized paints,

scenic paint is manufactured without the usual mold inhibitors, preservatives and fungicides present in domestic paint. (About Civil 2023). Scenic paint is a product manufactured for exclusive use in painting scenery, that benefits from being more saturated, (intensely coloured,) and has no sheen compared to domestic paint making it more versatile for use by the scenic artist. While many paint producers engage in more sustainable production methods, ROSCO, the global leader in scenic paint manufacture and distribution, makes no mention of their ecological footprint. “The Ecological Footprint measures how fast we consume resources and generate waste, compared to how fast nature can absorb our waste and generate resources.” (Global Footprint Network 2023) and in their FAQ (frequently asked questions,) section on their website regarding the response to, “Why should I use Rosco paint rather than housepaint?” ROSCO points to function:

> “All of Rosco's paints are manufactured with a high volume of finely ground artists pigments. They are designed to give an artist clean, bright color that can be mixed without greying. Rosco's paint lines were designed with scenic art in mind, they stay supple and have good adhesion to a wide variety of surfaces. Rosco paints have a matte finish which will not reflect stage light--even house paints that are labeled "flat" have a sheen which can be distracting on stage.” (Rosco 2023).

Conceptually this is problematic in and of itself because it speaks to a global acceptance of industry norms that not only compromise, but blatantly ignore, the potential damage that conventionally painted scenery poses to our environment. “Wood that has been pressure treated, painted, varnished or otherwise finished is not a good candidate for recycling,” (W&S Waste Management Ltd 2023) meaning that even when painted on a recyclable or biodegradable substrate, the addition of a paint product renders it functionally a mixed material: an impediment

to its recyclability. Mixed materials will end up in landfill. In this second chapter, I will also unpack some aspects of why it is a problem to throw out our used scenery into landfill, with regards to climate change and ecology. I will refer to another discipline, in this instance: sustainable fishing. I draw parallels between our realm of theatre and a high functioning industry with its own ecological systems thinking and checks and balances, in order to assert that looking for synergy between theatre and café culture may not be so far-fetched. I will establish that many organizations are already working to forefront sustainability in their mandate.

In Chapter Four, Buy-In and High Functioning Industry, I discuss what buy-in is and why I think it is critical to inspire people to engage. I expand on systems thinking that exists in the sustainable fishing industry, which is an industry with ecological praxis that stretches back over 100 years. I unpack leverageable strategies that can benefit us in a sustainable theatre context. In my booklet I have tried to design something easily comprehendible, that is purposefully lighthearted, and that is interactive in nature. My thesis invites engagement as a core aspect. It is my hope that starting with small acts can engender a more hopeful outlook from the upcoming generation of young theatre practitioners as outlined by York University in the Sustainability Strategy published by the Office of Sustainability. There is a clear imperative to, "communicate and implement a shared vision, inspire positive change, build capacity, empower people, harness innovation and creativity, and foster a culture of sustainability within and beyond the University." (York University 2023). Part of what influenced me is the community aspect of what a café represents and how it collectively nourishes. Perhaps it is this "culture of sustainability," in terms of human connectivity, that I seek. It is the subsection entitled: 'People,' that offered me deeper reflection: "York University is working to foster a culture of collaborative behaviour that harmonizes the efforts of the York community to pursue widely understood

sustainability objectives." (York University 2023). The phrase, "widely understood sustainability objectives" is dropped lightly into this assertive statement. In contemplating this statement somewhat rigorously, I suggest that one of the myriad of challenges that confronts any practitioner with an ecological mindset, is buy-in. The average six-year-old can be taught to reliably put their banana peel into their household's organics bin - it's not comprehension that presents an impediment to enacting better ecologically sensitive practices – it's emotional exhaustion, and compassion fatigue. Many people struggle, even when we understand on an intellectual level that we must do something, and furthermore that time is of the essence. In the Harvard Business review Rebecca Zucker explains with reference to: *Immunity to Change: How to Overcome It and Unlock Potential in Yourself and Your Organization.* (Kegan & Laskow 2009).

> "The cognitive impact of feeling perpetually overwhelmed can range from mental slowness, forgetfulness, confusion, difficulty concentrating or thinking logically, to a racing mind or an impaired ability to problem solve. When we have too many demands on our thinking over an extended period of time, cognitive fatigue can also happen, making us more prone to distractions and our thinking less agile. Any of these effects, alone, can make us less effective and leave us feeling even more overwhelmed." (Zucker 2019).

I imagined not only a refueling station for the body, but also a respite for the emotionally weary, to try and foster more inspired thinking around sustainable colourant from a place of emotional positivity instead of feelings of being overwhelmed. Being overwhelmed by the climate crisis can lead to feelings of helplessness. When one feels helpless, it becomes increasingly more

difficult to be in a positive mindset to actively effect change. An Australian study noted that students describe negative feelings when they think about climate change. “The most prominent emotions were fear, sadness and anger, foretelling widespread disempowerment and fear for the future.” (Pfautsch and Gray 2017.)

I suggest a combined initiative that helps to make the right choice – less environmentally destructive colourant, also the easiest choice – eat and drink at an on-site theatre café. Entice the next generation of a theatre going public and professionals, with delicious, nutritious, and easily accessible comestibles. It is my aim to nudge people into accepting naturally derived colourant as a concept. We need to restore, re-invent and build upon lost knowledge and practices that historically formed our methods of colourant production.

In Chapter Five, The Café, I lay out the hypothetical onsite café menu. I delve into the menu ingredients and offer insight into their health benefits. I describe what it might look like to obtain colourant from naturally derived sources. In Chapter Six: Café Procurement in Toronto, I contextualize the basics of produce, pertaining to the operational side of a café. Where might produce emanate from? How much does it cost? Where does the waste usually go to? How can I better understand the supply chain, and subsequent impact, of raw ingredients?

The impetus to create a synergistic liaison between a hypothetical onsite theatre café menu, and naturally derived colourant was, in and of itself, an organic process. I was intrigued and inspired by research and learning that spanned all corners of my university courses. The History of Visual Sources allowed me the opportunity to chart the history of colourants from the first known human paintings on cave walls, “two deliberately engraved ochre pieces from c. 75,000-year-old levels at Blombos Cave, Western Cape, South Africa” (Henshilwood et al 2009)

up until the introduction of Winsor Violet (Dioxazine) by the artist's paint manufacturer, Winsor & Newton, in the 1960s. (Winsor & Newton 2023). One of the things that left an impression on me is that historically speaking, colourant was necessarily naturally derived. The consideration that has made us turn to chemically engineered products is longevity. With climate crisis as the defining lens through which to contemplate better ecological practices as they pertain to my own discipline of scenic painting: can we stay fixated on longevity? An audience member will probably only see a performance once. If there is a subtle shift in hue, (colour,) value, (light or darkness,) or chroma, (intensity,) can we still feel comfortable to hold our surface treatments in high regard?

In looking at this concept from the perspective of sustainable design for performance, there exists an imperative to look more comprehensively at the legacy of creation. In an article published in *Theatre and Performance Design* in 2021:

> "Through acknowledging that the material, the natural and the cultural are not separate but co-constitutive, our aim is to provoke new insights into the interrelationships between human thought and material agency in the context of performance design" (Pantouvaki et al 2021).

Food derived colourant is known to have been in use since before the Bronze Age. (Circa 3300-1200 BCE.) According to an article examining food colour additives from historical (and regulatory perspectives,) published in Comprehensive Reviews in Food Science and Food Safety, "Food coloring has been known to be in practice [from] as early as 1,500 BC (Burrows, 2009). Earlier, all the colorants used were of natural origin such as saffron, paprika, turmeric, various flowers etc." (Burrows, 2009).

At the World Stage Design 2022 event, held in Calgary, Alberta, Ingvill Fossheim, Doctoral Candidate, Aalto University Helsinki, Finland, spoke directly to the concept of organic change as it applies in her area of expertise: costumes. In discussion it was positioned that, "When the run of a production necessitates the regular laundering of the costumes, it can no longer be 'business as usual.'" (Fossheim 2022). Her research involves a tangential discipline: BioCostume: Experimental Costume Design with Biobased Co-Actants.

As a cohort of theatre professionals concerned with better ecological practices, we are being collectively called to firmly reposition ourselves towards envisioning a more sustainability conscious future in live performance. This radical new thinking, as it pertains to the world of costuming, entails not only accepting, but moreover fully embracing, the potential for organic change. It fundamentally welcomes how the costumes may look different, over the course of the run, of any given production. I believe that this concept needs to be absorbed in terms of surface treatments and scenic painting. We intuitively understand that live performance is, by its very nature - organic. As theatre practitioners, we must invite this fundamental change. I suggest that it is advantageous to encourage a shift from our current perspective, whereby we view the surface treatments of scenic painting as a static entity, to something more mutable. This is not a foreign concept in the realm of live performance. A 'show report' (the stage managers daily written assessment,) exists partly because we understand this reality in terms of the performers; every show is going to be subtly different. Live performance is by its very nature – organic. Factors that can affect the performers in a production might include fatigue, or a very small number of audience members, (the house,) which can make a performance lack lustre. Which show it is in the run of a production, is known to make a difference: the second night in the run

of a performance is notorious for being low energy, whereas an opening night performance is often discernably buoyant. These are some of the ways that as theatre professionals, we already accommodate organic change as part and parcel of live performance. I suggest we actively embrace this concept of organic change further and move towards encompassing these elements into naturally derived colourant for surface treatments. This is one way to expand our conceptualization of not only what live performance is, but needs to be, in a more sustainable future. The Green Book UK Co-ordinator frames it succinctly in the introduction:

> "Climate emergency is the reality in which theatre – like everything else – is now made. But producing sustainable shows is not an end in itself. Theatre's purpose, range, creativity and ambition should remain as broad and vital as ever. Indeed, it is that very creativity and theatre's ability constantly to reinvent itself which will generate fresh theatrical thinking in this new reality." (Dillon 2021).

Challenging our current concepts of static surface treatments does require accepting more dynamic co-creation, by virtue of the organic nature of the material. I propose we invite conversation gently, fostered in the environment of a café setting: buy-in engendered by cake.

Chapter Two: Colour Space and Colour Theory

"[C]olour is within the experience of almost everyone and (that) the colours of nature are continuous with the colours of art. But of course, artists have a special way of seeing colour and a special way of presenting what they see" (Gage 1993).

There are different ways to describe colour depending on whether One is speaking of the spectrum of light, pigment, and dye colourants, or pixel dots of ink in the medium of printing. In this thesis, I delve into how we describe colour across these different modes of visual communication and outline how I have come to choose the specific colours of the naturally derived colourant, that I suggest as a palette, based on modern colour theory.

The job of the scenic artist is to fabricate a surface treatment to the designer's specifications. These specifications may come to us by a variety of different media that express not only the surface treatment, but also the colours that a designer has chosen. Some of these visual media present challenges to the scenic artist, because of how they represent colour, in comparison to how the scenic artist presents colour. The way we have come to understand colours, and their relationship to each other, has a rich and complex history. To understand what is meant by 'colour' in a scenic art context, it is important to understand something of what is meant by 'colour' as a concept, and furthermore, which colour space and colour theory we are using.

Traditional concepts of colour theory originate from Sir Isaac Newton, the physicist. In 1721 he published his book, *Opticks* (Newton 1721). "Newton demonstrated that colour is a quality of light. To understand colour, therefore, it is necessary to know something about light." (Encyclopaedia Britannica 2023). He concluded that daylight was not in fact colourless, but

rather a combination of the visible colours of the spectrum. He showed that when white-light, (which is daylight,) is passed through a prism, (three-dimensional triangular piece of glass, see Figure 1 below) it bends or *refracts.* This refraction allows for the spectrum, comprising of the seven colours of the rainbow: red, orange, yellow, green, blue, indigo, and violet, to become visible.

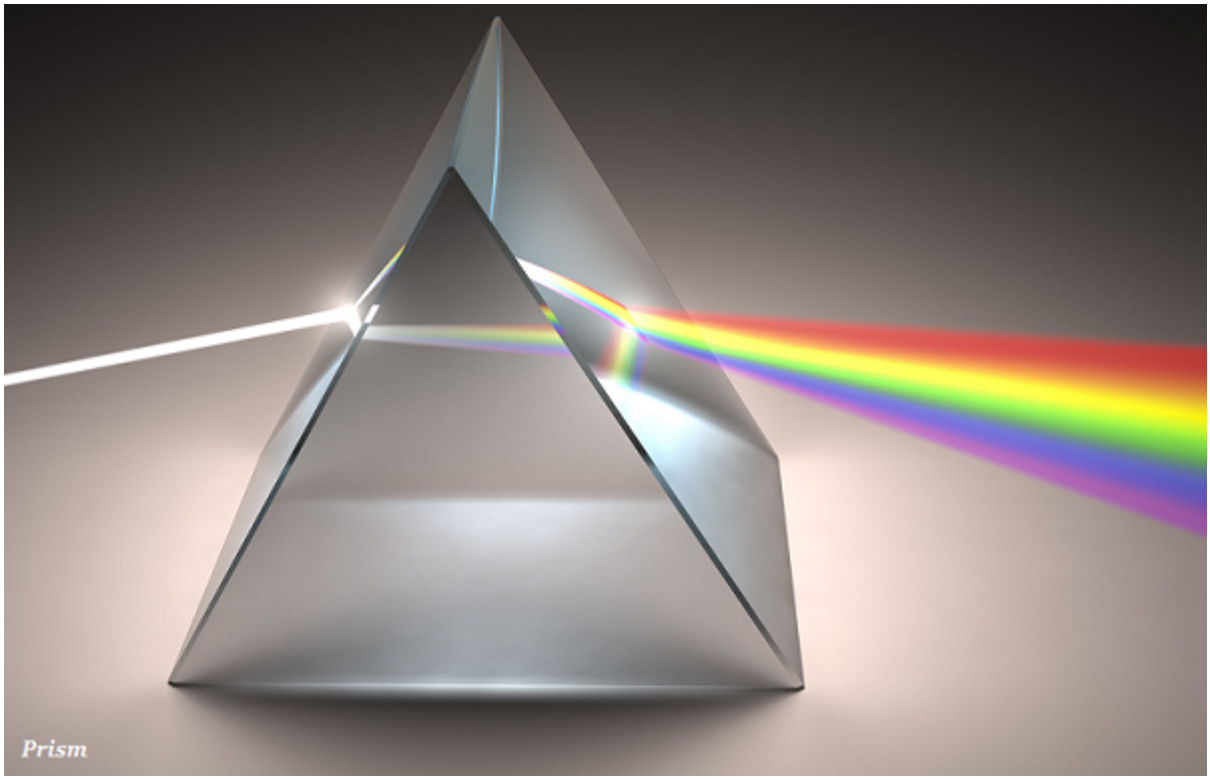

Figure 1. © Prism: Tutorialspoint

Newton is responsible for "arguing that colour is an intrinsic property of light" (Fara 2015). and he surmised that the presence of light is the source of the way in which we perceive the colour of a thing. It was understood to be the absence of that part of the spectrum, not being absorbed by the object that it falls on, but rather bouncing off an object to our eyes.

In the *additive spectrum* three of the colours, (that we can see in the visible spectrum,) red, blue, and green, (RBG,) are added together as coloured beams of light, that meet in one place, and create white light. (See Figure 2 below.) This is known as additive because it refers to the concept of adding to create white light. A colour space describes a specific, measurable, and fixed range of possible colours, or luminance values.

Additive Spectrum: RGB Colour Space

Figure 2. Additive Spectrum: RGB Colour Space. © Keuhni 2012

The three *secondary colours* of the additive spectrum are created by the overlapping of any two of the RBG colours. These three secondary colours: cyan, magenta, and yellow are unto themselves the primary colours of the *subtractive spectrum.* The subtractive spectrum is the

conventional explanation of the way in which we perceive the colour of an object. It is named to illustrate the concept that “when light illuminates an object, colors are subtracted from the light rays because the object absorbs them.” (Ames 1996). I have illustrated this below in Figure 3.

