Atmospheres of Change: Virtual Production

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Atmospheres of Change: Virtual Production

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Abstract

There is much we cannot see about change as it occurs. Virtual production indicated a shift in traditional workflows of filmmaking at a time when the world was going through massive upheaval–The COVID-19 pandemic. What made this case a rich resource for theorizing was that it offered an opportunity to examine change as it occurs. The technology had vast possibilities, even if many of these possibilities were yet to be realized. Drawing from trade and fan publications, I begin by exploring how sound was first introduced to film production in the year 1930, shedding light on pre-existing representations of production atmospheres. I then turn to contemporary artifacts in the year 2020 which showed how shifts in production pipelines through virtual production were being represented. I conclude by offering a medium-based approach to the LED screen as a way to articulate how technological objects can be mediums for relational exchange. Building upon existing theories of technological frames as developed by social constructivists, I propose an "atmospheric frame." The atmospheric frame gives rise to situations of negotiation and these situations are jumping-off points for theorizing around labor, economics and policies in adopting new technologies. My thesis is meant to be a start and not an end. How do we understand change as it occurs? What could be this ongoing heuristic?

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Acknowledgments

I dedicate my thesis to my aaji (grandmother) Vimal Kabir. She was admitted to the ICU in Mumbai, India one week before my defense. It was tough. Whoever you are, reading my words in a collection of theses, remember that it is okay to feel things. It is okay to love and to be affected by loss and change. We persevere. Always. We are resilient. I took a risk with this work, not always knowing where I was going and continuously challenging myself to be innovative in how I approached academic thinking. I was making sense of change in a fluid world. My grandma was a teacher. She believed in education. So to walk the halls of this institution, to challenge myself and to be situated in the communities around Cambridge, Massachusetts was beyond her wildest dreams. To meet incredible and kind people from all over the world–could my ancestors have imagined? But more than anything, to pursue work from a place of love. "What an honor," I think to myself. What an honor it is to be here and to be growing every day.

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Finally, here is the tree outside my room in Cambridge. The tree reminded me that change is constant. It reminded me to build a relationship with birth and death at every stage and across seasons. This is life. Change can be tough. But our world needs deep, motivated and joyous thinkers. May we begin today and continue on.

Figure 0.1. Tree outside 61 Bishop Allen Drive, Cambridge, Massachusetts.

Introduction

“Many media scholars begin their intellectual fascination via practice,” wrote John. L. Sullivan in his chapter about American humorist and ethnographer Leo Rosten. (Sullivan, 41) Rosten’s *Hollywood: The Movie Colony, the Movie Makers" (1941)* marked one of the first sociological studies of the film industry. (Sullivan, 41) My journey to engage in academic inquiry was similar. As a working producer in small-scale digital media production, I spent much of my time before graduate school staring at call sheets, budgets, job requirements, and resumes, and ensuring that crew, cast, and post-production teams made it from point A to point B. I saw that new media collaboration often adopted hierarchical structures from traditional media. The producer, director and crew functioned in tandem to the story of Hollywood workflows. But innovation also offered an opportunity. I noticed how emerging editing and camera technologies like Adobe Premiere Pro and Canon EOS 5D Mark II became mediators for creative interventions. The proliferation of these tools empowered smaller creative communities to attain visibility in countries where there had been minimal support from the government or private sectors.

In the 1930s, there was a timely and widespread interest in the relations between public trust, economic stability, and governance. Situated across industries, Rosten found himself in dialogue between government and motion pictures. Similarly, in the years leading up to September 2020, in addition to production, I was working in community education, media entrepreneurship, and human rights. My engagement across different fields ensured that my production practice went deeper than simply running a set or hiring crew. With this interdisciplinary approach to studies of change, I examine virtual production as a case study in hopes of testing some of the contradictions that come from observing change as it occurs.

Virtual Production

The term virtual production first came to my attention in late September 2020. Headlines such as “The rise of the LED video wall technologies” and “Why virtual production is the future of Hollywood” introduced articles filled with strong cases for the affordances of this emergent framework but revealed very little about the technologies themselves. What was this revolutionary technology? How was it going to propel Hollywood into the future and why were the affordances of the technology so thrilling to an industry adapting to a global pandemic? At the height of Covid-19, Hollywood was pivoting. Virtual production seemed to be the answer. As I dug deeper into the digital artifacts, I uncovered a well of resources: more articles, videos, interviews, roundtables, and Reddit forums. Then the story got complicated.

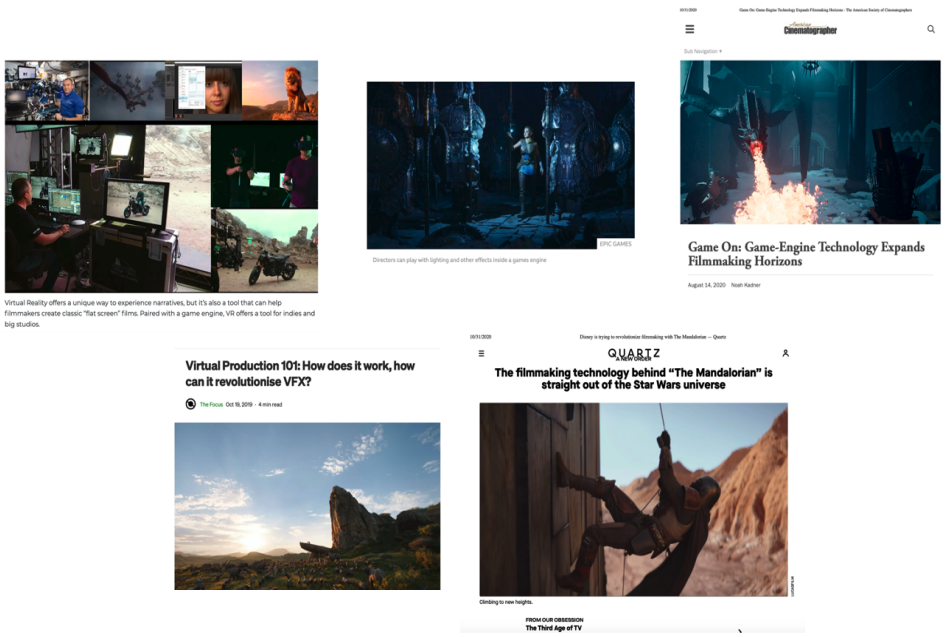


Figure 0.2. Collage of headlines on virtual production from 2020.

Much of virtual production’s hype was linked to a Disney+ television series called *The Mandalorian*. *The Mandalorian*’s storyline takes place five years after 1983’s *Return of the Jedi*.

It was widely reported that Industrial Light and Magic (ILM), a visual effects and post-production company owned by Disney, had developed StageCraft*,* a technological system built with accessible tools for seamless live-action production. (Desowitz) In September 2020, ILM uploaded a video onto social networking site YouTube depicting a behind-the-scenes look at a larger-than-life LED screen. ("The Virtual Production of The Mandalorian Season One") "How incredible!!" exclaimed almost every interviewee. The screen, framed as a game changer for studio-based production possibilities, showed that the sky was no longer the only limit. A galaxy far, far away had come within reach. How would we ever go back to the way things were?

Over the last two years, I have embarked on an extensive project to understand the landscape of virtual production, excited by possibility and reinvention but cautious of taking a strong techno-deterministic stance. The issues at hand are far more complicated and interconnected than they first appear in industry artifacts. I attended conferences, conducted off-the-record interviews, and kept a keen eye on avenues for intersecting dialogue. I have been invited to speak about virtual production at university classes and led a journalistic initiative titled *The Virtual Production Bulletin* for *Immerse* and the MIT Co-Creation Studio on how this emergent space of games, tech, film, and TV intersects with nonfiction media. I also spoke informally with several executives, cinematographers, Visual Effects (VFX) artists, and virtual production supervisors. Hence, my work is ethnographically informed, although it does not use formal ethnography to derive discursive conclusions.

Three main reasons led me towards omitting formal ethnography as my core methodology. The first was an observation that, in the middle of a global pandemic and extensive layoffs, the idea of virtual, recorded interviews made several of my potential informants uneasy. These conversations were occurring on virtual conferencing platforms like Zoom or Google

Meet, where the act of being recorded through the chat function itself was new. Secondly, to conduct deep participant observation I would have had to embed myself into either an ongoing production or several virtual meetings. As the industry coped with glaring changes, both access points were increasingly difficult to procure. Thirdly, the notion of placing someone at risk of losing their job for saying the wrong thing did not align with my personal ethic of protecting the worker. Much of the information I was gathering off-the-record revealed itself as far more useful in shaping my analysis of artifacts, technologies, and social constructions within a rapidly developing space. I decided to narrow my focus to close readings of discourse surrounding virtual production, a precedent to this discourse and an analogy that expanded the readings.

Given the two-year duration of my masters program, I adopted an interdisciplinary methodology that situates itself between social constructivist views of technology, production studies' industry artifact analysis and atmospheric phenomenology. The project is ambitious for the reason that it aims to engage fields that do not always converse. However, they are far more adjacent than they first appear. I will speak to the potential of their intersections in the concluding chapters. As scholar Lisa Parks wrote in her 2020 mapping of media studies, "Media Studies now engages with so many different objects that it has become difficult to imagine what media studies is not." (Parks, 644) As a student of media studies, this mesh of networks supports the foundation upon which I can build an ambitious project. However, it can also lead to several contradictions. I highlight these contradictions as I encounter them in the arguments below.

As authors David Hesmondhalgh and Sarah Baker argued in their work *Creative Labour Media Work in Three Cultural Industries*, there is a large amount of commercial information unavailable to researchers working within a time constraint. Hesmondhalgh and Baker merged sociology of work, media, communication and cultural studies with business, management and

organizational studies to theorize around good and bad notions of work in three creative industries. In comparison, my scope is much smaller. I was inspired, however, by their eclectic desire to experiment with seemingly disparate modalities of knowledge. (Hesmondhalgh and Baker, 8) Ultimately, my question concerns itself with interpretations of adoption as they are produced through industry artifacts. What is the ongoing heuristic? What is the discourse that can help identify this heuristic?

Complexities

In the introduction to his *Social Change Theories in Motion*, Thomas C. Patterson wrote that social change in the twentieth century was "both imagined and real." (Patterson, 9) It was ongoing and therefore required intervention. Even the most prolific social theorists like Emile Durkheim complicated their terminology around change using words like metamorphosis, enhancement, alteration, and mutation. (Patterson, 9) Did they mean the same thing? Does meaning change if sound was considered an "alteration" as opposed to a "metamorphosis"? How is an analysis of frames around the "new" seen across contexts? What is lost and what is hidden? Tom Gunning's essay in *Rethinking Media Change* introduced the finding of Russian formalist Victor Shklovsky, who stated that the "new arrives unnoticed." (Gunning, 44) He spoke in relation to the introduction of electric light in Moscow and Saint Petersburg, pointing out how journalists failed to mention technological innovation. A post-structuralist like Roland Barthes would argue for a focus on meaning. A linguist like Ferdinand L. Saussure would argue for a focus on words as "things" in the real world. My concern is to situate meaning through frames. Frames then serve as jumping-off points.

The social construction of technology (SCOT) is a subfield that intersects with other studies in the new sociologies of technology such as Bruno Latour's Actor-Network-Theory (ANT) and Large-Scale Technological Systems (LTS). (Bijker, Hughes, Pinch, xiv) They all deal with similar assertions on interconnectivity, although for someone like Latour, ANT does not offer indeterminacy as an "anything goes" approach. (Latour, 30) Instead, it is a relativist analysis that shifts focus to the connection between frames of reference as opposed to the pursuit of absolute truth. Relativist approaches expand time. They are slow, in some senses. As Latour says, "Traveling with ANT, I am afraid to say, will turn out to be agonizingly slow." (Latour, 25) Major debates have separated these "studies"; like the distinctions between human and nonhuman actors, but they overlap significantly on the basic premise that the study of technology should be placed in the social sciences. I build off of this main premise.

Atmospheric Thinking

Figure 0.3. The Atmosphere. (Phelan)

My thesis proposes to examine this heuristic through an "atmospheric frame." The first chapter introduces a deeper exploration of the terminology of "frames" as I use it in the tradition

of sociologists Wiebe Bijker and Trevor Pinch. But what is the atmospheric and how is it characterized? Atmospheric thinking in the space of art and literature has precedence. Atmospheres of the screen in mediums like photography have been theorized extensively by 20th century scholars like Béla Balazs, who wrote about the soul of cinematic film. "Atmosphere is to be sure the soul of every art," he said, adding, "It is the air and the aroma that pervade every work of art, and that lend distinctiveness to a medium and a world." (Balázs, 22) Walter Benjamin's work on "aura" also highlighted how presence in space and time is felt. (Benjamin 220) He defined "aura" as a "strange weave of space and time." (Benjamin, 19) Hans Ulrich Gumbrecht's *Stimmung* focused on the moods around reading literary texts. There is certainly overlap between their ideas, and my proposal for this thesis draws from this overlap to offer what I'm calling the "atmospheric frame." The frame also pulls from the works of scholars who examine more contemporary case studies while tapping into the work of French philosophers like Giles Deleuze and Felix Guattari's notions of assemblage as a "constellation of singularities." (Deleuze and Guattari, 406)

My working definition of the atmospheric frame is one which incorporates indeterminacy at the forefront. This is tricky, because how does one theorize around indeterminacy? It complicates the project. There are multiple examples of atmospheric analyses overlapping with fields such as architecture including theorists like Gernot Bohmë, the geohumanities with Sasha Englemann and Derek McCormack and screen studies with Giuliana Bruno and Antonio Somaini. Böhme, a German philosopher, wrote extensively on the overlap between atmosphere and architecture. According to him, "atmospheres" are meant to be uncertain. They break from a subject-object dichotomy, making them "haze-like":

> Atmospheres are indeterminate, above all, in regard to their ontological status. One does not quite know whether to attribute them to the objects or environments from which they

> emanate or to the subjects who experience them. One also does not quite know where they are. They seem to fill the space with a Gefühlston (feeling-tone), like a haze, as it were. (Bohmë, 14)

Outside of a humanities and social science perspective, the scientific development of the word "atmosphere" has its own history. As Craig Martin wrote in the journal *Studies in the History and Philosophy of Science*, the atmospheric sciences now use expensive, sophisticated tools and have their own departments, divisions, and funding. (Martin, 44) Martin argues that, although much of today's scientific atmospherics look at the use of spacecraft, radio waves, and X-ray machines to define what the atmosphere is, there are clear parallels between the medieval and early modern traditions, despite not being directly related. (Martin, 52) As he states, "Density, chemical composition, temperature and movement define the five layers, and the borders between the layers and between outer space are for the most part fluid rather than fixed." (Martin, 52)

Although the word "atmosphere" has what Martin calls a "flavor" of a classical term, it appeared at the beginning of the seventeenth century across Europe. While scientists and mathematicians such as Galileo and Descartes don't appear to have used the term, it did show up in fields like botany and medicine. (Martin, 52) Of course, more obvious fields like cosmology and meteorology worked extensively on atmospheres, specifically using philosophical and mathematical analyses, but I point out these crossovers to elucidate the complicated nature of the term's origin and how it emerged in multiple scientific fields. Martin's article is significant not for the purpose of explaining the science itself, but rather to highlight that the term has shifted through and in between what he terms Europe's network of "learned cultures." (Martin, 52) I make the case that something similar appears to be happening within the space of visual studies, architecture, film, and media studies, although my overview does not by any means cover how

expansive the emergence of this nascent space is. Instead, I elucidate on existing scholarship to highlight the truly networked nature of the term and why this characteristic makes it a rich resource for a sociological analysis of technological adoptions.

The literature around atmospheric analysis has continued to grow extensively in the spaces of art and visual studies. Besides Bohmë, scholars like Sasha Englemann, Derek McCormack and Tim Ingold have theorized varied interpretations. Engelmann's background as a creative geographer ensures that her concepts in *Sensing Art in the Atmosphere: Elemental Lures and Aerosol Practices* focus on "foregrounding the practices and experiments of the aerosolar arts by advancing notions of elemental lures." (Engelmann, 141) She draws extensively from mathematician and philosopher Alfred North Whitehead's notions of the aesthetic "lure," or the blurring between ontological boundaries. (Engelmann, 144) In this thesis, I draw inspiration from the works of Engelmann and Whitehead as an interdisciplinary producer and scholar to infuse new meanings and intersections.

The "atmospheric frame" I propose certainly uses much of Whitehead's philosophies and builds off of Engelmann and McCormack's interpretations. When scopes are large, specificity helps. As I will argue with the rest of the paper, the atmospheric frame is characterized by "situations of negotiations" alluding to the atmospheric process. Scholars like Engelmann and McCormack both speak of process. In a chapter titled "Lures of perception: Becoming Aerosolar," Engelmann dives deep into the workshop dynamics and processes of setting up artworks.

> In this workshop, the testing of the sculptures generated specific imperatives to action: the need to use less tape for edges, to expand the sculptures' volumes and to better stabilise the designs. These actions involved particular corporeal sensibilities that affected posture and movement. (Engelmann, 67)

Those specific imperatives are what I call “situations of negotiation” arising out of the atmospheric frame. As I examine the sources in the chapters below, those situations interconnect to form deeper webs of relations. However, there is a “sensing,” and while I am not interested in theorizing around the “sensing” itself, using a sensorial context offers a generative space for understanding how new technologies enter pre-existing processes.

To study representation is to ask several questions about perception and reception. Derek McCormack, a professor of cultural geography, introduced an approach to atmospheres through the notion of envelopment. In his book *Atmospheric Things: On the Allure of Elemental Envelopment*, he used the balloon as a speculative device to explore how atmospheres are sensed through processes of envelopment, presenting examples for political arenas as well as engineering. He used a working definition of atmospheres to mean “elemental spacetimes that are simultaneously affective and meteorological, whose force and variation can be felt, sometimes only barely, in bodies of different kinds.” (McCormack, 4) His project is to develop a vocabulary through breaking down the ontological, empirical, and methodological questions. Hence, the terms function to provide possible access to what he calls “a rather alluring concept in the humanities and social sciences.” (McCormack, 6). McCormack's main question concerns “sensing” itself. How are atmospheres sensed and felt? More specifically, how do balloons help us speculate around the process of envelopment?

In *Life of Lines,* Tim Ingold highlights the lack of relation between the meteorological origins of atmospheres and its metaphorical interpretations. He makes the case for including weather; more specifically, the impact of air. As he says, “The sphere of affect, it seems, has been entirely divorced from that of the meteorological.” (Ingold, 77) My goal with the literature overview was not to highlight rigid boundaries between the meteorological and metaphorical

uses of the term, but rather point to where the debates linger and how I situate myself within them. The atmospheric frame is not about articulating atmospheres but about identifying where social groups around new technological adoption refer to the "atmospheric." Ben Anderson introduces the notion of "affective atmospheres" at the intersections of emotion, space and society. His work falls deeper into the space of affect theory[1]. For him, the vague definition is an opportunity and not a limitation. It is interesting, for it "unsettles" the often rigid distinctions between "presence/absence, definite and indefinite, singularity and generality," which then gives rise to a "relation of tension." (Anderson, 80) As he states, "to describe the characteristic affective qualities of a complex assemblage such as a society or even a city, risks reification of the inexhaustible complexities of affective life." But the journey is worthwhile and has been for preceding scholars like Peter Sloterdijk and Michel Dufrenne. In making the case for atmospherics, he states that it is worth exploring because it "enables us to think further about the intensive spatialities of atmo-*spheres.*" (Anderson, 80) This "intensive spatiality" and "relation of tension" both coincide with my proposition that the atmospheric frame gives rise to "situations of negotiations." Situations of negotiation require a tense atmosphere.

In Jonathan Sterne's book on the meaning of mp3 (sound compressing), we see an extensive discussion on the marketability of new technologies. (Sterne, 4) He specifically brings up a trend that observes corporate entities focusing on definition as a proponent of marketing. (4) Why should clearly-defined sound be the most valued? Why not work through static? Or auditory glitches? Evoking Gilles Deleuze, Félix Guattari and Gilbert Simondon, cultural anthropologist Stephen Helmreich makes the case that sound is transduced. (Helmreich, 223)

[1] I chose not to use affect theory because the beauty of merging affect with science and technology is in the details. Unfortunately, the science of virtual production does not have literature with substantial, scientific details to theorize affect–based stances on. A few decades from today, when such details from scientific journals have emerged and the technology is no longer "new", an affect-theory focus would be fascinating.