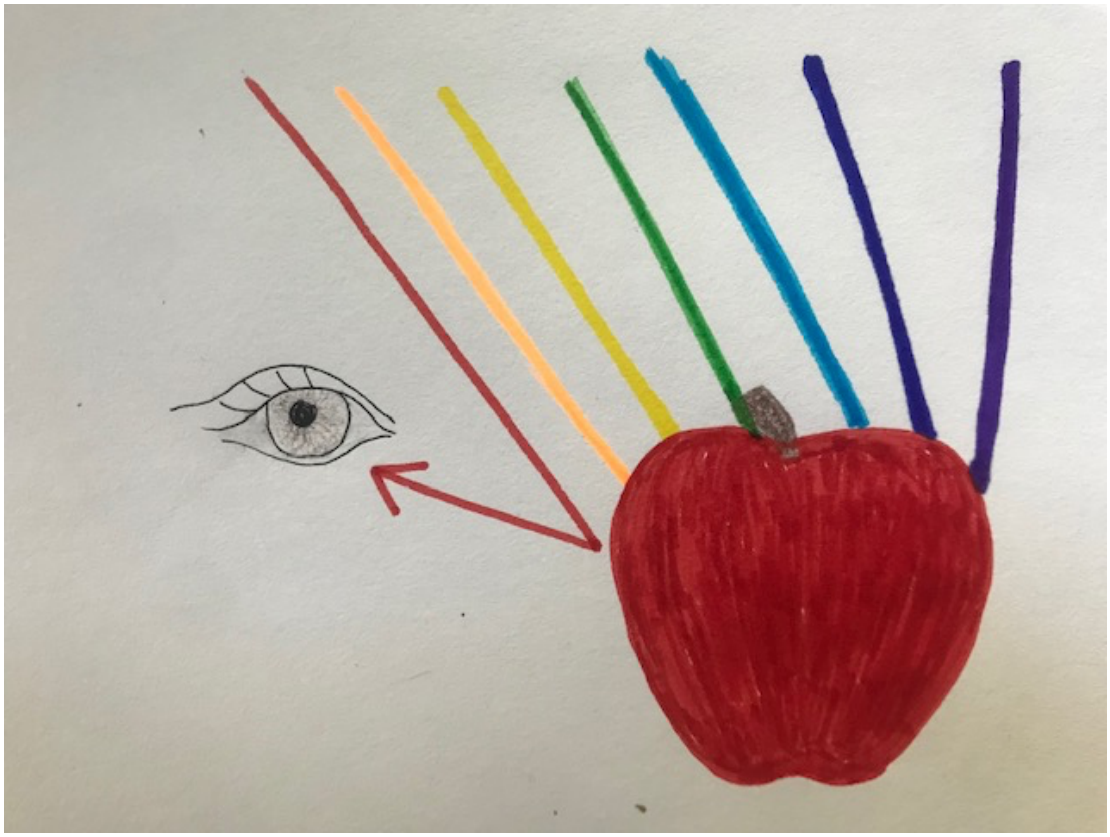

Figure 3. Red Apple. Mattea Kennedy 2023

In this theory: if the red shown in Figure 3 is not bouncing off but instead being absorbed, the object would appear black, as in Figure 4 below.

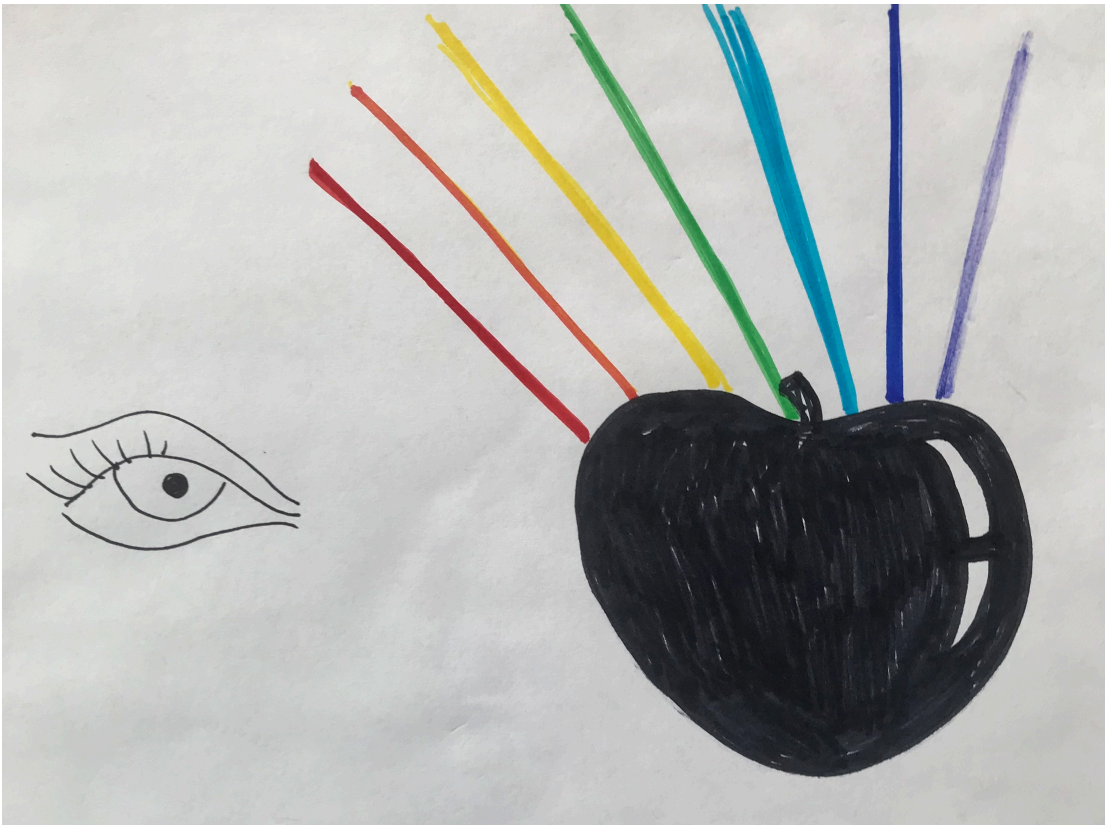

Figure 4. Black Apple. Mattea Kennedy 2023

In the subtractive spectrum, (Figure 5 below) the secondary colours are also created by the overlapping of any two of the three primary colours. They make red, green, and blue, (which are the primary colours of the additive spectrum.) A major difference is that where all three colours meet, all possible rays are subtracted creating what we perceive as black.

Subtractive Spectrum

Figure 5. Subractive Spectrum. Photo credit: © Keuhni 2012

There is a third colour spectrum, usually referred to as the *artists' palette,* (Figure 6. below) which is the one that we learn about in grade school. It propounds that the primary colours are red, yellow, and blue. Secondary colours are orange, green, and purple. This colour spectrum is made up of colourant. It is a physical entity made up of particulate matter.

Artists' Palette

Figure 6. Artists' Palette Photo credit: © Ames 1996

In 1963, Pantone developed a proprietary global system of colour standards, known as the Pantone Matching System, (PMS.)

> "The tool organizes color standards through a proprietary numbering system and chip format, which have since become iconic to the industry standard across the globe now encompassing over 10,000 colour standards across multiple materials including printing, textiles, plastics, pigments, and coatings." (Pantone 2023).

Using this method, it is possible to transpose a colourant reference into a colour space. HEX, (hexadecimal colour coding,) is used for web design. It is related to RGB as it encodes the values of each of these primary colours for online use.

CMYK, which indicates the colours; cyan, magenta, yellow and black, is used for printing. CMYK used pixel dots of ink in an almost single layer to create a variety of colours. In the CMYK system, the colours are notated by the percentage that they contribute. Our eyes are unable to identify each individual pixel, so we accept the colour as an entity. Similarly, television screens are lit in this way and the 'resolution' of a television screen, describes its number of pixels, each with RGB values.

One way to think about how we perceive pixels, is to imagine being in a plane, over a football pitch, which is entirely covered by an equal amount of blue and yellow marbles: the football pitch will appear to be green.

When a designer sends the scenic artist a PDF (portable document format,) as reference for their colourant choices it can present challenges. A PDF is viewed onscreen in the additive spectrum of light. Colourant is a physical entity and therefore it exists in a different colour spectrum. If we print this PDF onto paper as reference, then we have converted RGB or HEX values representing RGB colour space (Red, Green Blue) into CMYK colour space. Printed media is one of the mediums that is often given to the scenic artist as reference for the design specifications, regarding the surface treatment. It prints the variety of chosen colours with a combination of primary inks. Pixels are converted to pixel dots of ink in CMYK colour space and can replicate thousands of colours. It represents images with pixels: a different medium to painting with colourant.

How we feel about colourant in the form of the artists' palette has changed considerably since Sir Isaac Newton refracted light through his prism in the 1700s. This ability of cyan, magenta, and yellow to represent such a wide variety of expressed colour has led to the evolution of a more modern colour theory for colourant itself. We have moved away from the red, yellow, blue artists' palette. An aspect of this rationale responds to the fact that it has always been impossible to make magenta comprised of mixing colourant from the traditional artists' palette. "[M]agenta is one of the three true primaries, not red. Mixing magenta with yellow can give you red" (Walcott 2014).

I reflect this concept of modern colour theory in choosing the base ingredients from which to make naturally derived colourant. I have sourced magenta colourant from beets, cyan colourant from blue pea-flower tea and yellow colourant from turmeric. This encompasses the modern artists' palette and aligns with the subtractive spectrum.

Chapter Three: Problematic and Other Disciplines

In contemplating naturally derived colourant and discussing why it should factor in the global conversation around sustainable design as it pertains to theatre, it may be prudent to delve a little deeper. Why are conventionally derived colourants and some typical paint ingredients problematic in the first place? What are some of the sustainability impacts at play? Progress regarding more sustainable paint is somewhat slow but does exist.

Firstly, let us define some of the ingredients that occur in the types of paint that we regularly encounter in the scenic art department.

Pigment

Pigments can be classified as either synthetic or natural. Synthetic pigments involve engineering molecules which are often manufactured from coal tars, (a by-product of coal processing,) and other petrochemicals. Coal is a fossil fuel originating from within the earth, and a nonrenewable energy source, (United Nations 2023). Processing adds to the creation of a cocktail of dangerous gasses, that are collectively referred to as greenhouse gasses.

> "As greenhouse gas emissions blanket the Earth, they trap the sun's heat. This leads to global warming and climate change. The world is now warming faster than at any point in recorded history. Warmer temperatures over time are changing weather patterns and disrupting the usual balance of nature. This poses many risks to human beings and all other forms of life on Earth."
>
> (United Nations 2023).

Many paint ingredients are derived from crude oil. This manufacturing process is very energy intensive and results in significant waste products that can cause environmental contamination.

This information is not new, as far back as 2003, the U.S. organization, Hazardous Substance Research Centers published an article pointing to environmental hazards of petroleum refineries:

> "Refineries are generally considered a major source of pollutants in areas where they are located and are regulated by a number of environmental laws related to air, land and water." (Hazardous Substance Research Centers 2003).

Other colourants that are less harmful to the environment, can include various clays, chalks, minerals, or vegetable matter. It must be noted that mining for, and the subsequent large-scale processing of, minerals is not without an impact in terms of the environment. (Haddaway et al 2019). This is just one place where we must therefore seek, "'creative expansion'—a widening in identity that expands from the individual practitioner, to acknowledging the multiple interconnections across communities and environments in the making of the work that we do." (Beer 2021). In other words, we must take responsibility for the repercussions of our material choices in theatrical fabrication.

Although binders and solvents are not a focus of this research, I will touch upon them here to provide a fuller understanding of some of the issues of equal importance at play regarding typical paint ingredients, and why we might want to reconsider utilising them with such a cavalier fervour.

Binders

Vinyl Acetate Monomer is a commercial binder. It achieves its cohesive strength at a low cost. It is relatively inert to the user on an individual basis. However, this not so in the context of the environment, say from an accidental chemical spill, or where manufacturing by-product is released into waterways. (NOAA 2023). In better news, natural binders that can be harnessed are chalk, lime, eggs, casein (known as milk paint), and animal or vegetable glues.

The lime or slaked chalk, in this regard known as Whiting, makes a paint called Distemper. Lime also has naturally occurring antibacterial qualities. A recent article by a bureau of the U.S. Department of the Interior, confirms its “fire retardant, antiseptic, antifungal, odorless and non-allergic paint” qualities. (National Park Service 2023.) It has been examined recently in terms of its potential against pollution damage. According to an article published in: Progress in Organic Coatings. “The selection of lime-based tempera paints for conservation interventions must be made.” (Herrera et al 2018). In one example from the U.K., Graphenstone is marketing:

> “[N]atural paints and mortars using lime from the highest quality local sources. This unique lime is created through using a 100% natural and environmentally friendly production cycle. Thus, a tradition which had almost been forgotten has been brought back onto the market. (Graphenstone 2023).

In a surprising tangent to my own café project, because of its low toxicity and the mildness of its basic properties, slaked lime is also widely used in the food industry, as illustrated in an article from Food Science & Technology, in the manufacture of the humble tortilla chip. (Salazar et al 2014).

Other natural binders can include sticky things that are found in nature, such as various cooking oils, saps, and resins. Many of these have been used for hundreds, if not thousands of years. They do not cause the same types of ill effects to the environment, and in some cases are completely biodegradable. Progress is being made. In 2000, the ACRES group, (Affordable Composites from Renewable Sources,) published research on “the development of all-natural composites”. (Williams & Wool 2000).

Solvents

Solvents in paint vary. The CEPA, (Canadian Environmental Protection Act,) has a published list regarding management of toxic substances, in which solvents feature quite heavily. More information can be found via the government website. (Government of Canada 2023).

It is probably VOCs (volatile organic compounds) that we most readily recognize in terms of solvents in paint. (EPA 2023). Part of the problem continues to be that excess paint, is routinely washed down the sink, ending up in our groundwater very quickly. Typical solvents found in these types of paint are hydrocarbons: "Hydrocarbons are petroleum products, such as gasoline and kerosene, and are also ingredients in paint thinners, solvents, glues, and some cleaning products. They are dangerous when the fumes are breathed" (Merk Manuals 2022). It is of note that a natural citrus solvent can be used. This alternative is 98 percent pure orange peel extract, fully biodegradable, will not add colour to the paint, and has no known health hazards (The Green Design Centre 2023).

Multiple other additives are too numerous to contemplate for the purposes of this thesis, as almost infinite varieties exist depending on such parameters as: the specific paint, manufacturer specifications, desired sheen, intended lifespan, price point, and the intended quality of, and market for, the product. Suffice it to say that there is an environmental impact of many of these products to the detriment of our environment, or us: either from a manufacturing standpoint, a health hazard standpoint, a disposal standpoint, or all the above.

Disposal

Disposal is another factor that should be considered. In terms of most theatrical scenery, disposal happens relatively quickly, within months and not years. It may be possible to up-cycle leftover paint by using it on another set, indeed, paints of similar chemical families can be mixed

into a type of universal base coat, although efficacy will depend largely on what the next layer needs to be. No scenic artist will thank you for base coating in a dark value when the next layer is a very light one. The Guild of Scenic Artists recently posted an article that suggests easily achievable methods to be more ecologically conscious:

> "Reuse, and recycle, but don't dump paint! One easy-to-do option is to combine like colors, this can save storage space and weird, random, or otherwise un-useful colors can be incorporated into "slop paint" for Back or Base-painting. Many States [in the U.S.A.] now have programs that will let you recycle paints if they are still in their original containers they can be recycled." (Power 2023).