While Helmreich mentions Sterne in his essay, specifically Sterne's proposition of the traveling of sound, he joins philosopher Casey O'Callaghan in disputing the claim that sound travels at all. (223) O'Callaghan instead proposes sound as an individual event. Helmreich then argues that we must think across transduction. Not at a particular site or through a traveling modality but as transduced across space and time. (229) Why do I bring this up? To pick apart notions of definition and movement. Could terminology carry promises of fidelity i.e., photorealism, much like an mp3 file carries sound and in doing so, invariably transduce ideas of aesthetic and linguistic dominance?

Again, my point is not to confuse the atmospheric with the existing theories around technologies. Why even theorize around the atmosphere? Why not simply look at change through the lens of traditional historical analyses or even sociological practices? Technological frames in the legacy of Bijker and Pinch would be sufficient. I argue that the literature around atmospherics, despite its large range, offers an opportunity to account for the unaccountable. As I explain in chapter 1, the atmospheric frame does not go against the development of societies or technologies but sits within that discussion to account for the elusive, unspoken, and unseen.

Deep Texts

> Compared to academic media and film theorizing—a discipline developed almost entirely through logically argued written texts—the industry argues with and deploys a far richer variety of communicative registers and media formats to collectively examine and understand film. (Caldwell, 348)

John Caldwell, a leading scholar in production studies, identified the differences between academic media theorizing and industrial communication. I use discursive analysis from the tradition of production studies, specifically the "deep texts" framework introduced by Caldwell to highlight how industry artifacts interact with one another. The richness that he speaks of

continues to change as communication technologies evolve. Production studies aim to eradicate these ancillary assumptions by introducing methodology unique to Hollywood. I use Hollywood here in the same context as Caldwell referred to it in his book *Production Culture: Industrial Reflexivity and Critical Practice in Film and Television* circa 2009, which is the "geographically-situated cultural phenomenon…networked across the greater Los Angeles region." (Caldwell, 424) Although much has changed since Caldwell's book was first published, I use this definition as a way to later highlight how the representation of shifting global dynamics does not accurately reflect the realities of transnational labor. As scholar Hye Jean Chung wrote in her book *Media Heterotopias: Digital Effects and Material Labor in Global Film Production*, the invisibility of transnational labor, especially in the compositing, post-production, and visual effects industries serves as a rich ground for scholarly theorizing because industry often misses the point: certain facets of post-production labor continue to remain highly invisible. (Chung, 2) But Caldwell's embedded theoretical discussions occur through a multiplicity of artifacts. Hence, analysis must incorporate the diversity of artifacts themselves. As he wrote,

> ...a form of embedded theoretical ''discussion'' in the work world takes place in and through the tools, machines, artifacts, iconographies, working methods, professional rituals and narratives that film practitioners circulate and enact in film/video trade subcultures. (Caldwell, 345)[2]

Caldwell's methodology has always been a mixture of ethnography through practitioner explanations and what he terms a systematic study of "deep industrial practices of film/video production." (Caldwell, 346) He executed this mixed-methodology by using a categorization framework of both artifacts and rituals: fully-embedded, semi-embedded, and publicly disclosed "deep texts" as one of several methodologies. (346) There were three categories of "deep texts":

[2] He elucidates this point in the notes to his conclusion as opposed to the body of the text itself. This begs new questions about end-notes and their value in academic writing.

A. Fully-Embedded: Cut off from the public, "commercially enacted or circulated by production personnel within the relatively bounded, proprietary worlds of work." (346)
B. Semi-Embedded: Functioning as institutional dialoguing between media corporations and trade associations. Their success is also determined by "forging new relationships between makers, advertisers, journalists, new personnel, etc." (346)
C. Publicly disclosed: Self-consciously directed at the viewing public by providing "access" to the ways that practitioners work, think, and talk. (346)

The boundaries between the categories continue to remain blurry, especially given how networked a production set can be. Below, I will make arguments for these relations as giving rise to situations of negotiation. In doing this, I highlight the atmospheric frame as blurry or "muddy," the latter term as used by Lisa Gitelman. (Gitelman, 4) This blurriness or muddiness indicated that artifacts do not always fall into one deep text format or the other. For example, Caldwell called the Super-Technocrane, a crane tool used to move cameras around, a "loaded cultural artifact." (Caldwell, 22) In reference to the artifact's movement, he stated that "while the interface design and use of production tools are 'fully embedded' within production culture, staged demonstrations for other technicians also function as 'semi-embedded' practices." (Caldwell, 22) It is not so much the artifact itself that determines whether a text is semi-embedded or deeply-embedded, but rather the ways in which it reaches audiences and is utilized. Hence, in the case of several texts I will look at, their categorizations matter less so than the ways in which those categories interact with each other. Caldwell's framework ultimately serves to focus on the worker, as is the case for production studies at large. More specifically, the field aims to "capture the way power operates locally through media production to reproduce several hierarchies and inequalities at the level of daily interactions." (Caldwell, 15) But my analysis combines the work of social constructivists with the production studies frameworks to

ultimately argue for the atmospheric frame as an interdisciplinary perspective from which discourse around power, labor, and economies can then be built.

Chapters Overview

Chapter 1 looks at the coming of sound to film production. Laced with historical analysis of trade and fan publications, I build upon the work of social constructivists Wiebe Bijker and Trevor Pinch with conceptual influences from the likes of Thomas Hughes. I aim to interpret how the introduction of sound occurred while it was "new" by looking at representational frames of change in four trade and fan publications from January to December 1930. In her introduction to the book *Always Already New*, professor Lisa Gitelmann questions how media should be studied. She argues that media share attributes of historical objects and scientific ones given that they are integral to a sense of what representation is and what counts as adequate. Using her terms, they "muddy the map." (Gitelman, 4) Chapter 1 highlights the atmospheric frame as having precedence before virtual production. I argue that, much like the affordances of virtual production were framed as the future of Hollywood production in 2020, sound was emblematic of a shift that inherently prioritized this atmospheric frame. The ultimate aim of the first chapter is to draw from a discursive analysis of sound when it was being introduced as a comparative space for virtual production in the year 2020. Cultural studies scholar Stuart Hall argues that representation is systemic. (Hall, 15) His pioneering work in British cultural theory laid a post-Gramscian foundation for viewing culture as a site of intervention and revelation. As in, it is not the individual ideas but the relationships between the ideas that create a web of complexities. (Hall, 15) The maximum potential of the atmospheric frame is therefore situated in a network.

Chapter 2 is focused on virtual production. I examine resources like the Virtual Production Facebook group, Reddit threads, field guides, and journalistic videos and podcasts as artifacts that interconnect. Ultimately, the second chapter expands upon the first to argue that the atmospheric frame gives rise to situations of negotiation much like in the 1930s, albeit with a few differences. I conclude by calling out some of the risks in making such comparisons. While the atmospheric frame did give rise to situations of negotiation, it is still complex. Could there be other components to the atmospheric frame? What other frames arise as a result?

In chapter 3, I focus on the LED screen by arguing that the screen itself is a medium. It is in, through, and behind the screen that the atmospheric frame is negotiated. I explore whether theorizing around the screen as a medium gives rise to a deeper understanding of the atmospheric frame and situations of negotiation. The first two chapters explored industry publications as artifacts of exploration. In chapter 3, I draw from industry texts but instead focus on elaborating components of the screen as seeds for deeper discussions on its affordances. The components I speak of include the relationship between camera and screen, the game engine, hapticity and non-hapticity, concepts of radiance and the lag. These frames and their interconnected relations show an emergence of mediation. "Mediation" is used in the context of "medium-ness." I build upon Raymond Williams' definition of mediation, leading into definitions of "media" and "medium." (Williams, 206) I also pull from John Durham Peters and Walter Benjamin's notions of mediation and immediacy. I conclude by arguing that situations of negotiation and mediation arise from the atmospheric frame but they are not limited to it, and vice versa. These boundaries are simply created to explore possibilities of observing change as it occurs. They are continuations.

Let us pause this roller coaster. My introduction could seem like an overly broad literature review. In some ways it is. I am attempting to situate the many fields and subfields I drew from while developing this research. Again, disparities between fields may appear apparent, but they overlap to reach a grander aim of articulating relational thinking and interconnectedness. Therefore, indeterminacy and the atmospheric frame are prompts and not ends. Any assertion I make is in constant motion and hopefully leads to newer, emerging ways of theorizing. Atmospheres, in their vaporous histories, make for fruitful and challenging attempts to push rigid boundaries between fields, concepts, and emergent ways of thinking.

Chapter One: Sound

Introduction

I arrived on my first professional film set at age 18. Naïve, young, and enthralled, I was a silent observer. Taking in the sensorial experience of a small slice of Mumbai production culture, contrast became a generative space, urging me to lean into discomfort and study relational dynamics. Everyone had a role. Everyone knew their role, or so it seemed. With prior knowledge from behind-the-scenes videos on social networking site (SNS) YouTube, I was captivated by the intensity of collaboration: the way time moved, froze, and began again. Over the years, I became accustomed to production language. The "sound guy," the "boom op," the "gaffer," and the "mixer" became culturally fluid terms used sparingly, sometimes overlapping from region to region, sometimes differing. When I began studying film history, I realized that cinema was once a technological revolution. It still is. How were technicians viewed? What did the very first sound engineer do on a film set? What were the responses to their role, and could something similar be occurring with the game engine developer on a virtual production set? This comparison becomes clearer in the second chapter.

There is much we cannot see about change as it occurs. However, historical readings are opportunities to reflect back onto a period when old technologies were new. Carolyn Marvin writes that "new media intrude on negotiations by providing new platforms on which old groups confront one another." (Marvin, 5) What could an article in *American Cinematographer Magazine* say about how sound was presented to a predominantly visual audience? How would a studio producer or a director have understood new workflows around sound as it was being iterated? With these questions in mind, chapter 1 will situate sound in film discourse at a moment in time: January to December 1930. I chose the time frame of 1930 to mirror the year 2020. One

cannot draw immediate parallels, but 1930 and 2020 both marked new decades at times of mass upheaval and shifts in the world orders. It was far less about drawing out these parallels at random but exploring whether a fundamental, dogmatic shift in the system around sound could lay a foundation for observing change with virtual production. We know through film sound historian Douglas Gomery's arguments that in the mid-1920s, the U.S. motion picture and radio industries were competing for an audience. (Gomery, xviii) Motion pictures were also competing with the music industry for record sales and with live vaudeville entertainment for viewership. Studios like Paramount Pictures Inc. and Loew's Incorporated dominated the market.But this dominance was shaped by a waiting game. (Gomery, 63) Here, information was leverage and newness was a catalyst. By observing the actions of innovators like Lee De Forest, studios were able to protect their interests in the long run. 1929 and 1930 were record-setting years for film attendance, especially for theaters that made the switch to sound. (Gomery, xv) The Great Depression had caused some studios to close. But still, by the 1930s the talkies had arrived. It is this arrival that I base my argument around. How exactly had these talkies arrived and how was their arrival characterized in 1930? Were adopters working towards the frame or against it?

For decades, Donald Crafton, a prominent sound scholar, argued that "sound divides the movies with the assuredness of biblical duality." For Crafton, the transition was "years in the making and in the finishing." There was not as much a clear "before" and "after" to demarcate when the talkies spread and the end of the silent film occurred. Crafton's three phases of invention (leading up to 1925), innovation (1926-1928), and diffusion (global adoption throughout the 1930s) become significant as I align his work with approaches like social constructivism. (Crafton, 1999) Other frameworks to interpret sound also come from Robert C. Allen and Douglas Gomery, who described film as a system rampant with multifaceted divisions

across culture, art, economy, and technology. Was a seemingly networked system also then represented as "networked"?

Gomery's independent book *The Coming of Sound*, published in 2014, frames the transition to sound in film production as "rapid but not chaotic." (Gomery, 1) He argued that while film historians have debated sound's organic arrival, corporate interests and strategic planning played significant roles in how this innovation shifted cinema. The change was seismic not purely because of a singular invention, moment, or act but rather through a myriad of collaborative steps broken down into categories. Media scholars like Brian Winston would agree with the overarching sociological viewpoint of complexity. Winston introduced the idea of "supervening social necessities," meaning that for any new technological development, a social need was required. (Winston, 67) However, he also argued through the "law of the suppression of radical potential" that a status quo would continue. (68) There would be no radical change. For Gomery, the dust had settled by 1930 and there was no denying that sound was going to be an integral part of the cinematic experience. Sound had "arrived" in so far as it was gaining traction. But how was change being represented at the site of this arrival? This is where I argue for the atmospheric frame as situated within Bijker's technological frame. The atmospheric limits change as it occurs to a specific moment in time. It is in an offering for the ongoing heuristic.

Sources

The four publications chosen are exemplary, not exhaustive; they function to offer a slice of historical nuance. I conducted analyses of trade and fan publications to assess how knowledge about change was formed as the technology was being introduced. I noted language around

headlines and repetitive patterns in both text and format, but my evidence is largely anecdotal. The four publications are described in the table below.

Name	Type	Description	Deep Text Category
American Cinematographer Magazine	Trade Magazine	Focused on cinematography.	Fully-embedded
Variety	Trade Magazine	Originated as a weekly newspaper reporting on theater and vaudeville.	Semi-embedded
Photoplay	Fan Magazine	One of the first fan magazines in the United States.	Publicly-disclosed
Talking Screen	Fan Magazine	Ran from January 1930 to October 1930.	Publicly-disclosed

Figure 1.1. Table showing trade and fan publications from the year 1930.

Using Caldwell's framework, *American Cinematographer Magazine* could be categorized as fully-embedded in that it was relatively "bounded" in its instituted industry dialogue. *Variety* was semi-embedded in facilitating dialogue between makers and trade associations, while *Photoplay* and *Talking Screen* served as publicly-disclosed texts. As Caldwell argued, these boundaries are not as rigid. ACM also facilitated dialogue between advertisers, for example. The difference between ACM and *Variety* was in the specification of the audience. Ultimately, ACM was for cinematographers and technicians. Variety was intended for a business audience. (Biltereyst and Vijver, 19)

SCOT, the atmospheric frame, and the "situation of negotiation"

Scholars from both the social sciences and the humanities have long debated the relationship between technology and society. The Social Construction of Technology (SCOT) approach argues that technology is shaped by society, and in turn shapes technology. Sociologists

Wiebe Bijker and Trevor Pinch's concept of "interpretive flexibility" states that a technology can sustain divergent opinions. (Bijker, Hughes and Pinch, 7) These interpretations lead to contradictions that must be solved. SCOT is predicated on the understanding that relationships, technologies, and societies are so interconnected that we must take up multiple disciplines if we are to make sense of them. I argue that the coming of sound in film production can be viewed through the "atmospheric" frame which lives within the technological. What is the technological? For Bijker and Pinch, technological development is a "non-determined, multidirectional flux that involves constant negotiation and renegotiation among and between groups shaping the technology." (Bijker, Hughes and Pinch, 7) However, the technological development frame is not limited to engineers.

> The need to make a technological frame into such a broad concept arises from the requirement that it must be applicable to social groups of non-engineers also …Thus a technological frame should be understood as a frame with respect to technology, rather than as the technologist's frame. (Bijker, 167)

My concern is less with the makers of the technology and more with the adopters of sound in the context of film production. But these boundaries again, were not as rigid at the time of adoption. As Crafton argued, phases of invention, innovation, and diffusion were not clearly demarcated. Hence, the entanglements between various social groups were inevitable. But how does one identify the atmospheric to elucidate a heuristic on change? What counts as a signifier of the atmospheric? Here, I bring in the "situation of negotiation." A situation of negotiation is created as a result of social groups working towards the atmospheric frame. One can only begin a discussion of the atmospheric frame if situations of negotiations have been identified and argued for.

Definitions are important. For the purpose of my work, "situation" and "negotiation" are not used separately but rather as "situations of negotiation." This is a crucial distinction of

meaning. The Oxford Learners Dictionary defines negotiation as the "formal discussion between people who are trying to reach an agreement." ("Negotiation") Negotiation theory is examined heavily in fields such as conflict resolution, global policy and business administration. It can also be viewed through behavioral frameworks and game theory. However, I use negotiation in the context of Bijker's argumentation. Let us revisit his definition of technological development above, where Bijker defines the technological frame as "non-determined, multidirectional flux that involves constant negotiation and renegotiation among and between groups shaping the technology." (Bijker, Hughes and Pinch, 7) I am not as concerned with what the negotiations are in their specificities, but rather the conditions upon which they arise. These "conditions" are what I term "situations." Keep in mind that I argue for the atmospheric as situated within Bijker and Pinch's technological frame when alluding to the adoption of sound; the atmospheric frame is identifiable through situations of negotiation but it is not limited to this one situation.

The term "situation" can bring up slight complications when used in an undefined form. The Oxford Dictionary defines situations as "all the circumstances and things that are happening at a particular time and in a particular place." ("Situation") Chicago school sociologists like William I. Thomas and Florian Znaniecki laid out frameworks for a definition of situation when addressing the social group of polish immigrants to Chicago between 1918 to 1920 as social milieus taking into account traditions, customs and beliefs. Robert E. Park and Ernest Burgess in 1921, wrote that "every single act, and eventually all moral life, is dependent upon the definition of the situation." (Park and Burgess, 764) However, social constructivists place situations in the context of frames. When speaking to the development of Bakelite plastic, for example, Bijker used "situation" to identify three extensions of the technological frame in the process of development–no dominant technological frame, one technological frame, and several dominant

technological frames. (Bijker, 181) Bijker cautions scholars to avoid interpreting false rigidity as a trap that ultimately avoids the true complexity of the techno-social relationships.

> These situations should not be interpreted as forming a rigid scheme of phases through which an artifact successively has to pass. Rather, it is a heuristic device to simplify the description of the "seamless web" of history. (Bijker, 181)

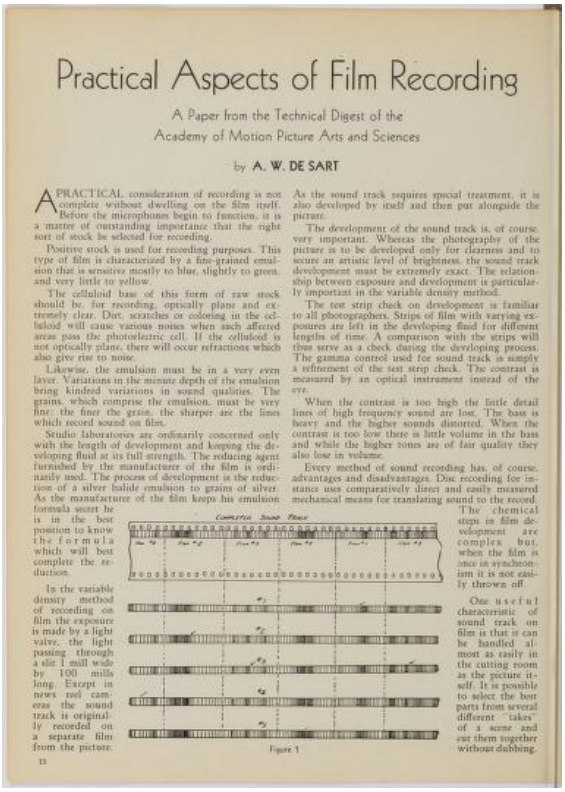
I build off Bijker's use of the term to expand the atmospheric frame. The situation of negotiation is hence not a rigid dogma under which the atmospheric frame is highlighted. It is another heuristic device to elucidate how the atmospheric frame occurs within the technological frame. Both the atmospheric frame at large and the situations of negotiation are mere starting points to examine deeper "seamless webs."

Access

In August 2004, film editor and historian Robert S. Birchard published an article in the 85th anniversary edition of *American Cinematographer*, cinematography's "magazine of record." (Birchard) He argued that while *American Cinematographer* (*ACM*) was one of few trade magazines to run continuously for almost a century, it had its fair share of changes. Since its launch in 1921, it was widely known to attract industry professionals, specifically cinematographers. (Birchard) With the coming of the 1930s, the magazine saw several editorial shifts. It was reorganized and more pages were added. Hal Mohr, president of the publisher of the magazine, the American Society of Cinematographers (ASC), wrote a manifesto at the beginning of the November 1930 issue.

> From a four-page paper it has grown into a fifty-four page magazine that is eagerly looked for by thousands of readers all over the world. And–within the next few months, it will again expand in size and before another year is expected to contain close to one hundred pages in instructive material each month. (Mohr, 9)

This manifesto is an indication that not only was the industry rapidly changing but so were the structures of knowledge production and information distribution. According to Mohr, as the need for technical information expanded, *American Cinematographer*'s value would inevitably increase, calling for adaptable coverage of the growing and intersecting departments. Mohr also wrote, "When sound came into existence this magazine was one of the first to give to its readers the latest technical developments." (9) In the same issue, a reprint from *The Journal of the S.M.P.E* (Society of Motion Picture Engineers) elaborated further on the measurement of density in variable density sound film. (Tuttle and McFarlane, 14) This piece was deeply scientific and focused more on the optical characteristics of the developed image via sound film. The scientific bent may have to do with the fact that this research was communicated from the Kodak Research Library and read out at an SMPE meeting in Washington. (15) The Society of Motion Picture Engineers was founded in 1916 and designed to exchange technological information. But *American Cinematographer Magazine* was not simply known for its technical coverage. As in, the detailed scientific coverage signified just a portion of the magazine. Contrary to Mohr's declaration that ACM covered the latest on sound technologies, just a few months prior, its coverage read as far more anecdotal. What could this reveal about the ways in which situations of negotiation arise?