Paint can also be left to dry out completely, or mixed with sawdust, and then disposed of into the domestic waste stream. This means that it is destined for landfill, where it will leach its ingredients into the groundwater, perhaps comparatively slowly, over many decades. In this regard, the paint in question must contain no prohibited substances. Reading the label, SDS (safety data sheet) information and keeping track of what is mixed into this 'junk paint' is imperative. The paint needs to dry out in something, and that 'something' is also destined for landfill, whereas it could potentially have been recycled, for example a metal paint can, or a plastic bucket. Disposal in its liquid form requires special handling, and must be treated as hazardous waste, discarded according to local regulations. Here in Toronto, the city publishes information via its website. (Toronto 2023).

Looking Outward

Whilst our own industry of theatre, is taking steps to tackle environmental initiatives, there are other close cousins, so to speak, achieving much. “Related industries, such as architecture, product design and fashion, have already shown us how an ecological ethic can reap enormous rewards.” (Beer preface xvi). Multiple other practitioners have offered a variety of initiatives or products, that offer hope towards more environmentally friendly colourants. Beer is clear to point out that, “Ideas of ‘hope’, ‘mutuality’ and ‘reparation’ are at the crux of Ecoscenography, and ultimately at the transition to an ecological approach to theatre production.” (Beer 2021).

In the discipline of costume dying, the Glyndebourne Opera House in Sussex, England, is taking a very old approach: traditional plants like madder, woad, and weld are being grown onsite in a dedicated garden. These petals, stalks and roots are being harvested for use in the dying of costumes for their professional production seasons. An article from the U.K. publication, Country Life outlines this initiative, penned by John Hoyland, Garden Advisor at Glyndebourne. He describes part of the problem. “Chemical dyeing is a very polluting operation, using huge amounts of water, which often gets dumped back into rivers and waterways, together with the toxic residues.” (Country Life 2022).

A new initiative has been invented by Imperial College Graduate, Nicole Stjernswärd. KAIKU is powdered paint pigment harvested from the organic waste from produce including avocado peels, lemon rinds and beet remnants. Inspired as a response to the fact that, “there are few alternatives to petrochemical colors. KAIKU is the result of collaborating with artists and scientists to rigorously test and understand natural colors.” (KAIKU 2023). KAIKU is one of the recent developments in ecological surface treatments that inspired me in terms of an idea. In her

article for the Journal of Chemical Education, entitled, *"Colorful and Creative Chemistry: Making Simple Sustainable Paints with Natural Pigments and Binders."* Jillian L. Blatti beautifully encapsulates this concept. "[O]utreach efforts aimed at teaching chemical concepts in a creative way, inspiring the next generations of scientists and educators to use the tools of chemistry toward the development of a sustainable future." (Blatti 2017).

I suggest that less ecologically detrimental colourant should factor into the global conversation around sustainable design. The ingredients discussed, (as well as plentiful others to numerable to contemplate,) confirm that conventionally derived colourants, and some typical paint ingredients, are indeed problematic. Therefore, I conclude that sustainable paint options are a critical component in sustainable design for live performance.

Chapter Four : Buy-In and High Functioning Industry

Buy-in is defined as “acceptance of and willingness to actively support and participate in something (such as a proposed new plan or policy).” (Merriam Webster 2023). As an act of alignment with regards to Ecoscenography, my thesis invites buy-in as a core concept. It is my hope that starting with small acts of engagement in my hypothetical café can engender a more hopeful outlook. Tanja Beer speaks to ecoscenographic relevance in her wisdom of, “creativity, abundance and hope.” (Beer 2021).

Holistic thinking towards better sustainability practice is at the forefront across high functioning industry. At York University this is encapsulated in the *Whole Institution Approach* that is cited by our Office of Sustainability:

> “At York, sustainability is more than a promise to control our waste and energy. It is the lens through which we see everything we do. It is in the character that we all have, in the space we all occupy, and in the culture we create for everyone—on campus and in our communities. Most importantly, it is the challenge that we must all agree to tackle together.” (York University 2023).

Without buy-in, it is very difficult to conceptualize a framework that voluntarily embraces the systemic change required in our industry of sustainable design for live performance. It is my fervent desire to encourage a mindset that can embrace more sustainable surface treatments for scenic production. By creating an interaction between two elements in relationship: café fayre and naturally derived colourant I have introduce ecological engagement and aim to expand ideas around concepts that further critical thinking. I intertwine the sensory pleasure of café fayre with the naturally derived colourants from the café waste. In addition to

bringing to the forefront the concept of a ‘closed loop’, the objective of this synergy is to engender a way to think differently, and subsequently voluntarily choose to *act differently*, regarding the creation of more sustainable colourant initiatives. This is buy-in. According to an online article in Forbes magazine from 2015, “Our research has shown that 70% of all organizational change efforts fail, and one reason for this is executives simply don’t get enough buy-in, from enough people, for their initiatives and ideas.” (Hedges 2015).

Where could we leverage high level systems thinking towards better ecological practices, that already exists in other industries, to help us foster a more sustainable methodology for theatre and possible inter-relationships?

> “[S]ystems thinking sets out to view systems in a holistic manner. Consistent with systems philosophy, systems thinking concerns an understanding of a system by examining the linkages and interactions between the elements that comprise the whole of the system. Systems thinking in practice encourages us to explore inter-relationships” (Learning for Sustainability 2023).

To view this critically from a more expansive perspective, there are a multi-level actions taking place every day to combat climate crisis, across a broad spectrum of industries, organisations, and businesses. High level systems thinking, and ecological best practices, that come from other well-established realms, can pertain to sustainability in a design-for-theatre context. I explore the idea that we may not necessarily always need to start from the blank page, so to speak, in conceiving of methodologies and practices towards a more sustainable future, in our own discipline.

This is how I came to choose one such high-functioning industry: Sustainable Fishing. I sought out this field in particular because it is arguably the world's first sustainable industry. It has achieved a massive amount of buy-in. Before the 1600s it was widely accepted that God put fish into the sea. After the Enlightenment, the period where to quote the British Library, "Centuries of custom and tradition were brushed aside in favour of exploration, individualism, tolerance and scientific endeavour," (British Library 2018). It was accepted that fish put fish into the sea, and this realisation created the world's first working model of sustainability.

In early 2023 I conducted field research in New Zealand, canvassing a global sustainable fishing expert, Dr. Geoffrey Allan Tingley. I explored this area of expertise by way of analysis of best practices, break-down of system thinking and function, to better understand where the core methodologies of this specialised field emanate from. Although the two disciplines of sustainable design for theatre performance and sustainable fishing may seem far apart – my research has confirmed that there is genuine and, moreover, leverageable insight that can be effectively parlayed across from sustainable fishing to sustainable theatre. A fishery can be considered akin to a theatre construction facility in this analysis: It is the place where fish are deposited in an unprocessed state, (raw material,) to be manipulated by workers, and turned into a product, that is moved to a different place for sale to the general public, who subsequently consume it.

To delve further into this analogy: the raw materials of theatrical production for performance are deposited to the theatre production facility. For example, this may be the wood that is manufactured into 4'x 8'sheets of construction grade plywood - destined to become flats, or bolts of fabric - ready to upholster a piece of furniture. These materials are manipulated by workers, who turn them into the product of the set. This set is then moved to the theatre auditorium. This 'product' is sold to the general public by way of ticket sales. The people that we

refer to as ‘The Audience,’ effectively ‘consume’ the live performance. The Producers benefit from the potential profit of a successful run, and the Theatre Company re-invests the money back into its future theatrical endeavours.

The Flourishing Business Canvas have developed a matrix of 16 necessary and sufficient questions which form part of their collaborative toolkit. It is a common language developed to create and share meaning for communication. This flow from environment, to society, and ultimately economy, is encapsulated in Figure 7 below:

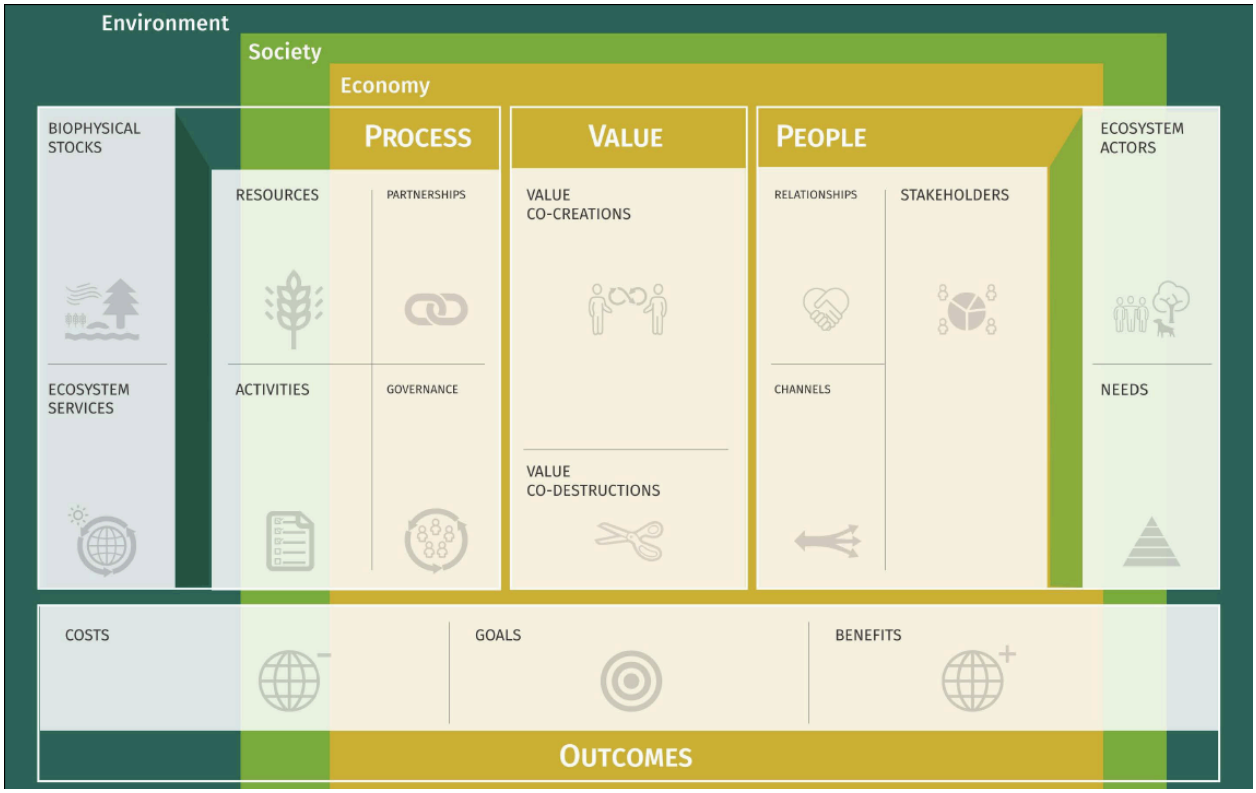

Figure 7. Flourishing Business Canvas © 2022 Flourishing Enterprise Co-lab

In an ideal world there would be little waste generated as the by-product of theatrical production. Re-use would be commonplace, and a streamlined system would exist moving the materials of scenery manufacture back around in a loop which would effectively turn it back into more theatrical scenery. This aligns with the concept of a circular economy versus a linear

economy. The Government of Canada defines these concepts well in the information posted in: Environment and Natural Resources. This information is available online.

> "The way our economies extract, use, then dispose of resources is putting pressure on our natural systems, communities, and public health. This is a linear economy—it moves in a straight line from resource extraction to waste disposal. In a circular economy, nothing is waste. The circular economy retains and recovers as much value as possible from resources by reusing, repairing, refurbishing, remanufacturing, repurposing, or recycling products and materials." (Canada 2023).

It seems that we are not always conducting ourselves as sustainably as we might be, at the theatre production facility level. As we have seen, oftentimes scenery is discarded, where it will end up in landfill, or saved to be re-used in untenable conditions, such as outside where it is vulnerable to the elements. This is problematic and it highlights that effective planning is one key element that must accompany any long-term goals of reasonable longevity. All of this is not to say that industry progress has not been made.

Tanja Beer is notable in her promoting of a system that she has coined the 3 Cs of Ecoscenography, "co-creation—celebration—circulation" (Beer 2021). Here then, the co-creation refers to not only the concept of 'many hands make light work,' (although that as a working model remains to be true,) but implies that the set can literally be co-created with all human and non-human collaborators, including from existing scenery. Celebration in this context encompasses the performance aspect of theatre, and circulation is the rally cry for us to reconsider and improve our current practices through circular economies and consumption, as opposed to our current relatively linear system.

This is one way that we can view our own unique industry supply chain, and the waste that we currently generate. What I am offering is that in consort we can look to an action plan FIP, (Fisheries Improvement Project,) model of assessment. This is a style of tool that could be an asset to a production facility precisely because it systematically aids progress towards better practices. Progress versus perfection, or as Dr. Tingley states, “FIPs are designed to lift up, versus shut down a fishery.” (Tingley 2023).

He shared an example of an Action Plan FIP with me:

- What is currently being done?
- Is there a stock assessment?
- Is there public access to this information? Address transparency.
- Which type of public documentation is appropriate? (They can range from a publicly displayed check-box system (such as those found in an airport washroom facility) all the way to a published independent audit
- Are there any gaps?

Make an evaluation. (Utilising standard industry analysis)

- Establish the monitoring procedure for these three areas:
    1. What are the critical elements that require immediate attention?

       (The budget/infrastructure exists)
    2. What are the most pressing elements that should be addressed soon?

       (The budget/infrastructure may not exist)
    3. What are the optional recommendations?

       (The budget or infrastructure does not exist.)
- What is a reasonable timeline for implementation across all recommendation areas?

- Define the parameters: [such as] every day, next week, once a year, or every 5 years

Some of the core ideas he shared were seemingly simple:

> "Pick things where you can make a difference. Focus on the easiest things first. You want deliverables, not dreams. Systemic change must contemplate scope and scale: change that is too big or too fast may be difficult to assess, too small a change may not have a viable impact." (Tingley 2023).

This type of system aligns well with theatre praxis: a model with the parameters set at industry request, functioning as a self-monitoring system because there is inherent buy-in.

I am not suggesting that many individuals, and indeed groups around the world, are not currently engaged with sustainable theatre methodology. Clearly, there is much critical thinking in existence. It is the action that we are mobilised to take that must compel inception. Ian Garrett is clear to point to this in the foreword to Beer's prescient book, *Ecoscenography*: *An Introduction to Ecological Design for Performance.* "But I, and any other individual scenographer with similar advantages, serve as mere novelties within the larger world of performance design if collective action eludes us." (Garrett 2021).

Others are clearly and competently enacting multi-level, structured implementation. As an example, in the U.K. there is an organisation that has been working tirelessly: "In collaboration with cultural and environmental partners, *Julie's Bicycle* delivers learning programmes, tools and resources, and leadership initiatives, which respond to the demands of the climate crisis." (Julie's Bicycle 2023). A huge amount has been achieved by this pioneering organisation since its inception in 2007.

What I posset is moreover an invitation to expand our awareness. If we fully desire to encompass a paradigm, that not only offers an implementation model, but excels in a reasonable

timeframe, we might wish to incorporate both a curious and collaborative mindset by contemplating functioning structures that exist in global specialities. Subsequently, I suggest we can grow further in our own unique discipline, by leveraging learning from industries that are in essence, running in parallel. There is much to learn, as I have seen first-hand, from investigation and subsequent appreciation of an industry with a proven track record of integrated systems thinking, that achieves an extremely high level of buy-in. This I believe, is part of our own collective responsibility to not only succeed – but excel at creating sustainability in a theatre design context, in the Anthropocene.