Practical Aspects of Film Recording

A Paper from the Technical Digest of the
Academy of Motion Picture Arts and Sciences

by A. W. DE SART

A PRACTICAL consideration of recording is not complete without dwelling on the film itself. Before the microphones begin to function, it is a matter of outstanding importance that the right sort of stock be selected for recording.

Positive stock is used for recording purposes. This type of film is characterized by a fine-grained emulsion that is sensitive mostly to blue, slightly to green, and very little to yellow.

The celluloid base of this form of raw stock should be, for recording, optically plane and extremely clear. Dirt, scratches or coloring in the celluloid will cause various noises when such affected areas pass the photoelectric cell. If the celluloid is not optically plane, there will occur refractions which also give rise to noise.

Likewise, the emulsion must be in a very even layer. Variations in the minute depth of the emulsion bring kindred variations in sound qualities. The grains, which comprise the emulsion, must be very fine: the finer the grain, the sharper are the lines which record sound on film.

Studio laboratories are ordinarily concerned only with the length of development and keeping the developing fluid at its full strength. The reducing agent furnished by the manufacturer of the film is ordinarily used. The process of development is the reduction of a silver halide emulsion to grains of silver. As the manufacturer of the film keeps his emulsion formula secret he is in the best position to know the formula which will best complete the reduction.

In the variable density method of recording on film the exposure is made by a light valve, the light passing through a slit 1 mill wide by 100 mills long. Except in news reel cameras the sound track is originally recorded on a separate film from the picture.

As the sound track requires special treatment, it is also developed by itself and then put alongside the picture.

The development of the sound track is, of course, very important. Whereas the photography of the picture is to be developed only for clearness and to secure an artistic level of brightness, the sound track development must be extremely exact. The relationship between exposure and development is particularly important in the variable density method.

The test strip check on development is familiar to all photographers. Strips of film with varying exposures are left in the developing fluid for different lengths of time. A comparison with the strips will thus serve as a check during the developing process. The gamma control used for sound track is simply a refinement of the test strip check. The contrast is measured by an optical instrument instead of the eye.

When the contrast is too high the little detail lines of high frequency sound are lost. The bass is heavy and the higher sounds distorted. When the contrast is too low there is little volume in the bass and while the higher tones are of fair quality they also lose in volume.

Every method of sound recording has, of course, advantages and disadvantages. Disc recording for instance uses comparatively direct and easily measured mechanical means for translating sound to the record. The chemical steps in film development are complex but, when the film is once in synchronism it is not easily thrown off.

One useful characteristic of sound track on film is that it can be handled almost as easily in the cutting room as the picture itself. It is possible to select the best parts from several different "takes" of a scene and cut them together without dubbing.

Figure 1

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Figure 1.2. A digital archive print of A.W. De Sart's piece on film recording. (De Sart)

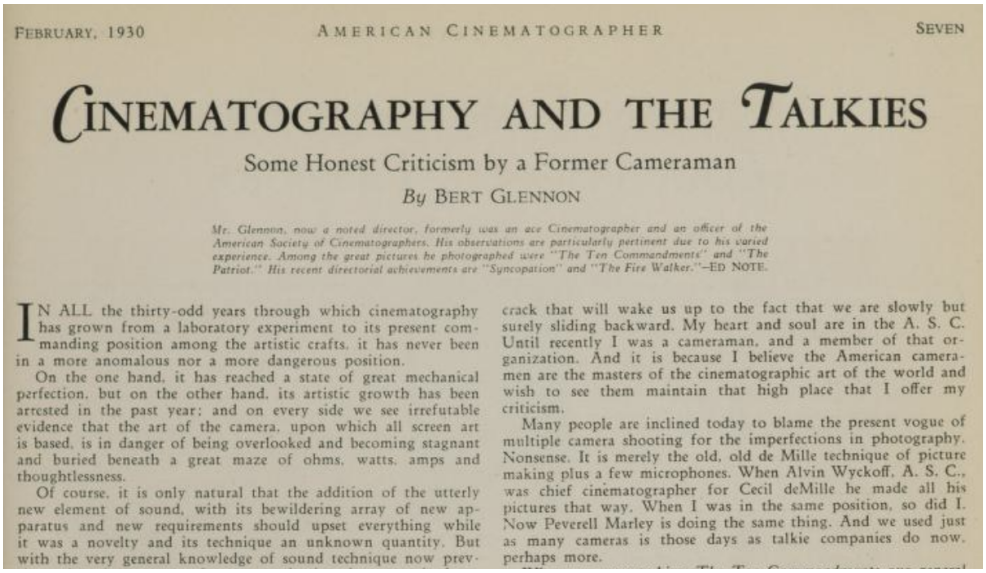
In July 1930, a writer named A.W. De Sart titled his piece "Practical Aspects of Film Recording." He used the first-person voice to elaborate on the science behind sound-on-film and sound-on-disc recording. "Both had advantages and disadvantages," he claimed. (De Sart, 12) One would need to choose the right stock. As the first two paragraphs explained, the celluloid base of the stock "must be clear and optically plane such that there are no refractions and noise." (12) The next paragraph mentioned the process of development in the reduction of a silver halide emulsion to grains of silver while pointing out that the best person to know such a formula would be the manufacturer of the film who "keeps his emulsion formula secret." (12) The language of secrecy denoted an informality. So although he began the piece with technical advice, De Sart was still not the ultimate expert. He was a conduit. To keep information secret would also mean circumventing the legal language around patents. As we will see below in *Variety*'s coverage,

sound technology was mired in patent battles and legal issues. De Sart's suggestive tone maintained an informality around a technology that indicated a situation of negotiation for knowledge. The technology was clearly being iterated, but this was what he could offer based on experience. I argue that the atmospheric frame is what De Sart and Mohr were working towards. The representation of sound adoption was being negotiated through the formatting of the publication which would carry this knowledge at a growing scale.

Carolyn Marvin states that "old habits of transacting between groups are projected onto new technologies that alter, or seem to alter, critical social distances." (Marvin, 5) In speaking to a community of cinematographers, was there an encoded language being carried forth into sound? Suggesting new techniques and tools without the promise of their success would not have been out of the ordinary. But perhaps the culture of cinematography, specifically speaking to the relationship between cameraman and equipment, was yet to translate to new ways of working. And why would it? While arguing that the atmospheric frame is negotiated, it is in the transaction between groups where we find the most vivid examples. These murky transactions also extend Crafton's main premise, which is that three phases cannot be so easily categorized. An atmospheric frame allows for the transfer of these cultural nodes to occur while change is "in the air." Secrecy was "in the air." It was atmospheric in so far as it suggested there were hidden pieces of information. But where, with whom, and why they were hidden can only emerge from examining the situations of negotiation. Secrecy meant that information itself was negotiated. The situation came from a variety of circumstances occurring at once. On the one hand, the magazine itself would be expanding. On the other hand, information was still hidden. The juxtaposition of secrecy around knowledge and extension of accessibility were connected by a shared situation of negotiation. The atmospheric frame can be understood through comparing

such negotiations as they give rise to situations but it aims to interpret how change occurs as an ongoing. How might such analyses assist us in understanding more contemporary adoptions of new technologies such as virtual production? This will be discussed in the second chapter. Notably, not all the exchanges were enveloped in a secrecy or promise of access. The talkies were met with much harsher criticism just a few months prior.

Critique



FEBRUARY, 1930 AMERICAN CINEMATOGRAPHER SEVEN

CINEMATOGRAPHY AND THE TALKIES

Some Honest Criticism by a Former Cameraman

By BERT GLENNON

Mr. Glennon, now a noted director, formerly was an ace Cinematographer and an officer of the American Society of Cinematographers. His observations are particularly pertinent due to his varied experience. Among the great pictures he photographed were "The Ten Commandments" and "The Patriot." His recent directorial achievements are "Syncopation" and "The Fire Walker."—ED NOTE.

IN ALL the thirty-odd years through which cinematography has grown from a laboratory experiment to its present commanding position among the artistic crafts, it has never been in a more anomalous nor a more dangerous position.

On the one hand, it has reached a state of great mechanical perfection, but on the other hand, its artistic growth has been arrested in the past year; and on every side we see irrefutable evidence that the art of the camera, upon which all screen art is based, is in danger of being overlooked and becoming stagnant and buried beneath a great maze of ohms, watts, amps and thoughtlessness.

Of course, it is only natural that the addition of the utterly new element of sound, with its bewildering array of new apparatus and new requirements should upset everything while it was a novelty and its technique an unknown quantity. But with the very general knowledge of sound technique now prev-

crack that will wake us up to the fact that we are slowly but surely sliding backward. My heart and soul are in the A. S. C. Until recently I was a cameraman, and a member of that organization. And it is because I believe the American cameramen are the masters of the cinematographic art of the world and wish to see them maintain that high place that I offer my criticism.

Many people are inclined today to blame the present vogue of multiple camera shooting for the imperfections in photography. Nonsense. It is merely the old, old de Mille technique of picture making plus a few microphones. When Alvin Wyckoff, A. S. C., was chief cinematographer for Cecil deMille he made all his pictures that way. When I was in the same position, so did I. Now Peverell Marley is doing the same thing. And we used just as many cameras is those days as talkie companies do now, perhaps more.

Fig 1.3. A digital archive print showing a headline by Bert Glennon. (Glennon)

In February 1930's issue of *American Cinematographer Magazine*, a former ace cinematographer and officer of the ASC named Bert Glennon wrote a scathing criticism of the talkies. Unironically, the subheading read "Some Honest Criticism by a Former Cameraman." (Glennon, 7) Placed at the forefront of the magazine, Glennon began his piece by stating the following–

> ...in the thirty-odd years through which cinematography has grown from a laboratory experiment to its present commanding position among the artistic crafts, it has never been in a more anomalous nor a more dangerous position. (7)

In a "great maze" of "ohms, watts, amps and thoughtlessness" Glennon believed that, while on the one end, cinematography had reached great mechanical perfection, it was artistically stunted through the year 1929. (7) Almost nonchalantly he argued that the "new element of sound" and its "bewildering array of new apparatus" was upsetting everything. (7) Towards the end of the piece, he made a strong case for the artist. Underneath Glennon's criticism was a plea for the value of cinematography. At the core of his argument was a call to prioritize the visual by framing sound as a detractor from high visual standards. I argue that even further beneath was the atmospheric frame as highlighted by a situation of negotiation. The situation was a set of multiple circumstances occurring to give rise to new negotiations. "Screen audiences want beauty," he wrote. (7) He used coded language to speak directly to an audience of cinematographers when he called on them to maintain a "high artistic standard that marked the silent pictures just before sound came in." (7) He believed in their "intelligence" and their potential to maintain artistic integrity, and he did so by evoking the near past. But his critique and plea were not shy of naming the detractors. As the piece continued on, he wrote specifically on resisting industrial shifts.

> In the old days, the studios vied with each other in the beauty of their photography. Today, sound is uppermost in the executives' minds. So the cameramen themselves must fight the battle for artistic duty…They must look beyond the mechanics they have so highly perfected to the inner meaning of their work– the visual art which is the true and lasting foundation of whatever artistic merit the screen can claim. (45)

Glennon's criticism evoked strains of resistance to the aesthetic standards of the present in exchange for the "old days." (45) While it seems like this nostalgic tone marked a contrast to the practical information which followed shortly in the same issue, I argue that critique was not at odds with the practical. On page 10, a paper included in the technical digest of the Academy of Motion Picture Arts and Sciences directly addressed the sound recording method. (Mackenzie,

10) In this piece, Dr. Donald Mackenzie, a technical service engineer, described a method used in the Western Electric system which depended upon the "light valve to effect modulation of the light on the sound negative." Towards the second half, he dove deeper into the condition under which the microphone would pick up sound.

> If the cameras are noisy, if the population on the set is noisy, such noises will appear as contributing to the ground noise although they are not due to the recording itself. There is some noise in amplification and often some cross-talk due to pick up from neighboring circuits: this may be called system noise. Set noise is the most important and system noise may be reduced to nearly nothing by careful maintenance. (11)

In order to achieve Glennon's visual standards with sound, cinematographers would need to understand that sound impacted several social groups in production. "System noise" and "set noise" were now considerations. These considerations contributed to the situation of negotiation. Cinematographers and sound engineers would be working towards an atmospheric frame within the technological. The situation was negotiated by merit of a new type of knowledge–noise. One of Bijker's situations within the technological frame offers up a comparative case. He argues that the technological frame from the community of chemists who were working on Bakelite plastics was dominated by the "celluloid frame." (Bijker, 171) The celluloid frame was guided by the search for a substitute for celluloid. The chemists either worked according to the frame or against it. I mention this case to argue for a similar assertion around the atmospheric frame. (Bijker, 166) Evidence from *American Cinematographer Magazine* shows that cinematographers and engineers were working towards a negotiation with the technology. But the negotiation had far more to do with the way a set was to be organized and therefore, how ways of working were structured around the atmosphere of the set.

Bijker's technological frame attempts to explain why chemists had not tried to modify phenol-formaldehyde into a usable plastic. They had other goals of producing a synthetic dye.

(Bijker, 164) Plastics were not on the radar. Additionally, chemical theory at the time could not "cope" with such a substance. (164) Hence, the technological frame of the community was simply not in existence yet. I reiterate that the atmospheric does not aim to replicate Bijker and Pinch's work but rather build off of their method into a case study of adoption. To articulate the networked causes, effects, and entanglements of a new technology depends on the ability of social groups and knowledge to cope with these introductions. In this case, the multiple social groups of cinematographers, art departments, directors and producers from all divisions made negotiations with the atmospheric changes of sound introduction. Because I do not focus solely on the engineers, the atmospheric frame aims to do what the technological and celluloid frames did for Bakelite. It complicates the assumption that sound was simply a matter of introducing new equipment. Instead, it gave rise to situations of negotiation.

While it may seem that Glennon's critique was contrary to the atmospheric frame given that it was simply making a case for the visual, I argue that the visual in context to cinematography was still based on a situation of negotiation. If there were no issues around noise caused by the lighting equipment, the social group of cinematographers would not have compromised on the "artistic standards" as stated by Glennon. There would be no resistance if the transition to a new system of operation was seamless. If sound did not affect lighting, would the cinematographer care? While Glennon's persuasive, if skeptical, speech and the technical information from the S.M.P.E had varying intentions, his critique was still governed by an atmospheric frame. He accepted change would happen but made a case for the visual. He acknowledged the audience's draw to novelty and why sound would be appealing. But for him, de-prioritizing the visual would equate to wasting a thirty-year journey of perfecting the craft of beautiful imagery. That craft was collaborative. It blended the artist and the engineer, the actor

and the director. This will become increasingly clear as we examine the promises of virtual production in the coming chapters.

Speaking to the development of the soundtrack and a need for exactness, De Sart also made a comparison to photography. He claimed that photography was developed only for "clearness" and to secure an artistic level of brightness. (De Sart, 12) The soundtrack would need to be developed in extreme exactness. This indicated a hierarchy. The visuals were superior. Mackenzie introduced his article by saying, "The object of all recording is to furnish a sound which would be indistinguishable from the sound one would get from the real source as if it were there." (Mackenzie, 10) André Bazin's "myth of total cinema" argued that cinema's beginning and end point is a reproduction of reality. (Bazin, 166) In the mind of the inventor, one finds an innate desire to create exactness of the world around them. Was the focus on the "exact" replication a "mimetic" move? Was there a call for the atmospheric to work in favor of the "mimetic" through words like "exactness and clearness"? The word mimesis can mean several things. It denotes imitation, mimicry, and resemblance. The ancient Greek term Mīmēsis was derived from Mīmeisthai, to imitate. (Auerbach) But perhaps the coming of sound was so focused on the myth of total cinema that the atmosphere required to achieve the mimetic was seen as a byproduct and not a negotiation. The situation of negotiation occurs where the lines between the social groups dictating the changes and adopting the changes blurs even further.

In his 1983 book titled *Networks of Power: Electrification in Western Society, 1880-1930*, Thomas Hughes introduced the concept of a reverse salient. (Hughes, 79) A reverse salient is a component which prevents a system from achieving its development goals. (91) The component could be either technological or social, but most of the time it combines the two. Those entanglements hinder the movement of a "system." (6) Both De Sart and Mackenzie presented a

frame that dealt with the mimetic dimension, but the reverse salient was unidentified. It was technological in that it addressed a situation to achieve synchronous fidelity during production. The situation was negotiated. It assumed that exactness was what the viewer desired. But this assumption was also predicated upon the notion that the mimetic was the "actual." While the atmospheric frame in this case study does not concern itself with discussions on mimesis, reality, and representation; the presumption of mimetic situations of negotiation elucidates the atmospheric frame, regardless of whether the situation itself was agreed upon by all social groups. Hence, the situation of negotiation is not predicated upon the notion that all social groups are equal participants or equally aware of change as it occurs. In the case of the mimetic, assumptions were made in small, incremental ways. But the awareness or equanimity of each social group in the situation of negotiation is something an atmospheric frame could help argue for.

Attunement

The atmospheric frame also calls for a situation of negotiation as shown through the frame of attunement. Attunement of atmospherics was a concept introduced by cultural anthropologist Kathleen Stewart. She wrote that "an atmospheric attunement is an altered sense that something is happening and an attachment to sensing out whatever it is." (Stewart, 3) De Sart identified how studios should adjust to sound technologies by hiring for attunement. For example, he talked about the need for one's ability to sense "pleasing and satisfactory" soundtracks.

> …it should be the duty of every sound department to test the ears of every individual who is called on to judge sound including every studio executive, who should know whether he is capable of judging a soundtrack that is pleasing and satisfactory. (De Sart, 13)

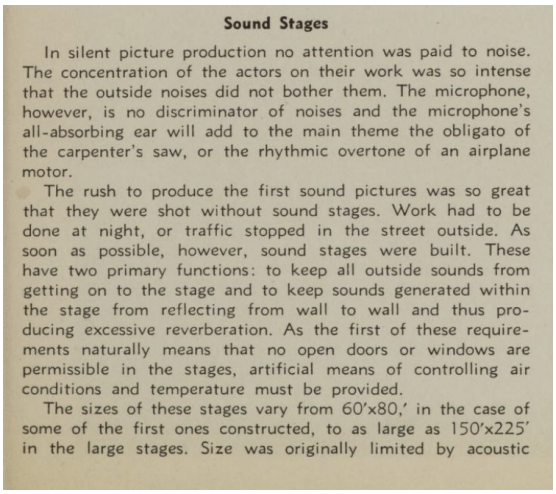
His advice to studios was to be mindful of emergent necessities. By stating that "every executive" must be able to judge sound, he was proposing a new requirement for the atmospheric frame: the ability to hear. Stewart also described attunement as a "tuning up to something, an accretion chosen or unwillingly shouldered. A labor." (Stewart, 5) Her notion of unwillingness is relevant because it heightens the case for a situation of negotiation to be removed from a requirement to identify a willing or unwilling social group. Instead, the atmospheric frame is one where the situation arises. As she continued saying, "Attunement is … a sentience to a world's work, bodies, rhythms, ways of being in noise and light and space." (Stewart, 5) In the case of sound, a need to be attuned to "hearing" was negotiated. Glennon's not-so-subtle opinion of the "grossly overlit modern sets" (Glennon, 7) or the management of noise on set as recommended by Mackenzie shows that the atmospheric frame in the context of sound had hints of the sensorial in relation to the attuned. I argue for an extended dimension to the technological frame, expanded to converse with the atmospheric, which is the attuned.

Let us look at another case. In the same issue that featured Glennon's critique was a piece about the microphone and a piece about recording devices. In the ACM issue of October 1930, technical director of sound at Pathe Studios L.E. Clark penned a technical digest paper from the Academy of Motion Picture Arts and Sciences titled "Sound Stage Equipment and Practice." (Clark, 15) The following quote highlights the complexity of this stage:

> In silent picture production no attention was paid to noise. The concentration of the actors on their work was so intense that the outside noises did not bother them. The microphone, however, is no discriminator of noises and the microphone's all-absorbing ear will add to the main theme the obligato of the carpenter's saw, or the rhythmic overtone of an airplane motor…The rush to produce the first sound pictures was so great that they were shot without sound stages. Work had to be done at night, or traffic stopped in the street outside. As soon as possible, however, sound stages were built. (Clark, 15)

The attunement frame also gives rise to negotiations around time, labor, and location. Hence, while it would be logical to call it an acoustic frame, the acoustic dimension simply gave rise to a situation of negotiation. This situation required an attunement. As the piece went on to say, “It has cost many millions of dollars to build the sound stages with which all studios are now equipped.” (Clark, 15) The attunement frame is hence not about the mechanics of the sound stage but rather the complexities of relations around the stage and beyond it. The seamless web is heightened, and a complexity of time and space are added when the attunement frames emerge within the atmospheric. In reference to sound stages, Clark stated the following:

> These have two primary functions: to keep all outside sounds from getting on to the stage and to keep sounds generated within the stage from reflecting from wall to wall and thus producing excessive reverberation. As the first of these requirements naturally means that no open doors or windows are permissible in the stages, artificial means of controlling air conditions and temperature must be provided. The sizes of these stages vary from 60’x 80,' in the case of some of the first ones constructed, to as large as 150’x 225’ in the large stages. Size was originally limited by acoustic conditions but recently has been governed by studio space and production requirements. (Clark, 15)



Sound Stages

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The rush to produce the first sound pictures was so great that they were shot without sound stages. Work had to be done at night, or traffic stopped in the street outside. As soon as possible, however, sound stages were built. These have two primary functions: to keep all outside sounds from getting on to the stage and to keep sounds generated within the stage from reflecting from wall to wall and thus producing excessive reverberation. As the first of these requirements naturally means that no open doors or windows are permissible in the stages, artificial means of controlling air conditions and temperature must be provided.

The sizes of these stages vary from 60'x80,' in the case of some of the first ones constructed, to as large as 150'x225' in the large stages. Size was originally limited by acoustic

Figure 1.4. Original text from October 1930 ACM issue on sound stages. (Clark, 15)

Attunement was largely acoustic but it wasn’t only acoustic. The situation of negotiation is a continuity, and hence attunement led to an acoustic consideration. The consideration of this acoustic dimension was a situation of negotiation that transcended one social group. It was

continuous in that negotiations were made at every stage and across a range of intersections. The attunement frame therefore worked within the atmospheric frame via giving rise to new situations of negotiation. However, when it comes to issues of location and labor, the attunement frame within the atmospheric requires further articulation. Otherwise, such frames remain murky and while the atmospheric is intended to pull back the situations of negotiation, an attempt to be specific is a useful doorway into emergent thinking.

An analysis of *Variety*'s 1930s coverage reveals how truly murky the theorizing of atmospheric frames can get when accounting for emerging ones like that of labor. As we will see, the coverage showed dialogue occurring between key characters, such as Lee De Forest, with a focus on business organizations and studios as determinants of change. Hence, the atmospheric frame gave rise to situations of negotiation not only between cinematographers and sound engineers but also between producers, executives, and the locations themselves. While less technical than ACM, many of the articles in *Variety* dealt with patent battles, organizations, and inventors. For example, in the July 9 paper, a short piece titled "Business Execs go, Harmony, when Mixing in Industrial Talker" cautioned producers from venturing too far off the east or west coast. ("Business Execs") The article provided an example of a larger studio taking up a contract to film at a Pennsylvania Steel Mill. As it turned out, the steel mill proved to be an unsuitable condition for photography, sound recording, and the crew, who were shipped to the steel mill, and ended up having their "going get 'plenty tough.'" ("Business Execs")

> A steel mill is no studio, and the studio-trained technicians were confronted by obstacles to photography and sound recording. Result was that the producer finished the picture with part of his own dough. ("Business Execs")

Clearly studio-trained technicians worked best in sound-specific studios. As the article from ACM above showed, sound stages, despite being expensive, had become a necessity. Right

from the flooring to the auxiliary equipment, the sound stage was as important as the recording devices in order to restore and extend, as Glennon stated, “values developed in the silent motion picture.” (Glennon, 7) A studio environment where technicians were comfortably trained with technology would benefit not only the workers but the business. In turn, this would save costs. Producers had to understand the mechanics of production. I argue that this is how a situation of negotiation gives rise to the attunement frame through labor considerations. Producers had to be attuned to a situation of noise, thus affecting where they could build studios. They were attuned to the acoustic through which labor negotiations would need to be made. Such was the situation arising within the atmosphere of change.

Language

The framing of institutional battles over inventions and patents certainly had a dramatic flair. What could a reading of the dramatic language reveal about the atmospheric frame? The advancement in sound recording through a process of “wins and losses” was deemed a form of progress. A headline saying “Light invention is awarded to Fox. Co” was followed by a report on the decision of the New York Supreme Court to award Fox Corporation with a new invention aimed at improving sound recording by means of light. (“Light Invention”) The coverage of patent suits situated technology as a prize, or rather, a conduit for advancement. While the wins were overt, so were the losses, mostly found in the “Foreign Productions” section, which also revealed much more about attunement as a frame. (Abel, 73) In a July 2 issue, German musicians employed for silent pictures were losing jobs and hence, protesting against sound pictures. (Abel, 73) To use Hughes’ reverse salient concept, it was important to note that this hampering of so-called progress was occurring because of fundamental shifts in yet another negotiation, albeit

one that was met with resistance. Musicians protested because significant labor challenges posed new situations of negotiation. Situations of negotiations therefore required resistance. There was a "tension" necessary for the situation to arise.

Tension was framed dramatically across both semi-embedded artifacts like *Variety* and publicly-disclosed ones like *Photoplay* and *Talking Screen*. Using the fan magazine as an artifact of representation assumes a form of mutual dependency between industry members and audiences; that is, a cyclical knowledge exchange. As Marsha Orgeron has pointed out, the film industry, the magazine publishing houses, and the fans all had "mutually dependent relationships": one controlling, one mediating, and one supporting fans. (Orgeron, 19) This relationship blurred vested interests. A fan magazine was a publicly-disclosed artifact in that it was positioned for those "lucky enough to have been given access to those ''inside'' the production process." (Caldwell, 348) Donald Crafton's analysis of fan magazine editors' espionage tactics showed that while the fan magazine is not often used as a traditional artifact to reveal the exact impact of sound on production, it can reveal much about the complexities around adoption of new technology. As Crafton wrote, Cal York, a reporter from *Photoplay* was known to boastfully suggest an illegal gateway onto sets, a proliferation of the double-agent lifestyle. (Crafton 484) Hence, he proposes it best not to use fan magazines as traditional artifacts to produce a 'truth' of sound (485). Instead, he suggests using them to gain insight on a "complex web of exchange between the industry, commercial world and consumer." (485). The atmospheric frame involves the fan because in a seamless web, fans are social actors. They contribute to the atmospheric shift of sound as a larger, fundamental move in cinematic history. The atmosphere of change extends far beyond the set.

Photoplay, a prominent fan publication, did not hesitate to infuse a rather dramatic frame. Elaine Ogden penned a first-person piece titled "Inside the Monitor Room." (Ogden, 76) She began by using descriptive language and situating the reader inside a monitor room. The dramatization of the monitor man or the sound mixer was clearly articulated in the first two paragraphs. "They call him a god around the studios," wrote Ogden as an image of a man perched atop what looks like a studio can be seen on the left of figure 1.5 below. The image in question took up a considerable portion of the page, with a caption that explicitly stated, "He is the uncrowned ruler of the studios, these talkie days." (76) What this "mixer fellow," as Ogden callously referred to him, had was a relationship to fate. He was in control of the stars. "He has more power than the cameraman ever had," she claimed. (76) Power? God? Fellow?

By Elaine Ogden

Inside the Monitor Room

IN a little room perched high above the sound stage, away from the temperament and excitement and petty chatter of the set, overlooking the beauty and glamour of the studio world, sits a solitary man anxiously toying with what appear to be four or five radio dials.

Technically, he is known as a "mixer."

They call him God around the studios and a god indeed he is, since he controls the destinies of the famous ones of filmdom. All the strange and beautiful favorites who delight you are in his power. He is the Zeus of Hollywood, the Il'shtar of the screen world. He sits high above the stars and looks down upon them.

This little room, which contains only him and a loud speaker, is called a monitor room. It is, really, Mount Olympus and Valhalla. He sits before his row of dials. He turns one ever so slightly. He turns another. The voices from the stage below thunder out at him. He can make or break the stars.

I don't pretend to know how it's done, but I do know that that little room is more dramatic and exciting than the satin-draped dressing rooms of the stars, or the mahogany-paneled conference chambers of the executives. Fate and the mixer enact their rôles.

THIS mixer fellow is the man of the moment.

I can't go into technicalities. The effort I made to understand and untangle the maze of such scientific phrases as "high and low frequency," "controls," "re-recording" and the rest would give me a worse headache than Hollywood gin. I can't tell you why the mixer controls the voice fate of the stars. And, although the sound engineers are very fussy about having their deeds reported correctly, I can make no attempt at it.

I know only this, that I've sat breathless in that little monitor room (approached by a flight of steep stairs, barren except for the loud speaker) and felt as if I were in the presence of Fate.

When you're down on the set below you may glance up and see the mixer sitting there, an ordinary enough looking worker behind his double plate glass window. But when you're there with him, looking down upon that same set, hearing the voices of the great ones below, you realize the power, drama and strange beauty—beautiful because of its very force—of the monitor room. You know that by a touch the mixer can make them. By another touch he can break them. He has more power than the camera man ever had.

Here he sits, fussing with his gadgets high above the set—the all-powerful Man in the Monitor Room, who sees that the voices of the players come out of the horn just as sweetly as they went into the microphone. He is the uncrowned ruler of the studios, these talkie days

Meet the new god of the studios. We unlock the door of the mystery room of the talkie stages and show you the man inside —the magician who can make or break the voices of the stars

For the voice is more important than the face in these trying days. Time was when the stars brought large red apples daily to their favorite cameraman. He was master then. Little extra girls begged for his advice about make-up and angles. Great actresses sought him out for consultations.

For he—this cameraman—could photograph a mediocre face and make it look like an angel's. By a simple twist of the lights he could turn the divine profile of a Helen of Troy into a hateful caricature.

The cameraman still has his place, of course, but the voice has superseded the face. It is that little man who photographs the voice, the mixer, who is the big shot at the studios now.

In the old days the stars used to insist on their favorite cameraman. Now they struggle for the best mixer. Ramon Novarro has Ralph Shugart mix all his talking pictures. He will have no other. And, because Ramon is a technician as well as an artist, he works hand and hand with his mixer, and seeks him out for his words of wisdom.

Like the once all-powerful cameraman, the mixer has no illusions. He knows what he can and can't do with the voices in his power. He knows all the little speech foibles and vanities of the stars. He knows that he controls their destinies and could, if he chose, ruin any scene for them.

HE'S a hard-boiled guy, this god of the high places.

With very few exceptions, the mixer likes a natural voice. Maybe you've welcomed the horde of new stage folk with open arms. As a rule they are, to the mixer, just another monkey wrench in the machinery.

These "legit" people are always talking to that slightly deaf old gentleman in the last row of the gallery. They have been taught for years to throw their voices, to give volume. That's bad on the sensitive ears of the microphone. The mixer will give them all the volume they need if they'll let him. That's his little job.

As a rule, the stage people are arbitrary. They feel that they have nothing to learn. And, as a matter of fact, they have more to overcome than the screen folk. They must forget entirely the old technique. The sons and daughters of Hollywood are natural. They don't go tossing their voices all over the place.

The great stage stars, the ones who have carved their particular niches in celluloid, are the ones who have worked with the mixers and have taken their sound advice (no pun, either, there you!).

Paul Neil was the recording man on Lawrence Tibbett's "The Rogue Song." The volume of the baritone's notes shattered many a sensitive tube. Nothing, apparently, could be done about it, until at last Neil hit upon this simple and efficacious method.

"I PLACED my microphones as best I could," he said, "I put the dials at what I thought the proper place. Then I went to the other side of the room, stopped up my ears and trusted to God. That's all you can do with Tibbett." And that you may take with a grain of salt, because Neil did a careful and superb job with "The Rogue Song."

Franklin Hansen, now head mixer at Paramount, who was responsible for the sound in "The Vagabond King," had like trouble with Dennis King. King is, by far, the most dramatic actor on the lot. Sometimes in just one scene his voice ranges from the lowest whisper to the highest shout, and if he were held down, if he were told to be more careful, the beauty and dramatic power of his performance would be gone. So it is the mixer's job to follow him and record him properly. The mixer must catch the low whisper as well as the high notes.

During rehearsals the mixer saw about what was expected and worked the dials accordingly, but King is an artist, an emotional artist, and he never did the scene twice alike. The mixer had to be just one jump ahead of him and try to figure out his next vocal move.

Maurice Chevalier, too, was difficult. He spoke his lines very low and quietly. He sang his songs loudly. But Ernst Lubitsch, who directed "The Love Parade," is a careful workman. He demanded absolute perfection. He insisted that every word be sharp and distinct and nothing was too difficult for him to attempt

[PLEASE TURN TO PAGE 108]

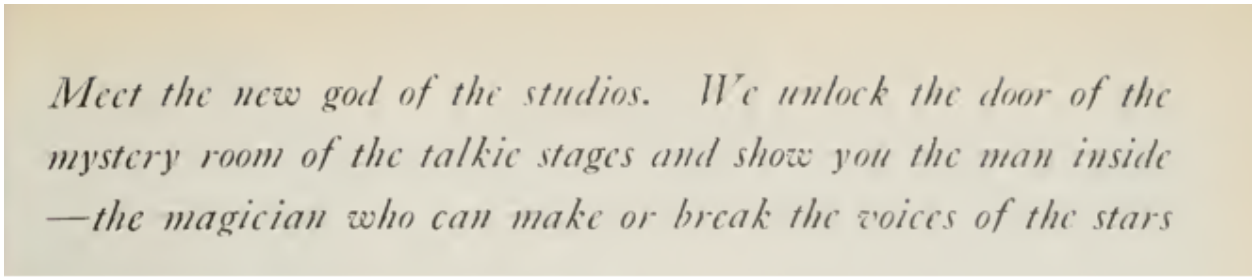


Fig.1.5. Two-page spread in *Photoplay,* a fan magazine in 1930. (Ogden)

The atmospheric frame was producing a situation of negotiation that involved the fans and extended beyond attunement as it referred to production. The situation of negotiation at the moment in time required a shift in public perception. Industrial theorizing was undergoing changes in who was receiving publicity and how this publicity was framed. Ogden's reference to the monitor room articulated a negotiated relationship between change itself and publicly-disclosed articulations. As Pamela Hutchinson wrote in a *Guardian* article on January 26, 2016, *Photoplay* was known for its dramatic editorial voice. (Hutchison) It was created to provide "insider" access to the movie business while staying true to its audience: the fan base. I now bring in another profile to identify the differences between the framing of the monitor man and a film star. To identify the situation of negotiation is to note the dramatic tonalities. How did the setup of sound, the stage, contrast Ogden's other profile pieces?

Profile pieces were a common feature of *Photoplay.* In the September issue, Ogden wrote a piece on Ivan Lebedeff titled "The Most Disliked Man in Hollywood." (Ogden, 73) It focused on the famed Russian actor and his complexities. Much like her piece on the sound mixer, she laced it with first-person observations, conjecture about his "way with the ladies," and, as expected, infused it with the dramatic. However, the tone of the piece differed. While her aim with the sound mixer was to glorify a nascent profession, she took a sympathetic, apologetic, and

explanatory one towards Lebedeff's profile by using phrases like "he has seen the world in the most sordid version." (73) The specific situations of negotiation pertaining to the atmospheric become clearer when compared. The sound mixer, this unglorified god, was swept to the side while Lebedeff, the "womanizer" and "troubled star," sought redemption. (73) On one hand, "Inside the Monitor Room" showed a glorification of the sound engineer, or the new "god of the studios." But the monitor man was still no star. He was still not the coveted "ladies man." Instead, in his mysterious room, he controlled fate itself. Lebedeff, on the other hand, was personified by the merit of his private life. These entanglements are tricky to highlight because the negotiations occur in "webs." The "insider" information was also networked. Lebedeff's story and the sound mixer occurred in tandem while working towards the atmospheric frame. Without the monitor room, would there be an exclusive "insider" look for the fans? Would the sound technician, without his equipment, still be glorified? Would he get away with Lebedeff's womanizing ways? In this case, the situation of negotiation was one involving representation of a new job. How far would Ogden go to make the sound technician seem godlike?

Talking Screen had the least amount of life beyond the year 1930 given that it ran for a short span of eight issues. It was a fan magazine and publicly-disclosed in that it intended to engage with groups outside of the production process. Caldwell labels this "extra-group" industrial theorizing as opposed to "intra-group" which involves players in the production ecosystem. (Caldwell, 347) Page 68 featured a spread by Gordon R. Silver titled 'Training Voices for Talkies' (Silver, 68). Much like Ogden's piece, this referred directly to the voice teachers of Hollywood such as Otto Morando and Mrs. Paul Sloane, focusing on the people in association to the stars (68). For both the monitor man and the voice teachers, sound was a conduit of change through the emergent needs and skill sets made necessary. While the monitor

man controlled the fate of the stars, the voice teachers influenced the destinies of the stars' voices. What both *Talking Screen* and *Photoplay* highlight is that situations of negotiation involve a multiplicity of social actors but that situations do not always require resolutions. The framing of change was through an atmospheric lens that involved labor considerations.

Where did this all lead?

My aim was to synthesize. With this chapter, I argued for the situation of negotiation within the atmospheric frame to begin a conversation on developing a heuristic of change. Situations of negotiation are interwoven in that they give rise to newer frames such as attunement. However, such conclusions are not without their fair share of blind spots. Langdon Winner's 1993 critique of SCOT revealed contradictions in this research modality. (Winner, 362) He argued that SCOT ignores the consequences of technologies, and in doing so erases the voices of those who are affected by innovation but perhaps did not play a role in its development. (Winner, xxx) This may be true, given that the complex web of details within negotiations were difficult to entangle without a normative discussion on power and visibility. Chapter 1 explored whether an atmospheric frame could be identified in the adoption of sound at a specific moment in time. Whether or not the situation of negotiation continues to reveal itself as a condition of the atmospheric frame with virtual production is a task for the next chapter. The relations of any technological system are deeply entangled and cannot either be proven or disproven over the course of twenty pages. Hence, my argument does not veer from the core message of social constructivism, which is to elucidate the entanglement of technology and society. However, by adding a dimension of atmospheric theorization and situations of negotiation, I aim to heighten a contradiction: interconnectedness is difficult to articulate. Hence, any propositions remain open

to be challenged. The following chapter further develops these frames to ask whether an ongoing heuristic of change can be developed in 2020. Are there parallels between how situations of negotiation arose with the proliferation of virtual production in 2020 and the coming of sound in 1930? Is the atmospheric frame sufficient, and are there perhaps other “situations” that arise when observing more contemporary times? Ultimately, what can we identify about change as it occurs?

Chapter Two: Virtual Production

Introduction

Enter the words “virtual production” into Google’s Ngram Viewer. It will yield a string of results. The Ngram viewer is a tool from technology company Google designed to track the frequencies of a set of search strings. (Michel et al., 176) The tool utilizes n-grams and computational linguistics sequences to analyze printed sources from the years 1500 to 2019. Search results include, for example, an issue of the Naval *War College Review* from November 1970, which used the phrase “virtual production” in relation to a Soviet virtual production-line method for technicians and scientists in their research divisions. (Naval War College) It can also be seen in texts as recent as 2004’s *Service Worlds: People, Organizations and Technologies* which, in reference to manufacturing services, categorized “virtual production companies” as those no longer engaged in the act of physical production. (Bryson, Daniels, Warf, 60)

It wasn’t until the early to mid-2010s that we saw virtual production being used in relation to filmmaking, despite some of the core tools having been around since the 1990s. 2014’s *Production Pipeline Fundamentals for Film and Games* from Renee Dunlop and 2015’s *Digital Representations of the Real World: How to Capture, Model, and Render Visual Reality* discuss both technical and production information on rendering tools, the roles of Computer-Generated Imagery (CGI) and visual effects (VFX) in the elevation of creative outputs. This chapter seeks to continue making a case for the atmospheric frame using influences from production studies’ deep text analysis as well as Brian Winston’s “supervening social necessities” to complicate the notion of how industrial artifacts shape the framing of change. (Winston, 67) Could another approach lead to a better articulation of the atmospheric frame? Or

will there be new situational revelations? I use the following definition from the Virtual Production Field Guide as released in 2019 by Noah Kadner.