Chapter Five: The Café

The Theatre Greenbook, published in the United Kingdom and available online, has "brought together theatre-makers and sustainability experts to create a common standard for making theatre sustainably." (theatregreenbook.com 2021). In *Part 1: Sustainable Productions*, it is asserted that "Scenic art is a specialist theatre skill with an important contribution for sustainability." (Greenbook 2021). We are guided to acknowledge that paints can be harmful, and wherever possible should be sourced sustainably. In the "Toolkit" section of the manual concerning scenic art, guidance is given to prioritize "bio paints with a low VOC [volatile organic compounds,] content," (Greenbook 2021) and to "Explore traditional and natural size and powder paint." (Greenbook 2021). The Greenbook recommends to, "Explore flour and water solution for indoor use on papier-mâché which dries 'rock hard'." (Greenbook 2021).

Inspired by these critical concepts, my thesis design is a recipe book, offering a route from typical café fayre to scenic product: thereby harmonizing the intersection between the food and drink stream, and scenic surface treatment. Importance is also given to the impact of the ingredient choices themselves; this is in direct consideration of SDG (Sustainable Development Goal) #3: Good Health and Well-Being, "To ensure healthy lives and promote well-being for all at all ages." (UN 2022).

There are many naturally occurring colourants that can be found in food and drink ingredients. According to research published in the *International Journal of Food Science & Technology*, "Consumers are increasingly avoiding foods containing synthetic colourants, which lead food industries to replace them by natural pigments, such as carotenoids, betalains, anthocyanins and carminic acid. (Azeredo 2009).

This chapter focuses on the produce that contain these as well as other pigmented compounds, the dishes that can be made in an in-house theatre café setting, and a brief breakdown of the associated health benefits of consuming the ingredients, as well as offering simple methodology for making the colourants. The focus produce items are onions, beets, spinach, and red cabbage, their associated hue derivatives being broadly: orange, magenta, yellow/green, and purple/blue, and berries. Strawberries, raspberries, blackberries, and blueberries make a variety of jewel toned colourants. Other sources of colourants that derive from spirulina, turmeric, and blue pea-flower tea are also offered in the booklet to support the range of colours based on modern colour theory, in the palette concept that I suggest in Chapter 1. I have also included black tea, coffee, and cocoa.

Spirulina features in my hypothetical café menu in the Vibrant Smoothie recipe. “Spirulina is edible algae renowned for its content of protein and antioxidants, and for its desirable colorful properties.” (Exberry by GNT 2023). It is noted for its “staining ability cum stability with boiled rice as a natural colourant.” (Kathiravan et al 2022). Its efficacy is already well known in the food colouring industry and in use by the organisation, GNT Group. GNT Group have trademarked a ‘colouring foods’ system, which they have named *Exberry.* They define the categories of existing food colourants:

“In general, there are three predominant classifications for food colors:

- **Artificial Colors:** chemically synthesized
- **Selectively Extracted Additive Colors:** originate from a natural source and undergo selective extraction, often through the use of chemicals, to create a functional additive (e.g., beta-carotene, carmine, annatto extract)

- **Coloring Foods:** edible raw materials that have not undergone selective extraction of the naturally occurring pigments." (Exberry by GNT 2023).
- GNT Group work to forefront naturally sourced colourant, under the proviso of NATCOL, "The Natural Food Colours Association (NATCOL) [which] promotes the use of Natural Colors and Coloring Foods worldwide" (NATCOL 2023).

I have suggested spirulina as a deep green, however with the processing that is industrially possible within the food industry, it is utilised as a naturally sourced blue.

Turmeric is native to southern India and Indonesia; however, it can be grown here in Canada. (Wysocki 2023). Growing ingredients locally benefits the environment because it cuts down on the energy and resources needed for transportation. Turmeric provides a colour due to its staining properties, "Curcumin is a bright yellow pigment found in the rhizome of the widely utilized spice, turmeric" (Walker and Mittal 2020). It is also touted for its impressive health benefits, "including antioxidant, anti-inflammatory, anticancer, antigrowth, anti-arthritic, anti-atherosclerotic, antidepressant, anti-aging, antidiabetic, antimicrobial, wound healing, and memory enhancing" (Aggarwal et al 2013).

Blue pea-flower tea has gained popularity recently. Haleh Cohn, a student from McGill University in Montreal, Quebec notes that "This plant boasts a brilliant blue flower that can serve as a natural dye for fabrics and for…tea" and remarks that the change in colour in the presence of an acid is because: "The tea is an acid-base indicator! It changes hue in response to a change in pH." The pH stands for *potential hydrogen*. "It is a measure of hydrogen ion concentration in an aqueous solution based on a scale that ranges from 1, which is very acidic, to 14, which is basic. A neutral solution has a pH of 7." (Cohn 2022). I have utilised this property in my MaGINcian

Cocktail recipe. The blue pea-flower is native to Indonesia. Although it is a perennial in its native climate, it can be “cultivated as an annual in northern zones.” It is also a “reclamation plant that fixes nitrogen in the soil.” (Gillette 2023).

The black tea, coffee and cocoa in the recipe booklet are included two-fold. Firstly, they are ubiquitous beverages that would be hard to exclude, even from a hypothetical café. And for my scenic colourant purposes, because of their staining properties.

Tea has been used for a long time in the theatre to tone down soft goods (fabrics) that would appear too bright onstage. “China is the birthplace of tea and possesses rich tea resources, hence extracting natural dye from the waste tea can improve the economic benefit of tea and promote sustainable economic development.” (Zhao 2021). In this abstract Zhao says: “Natural dyestuffs are evaluated as green sources to color the fabric in the textile industry.” In this context ‘green’ refers to better ecological sources than the usual azo dye and notes the “recent ban on the use of azo dye by the European Union.” Azo dyes and pigments are from a large class of synthetic compounds.

Coffee sludge is a waste product of brewing coffee. It is the residue left after the liquid is poured off for consumption. In a study conducted in 2008, which looked at colourfastness as well as deodorizing properties, coffee sludge performed well: “Considering natural dyes generally have low fastness (about 2nd grade), the fastness of dyed fabrics obtained in this study are considerably good.” (Hwang et al 2008).

To make a naturally derived colourant from **onion skins**, the skins are boiled in water to extract their colour compounds, and then the resulting liquid can be strained, reduced, and cooled for use. It is the anthocyanins that give some onion skins a reddish-purple colour, and quercetin which gives the yellow browns to other varieties. Onion skin dye does not require a *mordant*,

(substance that permanently fixes a dye into a fabric,) although the addition of one will create different colours, as seen below in Figure 8.

Figure 8. Shades of wool dyed with various types of onion skins. Source: © Iran Pazirik Carpet 2022.

There is a significant "growing interest in natural dyes in the textile dying industry for coloring fabrics due to growing environmental consciousness of preventing toxic synthetic dyes." (Dutta 2021). The research adds that eucalyptus bark showed an excellent result as a natural mordant. Compounds from onion have been reported to have a range of health benefits which include anti-carcinogenic properties, anti-platelet activity, anti-thrombotic activity, anti-asthmatic, and antibiotic effects. (Griffiths et al 2002) as well as benefits to bone mineral density. (Wang 2020).

Beets are extremely versatile. They can be eaten raw, juiced, cooked, or pickled, in both sweet and savoury dishes. Beets can be grated raw, roasted, boiled, and add an earthy sweetness to recipes. I have incorporated them into my recipe for the Beet Choc-o-Cake. The magenta staining hue of beets is derived from betalains, which are water-soluble, (nitrogenous) pigments. The beet peelings are boiled to extract their vivid colour. Higher extraction yield can be obtained by adding ethanol or methanol alcohols to the water to leach out the betalian compounds, or by introducing slight acidic conditions, for example, by the addition of white vinegar to the boiling water. Research points to the many health benefits of including beets into our diets. They boast

an impressive list of positive bioactivities, (effecting a tissue or cell,) including antioxidant, anti-stress, anti-anxiety, anti-hypertensive, anti-inflammatory, anti-diabetic, anti-cancer, anti-obesity, and have a lipid lowering effect. (Nirmal 2021).

Spinach is a known source of naturally derived green colourant. An online article from *Gardening Know How* suggests a recipe: chop up the spinach, place in a saucepan, add twice as much water as spinach, bring it to a boil, and allow to simmer for an hour. Once the resulting product has cooled, strain well before use. (Spengler 2022). Until recently it was widely accepted that the green colour was due to the presence of the chlorophyll compounds, reflecting light. In fact, it is not these compounds, but rather the presence of cellulose in the leaf structure, that causes our perception of a green colour. “The cellulose of the cell walls is the main component that diffusely reflects visible light within plant leaves” (Virtanen 2020).

Due to the curvature of the human eyeball, we are more prone to perceive the spectral occurrence of green. Green light has more of a visible impact than other wavelengths, (of the visible spectrum.) It is this *spectral sensitivity,* (of the human eye,) that deepens our perception that plant leaves are green, because green light has a higher probability to become diffusely reflected. Spinach has been proven to combat oxidative damage of our cells, positively modulate, metabolism, gene proliferation, and inflammation, as well as curb food intake, by inducing our satiety hormone secretion. (Roberts/Régis 2016).

The hearty brassica: **red cabbage** can be consumed both raw and cooked. Eastern European cultures have a tradition of slow braising it with cinnamon, apples, and onions, which I have incorporated into the booklet: Braised Red Cabbage. Red cabbage will last for a long time once harvested. The colour is a result of the anthocyanins residing in the leaves. It is these same anthocyanins that point to corresponding benefits, when consumed by people. Once again, it is

the inherent antioxidant properties, that are highly correlated to our health. (Yuan 2009). According to an article published in Science Magazine, “It's not that hard to make a natural blue dye. Just take a red cabbage, cut it into pieces, and boil it. What you get is a purple broth that turns bright blue when you add some baking powder.” (Kupferschmidt 2021). The baking powder is a compound containing sodium bicarbonate as well as an acid.

Beyond the selection of plant sources for the colourants, it would be optimal to grow the proposed produce at the theatre premises itself. This idea is in step with other synergistic global initiatives as we have seen at the Glyndebourne Opera House in East Sussex, England. An article written for online publication *Garden Museum* featuring the dye garden at Glyndebourne Opera House U.K. comments, “There is a dye garden where dahlias, madder, irises and many other plants are grown for dying costumes.” (House 2023).

This serves as a framework for positioning naturally derived colourant, for the scenic art discipline, into the global conversation. From this research the fundamental nature of the proposed raw ingredients themselves already sustain us, nourish us, and aid in our health. They also create valuable jobs in our community. I have envisioned a synergy whereby we bring produce into the arena of scenic colourant, via a typical theatre café, and create a model whereby waste generated can find new purpose. My thesis is towards expanding the vision of a more circular economy where nothing is wasted.

Chapter Six: Café Procurement in Toronto

In this chapter I contextualize the basics of produce, as I feel it pertains to the operational side of my hypothetical theatre café. Where could produce emanate from? How much does it cost? Where does the waste usually go to? How can I better understand the supply chain, and subsequent impact, of raw ingredients?

I will start with the focus produce. Onions are an extremely versatile local vegetable. They are a main ingredient in my recipe for an Onion, Spinach & Turmeric Tart, and in my Braised Red Cabbage recipe. (Both found in my recipe booklet.) Onions are inexpensive, a 10lb bag of onions costs $10 for a business to purchase from 100 Km Foods, a distributer which sources their produce from small, organic farms, which are located at most 100 kilometres from their base in Toronto, Ontario. They consistently meet verified standards for social and environmental responsibility and have been recognized as being in the top 10% for [positive] Community Impact. (100 Km Foods 2022). They are also rated by the B Corporation, which is:

> "[T]he non-profit network transforming the global economy to benefit all people, communities, and the planet. Building on our standards and certification process, our network leads economic systems change to support our collective vision of an inclusive, equitable, and regenerative economy." (B Corporation 2022).

Their onions are sourced from Hillside Gardens Limited, a business that has been running for four generations. They grow root vegetables in the "rich muck soil" of the Holland Marsh in Ontario's Greenbelt. (Hillside 2022). At two million acres of protected land in Southern Ontario,

this Greenbelt is the world's largest, encompassing: farmland, forest, wetlands, rivers, and lakes. (Greenbelt 2022) and the Ontario Ministry of Agriculture, Food, and Rural Affairs, (OMAFRA). In 2009, *Hillside Gardens* implemented an innovative traceability system that earned them the Local Food Plus Certification, as well as the Minister's Award for Agri-Food Innovation Excellence. (Hillside 2022).

Good Leaf Farms produces the Spinach that 100 Km Foods distribute. They have a mission of "Ethically grow simple produce that inspires healthy lifestyles through environmentally conscious agricultural practices." (Good Leaf 2022). Their website speaks to their commitment to efficient water use, responsible land use, and a low carbon footprint, (at just half that of a traditional farm.) I have incorporated spinach into my Onion, Spinach & Turmeric Tart recipe. The protein in spinach contains all essential amino acids, which are critical for those amongst us who do not consume animal-based proteins. One cup of boiled, drained spinach is equal to 5.35g of protein. (Rochester University 2022). A 142g bag of baby spinach can be purchased from 100 Km Foods for $5.82 CAD. (Prices are accurate as of August 2022). Spinach spoils fast. Therefore, freezing spinach should be considered. Sustainable Communities SA Inc. is a non-profit, membership-based organisation in Southern Australia. In an online article, directions are given to freeze the washed and blanched fresh spinach in glass jars. (Sustainable Communities 2009). This allows the spinach to be locally purchased at its peak harvest season and cuts down on the *carbon footprint* of relying on spinach that is produced, and then delivered from far away. A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions. (The Nature Conservatory 2022). The choice to freeze the spinach in glass jars, (as opposed to plastic freezer bags or plastic containers,) should be considered. Plastics are particularly damaging to the environment.

> "With 4 to 12 million tons of plastic entering the marine environment each year, plastic pollution has become one of the most ubiquitous sources of pollution of the Anthropocene threatening the marine environment. Beyond the conspicuous physical damages, plastics may release a cocktail of harmful chemicals, i.e., monomers, additives, and persistent organic pollutants." (Delaeter et al 2022).

This should serve as a reminder to carefully consider the utensils and containers, of both the proposed theatre café, and the scenic art department.

Red Cabbage is sold by 100 Km foods at a cost of $2.59 per cabbage. It comes from local producer, Top Tomato Foods. This family owned and operated company spans back over 60 years. Their focus has always been on three main crops - cabbage, cauliflower, and broccoli. Vito De Filippis Sr. started the farm comprising of 100 acres of land in Uxbridge, Ontario. Since 1960, they can be found at Ontario Food terminal stall 354. (Top Tomato 2022).

Another source of colourant, berries, grow in reasonable proximity to Toronto, Ontario. There are multiple pick-your-own berry farms including, Reesors in Markham, Ontario. (Reesors 2023). Berries in our diet are good for us according to a 2015 article, "Recent clinical evidence indicates potential of berry-rich diet in controlling the risk of chronic diseases." (Yang and Kortesniemi 2015). I added them into the Vibrant Smoothie Recipe for taste and health.

In Toronto, our fresh produce is often centrally sourced from the Ontario Food Terminal, located on The Queensway, Etobicoke. It is the largest wholesaler in the country whose distribution encapsulates Fort Albany, (Northern Ontario,) Windsor, (Southern Ontario,) British Columbia, (Western Canada,) and Newfoundland and Labrador, (Eastern Canada.) It is a "Self-

funding Operational Enterprise of the Ministry of Agriculture, Food and Rural Affairs, and has been supporting the 'BUY LOCAL' movement since 1954." This facility contributes at least 100,000 direct and indirect jobs to the Ontario economy, excluding farm workers, and the terminal employees. (OFTB 2022). No public monies are used to support its operation, as it self-funds from facility user fees. In Ontario alone, it boasts over 5,000 buyer businesses. Environmental sustainability must be considered in regard to agricultural production if a viable liaison is to be brokered, even whilst contemplating a hypothetical theatre café establishment. According to the Malheur Experiment Station at Oregon State University:

> 'Agricultural sustainability is the idea of creating the most positive results, while reducing negative impacts. It encompasses three purposes: to maintain and advance lasting environmental, social, and economical practices.' (Shock et al 2021).