> Virtual production is a broad term referring to a spectrum of computer-aided production and visualization filmmaking methods which combine virtual and augmented reality with CGI and game-engine technologies to enable production crews to see their scenes unfold as they are composed and captured on set. (Kadner)

Virtual production, despite its vague origins, remains an umbrella term covering several "methods." The open nature of what these methods are and how they interconnect still leaves space for ambiguity, iteration, and change. However, my analysis does not aim to articulate what virtual production is, but rather how this term could either support or counter an atmospheric frame. Using texts from industry and academia can pose several challenges. Since the 1930s, the industry began employing a richer register of self-reflexive analysis. But the networks of communication had evolved with the coming of the digital era. As Henry Jenkins argued in *Convergence Culture,* the role of "producer" and "consumer" converged to form the participant. (Jenkins, 3) Many of the artifacts examined below speak to this converged participant.

Pipeline

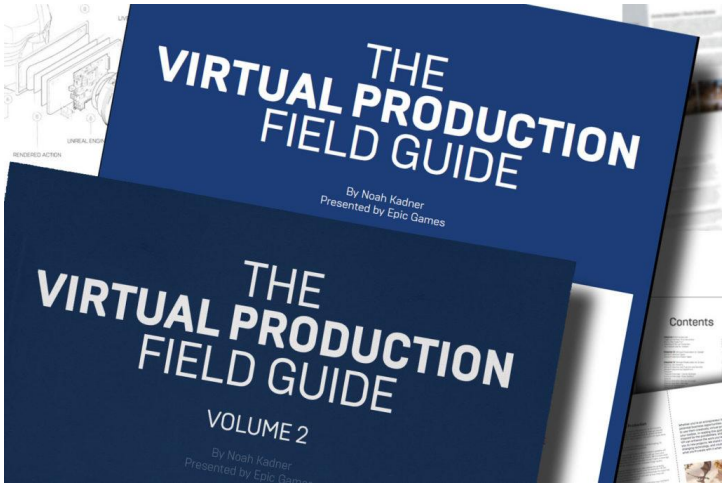


Fig 2.1. Unreal Engine's overarching image for the Virtual Production Field Guide. (Kadner)

To understand the Virtual Production Field Guide's impact is to examine how it was exchanged. I argue that this field guide, using Caldwell's frameworks, was both a semi-embedded text and publicly disclosed text in that it functioned as "institutional dialoguing between media corporations and trade associations," but also "self-consciously directed at the viewing public." (Caldwell, 346) However, the field guide was no mere journalistic account. It was sponsored by Epic Games, a video game and software development company that owns the Unreal Engine, one of the main game engines used in the visualization space. Kadner was an employee of Epic Games at the time.

The first half of Volume I was a descriptive overview of virtual production. In the second half of this 83-page document, Kadner published field interviews with directors, cinematographers and visual effects supervisors on the collaborations, roles and changes that virtual production tools have brought into their projects. Some notable industry members included Kenneth Brannagh, Kaya Jabar, Bill Pope and Wes Ball, who were all working on projects such as early Spiderman movies, The Jungle Book, The Matrix trilogy. (Kadner) Both volumes 1 and 2 featured a range of interviews, beginning with an introduction on virtual production, where it stood, and how the field was evolving. The second gave an update of "what's changed since the last volume." (Kadner) It had several hints that any decisive conclusions on virtual production should be met with trepidation given that technologies are constantly being iterated. (Kadner) The first volume was released in 2019 and the second in 2021. The beginning of the pandemic fell right in between.

I chose this artifact because the production of the field guide indicated that texts do not remain in static spaces. They are distributed. These distributions have a lot to do with how situations of negotiation arise. Situations do not begin and end within the confined time frames.

Instead, they are atmospheric in their movements through space and time. The situations of negotiation that an artifact such as the Virtual Production Field Guide would produce lived beyond the year 2020.

On August 14 2020, Kadner published an article titled "Game On: Game-Engine Technology Expands Filmmaking Horizons" in the *International Publication of the ASC (American Society of Cinematographers)*. ("Game On") He interviewed Director of Photography and previsualization artist Matt Workman to depict the many ways in which game engines could be used to create a new kind of cinematographer – one who understood programming language in relation to cinematic language. ("Game On") He then interviewed Casey Schatz, head of virtual productions at *The Third Floor,* a visual effects house based in London with an extensive roster of Hollywood motion pictures and series. ("Game On") Schatz attempted to set up the larger wheel of filmmaking as a guide for the blending in of pre-visualization and post-visualization artistry. He elaborated on the role of details such as focal length, f-stops, ISO and shutter speed as newly introduced components of the engines changing the possibilities for the field of cinematography. ("Game On") In contrast to Glennon's critique of sound impacting the noise on set and therefore, affecting the visuals, much of the discourse surrounding virtual production was far less critical, including that aimed at cinematographers. Kadner himself played a crucial role in shaping the discourse in 2020 as we will see through the chapter but unlike 1930, the field guide was also exchanged through a broader network of change. The situation of negotiation was networked in that it took artifacts and exchanged them across trade publications. In the 1930s, the S.M.P.E's technical reports were similarly translated across trade magazines. However, the field guide was uniquely distributed in that only specific images or texts were pulled out and shared on websites and social-networking spaces as we will see below.

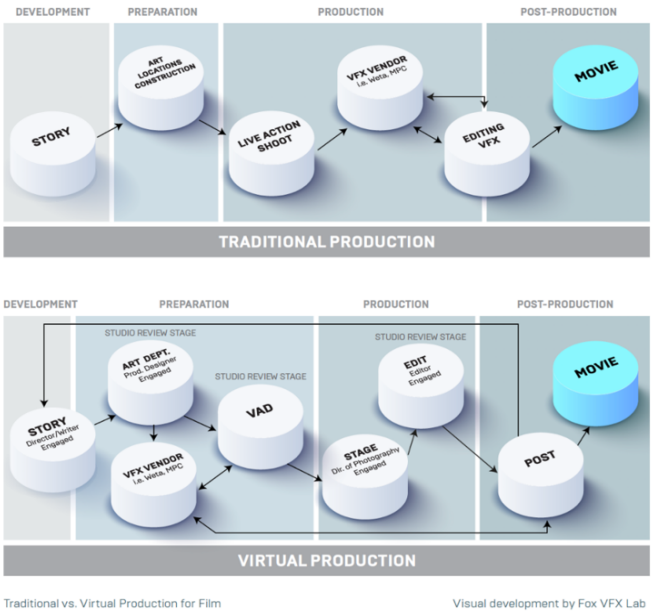


Figure 2.2. A diagram by Fox VFX Lab as used in the Virtual Production Field Guide. (Kadner)

On October 15th, 2020, a staff researcher at Carnegie Mellon's Arts Management and Technology Laboratory published a two-part series about virtual production. It was described as a capstone project by Master of Entertainment Industry Management students at the university, namely Matthew Bernstein, Yingtong Lu, Feng Qiu, and Eesha Rashid. ("An Introduction to Virtual Production and Its Use in the Entertainment Industry.") Figure 2.2 above was a diagram used in the first volume of the field guide. Change was represented through a shift in the pipeline. As in, what was once a linear production ecosystem was now evolving. The article pulled a few quotes from the field guide but focused on this graphic. You may recall Mohr's expansion of ACM's page count from ten to forty pages. Although the field guide itself was a digital file marketed as a resource, the expansion of the first volume to the second suggested the situation of negotiation between the participating audience and the corporate interests of capturing the language around an emerging space. While Mohr's intended expansion was to provide more coverage of technological changes to the community of cinematographers in 1930,

Epic Games as an organization would inevitably have a vested interest. If Epic Games and the Unreal Engine controlled the narrative, they could also impact aesthetic and labor outcomes. The field guide, although not journalistic, showed how semi-embedded artifacts could embed themselves into publicly-disclosed ones without the intention of being exclusively for industry experts or highly specialized audiences. They interacted through means beyond the production of the artifact itself but through the expansion of the networks carrying such artifacts. As I mentioned in the introduction, Stephen Helmreich argued that sound is transduced. (Helmreich, 223) Similarly, language and imagery transduces across "deep texts" to create seamless webs of exchanges.

One such promise of virtual production lay in the emphasis that virtual production, dispute being an umbrella term, was revolutionary because it shifted the pipeline altogether. However, virtual production framed as a pipeline shift was described in detail much before 2020. Artist and writer Renée Dunlop's 2014 book *Production Pipeline Fundamentals for Film and Games* defined "pipeline" as follows:

> The pipeline is the glue that holds together the work of each artist involved in a production. In this, a pipeline is much the same as an assembly line, in which each worker performs their task before handing off their completed work to the next. (Dunlop, 3)

Dunlop was clear in her intention. As she stated, the aim of her work was to "provide strategic guidance on high-level problems" focused on implementation. (Dunlop, 5) The book was not a critical analysis, but rather an informative overview of working pipelines in the games and film industries. However, she did speak to the emergent intersections of games and film production, drawing parallels not only for the terminology of virtual production but also pre-visualization, LIDAR scanning which uses a laser source to measure the distance from a fixed location to points on surrounding rigid surfaces, motion-capture, and more traditional game

ecosystems. (Dunlop, 47) It was always about the "pipeline." Virtual production was therefore a spectrum of tools used to shift some of the original production pipelines. It gave rise to situations of negotiation by suggesting a "non-determined, multidirectional flux that involved constant negotiation and renegotiation among and between groups shaping the technology." (Bijker, Hughes and Pinch, 7) Pulling from Bijker's definition of a technological frame, the focus on virtual production's shift in pipeline was a negotiation between multiple social groups impacted by this shift. However, how this shift impacted each social group was not heavily articulated. The field guide, although anecdotal in nature, was always meant to give an overview. Hence, it gave rise to "situations of negotiation" without articulating exactly where, how and amongst whom such negotiations were occurring. While this could be attributed to the industry's interest in remaining exclusive while building up its own narrative, as Caldwell has written extensively, it is worth noting how situations are different from Bikjer's technological frame. Situations are hazy in that they do not reveal the negotiations.

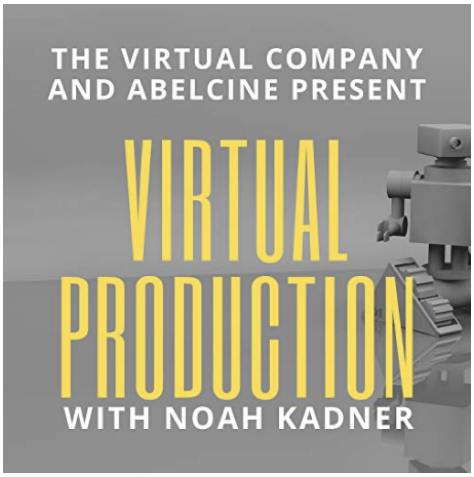


Figure 2.3. The main graphic for the Virtual Production Podcast. (Kadner)

Echoing through the airwaves amid the 2020 global pandemic, virtual production information was also presented in the form of an interview podcast by Kadner. Four guests were

featured that year working across the virtual production spectrum. The podcast elucidated how situations move through artifacts and reveal more layers about negotiations. 2020 marked a year of reckoning with the shifting global reality and the production industry's problem-solving around COVID-19. As mentioned earlier, industrial knowledge production through worker profiles and recycled information is a known element of production studies. *Voices of Labor: Creativity, Craft, and Conflict in Global Hollywood*, edited by Micheal Curtin and Kevin Sanson, was based entirely on interview-based case studies of creative workers in Hollywood. Many of the names were anonymized to protect workers. However, Curtin and Sanson's book was an academic source. A publicly released podcast sat somewhere in between a publicly-disclosed artifact and a semi-embedded one in that, while it could be seen as industry-focused, there was an option for those who would be interested. The podcast extended the situation of negotiation of the field guide while also giving rise to focus on the immediate context of the pandemic and its seismic impact on how technologies are adopted or how adoption itself is framed by production personnel.

The October 2020 podcast featured an episode with Robert Legato, a renowned visual effects supervisor. For Legato, virtual production workflows grew from necessity. He received his training as a cinematographer, but reading *American Cinematographer Magazine* on an airplane after college landed him a job working with blue screens. He went on to supervise visual effects on the Star Trek series, the Harry Potter franchise, and, more recently, *The Lion King* (2019). (Kadner) One of the tools under the umbrella of virtual production is known as pre-visualization. This includes the usage of innovative technologies like virtual reality to bring the storyboarding process closer to the final output of the film. Legato's early experimentations with pre-visualization were driven by frustration and a need to iterate. As witnessed in 1930, the

situation of negotiation required tension to push sound into adaptation. But what prompted this situation to be realized? As Legato said, it was an "inability." (Kadner)

> With a combination of real-world physics and virtual imagery that would eventually come to be known as virtual production my inability to communicate in storyboard form forced me to come up with these ways of doing things where I could preview it…it turned out to be successful enough so I introduced it to Jim Cameron. (Kadner)

Kadner went on to say, "When director James Cameron and Legato worked together on [feature film] *Avatar* in 2007, they were pioneering new workflows which formed the backbone of much of what we call virtual production today." (Kadner) Although the history of pre-visualization dates back much farther than *Avatar*, as we can also see in Dunlop's trade book, what Kadner alluded to was an experimentation around "workflow" and "pipelines." This experimentation had less to do with the technology itself but more with a culture that encouraged iteration as a space for experimentation. The value of photorealistic pre-visualization that ultimately served the final output required a break from the "traditional" ways of working and an openness to adaptation. As he said, "If you shoot and somebody else later puts it together not knowing what you were trying for, you get vastly different results." But even Legato's framing of virtual production ultimately alluded to a situation of negotiation that challenged a divided workflow. As he asked, "Why're we disconnecting all these disciplines? They should all be together because one affects the other so thoroughly…they cross-pollinate." (Kadner) Legato's use of the term "cross-pollinate" in reference to disciplines is also what Hye Jean Chung talked about in *Media Heterotopias*. (Chung, 2) As linear as the pipeline seemed in Kadner's graphic (See Figure 2.2 above), cross-pollination has always existed since the visual effects industry moved labor "overseas." (Chung, 2) The urgency of the pandemic made it such that the "cross-pollination" was now useful to the narrative being shaped around this pipeline shift. Hence, the situation of negotiation was arising from both the contextual factor of the pandemic

but also pre-existing knowledge that was simply placed to benefit a larger atmosphere of change. Having said that, resistance to virtual production was not ignored entirely. As Miles Perkins, head of the business development team at Unreal Engine said later in his episode, not every crew member was as open to such changes.

> I can't get into the details but someone was making a film using VR headsets. The set designer refused to put on the headset…but….it's not about the headset, it's about being spatially aware…you can move around and move objects. Eventually they did. (Kadner)

As Perkins later went on to say, "You're always taking a risk by being in that first wave. You're going to be [the] ones working the hardest and then at some point in time, it's going to level out and just be the way of working." (Kadner) By speaking to the resistance contributing to tension in this shifting production pipeline while framing it as a byproduct of martyrdom, Perkins was effectively placing a value on the situation of negotiation. Although there would be resistance, the promise of virtual production was so great that it was worth being one of the "firsts." This pioneering quality can be attributed to the corporate nature of the artifact itself but also an indication of how deep text categorization can get murky. The atmospheric frame is useful in situating this murkiness. The social actors contribute to the atmospheric frame by leaving the situation of negotiation as murky. Even a semblance of resolution does not answer the fundamental question of whether the headset for example, was used in following productions or whether considerations such as cost should be factored in. Perkins' interview and Legato's interview therefore also indicated a shroud of secrecy. This language was also observed in the 1930s. The industry was in conversation with itself while intentionally creating mystery. The mystery helped in keeping ideas enclosed. The podcast was publicly-disclosed but information would still be protected. The situation of negotiation thus lives within the exchanges between public disclosure and semi-embeddedness. As Dunlop also argued, the experimental nature of

pipelines in games and film has always been focused on people. “Pipelines change because they’re used by people, not machines,” she said. (Dunlop, 97)

> A pipeline is really the technical expression of a complex web of human activities, encompassing everybody from the loftiest creative director to the humblest production assistant, and those people’s tastes are as important as any technical constraint. Pipeline development is ultimately a service business, not an engineering project. (Dunlop, 97)

What Legato, Kadner, and Perkins showed was that despite an acknowledgement that virtual production was not “new” in its offering of iterative pipelines, they still were the “firsts” to push this pipeline into popular discourse. In *Production Cultures*, Caldwell introduced his chapter on trade stories and career capital by identifying the popular behind-the-scenes genre and its promise of delivering an “insider’s pose.” (Caldwell, 36) However, he challenged their claims to offer complete access, arguing that “no singular secret or governing principle to the business can possibly exist.” (36) He described production culture as “far too messy, vast and contested to provide a unified code–to either job aspirants or scholars–for breaching its walls.” (36) It is precisely this messiness that makes the atmospheric frame account for the unaccountable while change is ongoing. A moment of revolution is promised but that revolution has not yet occurred. Adoption is framed as a revolution while there may still be vested corporate interests. Scholars like Henry Jenkins and Tara Macpherson have also alerted academics to ensure an unpacking of the interlocked systems of discursive analysis, especially surrounding how much access is truly possible when examining industry artifacts. (Mann, 104) However, as Crafton suggested about examining fan publications, it is in the publicly-disclosed deep text, one that is focused on the “extra-group”, where we find the most compelling case for how representations of change are interconnected. Legato alluded to this secrecy when speaking of a film that he could not share much about, but wanted to speak to the change observed in 2020.

> Some of them are secrets so I can't really say but a feature film by a very unusual filmmaker and the whole Google chat and Zoom things ended up working out pretty well, you get to talk to a lot of people for as long as you need. To get everybody together in a room and schedule and all that stuff is really difficult but not to get on the phone for 10 minutes or google [sic] chat. It's also one step to being there because you get to see the person's face and their reactions. (Kadner)

He went on to talk about working with James Cameron, specifically giving an example of when they needed to utilize video conferencing in the 1990s to share visual shots from Mexico to Los Angeles. These comparative points offer up insights on how the year 2020 was an amalgamation of multiple pre-existing experimentations coming together. Kadner mentioned the rear-projection workflow of the LED wall. "Legato sees that workflow as important to a post-pandemic Hollywood via remote collaboration," he emphasized. (Kadner) The situation of negotiation was much larger in this frame given that "collaboration" across Hollywood covers several departments, locations, and hierarchies. As Perkins said, "world events changed everything." (Kadner) In Legato's interview, he also spoke about the condition in which being forced to adapt often leads to a systematic appraisal and the situation itself gives rise to innovative thinking.

> When you're forced to do it, you go, hey that's not so bad. Where before that, you're like I don't want to do that, that's bizarre, then all of a sudden…… That's why things can happen with the video wall because now you have to do something to minimize the footprint on stage and all of a sudden you can see the value in it and it's like, we're not going to go back 100% to the way we were, we're going to incorporate these things we've learned ….. you will adopt them and they will become a part of the movie business. (Kadner)

What does this influence from external forces reveal about the atmospheric frame? At the time of the publication of Dunlop's book, 2014, Gary Roberts was a virtual production supervisor at Digital Domain, a visual effects company based in Los Angeles. (Dunlop, 291) He wrote a segment specifically about virtual production. Using the first-person voice, he

highlighted the iterative nature of the pipeline, stating that "during the shoot itself we are not only using and creating digital and physical assets, we are also generating new assets—and large amounts of them." (Dunlop, 291) Both Roberts and Dunlop subverted the notion that virtual production was straightforward. In fact, they framed it as a combination of "preparation, metadata planning, time codes and database tracking" that ensured the project of virtual production met its original goal. (Dunlop, 291) But still, this was already being articulated in 2014. What was Perkins referring to as a "first wave"? Was it the popular proliferation? A corporate interest? Or simply a solution? These questions make the examination of virtual production in 2020 particularly poignant. Was it simply a re-introduction of a workflow that has existed previously? What was "new"?

Brian Winston's argument for supervening social necessities lays a theoretic foundation when questioning why virtual production was suddenly gaining traction in 2020 despite having been around for several years. What was the social necessity that made this "pipeline" so lucrative? The most obvious answer would be to assume it was the COVID-19 pandemic. Given the heightened physical restrictions, inability to travel, and a need to keep production operating, the industry's answer was that virtual production saved resources and time. It was the only choice. While the pandemic frame certainly gave rise to situations of negotiation and vice versa, there were other factors that influenced why all of a sudden, virtual production was the future of Hollywood. We cannot discount the role of corporate interests. According to a *Business Insider* report from July 13, 2020, Epic Games was valued at $18 billion that summer, a staggering growth from $1 billion in 2012. The company's biggest revenue was from *Fortnite*, a video game that dominated the market throughout the period. (Gilbert) While the pandemic clearly saw both studio-based and independent productions requiring quick pivots, the notion that a moment of

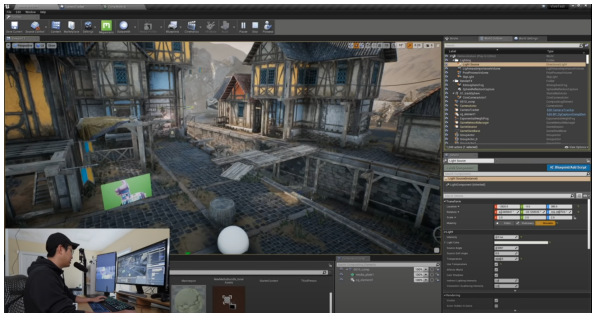
change is simply because of a supervening social necessity would be too rudimentary. In *How Media are Born*, Winston spoke to the case study of sound and film in the context of corporate influences. But he also stated that supervening social necessities are the "accelerators" pushing the development of media and other technology. (Winston, 58) Economics is important but not the "end of the matter." Hence, in any explanation of change, the overarching social forces play as much a role in the adaptation, or to use Winston's language, "application" of emergent technologies. The situations of negotiation were arising from a corporate focus. As Dunlop's work from 2014 showed, virtual production was certainly present before 2020. The pandemic was in a seamless web between the economic and the atmospheric, in this case as a result of the physical ramifications of a global upheaval. The urgency to find solutions for large-scale productions to stay in business meant a quick pivot to whatever technologies were available but also a competitive edge in a growing market. Hence, while the change was about a "pipeline" shift and a wider array of tools available, the adoption itself would have to be atmospheric.

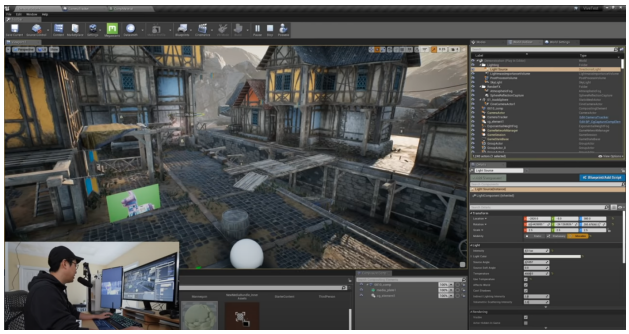
Virtual production's disruption of the status quo sat within a grander and arguably seismic disruption of global atmospheres. As Winston would argue, the powers-that-be simply continued on. Hence, while there was an illusion of disruption, the situations of negotiation arising from the atmospheric shift were situations resulting from bigger forces at work. But simply arguing for a framing of virtual production as a catalyst of change could land us in a technological determinism argument. The atmospheric frame does not block economic significance. If anything, an economic bend to the atmospheric frame aligns with the attunement frame introduced in the previous chapter. Instead of creating silos around "economic," "attunement" or "pandemic," by arguing that situations of negotiations are inherently relational and interconnected, we have an opportunity to emphasize the project of sociological approaches to

technology. The frames work together. They occur in a web. They are not separated through a rigid divide. Situations of negotiation occur between them. To refer to sound scholars like Gomery who argue that sound was diffused, I do not make the claim that virtual production was adopted overnight either. In many ways, it still remains a niche. However, the atmospheric frame takes on meaning and momentum when the social necessity meets the technology at a specific moment of time.

Attunement

Diffusion in both Gomery and Winston's definition is a much larger project, one that extended to practices outside of big-budget Hollywood products. Although 2020 is a self-imposed limit for the purpose of this thesis, I was able to identify that discourse within the independent filmmaking communities almost carried forth the industry dialogue seen through Kadner's podcast and the Virtual Production Field Guide.





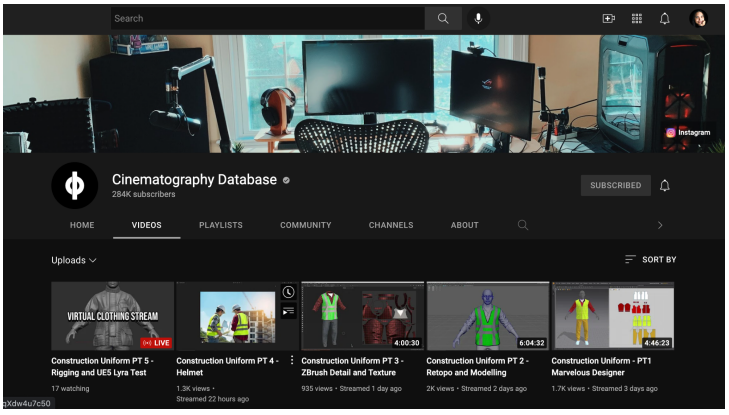


Fig 2.4. Screenshots of Workman's Youtube Page. (Workman)

Cinematography Database is a verified YouTube channel dedicated to the craft of cinematography. As of 2022, the channel boasts a subscriber base of 284,000 followers and has over seven million views. (Workman) The page is run by Matt Workman, a cinematographer who frequently posts detailed and technical videos on game engines like the Unreal Engine. The case of Matt Workman shows how language is carried through and across. In the 2020 virtual production discourse, Workman was one of few independent artists posting about this emergence. (Workman) He was interviewed by Kadner twice and has frequently appeared in videos sponsored by Unreal Engine. Under video titles like "Indie Virtual Production is HERE!," posted on February 26, 2020, and "Work from Home Virtual Production," posted on April 16, 2020, Workman tapped into a segment of the global production ecosystem that would have been absent from a Hollywood-centric conversation, one that was highly technical and spoke to creators without the budgets of live-action Hollywood productions. (Workman) Workman's videos were also distributed on sites other than YouTube. He was featured across several other publications, including ActionVFX in pieces such as "5 Virtual Production YouTube Channels you should be Following." (Thomspon) As he said in the podcast, "I think with virtual production, what I do in my basement, this level of visual effects, would've cost billions of dollars." (Kadner) Workman's example exhibited a situation of negotiation that expanded the situation beyond the geographical locations of Hollywood production or even a traditional production studio. Situationally, the world was locked down. Productions had halted. The atmosphere of virtual production had to extend beyond the physical parameters of the set. The promise of virtual production was a fundamental, atmospheric change that could be recreated from one's basement.

IndieWire, a publication focused on covering news for independent cinema and filmmaking, also featured a virtual production piece on May 8, 2020. It was written by Bill Desowitz and titled "'The Mandalorian' Leads the Way: Real-Time Virtual Production Is Saving Hollywood During the Lockdown." (Desowitz) *IndieWire*'s main audience is the independent film community. When speaking to the hopes for StageCraft, Desowitz described it as a platform eliminating the "need for costly and time-consuming location shoots entirely." (Desowitz) He interviewed Rob Bredwo, executive creator and head of Industrial Light and Magic. Bredow's comments on timing were significant because they heighten Winston's notions of supervening social necessities yet again. They also contradict the framing that virtual production was changing everything. As Bredow stated, "The technology has come at just the right time to help the industry continue to produce quality content despite the challenges we all face." (Desowitz) What was this "right time," and what other forces were at play in order for this technology to proliferate? Motion-Picture Control VFX Supervisor Nick Davis spoke directly to size. His comment unraveled a situation of negotiation around a gains and losses framework.

> There's always going to be an organic process, but we're going to have to look at the process of actually capturing those images, we're going to have to possibly limit the number of cameras — no big crowd sequences — and we know we can utilize virtual [production], the Unreal engine, and creating entire environments beforehand. (Desowitz)

The situation of negotiation included the visual. Yet, it was framed as a situation, one that had not entirely been negotiated yet. In both Workman and *IndieWire's cases*, space, scope, and budget were suggested but not critiqued. Much like the sound recorder's inability to eradicate noise caused issues for the cinematographer, virtual production was leading to a shift in the considerations of possibility. What kind of scenes could actually be filmed given these new negotiations? Where could they be filmed? In a basement? On a stage? In using a term like "organic", Davis echoed what Perkins also highlighted in the podcast. As Perkins said, "It's not a

science, it's so organic… the way…Hollywood runs is a little bit like a transmission but all of the pieces are not physically connected…it's the fluid that keeps everything running." (Kadner) What was this fluid he spoke of so openly? In both *IndieWire*'s coverage and Perkins' use of "fluid" and "organic," we see a transduction of terminology. Situations of negotiation occur through a "transmission," "a fluid," and while they are "organic," any consideration around nascency requires negotiation. The *IndieWire* article also featured several of the same people interviewed in the podcast, including Perkins and Legato. Not only are terminologies transduced but so are key players and knowledge experts that produce and reproduce the same situations of negotiation.

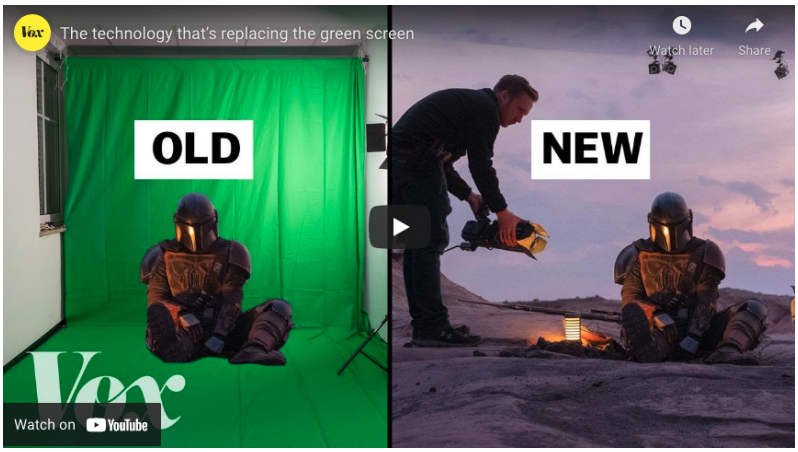


Figure 2.5. Screenshot of the Vox video landing graphic from YouTube. ("The technology that's replacing the green screen")

Media company Vox posted a video titled "The technology that's replacing the green screen" on October 23, 2020. Narrated by journalist Phil Edwards, the video featured an edited interview with lead compositor Charmaine Chan. A compositor's role in a live-action production is to synthesize. ("The technology that's replacing the green screen") As Dunlop wrote, "Compositing is the process of blending all of the rendered and live- action elements that make up a shot into a series of finished images." (Dunlop, 65) As the description stated, Chan's role

changed on *The Mandalorian*. But it was her observation of the stage itself that evoked a new form of attunement. Recall Kathleen Stewart's definition from the first chapter. There was a sensorial dimension, one that invoked a presence on set. "The moment you step in the middle of the volume, you're just….you're just there," she said. ("The technology that's replacing the green screen") Edwards then proceeded to ask if it was physically "confusing" for Chan to be on this set. Chan's response was enthusiastic.

> You're shooting all day and you're at that location. It doesn't feel like it's something fake. It just feels like an extension of a regular stage. You gotta be careful because there are times where people don't see where the end of the stage is and where the LEDs are. ("The technology that's replacing the green screen")

Notions of fake-ness, reality, and space echo some of the similar expansions on reality as explored in the first chapter, specifically around how sound had to be "exact." The realness of the game engine and the space itself had a lot to with the technology's promise. The pipeline was shifting relations but the pandemic served as context to discuss possibility amid mass change. The remainder of the eight-minute Vox video covered the shift in pipeline as well as a shift in lighting infrastructures as a result of the LED screen. However, the notion of discussing the stage itself or the environment itself was not simply seen in the Vox video. *Insider*'s YouTube page featured a short interview with Richard Bluff, visual effects supervisor at ILM. As Bluff said,

> even "The Mandalorian," with its technological advances, used a version of a green screen, but via the LED wall. Another capability of virtual sets is to choose pinpointed areas of the wall and turn those green. We now have the ability to limit the amount of green screen that's visible behind the character. So it doesn't wrap around the entire stage, it's just a little piece, but also, they gain the lighting from that environment. Which gives us a more seamless result in post-production. ("Why 'The Mandalorian' Uses Virtual Sets Over Green Screen")

What Bluff's, Chan's, and Bredoiwtz's coverage revealed along with Workman's independent channel was that much of the framing in both journalistic and independent coverage

regurgitated similar dialogue that was heard through artifacts like the Virtual Production Field Guide. However, what was different was that they were tending to an environmental dimension that involved an atmosphere far beyond the physicality of a set. The physicality was a factor, but for Workman, if virtual production was being done independently, then all of the same visuals could simply be recreated in a basement. Or so it was promised. The pipeline was less of a promise and more of a process that would lead to the possibility of creating something new. The atmospheric frame is useful in pulling out these other frames that emerge given that the field guide continued to reiterate that there was no certainty around what virtual production meant. The definition was up for grabs. They were iterating the concept using existing definitions and frames while keeping the opening for newness at the forefront of the dialogue. An emphasis on the LED screen hinted at attunement of a different kind. Unlike noise and acoustic dimensions of sound, the promise of virtual production's pipeline shift was presented through the possibility of environmental attunement. Suddenly, an LED screen on stage or a camera setup in a basement was enough to challenge both workflow possibilities and environmental considerations. This is expanded upon in the third chapter.

Critique

While at first it seemed like there was no public discourse to oppose the promises of newness in 2020, an expanded search proved otherwise. I began the first chapter with Glennon's critique of synchronous sound on a set compromising the visual quality of a film. Unlike 1930, 2020's critique came from Jenkins' converged-participant demographic. There was one virtual forum that indicated this demographic was countering some of the optimistic industry networks

around the new technology - an archived Reddit thread from December 6, 2020 proved to be an unexpected facilitator of what appeared to be a robust but informed critical discussion.

With the user *erics75218* posting under a community titled r/vfx, there was an enthusiastic but cautious critical discussion of virtual production. The post was titled “unpopular opinion - "Virtual Production" shots look bad....?.....” (u/erics75218) It had seventeen responses under a “thread,” which on the SNS Reddit counts as a discussion forum. Towards the end of the post, they asked, “Am I alone? Am I crazy? Am I a hater?” (u/erics75218) One of the several responses pointed to situations of negotiation arising through a clear indication that nothing was “new” about virtual production.

> I agree, I work in Virtual Production but I’ve been doing post production visual effects since the 90’s. LED volumes look like what they are. I see no real advantage aside from the lack of greenscreen spill. It’s also a pain in the ass for post production teams to have to rotoscope foreground elements if they need to add visual effects in post to a virtual production background. I’m sure they’d prefer a greenscreen where they have full control. The post vfx suffer as a result, which can make the overall shot look “off.” It also locks the production into one look for the background, they can’t easily change it after it’s been shot. Overall it’s a major pain in the ass for all involved, and visually I don’t see any advantages over traditional post production vfx. I don’t understand why people consider it an exciting new technology when rear projected footage has been used in films for 50 years or more. “But look how it moves with the camera!” Yeah great, we’ve had motion control for decades. A background moving in sync with the camera is nothing new. (u/RustWasGrand)

In this case, newness was being negotiated. The situation arose from a visual consideration. When almost all existing discourse had to do with virtual production’s possibility, Reddit provided a platform to discuss its limitations. While more industry artifacts were focused on discussing the expansion of the “pipeline,” the experience of being on set, and the precedence of virtual production, organic conversations were happening on a platform. Anonymity offered an opportunity. Take a look at the following responses in the same thread.

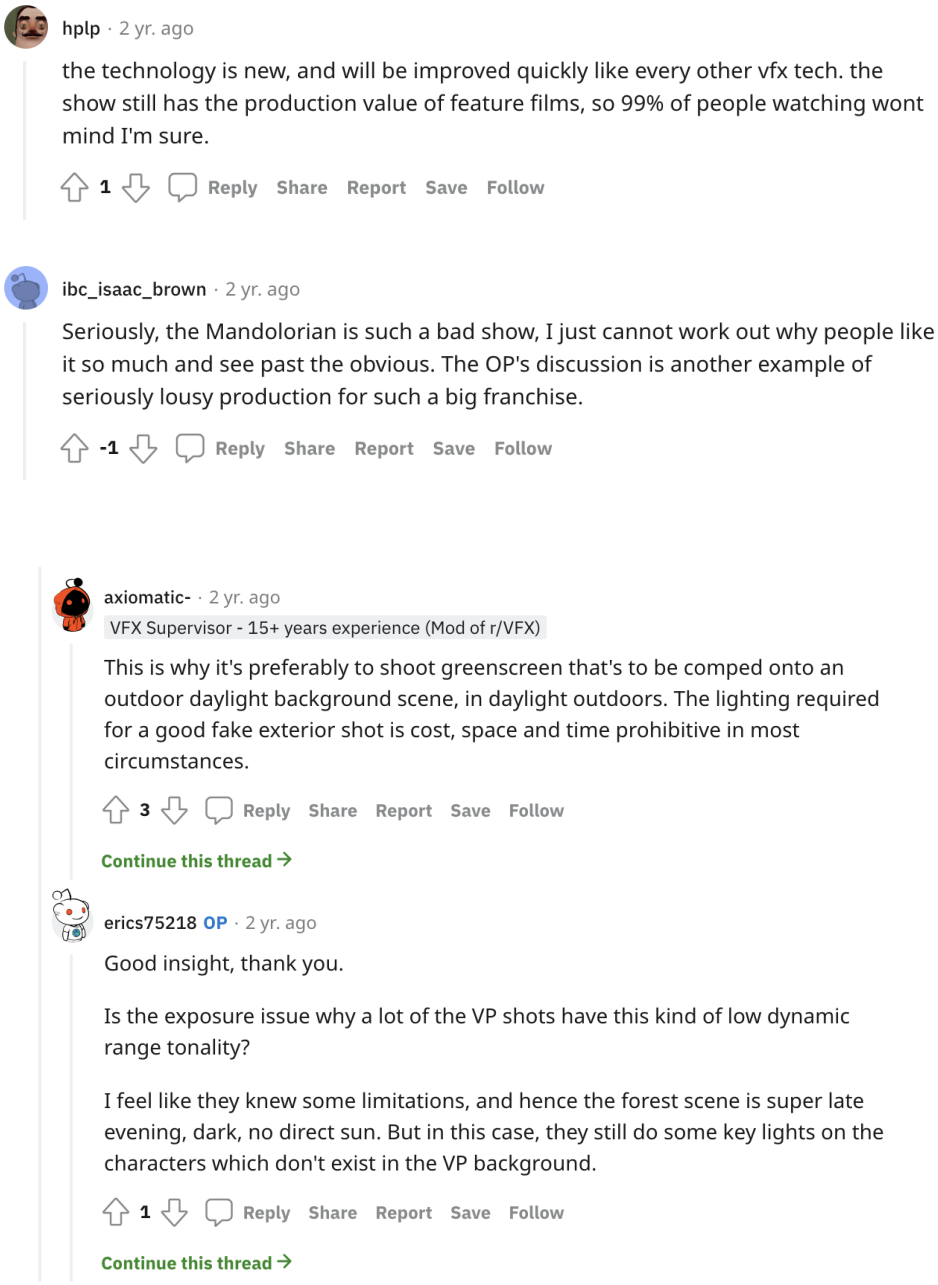


Figure 2.6. Reddit thread with responses from community members. (R/VFX)

Discussions were predominantly visual. Much like the fans as social actors in the 1930s, the commentary on changing visuals indicated that although industry artifacts were not revealing much about the limitations of the technology and focusing on the pipeline through the pandemic's urgency, discourse did not entirely ignore critical observations. Unlike Glennon's

critique, which was published in ACM, these conversations were occurring under the garb of anonymity and through internet forums like Redditt. Caldwell acknowledges these changes in industry artifacts, arguing that more contemporary industry dialoguing occurred through a conscious effort by the industry to mitigate how it was being discussed. (Caldwell, 329) The "industrial reflexivity" had economic benefits. (329) Hence, critique would perhaps not be encouraged in the publicly–disclosed artifacts nor in semi-embedded one if the supervening social necessity was predominantly economic. Yet, the forum proved to be a space where the visual fidelity mattered for a converged participant, which I use to mean both producers and consumers converged into one. Much like the 1930s, fans as social actors meant that situations were negotiated beyond simple production.

Change via adoption of new technologies in film and television is ultimately negotiated with the audience. In categorizing Reddit as either publicly-disclosed or semi-embedded, the platform falls somewhere in between, thus making it ideal to reveal a situation of negotiation. It cannot be publicly disclosed because there was no concerted effort to promote virtual production. The SNS took on a role of its own, operating to work against the industry's self-theorizing. As we saw in the 1930s, the atmospheric frame did not require cooperation from all social groups to give way to the adoption of new technologies. As user *hplp* wrote amongst a more critical discourse, "the technology is new, and will be improved quickly like every other VFX tech. The show still has the production value of feature films, so 99% of people watching won't mind I'm sure." (u/hplp) Still, the critical discourse revealed much about the atmospheric frame in that it gave rise to situations of negotiation between participants in the viewing process. Referring back to Bazin's myth of total cinema, what this discourse proved was that ultimately, the movement of virtual production forward would be determined by the "obsession" of mimesis. The ultimate

viewer's experience was hence determined not as much by the growing workflows, but rather whether the shots looked "good" or it was "obvious" that the locations weren't "real." The economic and industrial forces, while working towards virtual production's adoption also ignored some of these critical observations, thus showing that the situation of negotiation at hand was far more embedded in an atmosphere outside of publicly-disclosed behind-the-scenes videos and field guides.