They go on to state that:

> 'While sustainability is inherently complex and multifaceted, the overall goal of sustainability is to practice management methods that are safe, healthy, fruitful, and can stand the test of time. To practice total agricultural sustainability is to employ all three aspects.' (Shock et al 2021).

Warehouse Tenant, F. G. Lister & CO, is a distributer at the Ontario Food Terminal. This company has been in operation since the 1930s. Their website includes a commitment to environmental sustainability, "to engage in responsible sourcing of products and packaging material and execute using environmental[ly] friendly practises." (Lister 2022). As an example: During 2021 in Ontario, 5,316 total acres of onions were harvested at an average yield of 34,058

per acre. This brought 181,053,000 lbs of onions to market in Ontario, through distributers such as F. G. Lister & CO (Onions 2021).

Figure 9 below shows this traditional procurement, and regular supply chain, of produce:

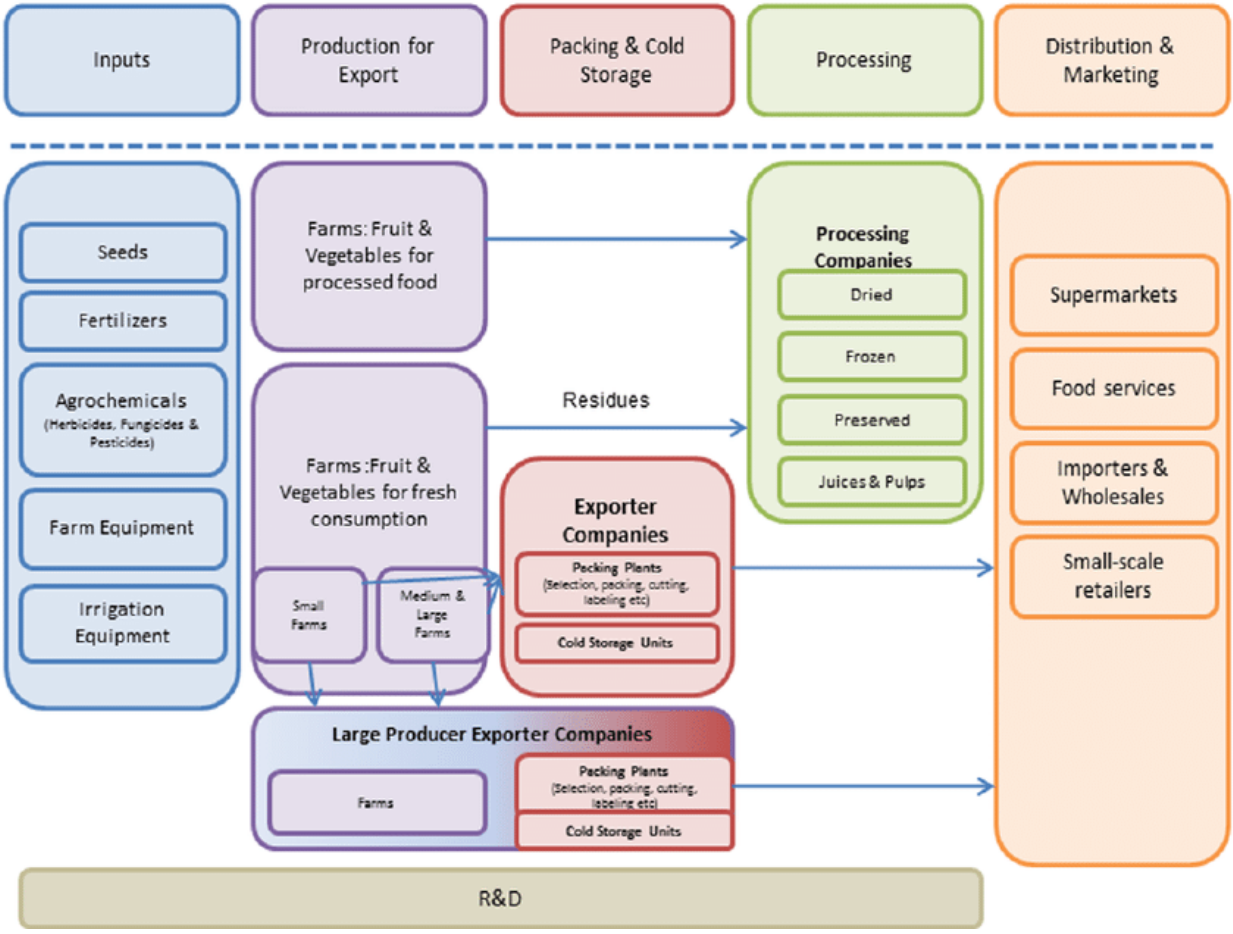

Figure 9. Center on Globalization, Governance & Competitiveness. © Duke University 2011.

In terms of the beverages, coffee is a product that is imported into Canada because it requires a hot climate in which to grow, However, according to the Canadian Broadcasting Corporation (CBC) in a news article from 2022, a Vancouver coffee shop successfully harvested coffee that was grown onsite. “After a few months, the flowers grew into coffee berries, properly known as cherries. Once they ripened and turned red, they were ready for harvesting.” (Gomez

and Mendoza 2022). I recognize the import costs to the environment regarding coffee crops and am pleased to note others attempting to redress this.

Cocoa powder is made by grinding up the seeds from the fruit of the cacao tree, which is native to the Amazon rainforest. Making the growing and harvesting of cocoa more sustainable, is a topic of international concern. In *Confectionary News* it was reported that, "41 players in the Swiss cocoa industry…committed to sourcing at least 80% of cocoa volumes from sustainable sources by 2025, under the newly formed, *Swiss Platform for Sustainable Cocoa*." (Nieburg 2018). This means that the cocoa will be "Produced and certified according to internationally recognized sustainability standards." (Nieburg 2018). The European Union has pledged to support Côte d'Ivoire, Ghana, and Cameroon, in another initiative. "[T]he European Union will contribute €25 million to enhance the economic, social and environmental sustainability of cocoa," It further commits: "[T]he Commission has initiated an informal dialogue in support of a sustainable cocoa sector, at social, economic and environmental levels." (European Commission 2023). There are documented health benefits associated with consuming cocoa products: "Cacao seeds thus provide nutritive value beyond that derived from their macronutrient composition and appear to meet the popular media's definition of a "Super Fruit"." (Crozier et al 2011).

A Calgary company, *SpiraVeg,* grows spirulina for the Canadian market and points out that, "spirulina can grow and thrive in closed-circuit ecosystems without compromising quality or purity." (SpiraVeg 2023). This is of note because it cuts down on the necessity of sourcing from overseas. Sourcing from geographically distant locations is problematic because transportation of goods impacts climate change. The internal combustion engine system that vehicles use, contribute negatively by adding detrimental chemicals into the atmosphere. The

Environmental Protection Agency explain this concept by using the example of a typical passenger vehicle:

> "In addition to carbon dioxide (CO2), automobiles using gasoline produce methane (CH4) and nitrous oxide (N2O) from the tailpipe and all vehicles can emit hydrofluorocarbon (HFC) from leaking air conditioners. For gasoline vehicles, the emissions of HFCs are small in comparison to CO2; however, the impact of these emissions can be important because they have a higher global warming potential (GWP) than CO2. Electric vehicles (EVs) also emit a small amount of GHGs due to air conditioner/HFC leakage." (EPA 2023).

In considering the running of a Theatre café, from a financial perspective, there may be variables, such as governmental subsidy or dependable revenue garnered from subscription support. However, in terms of a more regular type of establishment, it must be acknowledged that profit margin is paramount, in order that it be a viable enterprise. There are the *cost of goods sold,* (COGS) which reflect the initial financial outlay for ingredients and sundry items, (like toothpicks.)

The following formulae express this relationship:

> "Beginning Inventory + Purchased Inventory – Ending Inventory = COGS
>
> COGS ÷ Total Food Sales = % (Food Cost Percentage) where 28% is optimal
>
> Ingredients Price x Amount Sold = Total Food Cost Per Dish

> The impact of small changes can be huge for profits: If 50 customers per day order the same meal, and that menu item is priced by only 50 cents lower than optimal, then that results in a net loss of $25 per day, from that dish alone." (Gordon 2022).

There is momentum gathering in moving towards more sustainable initiatives. As part of our Climate Change Action Plan, the Ontario Government pledged in 2017, "The province of Ontario is shifting to a circular economy – a system in which materials are never discarded but reused or recycled into new products and reintegrated into the market." (Food and Organic Waste Framework 2017). This is a government pledge that commits to holistic practices regarding the life cycles of our food resources. See Figure 10 below. This commitment is emphasized regarding food waste.

> "[I]n order to move Ontario towards a truly circular economy, efforts should not be limited to recovering nutrients and resources at the end-of-life stage. We must also prevent food from becoming waste in the first place." (Food and Organic Waste Framework 2017).

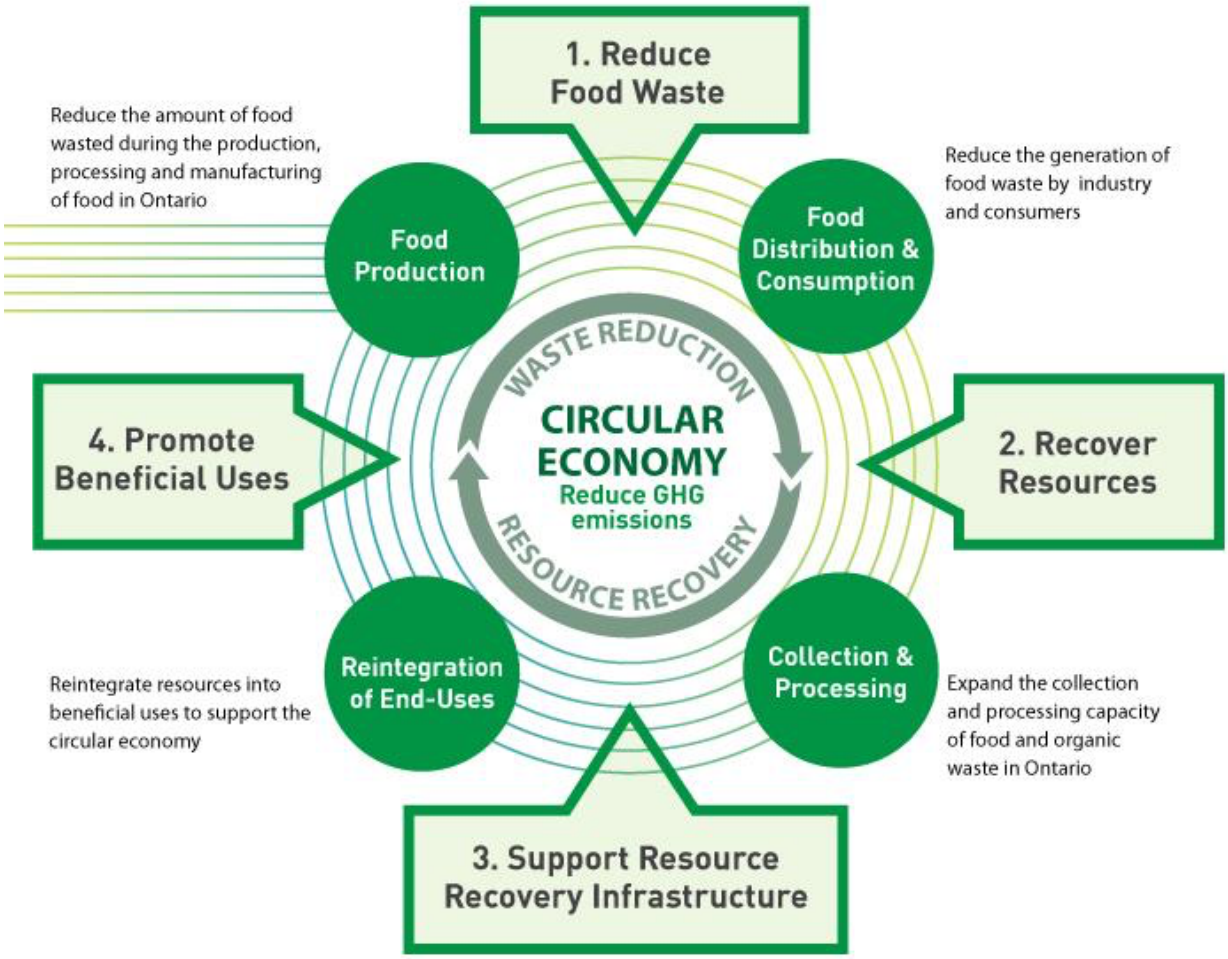

Figure 10. Climate Change Action Plan. Food and Organic Waste Framework 2017. © Ontario Government.

This is not to say that re-use of produce waste is the only option: In Toronto we have a tax funded, organics, 'green bin' collection service. This service is more specifically a collection contract, held by the for-profit, private company, *Green for Life*. The organic material is taken to a processing facility, where it is unloaded onto a tipping floor. It is pre-processed to remove the plastic bags and contaminant materials from the organics and is placed in a hydro-pulper where it is mixed with water to remove non-organic materials. Separation can also be achieved using a press. The material is sent to anaerobic (absence of oxygen) digesters, to break down the material

into solids and biogas. The solids are redistributed for free to city residents, in the form of compost, as well as being used by the City of Toronto. There is a process underway currently to harness the green energy potential of the biogas: upgrading it to renewable, natural gas. Whilst all of this is laudable, based on this brief description, none of it is achieved without financial cost, and a considerable amount of energy consumption, which again contributes to climate change. (Greenbin 2022). Food waste imagined as a country emits a vast amount of greenhouse gasses as shown below in Figure 11.

Global Greenhouse Gas Emissions related to Food Waste

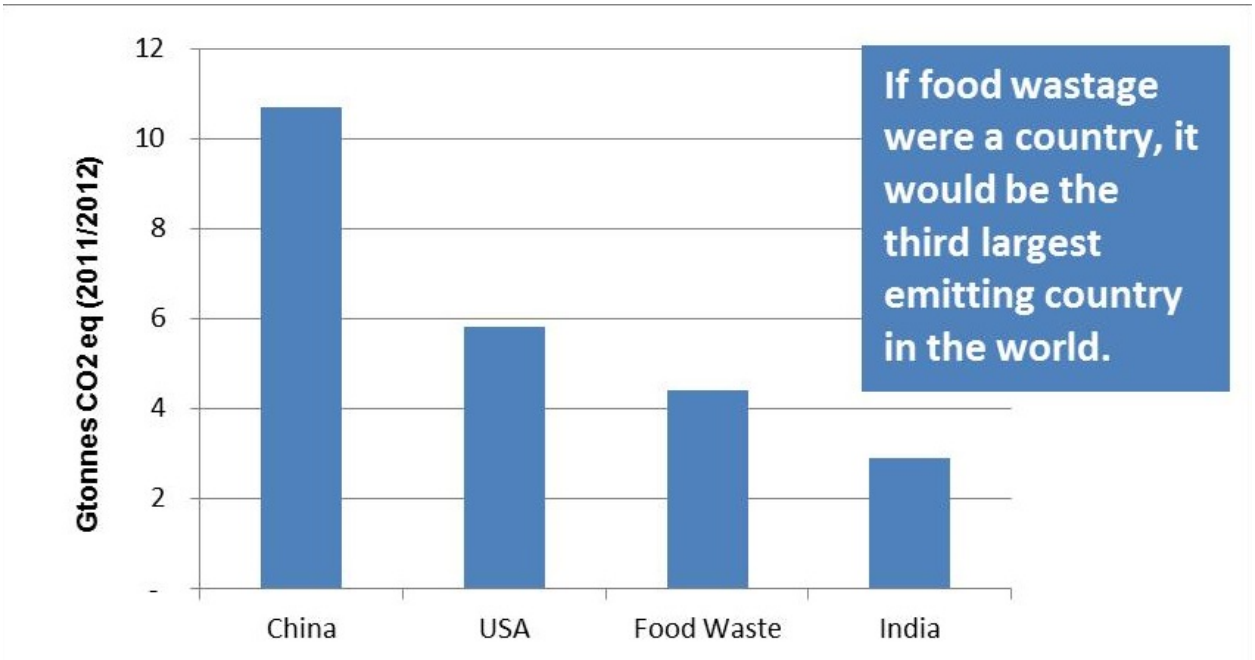

Figure 11. Source: Adapted from SDG Target 12.3 on Food Loss and Waste: © 2017 Progress Report Ontario Government. Climate Change Action Plan. Food and Organic Waste Framework Certification, as well as the Minister's Award for Agri-Food Innovation Excellence.