The proliferation of online community formation extended into yet another platform: Facebook and the Virtual Production Facebook group. I first heard of the Virtual Production Facebook group at the Real-Time Conference, which took place in December 2021. In a non-recorded breakout room with several CGI artists who, when asked about where they found information, referenced the group as a space of community building and support. It was mostly for technical questions, but pointed to signs that there was a resistance to the marketing campaigns with industrial interests. The group is public and as of July 2022 has 21.2 thousand members. ("Virtual Production.") It is administered by two public profiles, one under the name of Demian Gordon and the other under the name of Bren Dan. The first post dates back to July 3, 2020, with a "welcome message." ("Virtual Production.") The group states two main rules from the admins. The first is to "try to keep the direct marketing to a minimum," followed by this description:

> We don't like companies marketing directly to our members. If you are offering discounts, that's maybe ok....if you want to toot your own horn you need to do it through customer success stories or have your customers do the posting about their work ("Virtual Production.")

The second states "No likes or subscribe requests" with the following description:

> If you post your youtube channel or your kickstarter ...prepare to feel the wrath of the ban hammer. Unless the thing you are promoting is SUPER relevant to this group...it's probably going to get you swiftly banned. ("Virtual Production.")

Reddit and the Virtual Production Facebook group highlighted that while industrial sources, through independent coverage reflecting a semi-embedded dialogue of the industry remaining in conversion with itself, the virtual community spaces were working through their own domain. There was a tension between the atmosphere being created through industrial artifact exchanges and the communities being formed around the emergence of virtual production. The situation of negotiation had to do with vested interests, one focused on converged participants and one focused on selling virtual production as the solution for Hollywood.

Where did this all lead?

Peter Lunenfeld writes that the computer is "the universal solvent into which all differences of media dissolves into a pulsing stream of bits and bytes." (Lunenfeld, 7) As I reiterated through the chapter, the industrial artifacts I examined originated in the computer age, which is an important distinction to make from the 1930s. This distinction challenges the project of using two time-based moments as sites of comparative analysis. But the project of situating change as it unfolded through the last two chapters revealed that the atmospheric frame giving rise to situations of negotiation required certain attunements and highlighted what supervening social necessities such situations are created from. To interpret a technological frame at a contemporary moment added to the complexity of theorizing around change as it occurs, but also offered up a way to expand some of the unaccountable social observations around the introduction of revolutionary technology. Issues of attunement, a shroud of secrecy, distributed networks, and the role of critique, all interconnect to reveal situations of negotiation. When observing change as it occurs, we may not find resolutions to the negotiations. But they signify a

broader perspective. It is this broader perspective I call the atmospheric frame, despite the concept's haze-like quality. It is the haziness that makes it ideal as a heuristic for observing ongoing change. The immediacy of moments of change can offer opportunities to theorize around affordances and indeterminacies. Haziness or muddyness is therefore not a detriment. It can have the power to shape discourse and dialogue in the moment as ongoing. To refer back to Gitelman's terms, the map is muddy insofar as this "muddiness" is not acknowledged. In the third chapter, I propose theorizing around one of several technologies: The LED screen. In doing so, I continue the pandemic frame to examine what specificity could provide. What sites of intervention emerge from the arduous task of articulating the space itself?

Chapter Three: The Screen

Figure 3.1. An LED screen ("The Virtual Production of The Mandalorian Season One")

Raymond Williams argues that the complexity of mediation as a terminology rests in the "inevitable and important difficulties" of its usage. (Williams, 206) In some senses, it is used to denote conciliation in a political context. In others, it is used either directly or indirectly to denote relationships between otherwise separated facts and experiences. It can also mean "form" in context to a direct expression of unexpressed relations. (Williams, 206) The first political context is more aligned with my proposal of "negotiations." In this chapter, I use it in an ideological sense, to express the indirect and direct relations across virtual production. I propose that we examine the LED screen as a medium. By focusing on the object itself, what new insights can emerge about the subject-object relationship? How can change be understood through discourse surrounding the screen itself? In the previous chapter, we saw that the LED screen was referred to as the "volume." But "screen" is a broad term and carries with it a long history. Are we referring to screen in the sense of French "*écran*"? (Somaini, 160) Does the LED

screen align with specific objects like sound recorders? Is the screen a site in itself? Furthermore, what does medium-thinking reveal about the atmospheric frame and situations of negotiation?

The nomenclature of the LED screen was contested. This contestation is likely because there were a variety of players or rather, stakeholders involved in the establishment of virtual production. As we saw in chapter two's discussion of the Virtual Production Field Guide, certain artifacts, specifically those sponsored by corporate players, must be approached with trepidation. It is not to de-value the source itself but to highlight how the supervening social necessities of economic and global factors like the pandemic impact the framing of new technologies. For example, in a virtual production guide released by streaming service Netflix, the screen was referred to as a "studio with LED panels." ("Production Context") In an article by website *TechCrunch* dated February 2020, the screen was said to be an LED "volume." (Coldewey) Kadner referred to it as the LED "wall." (Kadner) A wall, a volume and a studio. All three terms cover a multitude of possibilities and implications. Which one stays and which one goes? If language carries forward through multiple deep texts, how does it shape the environmental indications of change? Is there an attunement to the environmental that alludes to the atmospheric?

I make the case for thinking across the transduction of nomenclature and of specific terms like "virtual production", the "LED wall" or "LED volume." The terms become extenders of atmospheric conditions outside a physical site of the set. In thinking across the LED screen and a set-specific atmosphere, we can understand terminologies as modalities of travel. As Helmreich would argue, sound is transduced. (Helmreich, 223) The haze-like feelings which Böhme writes about, occur in movements. Or to put it differently, movement is the site at which the atmosphere is generated. I argue that the haze-like feeling evoked by emergent relationships is a fundamental

component of the atmospheric frame. The situation itself is hazy. Atmospheres are thus created in and through the LED screen but extend beyond the physicality of the set. If the LED screen is a medium, then it is behind, in front and through the screen that a virtual production's atmosphere can be altered. In arguing for such a claim, the atmospheric frame is highlighted through descriptions of the screen and what they indicate about change as it occurs not through a broad discourse of pipelines but through the medium-based characterization of a technological object.

Using limited discourse around the LED screen as a way to examine the atmospheric frame gives light to other considerations. These considerations certainly intersect with those seen in the previous chapters, such as the context of a pandemic, the secrecy around industrial knowledge or the access to publications but when thinking through a medium, we are offered an opportunity for specificity that can be missed in broad discussions around "pipelines" or "sound." The LED screen's medium-ness comes from both the nascency of the screen's presence and also its invisible and visible considerations. I have identified several mediated frames of the screen that elucidate this argument below. But first, we must seek clarification on what medium could mean. Am I talking about something Aristotle would support in the theory of vision, this idea of in-between-ness, something situated across medium and milieu? Medium comes from "medius,*"* the Latin root connoting middle or milieu as media historian John Durham Peters calls it, or the French descendant of "medius locus." (Peters, 46) In order to make any claim about the LED screen as a medium, what are the missing, indescribable, indeterminate qualities like radiance, awaiting or unfolding that occur between its components? Here, the atmospheric framework comes in handy. The haze-like quality allows for a suspension of the indeterminate.

Atmosphere connotes an inclusion of that which cannot be described, thus leaving room for further, unbounded postulation.

What happens when an idea arises in the mind of an artist? What happens when they wish to transform this idea into a form? Where does possibility begin and end? If an LED screen is represented as an object at the center of virtual production's potential, then perhaps an artist may choose to conceptualize an idea for the screen's capabilities. Now the atmosphere is felt far before the set is even built. To circle back to Böhme's argument, the theorizing of atmospherics is inherently the theorizing of perception and this perception need not be simply related to technological objects. Transducing across origins suggests moving an atmospheric frame, one that situates the LED screen much before its sensed presence on a virtual production set. The following paragraphs explore this movement as mediation.

Presence

Let us look at an extended reality (XR) stage as a close cousin of the LED screen. Both are similar in that they both intend to project from a surface and not onto the surface. However, while rear projection and even something like the green screen were meant to disappear or be absent, the XR stage was not framed to disappear or create an illusion of reality. As in, the stage was meant to be "there." When watching an event or a broadcast where much of the XR technology had been used, the stage, the screen and the set all had as much a role in the message as do the actors, performers or contestants. (Hunter) The stage was a dream. It was the site of magic. It carried within a possibility of verisimilitude, amongst others. The LED screen's intended visibility, its promise of not being "there" as Charmaine Chan the compositor stated in chapter two evoked a sense of disappearance. The screen was meant to imitate reality. According

to Gernot Böhme, theorizing a new aesthetic is to theorize perception. (Bohmë, 34) He speaks of a perception that is liberated from dichotomies. Similarly, to theorize technological knowledge is to speak to perception as an atmosphere. The LED screen as a medium allows us to argue that the screen is invoking a disappearance of the studio and a desire for verisimilitude.

Stage, which originates from Old French "*estage"* connotes positionality, situatedness or dwelling. ("Stage Definition & Meaning.") The word "screen," despite having ambiguous origins, can be traced from associations with barriers, protections and shields. (Buckley, Campe and Casetti, 8) Scholars like Giuliana Bruno have theorized the screen through its role as a site of encounter. (Bruno, 58) A screen-based thinking which allows for a reframing of the LED screen as a condition of exchange is then foundational for a conversation on new relations. It is less so to do with the etymology than it is with the relationships that the terms generate. Once again, in thinking of words as purveyors of transduction, we are able to assign value to them as mediums carrying the atmospheric frame. But the LED screen is situated in a virtual production studio. As Brian R. Jacobson wrote in his book *In the Studio, Visual Creation and Its Material Environments,* "From their origins, studios were designed to generate technological visibility by remaining unseen." (Jacobson, 4) Jacobson argued that the studio has largely remained untheorized in the history of media. He postulated that the studio itself was a "hidden necessity for illusionary forms of cinematic and televisual production" but that both viewers and critics alike ignored their significance in shaping the story of production and reception. (Jacobson, 4) While the LED screen is by no means the only component of the studio space, its role in the mediation of atmospheric frames is crucial when arguing for an atmospheric frame.

Sean Cubitt suggested that when "keystoning" i.e. The stretching of an image at one edge reset by a projector was automated, it revealed a new materiality of projection. (Cubitt, 4) He

elucidated the technological and cultural implications of this automation. By thinking atmospherically, even the smallest form of automation can become a new relation. This is not to say that rear projection was the only early cinematic predecessor. That would be too simple. As the *Movie Insider* video from June 11th 2020 stated,

> you may be thinking, this isn't so new, I've seen something like this before and you're right….kind of. The predecessor to what we see on the Mandalorian is a driving scene like this one from Dr. No, you've got the actor in the car and behind them a screen with footage of the road they've traveled but the technology was limited. ("Why 'The Mandalorian' Uses Virtual Sets Over Green Screen")

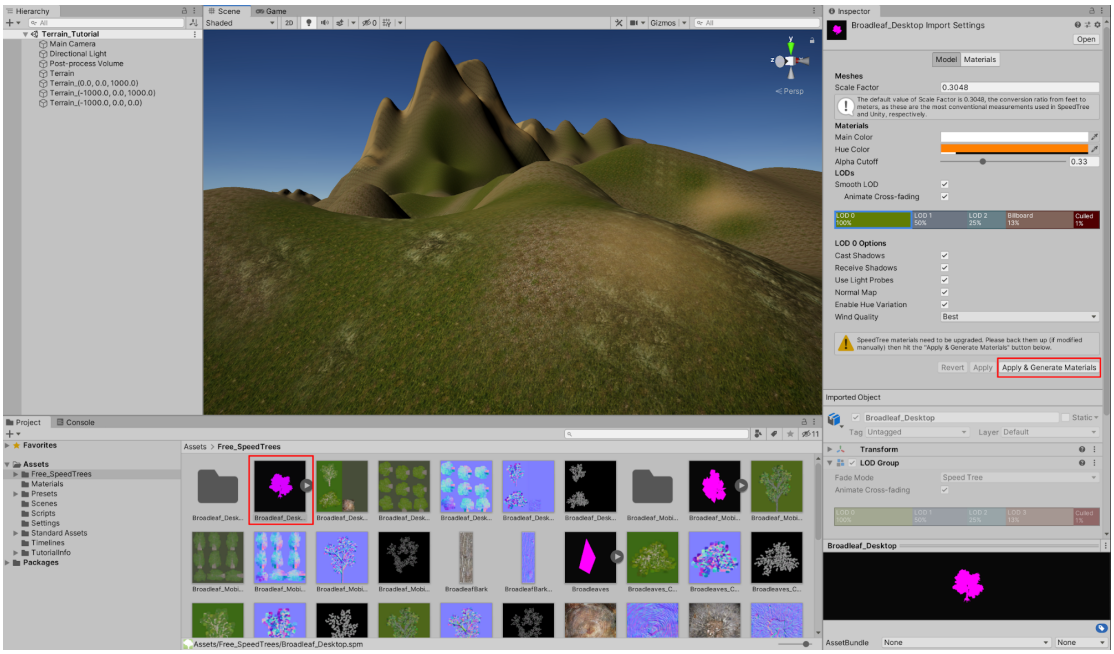
The framing of the LED screen's origin gives rise to situations of negotiation that involve precedence and therefore, the promise of newness. Precedence is often complex. For example, rear project was conjured by throwing an image onto a screen to show distant backgrounds in motion and has been traced to the 1930s with Frank Borzage's *Liliom*. (Knight) Green screen technology came later and was based loosely on something known as chroma-keying, a technique allowing two images or video streams to come together in post-production. (Foster, 3) It can also be traced back to early cinema with an early example of Frank Williams patenting the black-backing matting process in 1918. (Foster, 4) John P. Fulton also used this technique in the 1930s to create illusions in films like *The Invisible Man.* (Foster, 4) I bring these examples to suggest that materiality produced through an atmospheric approach requires a reconfiguration of where relations begin and end. Furthermore, despite having precedence within cinematic processes, the question of virtual production extends further out than simply being one or two technologies. Although it can be argued that the LED screen emerges from a lineage of screens, as Anne Friedberg stated in *The Virtual Window,* Georges Meliés was a compositor, if not the grandfather of compositing. He challenged film's mimetic assumptions. As Friedberg wrote,

> Digital compositing technology eased the combination of live-action, animated, and computer-generated images in cinematic and televisual production, and yet the

> turn-of-the-century magician-turned-filmmaker Georges Mélies could equally be considered as a compositing technician conjuring a world that did not exist outside of the filmmaking apparatus, a world with its own physical laws. (Friedberg, 3)

If Meliés was a compositor, then how do we define the differences between what was considered visual effects and the philosophy of compositing? Is it merely the breaking of physical laws? Let us look at a few components of the LED screen to understand what some of the possibilities reveal about the mediation of situations. This form of immersion on a set did not have the same movement-based relationship to the camera that an LED screen and game engine has, but there were still some relations. When the light projected onto the fabric of the screen bounced across an actor's silhouette, the camera had to be developed to work around this lighting. The *Movies Insider* video claimed that the Unreal Game Engine solved the problem that rear projection had set up. In doing so, it eliminates the potential for discussing situations of negotiation which arise from new problems created by the LED screen system.

The Game Engine



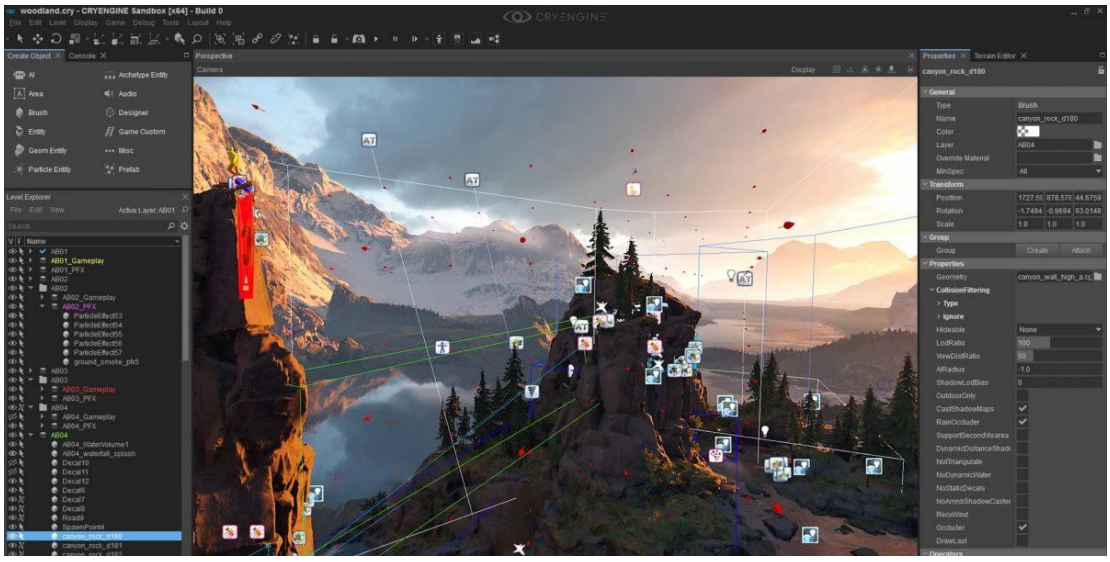


Figure 3.2. Screenshots of the game engines Unity ("Working with the terrain editor") and CRYENGINE. (CRYENGINE)

In *Game Engine Architecture,* Jason Gregory writes that the separation between a game and the game engine is dependent upon each individual software and hardware makeup. Game

Engines like Epic's Unreal, Unity 3D, Sony's PhyreEngine or Microsoft's XNA Game Stop were crafted to run particular games on particular hardware. (Gregory, 25) Hence, it is difficult to articulate exactly what a game engine is. To use SCOT's notion of a seamless web as fundamental to the technology/society relationship, the game engine can then be seen as a seamless web of not only the internal infrastructure of a game studio but also one that works towards socially embedded interactions between agents, materials, and world-views. Jason Gregory writes that "game studios are composed of five basic disciplines: engineers, artists, game designers, producers and other management and support staff (marketing, legal, information technology/technical support, administrative, etc.)" (Gregory, 25) Engineers handle the implementation of software and artists range from 3D modelers to motion capture actors to concept artists who produce sketches and paintings providing teams with visions. Thomas Hughes' system is embedded in socially-constructed and society-shaping components. But the components arise from a multitude of sources. As Gregory states,

> Any game engine must be fed a great deal of data, in the form of game assets, configuration files, scripts and so on. Games are multimedia applications by nature. A game engine's input data comes in a wide variety of forms, from 3D mesh data to texture bitmaps to animation data to audio files. All of this source data must be created and manipulated by artists. (Gregory, 59)

The assets are called Digital Content Creation (DCC) applications. They range from elemental components like the sun, trees, mountains and geographically-based pre-renderings to three-dimensional meshes of weapons and objects. I bring out these details not to highlight the technicalities of the game engine. This would be a separate task. Instead, it is the web-like network of the game engine that makes it a component of the LED screen's affordance. This highlights a mediated situation. In engines like the Unreal Engine, for example, a developer sitting in one part of the world has the ability to upload an asset to the digital library. This library

can then be utilized by any other user of the engine. Not all of the assets are free of cost. But all pre-rendered assets are uploaded to the engine and what is seen on the LED screen is then a combined effort between a developer i.e., someone who understands the software or the code, independent artists who are building the library and the emergent network of a virtual production pipeline." The interconnections and ongoing relations are both imagined and concrete. To evoke political scientist Benedict Anderson's concept of imagined communities, the formation of such a communal relation may or may not be known to each member. He argues that a nation is imagined. (Anderson) As in, while programmers, developers and LED screen technicians may be hired to work on a set, the assets within the engine can come from any source. The game engine is a component of the screen that mediates emergent situations of negotiation through the seamless web of networks it brings to the already complex technological system.

Let us look at the relationship between camera and screen as an example of how the LED screen also becomes a medium for such situations to arise. The following quote is narrated as a voice-over in the *Movies Insider* video used as a journalistic source in chapter 2.