In conclusion it is clear that many factors and nuances are to be considered towards any real café / naturally derived colourant endeavour. It is bolstering to reflect that there is an impetus within the infrastructure of our existing Ontario Government Climate Change Action Plan and the framework as it pertains to Food and Organic Waste. It is a matter of leveraging platforms to create viable change towards better sustainability in our discipline.

Chapter Seven: The Recipes

Onion Spinach & Turmeric Tart - Onion, Spinach & Turmeric Colourant

Vibrant Smoothie – Berry & Spirulina Colourant

Mag*in*cian Cocktail – Beverage Colourants

Braised Red cabbage – Red Cabbage Colourant

Beet Choc-o-Cake – Beets Colourant

In this chapter I will reflect upon the experimentation, process, and documentation of my recipes in the booklet. My hypothesis is that food waste, remnants and derivatives can be explored to make naturally derived colourant which is useful for scenic painting applications. I created a recipe booklet because I wanted the platform to foster engagement. The way in which someone will interact is designed to be easily understandable as a tenet of this project. One of my core concepts is that comprehension regarding the imperative to make more sustainable choices regarding the creation of surface treatments for theatrical scenery, is not the issue, but rather buy-in. I wanted to create a synergy whereby less environmentally detrimental colourant is generated from the simple process of creating sustenance, nourishment and hopefully, pleasure.

In this iteration then, the colourant must be both naturally derived and easily achievable. Engagement fostered by tethering dual acts of creation. The way in which I have chosen to forefront this idea is very simple: a recipe booklet of café fayre from which food, beverages and naturally derived colourant can be made.

The process of making the colourant for my booklet was multi-layered. I started by shopping for my ingredients in local stores and made efforts to buy produce that had not

travelled far to get to Toronto, where I live. The menu items were chosen based on the colourant outcomes that I wanted. I worked in my home kitchen for the purposes of this project. Whilst this framework is not ideal, it exists as a starting point. I experimented with varying ways of extracting the pigment from produce items, onion skins, red cabbage, berries, spinach, lemon and beets. I tried soaking the produce items separately in cold water. This only washed it. (With the exception of a small amount of colourant that came from the beets.) I catalogued each colourant by taking samples after various reduction times, sometimes with the addition of vinegar or baking soda, painting on a wooden substrate that had been primed with white paint, and dipping fabric swatches into the cooled colourant. The fabric swatches that I used in all cases were natural fibres of either cotton or silk; gauze, silk, muslin, canvas, and black sharks tooth scrim.

Onions

I used only the onion peels for colourant and the edible part of the onion was used twice: both in the Onion, Turmeric & Spinach Tart and as a core ingredient in the Braised Red Cabbage. The process for extracting the colourant from the onions can be seen in figures 12 – 16 below.

Figure 12. Onion skins boiled 1 hour

Figure 13. Onion skin colourant

Figure 14. Onion skins on substrate

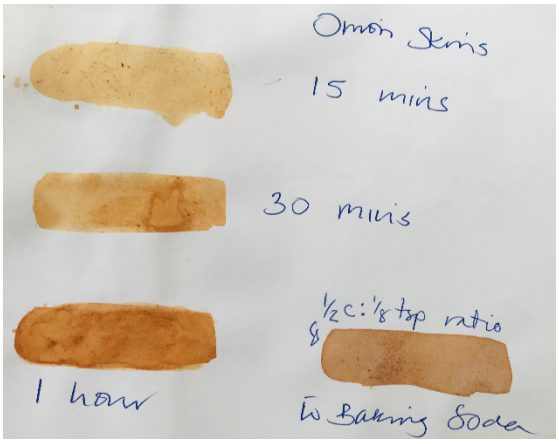

Figure 15. Onion skin colourant intervals

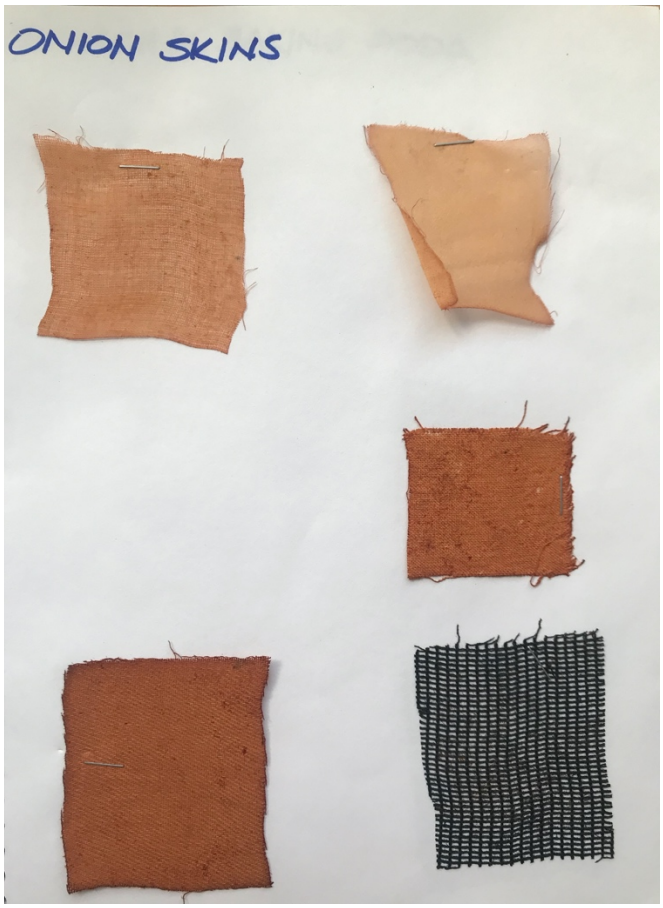

Figure 16. Onion skin colourant on fabric swatches
L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

Spinach

The spinach was used in the Onion, Turmeric & Spinach Tart. I used fresh spinach that I rinsed, chopped, and incorporated into the recipe. It was sautéed along with the onions, prior to the addition of the turmeric. The stalks, and any sub-optimal leaves were used to make the Spinach Colourant. The process and outcomes are documented in figures 17 - 22 below.

Figure 17. Spinach

Figure 18. Drained Spinach

Figure 19. Spinach colourant

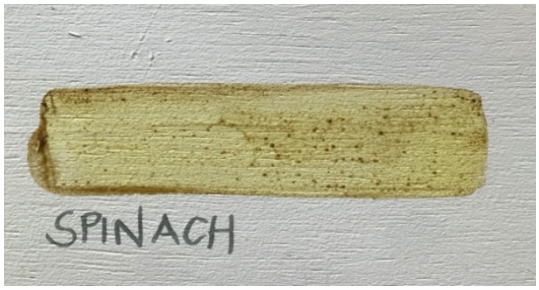

Figure 20. Spinach colourant on substrate

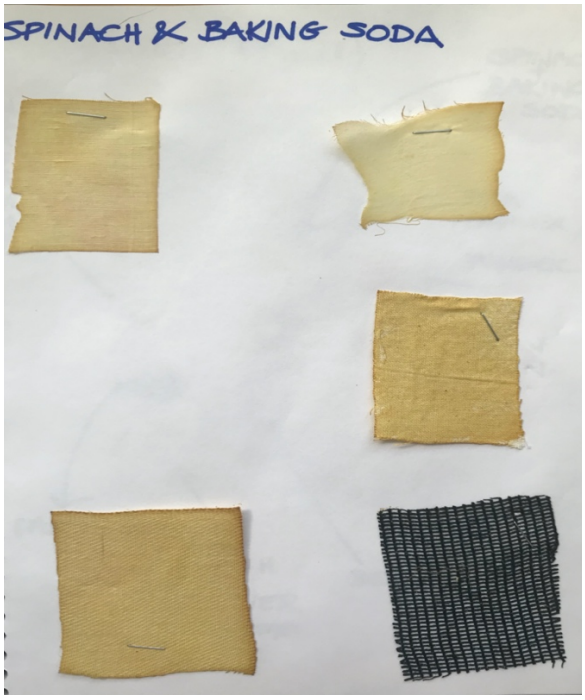

Figure 21. Spinach colourant with baking soda on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

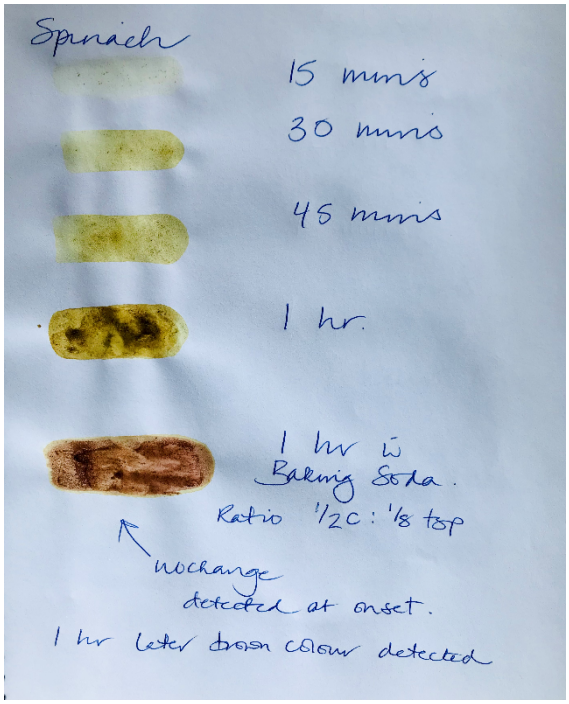

Figure 22. Spinach colourant intervals plus addition of baking soda

Blueberries

Blueberries are one type of berry that could be used in the Vibrant Smoothie Recipe. I experimented with them the most. The dark inky blue was a result of adding vinegar to the colourant. When I dipped the fabric swatches into this mixture, they stayed in the pink/purple family. But on paper and on the wooden substrate that I had primed with white paint, an inky blueness was more detectable, as can be seen following in figures 23 - 29.

Figure 23. Boiling blueberries for colourant

Figure 24. Blueberry colourant on substrate

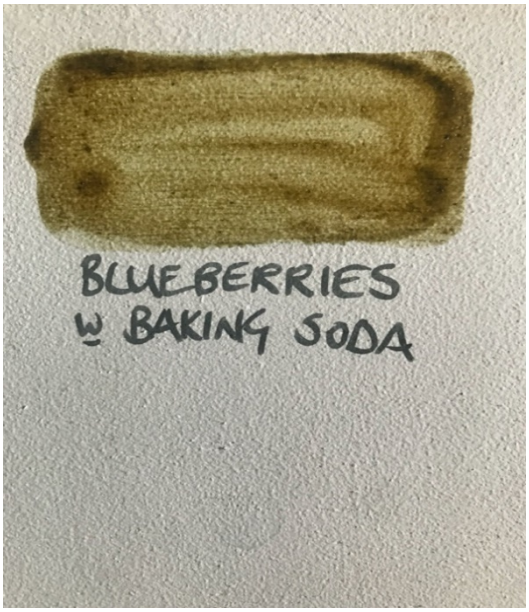

Figure 25. Blueberry colourant with baking soda

Figure 26. Crushed blueberry colourant on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

Figure 27. Boiled blueberry colourant with vinegar on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

Figure 28. Boiled blueberry colourant with baking soda on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

Figure 29. Blueberry swatches on paper: various

Red Cabbage

My recipe in the booklet utilizing red cabbage is for Braised Red Cabbage in the Viennese style. Again, it could form the basis of a coleslaw, stir-fry or be an ingredient in any number of savoury dishes. I choose this one because it is vegan, as even a hypothetical café must be able to service a diverse clientele. Figures 30 - 38 below, outline the process of methodology that I utilized for the red cabbage. In Figure 36, the red cabbage colourant was kept in the fridge for seven days before being applied to the swatches. In Figure 37 the colourant was reduced by boiling and applied to the paper at fifteen-minute increments.

Figure 30. Red cabbage

Figure 31. Red cabbage boiling

Figure 32. Red cabbage colourant

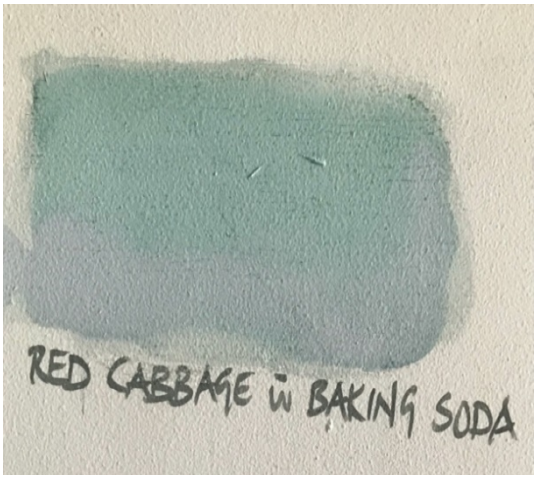

Figure 33. Red cabbage colourant with baking soda

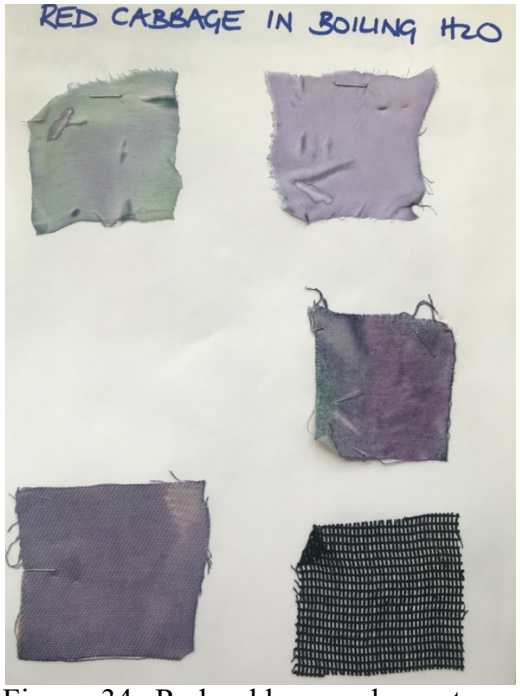

Figure 34. Red cabbage colourant on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

Figure 35. Red cabbage colourant with baking soda on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

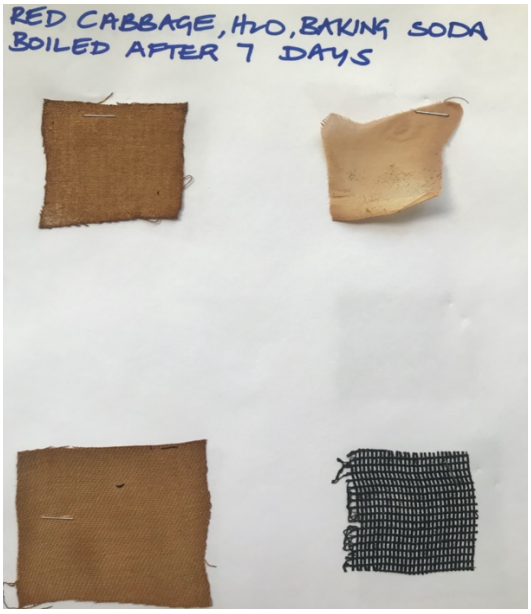

Figure 36. Red cabbage colourant with baking soda on fabric swatches after 7 days L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

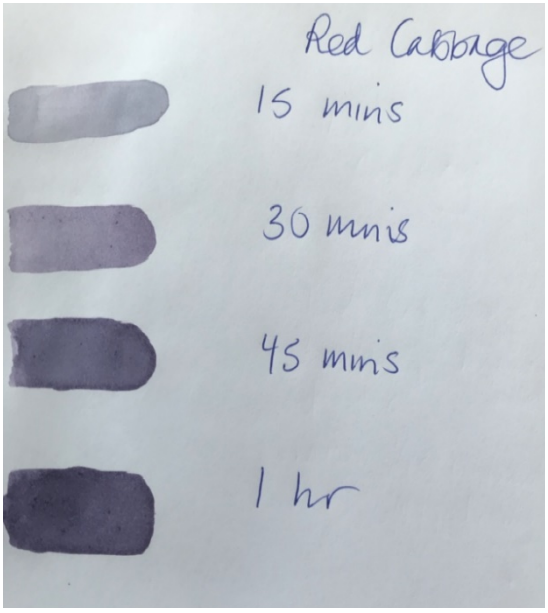

Figure 37. Red cabbage colourant recorded after four fifteen-minute increments of reduction times

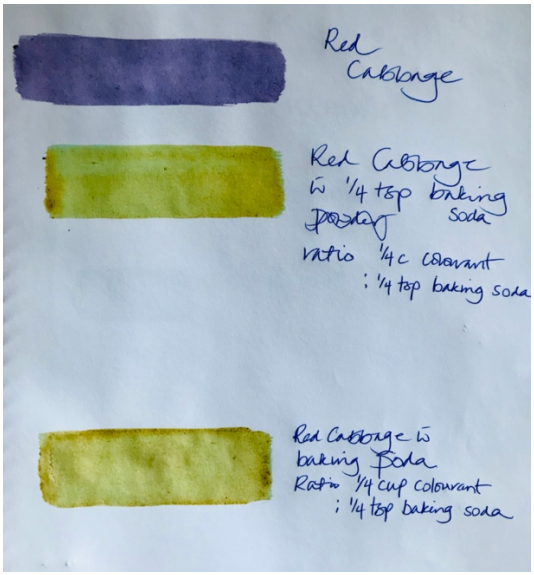

Figure 38. Red cabbage recorded on paper: various

Beets

In the recipe booklet I choose to feature beets in my Beet Choc-o-Cake, this was mostly a decision based on the flow of recipes, and my desire for a dessert offering. I wanted a cake in the hypothetical café because it is emblematic of pleasure versus meeting core nutritional needs. The beets could join the berries grated into the smoothie, or be juiced raw for a standalone beverage, or serve as the basis for a salad. The process of boiling the beets themselves, which feature as an ingredient in the cake, the cake batter, and the resulting colourant is documented below in figures 39 - 45.

Figure 39. Beets

Figure 40. Beets stain immediately

Figure 41. Boiling beets

Figure 42. Purée of beets for cake batter

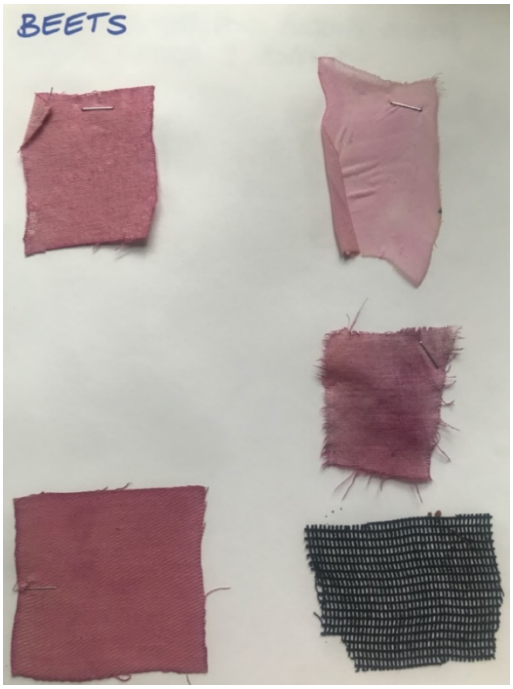

Figure 43. Beet colourant on fabric swatches L-R clockwise: gauze, silk, cotton, muslin, black scrim & canvas

Figure 44. Beet colourant on substrate

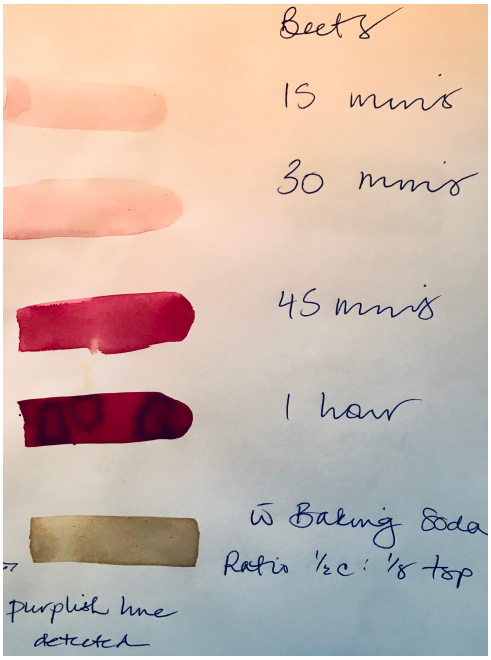

Figure 45. Beet colourant intervals recorded on paper plus addition of baking soda to final reduction at one hour

Making the Booklet

I organized the booklet with my recipe for a food item on the left-hand side of the open booklet. On the right-hand side of the open booklet my recipe for naturally derived colourant is located. In this way the reader can view both the café item and the suggested colourant in one location and at the same time. The colourant recipe is presented as a natural flow from the food item. Each recipe exits within this framework, and they are offered in relation to one another.

Based on the theories of more modern colour theory, as outlined in Chapter Two, I was clear about my choice to include options for yellow, cyan, and magenta. As we have seen, these specific colours provide the greatest opportunity for true colour mixing in the subtractive spectrum. When I researched which produce would be most suitable, I settled on turmeric, blue pea-flower powder tea and beets.

I did try other produce and beverage items. Lemon zest is a perfect cool yellow in terms of hue. There are challenges with this produce. Lemons do not grow well in most of Canada due to the cold winter months. In an article published by Donna Balzer from 2020, lemons can only be grown on the West Coast of Canada. Balzer interviewed Bob Duncan of *Fruit Trees & More* and further reports that very special considerations need to be met. (Balzer 2020). This means that lemons must travel some distance to arrive in Ontario. This is sub-optimal because it adds to their environmental footprint. The other impediment for me was particulate. Lemon peel does not dissolve in water. I tried letting the peel sit in cold water, but it did not yield a discernable hue. I boiled the lemon peel in water for 30 minutes, and a negligible transfer of colour was detected from the peel into the water. I also soaked lemon peel in vodka which I used as a solvent vehicle with which to leech pigment from the peel. The various methods that I tried in order to extract the pigment from the peel are documented below in Figures 46 - 50.

Figure 46. Lemon peel

Figure 47. Lemon peel soaked in cold water

Figure 48. Lemon peel boiled for 30 minutes

Figure 49. Lemon peel soaked in vodka 24 hours

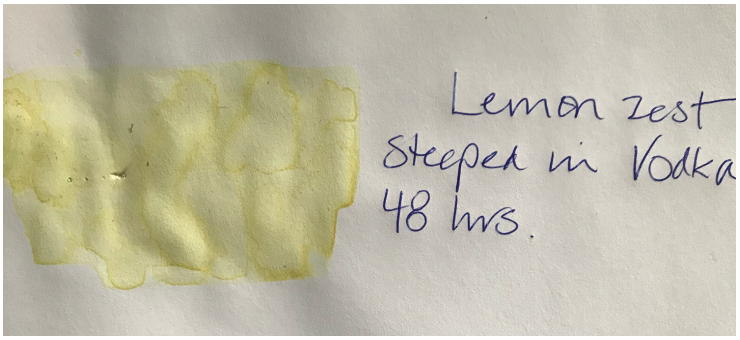

Figure 50. Lemon zest colourant on paper

The beets that I choose to create the naturally derived magenta are locally grown in Ontario. Another element that appealed to me is no part of the beets is wasted. The root itself is used in my recipe for Beet Choc-o-Cake and the leaves and stems can be incorporated into the smoothie. They would also make a great addition to the Onion, Spinach & Turmeric Tart. This leaves the peel and stems to be made into the colourant.

In conducting research regarding sources of naturally derived blue colourant there are options that exist from the commercial or industrial realm. Many ingredients including spirulina and red cabbage are under intense scrutiny. In an article published in 2016 by the New York Times magazine,

> "Among the contenders being tested in laboratories are a berry found in Central and South America, the huito, traditionally used to make dark blue, semi-permanent ceremonial tattoos and as a bug repellent; a blue gardenia flower; red cabbage; aged red wine; a bacteria used to make Swiss cheese; the Japanese kusagi berry; butterfly-pea flowers; and pigments derived from soil bacteria, tree-root fungi, sea sponges and mushrooms." (Wollan 2016).

She goes on to unpack the way in which, "About 10 percent of that [spirulina] powder is made up of molecules called phycocyanins, which, when wrested from the green, make the highly prized blue dust." (Wollan 2016). Clearly, the methods needed to extract and then manipulate the phycocyanins are available to neither the average café nor scenic artist. This is how I came to choose blue pea-flower tea.

The blue pea-flower tea that I was able to source is imported. "The plant is mainly distributed in the tropical regions of India, Sri Lanka, Malaysia, Burma, and Philippine islands." (Lakshan, Suraweera Arachchilage Tharindu, et al. 2019). However, according to research conducted in the Journal of Dietary Supplements in 2023, "Twenty-six of the most viable butterfly pea genotypes were directly seeded in mid-May at Byron, Georgia, [U.S.A.] during 2018" (Morris 2023). Their research suggests that this crop is poised to become much more widespread in North America in the near future.

I started to think about naturally derived colourant in terms of my thesis hypothesis in 2022. I realised that the preliminary way to explore and create colourant would be to make the colourants water soluble. This makes colourant most suited to soft goods which are fabric. This means that an additional vehicle, or medium is not required in which to suspend the pigment particles, (as would be the case with paint.) I experimented by sizing gauze with cornstarch. I let each of the four layers of starch dry before applying the next one with a soft brush. Once the gauze was dry, I painted onto it in a pointillist technique, inspired by: A Sunday on La Grande Jatte. Georges Seurat 1884-1886. (Figure 51.) The way in which it faded over time can be seen below in Figure 52.

Figure 51. Mattea Kennedy. April 2022. Naturally derived colourants on cheesecloth, sized with cornstarch. Inspired by: A Sunday on La Grande Jatte. Georges Seurat 1884-1886

Only some areas of the artwork faded over time, but not all the colourants have faded at the same rate. The onion skin colourant and the beet colourant retained the most chroma. The spirulina faded the most.

Figure 52. This is how much it has faded between April 2022 and July 2023

Chapter Eight : Conclusions and Next Steps

In contemplating any organic substance for theatrical purposes, it would of course be at least prudent, and from a scientific perspective empirical, to collect data regarding the lightfastness, longevity, robustness and qualities of the colourants of interest. This would necessitate a systematic charting of the various colourant's degradation over time: in controlled conditions. Although I would have been able to achieve this to a certain extent, by periodically photographing the swatches that I fabricated, the domestic conditions would not have been consistent with a theatrical environment. This is in part due to the fact that theatrical lighting instruments are powerful pieces of equipment, which pump out thousands of lumens of light. Depending on the instrument itself, (for example: tungsten, halogen LED,) varied amounts of heat are emitted. This has a knock-on effect to the environment in another way – theatre auditoriums are more arid than the typical home, which of course is a further consideration regarding how an organic substance breaks down. In terms of a hypothetical theatrical production, the running times for each Act of the Play would need to be considered, in addition to number of shows per week, and overall run length of the Production in question. Environmental factors such as time of year, (which impact humidity levels,) and seasonal heating or cooling would all have to be contemplated. This MFA thesis has not delved into these avenues of potential research, specifically because theatrical conditions cannot realistically be replicated in my home. And that is where I have laboured. Therefore, it is fully acknowledged that this project exists within limits. And I humbly offer that should a keen mind desire it, these limits could be further explored.

Even within these limitations, I have found the process of creation very enriching and valuable. I have been surprised by the intensity and subjective beauty of naturally derived colourant. It has been rewarding to assess the relative ease of which these colourants can be created. I have found it affirming to prove my hypothesis: food waste can be explored to make naturally derived colourant. I have seen that this naturally derived colourant can be leveraged for scenic art application.

Most of the produce that I experimented with achieved viable results. I was surprised at how rich, varied, and vibrant the colourant made from the onion skins was. It seems to have good staying power.

I thought that more of a green hue would emerge from the spinach leaves and stems. But I surmise that because of the procedures I undertook to derive the colourant, it turned out to be in the pale golden and brown family, and a rust cast was detected with the addition of baking soda and after one hour of sitting on paper. I wonder what the difference would have been with cold pressing, or as a result of blanching and shocking: a cooking technique used to retain both hue and intensity in cooked vegetables.

I was very surprised by the cool earthy green hue that emerged as a result of adding baking soda to the blueberry colourant. The range of hues that I was able to achieve was also unexpected. The dark inky blue which emerged as a result of adding vinegar, was a deep intensity that I could not have predicted.

I ultimately rejected lemons as a source of naturally derived colourant based on my assessment parameters concerning ease: a core concept of my project. Too many steps were required to procure the colourant. However, more globally speaking, this source of naturally derived colourant cannot be ruled out, because we have already seen it to be viable in KAIKU,

the pigment invented by Nicole Stjernsward. (Stjernsward 2023). The cool pale colourant was very pure and pleasing.

I considered pomegranate juice as a potential source for the magenta colourant that I was seeking. Although the juice itself is a ruby hue and readily available to purchase, I ruled it out without much experimentation. It is readily available, and it can be reduced extremely easily by boiling, however, whilst researching this fruit I discovered that, “The pomegranate tree is native from Iran to the Himalayas in northern India and has been cultivated since ancient times throughout the Mediterranean region of Asia, Africa and Europe.” (Maderachamber 2023). This information made it clear that pomegranates are not local produce, and further not suited to the colder Canadian climate.

If I were to continue this research myself, I would focus on exploring mordants in association with naturally derived colourant. I would want to investigate longevity, lightfastness, and relative stability in comparison to conventionally painted soft goods.

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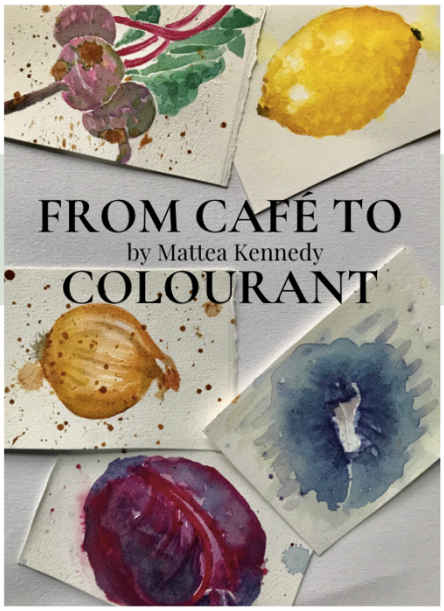
Appendix



When examined in the greater context of the environmental impacts of human activities: where there is a choice between an arts / cultural experience versus other activity, the congregating effect of collective experience trends toward improved impact metrics.

- Ian Garrett

This booklet is playfully inspired from the imagined menu of both a theatre café establishment, and onsite scenic art studio. An arts / cultural continuum that contemplates the concept of a closed loop, where ingredients and waste generated is repurposed into colourant with a less environmentally detrimental footprint than those that are conventionally derived. I invite you to imagine, pre or post theatrical production, the collective experience of congregating over food and drink. The concept is designed to lift the spirits, feed both ourselves and our optimism. The opportunity to be co- creators towards more sustainable colourant for scenic art purposes, which is made from remnant, or same ingredients as the café fayre. Connection, celebration and necessary change envisioned towards a more circular economy, as it relates to the colourant, as surface treatment, of theatrical scenery.

Front cover: all artworks painted with naturally derived colourant, sourced from the same ingredients or waste generated from the recipes contained in this booklet.

978-1-312-39484-1

WELCOME

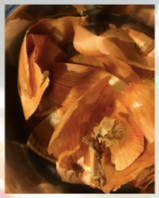
Bringing the pleasure of food into harmony with naturally derived colourant

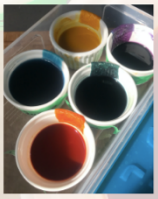
Meet Mattea

Originally from the U.K. and living in Toronto, I have been a scenic artist in the theatre community for almost 30 years. I fell in love with painted scenery in my early teens. It has been my privilege to express myself through this medium. What is Art, if not a visceral expression made tangible?

The Premise

I want to add to the growing conversation around sustainability regarding naturally derived colourant. This booklet is intended as a fun, interactive way to forefront that idea.



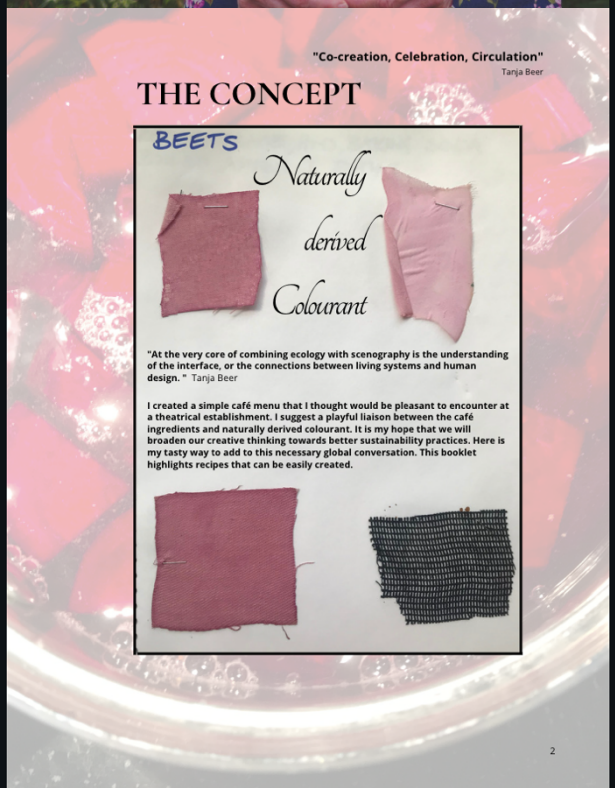


The Concept

Why should we consider naturally derived colourant? The sustainability imperative. This booklet grew out of an idea that if we want to engender fresh ideas and buy-in regarding ecologically less detrimental practices in theatre creation, then we need encouragement. In this project, the encouragement takes the form of food and drink recipes, and the easy colourants that can be created from the ingredients and remnants.

The Café Recipes


Meet Mattea
I am a Scenic Artist and creative soul. I have had the privilege to spend many years as a happy home cook and a happy professional painter. My experience as a scenic artist has given me a rich foundation from which to pursue my MFA in Sustainable Design for Theatre. Toronto 2023
Photo: Taeden Hall
1


"Co-creation, Celebration, Circulation"
Tanja Beer
THE CONCEPT
BEETS
Naturally
derived
Colourant
"At the very core of combining ecology with scenography is the understanding of the interface, or the connections between living systems and human design. " Tanja Beer
I created a simple café menu that I thought would be pleasant to encounter at a theatrical establishment. I suggest a playful liaison between the café ingredients and naturally derived colourant. It is my hope that we will broaden our creative thinking towards better sustainability practices. Here is my tasty way to add to this necessary global conversation. This booklet highlights recipes that can be easily created.
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ONION, SPINACH & TURMERIC TART

Prep 30 Mins
Time 45 mins
Serves 4
Level Easy

Ingredients

Butter	1 cup
Flour	2 cups
Ice Water	4-5 tbsp
Eggs	4 large
Onions	2 large
Spinach	2 cups chopped
Salt & Pepper	1/2 tsp each
Turmeric	1 tsp
Olive Oil	1 tbsp

Method

STEP 1 - THE PASTRY

Rub cold diced butter with fingers into the flour with a light touch until a rubble-like texture is achieved. (Do not overwork or pastry will be tough.) Add just enough ice water for the dough to become cohesive. Press into a fat disk and wrap with parchment paper. Rest in fridge 30 mins.

STEP 2 - THE FILLING

Peel and slice the onions into 1/2 moons. Warm the oil in a large skillet and gently sauté the onions and salt until translucent. Add the spinach and other spices.

STEP 3 - ASSEMBLE THE TART

Unwrap the dough and working deftly, roll out to a circumference1" bigger than a 9" tart tin. Gently lift the pastry into the tin and tuck the 1" under all the way around. Beat the eggs and pour them into the pastry case, add the sauté vegetables.

STEP 4 - BAKE

Preheat the oven to 375°. Place the tart on a metal baking sheet and place on the centre shelf of the oven. Bake for 45 minutes or until the pastry is golden brown and the filling has set. Cool before eating.

Enjoy

Onion, Spinach & Turmeric Colourants

ONION SKINS

Place onion skins in a saucepan just covered with water and boil with a lid on for about an hour. Remove and press well to extract, and conserve the colourant. It can be further reduced to create varied shades of amber richness.

SPINACH

The less perfect spinach leaves and any big stalks, (sacrifice a few pristine leaves if you want!) can be boiled for 45 minutes to make a pale hued colourant. Further boiling will create more concentrated colourant. Drain as for onion skins. Experiment!

TURMERIC

The perennial rhizome Curcumin produces the spice known as Turmeric. This powdered spice can be mixed with hot water to create a vibrant yellow colourant.

USE YOUR IMAGINATION

VIBRANT SMOOTHIE

Prep 5 Mins
Time 5 Mins
Serves 2
Level Easy

Ingredients

Berries	2 cups
Spirulina	2 tbsp
Milk	2 cups
Sweetener	to taste
Beet Greens	as desired
Beet Stalks	as desired

Method

STEP 1 - THE BERRIES

Pick your berries, literally if possible! Ontario is abundant with local berry farms in season, or forage for wild ones with proper guidance. Better still - grow your own.

STEP 2 - OTHER INGREDIENTS

Choose your other ingredients, milk, dairy free alternates, yogurt, and kefir all work well. Honey or maple syrup add a bit of sweetness. The beet greens and stalks that are leftover from the cake recipe, (p.11,) make a welcome addition here, adding both fibre and body.

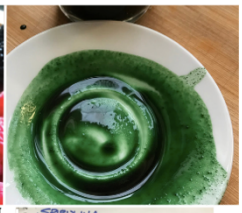
STEP 3 - SPIRULINA

Spirulina will change the colour a bit but not really change the taste. It is a potent superfood that can be added to a variety of dishes. Use it here in your smoothie for its many health benefits.

STEP 4 - BLEND

Blend all of the ingredients in the jug of a liquidizer until a pourable consistency is reached. A smoothie can last in the fridge for up to two days. Place in a well washed jar with a lid and up-cycle your recycling.

Healthy Easy Breakfast

Berry & Spirulina Colourant

BERRIES

Use seasonal local berries and freeze a glut for later in the year. Eat or blend the pristine ones and use the sub-optimal ones for a jewel toned colourant. Raspberries, blackberries and mulberries all grow in Ontario and work separately or in unison. Crush, juice or boil them.

SPIRULINA

This is a blue-green type of algae. Mix with hot water to make a richly hued colourant. Spirulina is high in protein and potassium. It is also considered an antioxidant that may help to reduce inflammation. It is also antibacterial and antimicrobial.

TRY LOCAL BERRY FARMS

MAGINCIAN COCKTAIL

Prep 5 Mins
Time of your life
Serves 1
Level too Easy

Ingredients

Gin	4 oz
Blue Pea Flower Tea	1/8 tsp
Ice	3 cubes
Soda Water	to fill
Lemon Juice	1 tsp
Smooth Jazz	to taste

Cheers!

Method

STEP 1 - THE BASE

Get yourself some locally made Gin. There are plenty of options to choose from. Support local!

STEP 2 - THE MIX

Put the ice into the bottom of a Martini glass. Pour over the Gin. Dissolve the Blue Pea Flower Tea in 1 tsp of boiling water. Add to the glass and fill with soda water. You will have a blue cocktail.

STEP 3 - THE MAGIC

Adding the lemon juice to this cocktail creates a chemical reaction. When you infuse blue pea flower tea into clear spirits like Gin – you make a blue drink. The addition of acid, in the form of lemon juice will turn the drink pink.

Beverage Colourants

STEP 1 - CHOOSE

Choose which drinks to experiment with: Red Cocoa, Filter and Instant Coffee as well as Orange Pekoe Tea all work well and will create a sample of natural brown tones.

STEP 2 - MAKE

Brew them to different strengths to achieve varying shades and concentrations. Leave the tea to brew for longer which will extract more from the tea leaves themselves.

STEP 3 - CREATE

Decide what to do with your colourant creations. Tea has been historically used in the theatre wardrobe department to tone down costumes and make them look older.

STEP 4 - COMPOST

These beverage remnants are great additions to your compost. The City of Toronto runs a free compost collection program generated from green bin collection. Find out more on the City's website.

BRAISED RED CABBAGE

Prep 20 Mins
Time 2 Hours
Serves 8-10
Level Easy

Ingredients

Butter	1/4 cup
Red Cabbage	1 head
Onions	2 large
Apples	2 large
Vinegar	2 tbsp
Salt & Pepper	to taste
Cinnamon	2 tsp

Method

STEP 1

Preheat the oven to 325°. Chop the cabbage, into quarters, removing the course outer leaves and core. (Save for colourant!) Shred each quarter into 1/4" slices.

STEP 2

Peel and finely slice the onions, save the skins as you go for colourant. Quarter the apples, core and roughly chop. (No need to peel!)

STEP 3

Melt the butter over a moderate heat in a heavy Dutch Oven. Add the cabbage, onions and apples. Stir gently until everything is just starting to soften, but not colour.

STEP 4

Add the salt, pepper, cinnamon and apple cider vinegar. Bake in the lower part of the oven for approximately 2 hours, stirring occasionally to prevent sticking.

Great hot or cold

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Red Cabbage Colourant

RED CABBAGE

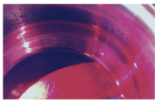
Remove the outer leaves and core of the cabbage and chop into 1/2" pieces. Boil covered for approximately 1 hour until the cabbage is paler and the water is deeply coloured. Squeeze out as much liquid as possible from the cabbage. It may be reduced further by boiling to produce a more intensely hued colourant.

DID YOU KNOW?

The anthocyanins in red cabbage are chemical compounds. Their water soluble properties create a rich range of pigments depending on the pH.

ACID AND ALKALI

The colourant will react differently with the introduction of an acid or alkali. Vinegar will turn the liquid red and baking soda will turn it blue. An excess of the baking soda will result in a green hue.
Try it!



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BEET CHOC-O-CAKE

Prep 20 Mins

Time 35 Mins

Serves 6-8

Level Easy

Ingredients

Beets	3 small
Eggs	2 large
Oil	3/4 cup
Sugar	1 cup
Flour	1 1/2 cups
Cocoa	1/3 cup
Baking Soda	1 tsp
Vanilla	1 tsp
Salt	1/2 tsp

Method

STEP 1 - THE BEETS

You will need approximately 3 beets which amount to 1 cup once peeled and chopped. (Save the peels and see the directions to make a jewel toned colourant.) Boil the beet pieces for about 10 minutes and cool before adding to the food processor.

STEP 2 - THE CAKE

Preheat the oven to 350° and grease a 7" x 9" cake tin. Purée the cooked beets, eggs, oil, sugar, vanilla and salt in the bowl of a food processor. Sift together the flour, cocoa and baking soda. Add to the wet mixture and pulse until just combined.

STEP 3 - BAKE

Pour the cake batter into the prepared cake tin. Bake on the centre shelf of the oven for approximately 35 minutes or until the cake is just starting to pull away from the sides of the tin.

STEP 4 - **BONUS AVOCADO FROSTING**

An added treat that contains a secretly healthy ingredient. Mash each avocado with 1/2 c icing sugar and 1 tsp cocoa. Add a dash of salt and vanilla extract. Taste and adjust as necessary to suit your taste. Frost the cake once fully cooled.

Enjoy

Beets Colourant

THE BEETS

Peel and chop the beets saving the peel. Boil the beets just covering them in water for 10 minutes, until a knife easily pierces them. Remove the beets from the water with a slotted spoon. Set them aside and cool for use in the choc-o-cake recipe.

DOUBLE DUTY

Add the beet peels into the boiling water and boil for an additional hour to extract as much colourant as possible. Squeeze out the solids and reduce the liquid further as you wish until the desired concentration is reached.

Clockwise: Beets, Spirulina, Onion Skins, Blue Pea Flower Tea and Turmeric

COLOURANTS:

Box of Delights

Once you have created naturally derived colourants they will keep covered in the fridge for up to one week. In your art projects you can build them up as each layer dries, which will concentrate their value or add different ones together to create new colours. Use them to paint on a hard surface, or watercolour paper for a traditional painting technique.

The colourant will stain natural fabrics such as silk, cotton, cheesecloth and muslin as an art surface. Without a mordant, (an ingredient to 'set' the colour,) it may not hold up well to being washed. You can add vinegar which will enable the fibres and colourant molecules to bond better. This has the potential to change the hue of the colourant, and make even more colours. Try it!

Turmeric	Mix with boiling water and dilute as you wish
Blue Pea Flower Tea	Mix with boiling water and dilute as you wish
Onion Skins	Boil and squeeze solids to extract a golden amber hued colourant
Beets	Boil and squeeze solids to extract a magenta hued colourant
Spinach	Boil and squeeze solids to extract a pale yellow hued colourant
Cabbage	This brassica will yield a red, mauve, purple or greenish hue with the addition of vinegar or baking soda
Berries	Berries can be crushed raw, or boiled and reduced, as for beets. Experiment by adding vinegar or baking soda
Spiruina	This powder is a vibrant dark green colour. It can be diluted with water as desired

Artwork painted with naturally derived colourant

Mathea Kennedy 2021

Red Cabbage painted with: red cabbage & blue pea flower tea
Onion painted with: onion skins & blue pea flower tea
Flower detail painted with: blue pea flower tea & cabbage
Beets painted with: beets, spirulina & turmeric
Lemon painted with: turmeric, onion skins & red cabbage

Some ways to use your naturally derived colourant:

- dip in white hen's eggs for an array of beautiful colours
- paint onto sturdy watercolour paper as a substitute for your favourite watercolour paints
- paint onto a substrate that you have pre-painted with a white base coat
- dip in clothing to give it a new lease of life
- add colourants to your favourite water based medium to create varying types of body and textures
- use for natural food colouring
- size your own canvas by dissolving starch, (potato and corn work well,) into boiling water. Paint on in layers. Once dry you can paint on your canvas with your naturally derived colourant

Record your own recipes:

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Mattea Kennedy. 2022. Naturally derived colourants on cheesecloth, sized with cornstarch. Inspired by: A Sunday on La Grande Jatte. Georges Seurat 1884-1886

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FROM CAFÉ TO COLOURANT

Mattea Kennedy

Don't forget to clean up!

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