> Say you want to move the camera angle during the scene— projected footage can't move with the camera. By using Unreal Engine, tech borrowed from the video game field–that problem is solved. Artists can create a photorealistic 3-D background so if the camera swings around and changes angles the background shifts in precisely the same way. This allows motion-tracked cameras to execute traditional cinematography techniques within the virtual set, achieving cinematic movements like the parallax effect where objects in the foreground move at a different speed than the background and amplifies the illusion of filming at an actual location. Now that LED screens can move with the camera's eye, virtual sets can solve a bunch of green screen problems, the biggest one probably being lighting. ("Why 'The Mandalorian' Uses Virtual Sets Over Green Screen")

When the camera moves, the background moves as well. While this relationship was promising and the illusion of filming at an "actual location" building upon notions of a mimesis opened up much possibility on the role of the LED screen, the video notably missed some of the

critique around this movement. There can be, what is colloquially referred to as a "lag." The assets, built as environments, interact with the camera's purview. This runs the risk of moiré, an effect that creates a refraction and hence, exposes the background as unreal. ("How moiré effect impacts LED display technology choices") In doing so, what was once a relation between camera and static object or natural backgrounds exists between camera and screen but also gives rise to new situations of negotiation involving accuracy. Jimena Canales, historian of science has written extensively on the history of the tenth of a second lag. As she said, "what preoccupied thinkers after 1850 was the existence of a lag time—of the order of a tenth of a second—between stimulus and response." (Canales, 120) The notion of a lag is not new to the negotiation between scientists, engineers and artists.

The lag can also reflect overlaps with the field of affect theory. In *Parables for the Virtual,* Brian Massumi writes about neurophysiologist Benjamin Libet's discovery regarding a half-second lag. The half second lag is the "conscious dawning of an action from the onset of its physiological stirrings." (Massumi, 7) For Massumi, affect theory cannot exclude freedom but does require redefinition, especially if carrying forth a body/mind duality. (Massumi, 7) A lag of any duration occurring between the screen, the engine and the camera is then simply an inevitability of its medium-ness. With a body/mind dualism, the body can be substituted for the camera and the mind, for the screen. If duality is to be presupposed, then there is no freedom between how the two interact. If the duality is shattered and the relationship becomes a site of intervention, then we might suspend a need to immediately articulate relations. The atmosphere remains, despite a lack of clarity around where the medium begins and ends.

The LEDs

Figure 3.3. Light-emitting-diodes

I argue that the LEDs (light-emitting diodes) themselves mediate situations of negotiation as components of the LED screen. An LED is a semiconductor light source. It runs on electroluminescence, which is defined as an "optical phenomenon of light in response to an electric current." First seen in the 1930s by French physicist Georges Destriau, electroluminescence is also defined as the "generation of (nonthermal) light by use of an electric field." High electric field EL units emit light through the impact of high energy electrons in luminescent centers in a semi-conducting material. (Encyclopedia of Modern Optics, 376) As Phil Galler, head of Lux Machina, the company managing the LED screen system on the *The Mandalorian* said in an interview, "Roughly 90% of all LED technology is a pulse-width-modulation-driven technology, which means there's a period of "on" and a period of "off" that dictate brightness." He followed that by adding, "scientifically, LEDs (Light-emitting-diodes) are terrible. They're not a black body source. So, ultimately, you're not getting a wide spectrum of color. You're getting very narrow valleys and peaks in the red, green,

and blue." (Kamat) According to Galler, since LEDs were not created to be filmed as backdrops, they are not ideal for virtual production.

Hapticity

While the green screen would emit green tones, it was still an opaque surface. Computer graphics and visual effects, including a rendered virtual environment would be added in post-production. Actors have had to play to the invisibility of the background. The LED screen in contrast evokes a new materiality, one that extends into notions of "being there" as compositor Charmaine Chan spoke of in the Vox video. As in, the actors and crew are able to experience the visual effects in real-time. Emitting electroluminescent light, the screen mediates a new type of relationship between actor and environment. In one way, we can see this relationship as a non-haptic mediation. Giuliana Bruno, scholar of visual and environmental arts, wrote that the cinematic screen was reinvented as a material architecture of becoming and that in the fibrous canvas dressed by luminous projections, a surface medium between art forms emerged.

> In addressing the reconfiguration of the screen in relation to the transformation of other visual planes of imaging, such as the canvas and the architectural façade, I have been reflecting on the surface as location and mediation, as a form of siting and a space for the materiality of media. (Bruno, 108)

Her work has been dedicated to shifting the discourse from the "optic towards the haptic," specifically when considering the intimate experiences offered by surfaces in our everyday thinking. (Bruno, 12) To her, the haptic is a "relational mode derived from a sense of touch" that ultimately serves to "apprehend the art object" and thus "turning contact into a communicative interface of public intimacy." (Bruno, 12)

In the case of the LED screen, while the intent of the screen is not to be an art object for

the public, it serves as a relational mode operating without touch. It mediates situations of negotiation with an environment that is rendered in game engine. But the surface itself, unlike a fabric-based screen of cinematic projection or even a green screen, does not invite a haptic sensibility. Instead, the three-dimensionality has depth without the depth being "felt." Any production personnel from actors and directors to lighting technicians find themselves in situations of negotiation with their immediate environment. They are embedded in a new atmosphere and much like the sound stages called for situations of negotiation with noise and traffic, the stage architecture and labor requirements, the LED screen mediates an emergent situation, one that calls for negotiations to occur in a multi-relational framework, or to use SCOT tradition, in a multi-directional seamless web. Therefore, it is the non-hapticity of the screen, accompanied by electroluminescence which contributes to a web-like mediation. The lack of touch with the surface of an environment doesn't flatten as much as it recreates an atmospheric modality. French phenomenologist Maurice Merleau-Ponty says that "nothing is more difficult to know than what we see." (Merleau-Ponty, 59) The atmospheric frame arises when situations of negotiation curate a not-knowing.

In *The Screen as Object: Art and the Atmospheres of Projection,* Bruno theorizes screens as luminous surfaces in art galleries and day to day life. She brings in the sensory capacity of the screen into a mediating light. In elucidating the views of French artist Phillope Parraneo, she reiterates that for him, "a digital LED screen has both a sculptural dimension and a morphing surface that is at onc electric and capable of electrifying the surrounding atmosphere." (Bruno, 158) This surface of projection "functions increasingly as a filter," transforming physical and imaginative environments. (Bruno, 158) The LED screen used in the context of virtual production is similarly an electrifying force that mediates situations of negotiation ultimately

impacting working conditions, creative potentials and adoption of new technologies. When thinking about representations of change as it is ongoing, the screen's medium-ness assists this filtering of new ways of working in, through and behind it. The atmospheric frame is alluded to through such negotiations.

Golden Hour, Radiance and Weather

Figure 3.4. Golden hour as seen on Unreal Engine's website. ("Sky Atmosphere.")

One of the main arguments made in favor of the LED screen's affordance is that it allows crews to shoot endlessly in "golden hour". In *Location Lighting for Television,* Alan Bermingham defines golden hour as "the period immediately after sunrise and the period immediately before sunset." (Bermingham, 276) As he says, it is not an hour-long time frame but sunlight does have to "pass through a very thick layer of atmosphere," which often leads to sunlight being seen as a warm lighting source. (Bermingham, 212) Allowing a crew to shoot endlessly in golden hour eliminates restrictions on the way a production is organized. Studio shoots in golden hour are not new. So then what makes the LED screen's appeal different from

shooting in golden hour on a regular stage? I argue that the promise of realism and “exactness” to a real-location mimics some of the observations from the 1930s. While three-dimensional built environments have been used extensively in visual effects and adjacent fields such as architecture, what makes the LED screen unique is that it projects a verisimilitude greater than a green screen. While it can be used to project fantastical imagery, the verisimilitude became the selling point, dominating the narrative around its affordance. In scholar Kristi McKim’s book titled *Cinema as Weather: Stylistic Screens and Atmospheric Change,* she elucidated representations of weather in cinema. Referring to the element of surprise, she quoted French painter Marcel Gromaire’s rose as an example of “waiting” for nature to unfold. (McKim, 27) McKim specifically discussed the evocative but labor-intensive quality of golden-hour footage on a location-based case -

> While cinematographers can await the magic hour in rough confidence that eventually the sun will "set" beneath the horizon, there's no telling what cloud cover or rainfall or pollution might impede or alter the desired look of the sky. Likewise, producing cinematic weather constitutes a huge portion of the budget…shooting film weather involves higher risks (we wait for snow; it doesn't snow; we waste a day of shooting) or higher costs (we produce the snow via machines that we've bought or rented). Regardless of weather produced or awaited (or, in numerous cases, weather that pleasantly surprises shooting crews for the better), these sequences of cinematic weather constitute a larger-scale equivalent of Gromaire's gentle appreciation of the blossoming rose. He thanks cinema for what he saw, and this revelation of natural change continually defines cinema's ontological significance, especially in the first half of the twentieth century. (McKim, 27)

What McKim calls ontological significance is an inherent time-boundedness through producing conditions such as “waiting.” Time-boundedness manifests in concrete structures like budgets, call sheets and crew sizes. In a case where the LED screen and studio space are absent and where uncontrollable weather must be factored in, the atmosphere that is generated emerges not from components such as electroluminescence or the built environment but rather, elements such as the sun, wind and rain. The difference therefore, between creating a rendered

environment in a studio projected through an LED screen and shooting on-location is that both situations give rise to different situations of negotiation–one involving a control-based relationship to weather and the other, to the possibility of verisimilitude.

To evoke Böhme's sentiment that atmosphere and perception are profoundly interlinked, an illusionary lack of control could be a starting point for appreciating surprise in weathered processes around cinema-making. Bijker talks about "interpretive flexibility" or the notion that technological change is perceived differently by different social groups, which affects how new technologies are developed. (Bijker, 159) With the atmospheric frame, situations of negotiation affect how technologies are then adopted into practice. Interpretive flexibility is thus realized through situations. In the case of weather, a producer may see the elimination of uncontrollable factors as advantageous. On the other hand, a director may appreciate Gromaire's "awaiting" or "unfolding" for the simple reason that the act of surrender offers significant creative possibility. In my interview with artist Deniz Tortum, he alluded to the situation of negotiation arising from the relationship between the story and the set itself.

> What is the relationship between the story of the film and shooting it on a virtual production set? I do sense that there are relations, but if I cannot articulate it in the end, I don't think I would shoot on a virtual production set. For me, the method of production should somehow reflect what the film is about. (Kamat)

Tortum's process is reflective of a tendency for artists to want production to fit the story or intent. The situation of negotiation is made visible through attempting to articulate the utility of the screen and the virtual production set as a system. For a producer, the weather being controllable makes it easy to organize working hours. However, for the cinematographer or director, a lack of control may emerge in the form of glitches, missing assets and potential hardware failures. Such elements are representationally far more unromantic than elemental weather but could pose crucial when building towards a new materiality. This thesis does not

deal with materiality, although an exploration of it would serve fruitful as a continuation into newer discourse. While I do not suggest that a hardware glitch is the same as "awaiting" a non-cloudy day for a shot of the sunset, I am suggesting that the act of waiting reconfigures itself as a possibility for emergent collaborative potential. Perhaps it is no longer a poetic "awaiting" as Gromaire experienced, but rather, the immersive real-time atmosphere contributing to emergent collaborations via the very landscape of the screen. These contributions could come in the invisibility of individual artists uploading assets as well as the new presence of a game engine developer in the cinematic process. What once existed in cinema as a surrender to the natural environment is now a situation of negotiation. The LED screen is a medium that "mediates" this situation. Tortum described this in his process of deciding whether to use a virtual production set up or not.

> Real-time game engines give a lot of freedom and a lot of reversibility during the shooting process. If you want, you can shoot during a virtual golden hour for hours. It takes away the tension of shooting in the physical world, the accidents, and the imposing presence of physical laws. But it also brings in something new. For example, you can suddenly turn a realistic rendering into a wire-frame rendering and then see how the actors will react or how it will change their improvisation. Or you can change the scene to something abstract while your actors are in the scene. It is almost like you can immerse your subjects in a virtual montage. (Kamat)

As he said, there are new potentials to shooting with LED screens. What Tortum exemplifies is a situation of negotiation, one without a necessary solution. The LED screen and its components like the game engine mediate such situations to highlight the atmospheric frame as a heuristic of change. Collaborative relations as settings for atmospheric thinking was also introduced by geographer Sasha Engelmann. Engelmann highlighted the field of geo-humanities as significant in the ways in which artists can aid geographers. She included a quote from English mathematician and philosopher Alfred North Whitehead in reference to the radiance of a

sunset. What happens when you may “know all there is to know about the sun and the earth but you still miss radiance?” (Engelmann, 144) What are the material conditions of radiance and can it be reproduced? What happens when you are depicting as opposed to imagining? What is the technology's claim to realism? Such questions are crucial when negotiating the future of production relations, pipelines and workflows. Much like noise gave rise to situations of negotiation across the pipeline of actors, cinematographers, producers and the new sound engineer, the emergence of a new environmental dimension gives rise to a situation of negotiation between set designers, lighting technicians, cinematographers and production personnel across the pipeline. Can an LED screen depict radiance? Is electroluminescence able to evoke such a dimension? Engelmann quotes Guattari in saying that “art generates possibilities for being and becoming in the shadow of dominant material and economic assemblages.” (Engelmann, 147) But I ask, even with the possibility of high-definition photorealism, what remains unseen? Can we “see” radiance? Is radiance simply re-materialized? And as Sterne argues in the case of sound, why is high-definition valued more than a blur, a moiré or as in the case of rear-projection, simple backgrounds in motion? Does radiance in any way overlap with McKim’s surprise element or the act of waiting? Is iteration in a technological context a new form of radiance? Of relationality? What are some alternative ways to define and understand the relation? As Tortum stated, by taking away the “tension of shooting in the physical world,” some other negotiations are resolved. (Kamat) American short story writer Donald Barthelme, argues that “not-knowing” is crucial to artistic processes.

> The not-knowing…is what permits art to be made. Without the scanning process engendered by not-knowing, without the possibility of having the mind move in unanticipated directions, there would be no invention. (Barthelme, 12)

Situations of negotiation are mediated by the LED screen. They are alluded to or arise from the atmospheric frame as seen through the deep text analyses of chapters 1 and 2 but they can be mediated through technological objects that ultimately challenge the dichotomous subject-object binary. I argued for the LED screen as a medium in order to highlight another approach at observing change as it occurs within the context of the atmospheric frame. What other objects can be theorized in such ways to understand heuristics of change and ultimately, what we do with this heuristic in our day to day lives, or as in the case of virtual production, in the creative process of film and television.

Onward

I encountered virtual production around the same time that I started my graduate program at MIT, sitting in Singapore, with a 12-hour time difference from Cambridge. Yet, when I characterize my "two-years-as-a-graduate-student," most assume I spent both years physically in the city of Cambridge. During the first year, although I wasn't "on campus," I was still an MIT graduate student. No one was on campus, yet there was an "atmosphere" that was devoid of a physical location. The "atmospheric frame" is a suggestion at this shift. As multiple social groups enter a hybrid and work-from-home reality filled with Web 3 developments, the material impacts of climate change and economic crises, the physicality of change will no longer be situated at one site. Instead, what I predict will be a new atmosphere that unites a multiplicity of places and people. The atmospheric frame is one way to understand this shift. My hope is that my work serves to provide a way forward.

"But Srushti, why even go down the atmospheric path? It seems too abstract," says a voice in my head. Change, when examined as it is ongoing, can offer a slice of interpretation. Change when read in hindsight can reveal hints of hidden relations. Atmospheric framing offers one of many ways to interpret these hints. A confluence of industries, social actors, and global conditions will determine virtual production's promise over the next decade. But as change happens across a spectrum of worlds, at-risk and marginalized populations will be hit first. With all due respect to my inner critic, no ambitious attempt is easily rectifiable with a few words here and there. To claim grandeur around conclusions would be too much of a feat. My intent with this project was to pull back some of the conversations around technology and society and highlight the indeterminate. When examining change as it occurs, those indeterminacies can

serve as useful jumping-off points for making decisions and conclusions about the world we live in.

What makes the atmospheric frame different from the technological frame? I could have situated my work within one field such as SCOT and argued either for or against concepts like "interpretive flexibility." (Bijker, 159) But in discussing the adoption of new technologies with its affordances fortified in a moment of time, the atmospheric frame is a niche heuristic. Any systemic change has atmospheric dimensions. That is the basis of my argument. As the world shifted to a work-from-home reality, the expected notion of place-based change needed to be challenged. Of course, the LED screen impacted the atmosphere on a set. But the set was no longer simply the site at which change was occurring. The atmosphere of a "set" is too limiting of a concept for the next few decades in production history. The "set" has not always been a concentrated site of change or power but more so, this change will need a framework of interpretation. I hope my work can continue to open doorways to more possibilities within industries, fields and research domains. How are atmospheres of change manifested in other areas?

To render the invisible is a challenging feat. As Francesca Ferrando, posthuman philosopher argues in the 2021 *Journal of Posthumanism*, the fear-based AI takeover scenario prevalent in the western world is mythical. (Ferrando, 221) The takeover has already happened. She makes the case that it is not the technology's fault but the human greed behind the products we must examine. (Ferrando, 221) Although her argument in this paper does not pull in more concrete examples, she effectively places the importance of the posthuman framework in an invisible paradigm where perception dictates fear. Similarly, we are already in a new reality. We are at the site of change. How we frame this change matters more than ever.

Summaries

Early in my research, the signs pointed clearly to the introduction of color as a comparative point in the histories of film and television production. It could be argued that the lighting of an LED wall directly affects the atmosphere on a set. It does so by changing the lighting requirements, hence transforming the technological expectations, the environment itself, and other adjacent requirements. From a visual standpoint, it would also have been obvious to examine the introduction of computer graphics or VFX in the pipeline of filmmaking as a close comparison to virtual production. However, I assert that elucidating the atmospheric frame through the introduction of sound deepens the complexity of how seismic the potential of virtual production can be in shifting our fundamental understanding of art and reality. In High Gray's 2005 translation of Andre Bazin's *What Is Cinema Vol. 1,* he writes that:

> The reality produced by the cinema at will and which it organizes is the reality of the world of which we are part and of which the film receives a mold at once spatial and temporal. (Bazin, 13)

For Bazin, the history of film moved towards "a total and complete representation of reality." (Bazin, 235) Virtual production discourse pushes notions of reality. To toss in words like "discourse" and "reality" together is risky. So is using Bazin. While this thesis did not discuss art and reality in detail, there is much to be built upon for future research in this domain as we enter Web 3.0, whatever that may mean. As French philosopher Michel Foucault would say, discourse formation is interwoven between types of statements, objects, and subjects. (Foucault, 38) That a discourse is "an entity of signs" is equally as important as the relationships between those entities and the flow of information occurring at each end of the relation. The discourse around virtual production was networked in the year 2020, thus making it the site for my sources.

My second and third chapters, although focused on virtual production, offered two ways to interpret the atmospheric frame. The first is to use industrial texts. The second is to observe a technological object as a medium to challenge the subject-object dichotomies. To attempt an articulation of these contradictions within the indeterminate quality of atmospheres was a risky feat. The risk of vaguess using haze-like terminology often led to circular motions in my thought process and argumentation. Cultural and political geographer Ben Anderson does an effective job of consolidating the thinking around atmospheres but it is ironic that perhaps the very vagueness of the concept is what makes a definitive stance on atmospheric thinking both challenging and worthwhile. It is somewhere in Anderson's further affirmation of indeterminate frameworks that he evokes 20th century phenomenologist Mikel Dufrenne. (Anderson, 78) While Dufrenne suggests the medium-ness of aesthetic objects, he chooses to think of such objects and atmospheres through approximations. (Anderson, 78) Is the LED screen an aesthetic object or is it merely an approximation? As Anderson says, there is a cost in accepting Dufrenne's argument because it narrows atmospheric thinking only to visual media or architecture. By looking at the LED screen and its relational properties as medium and thinking across transduction, as Helmreich posits, I argue for indeterminacy as a space in itself. A space from which we can deliberate notions of truth and change and from which we may further deliberate organization, social behavior and labor. The LED screen can then be an approximation of a medium that allows for relations as opposed to static medium identities.

Next Steps

My hope has always been to facilitate dialogue between industry and academia as they work side by side and interconnectedly. Here are a few ways in which the atmospheric frame can be further developed.

A. Production management and labor distribution–Virtual production signifies the tip of the iceberg in respect to changes around labor. From an academic viewpoint, there is potential for deep ethnography and an examination of trade unions, location-based economies and the adaptation that occurs when labor dynamics are significantly disrupted. Thinking through the atmospheric frame, the technological frame and notions of representation clarifies how newer modalities of labor could emerge. How do we organize workflows as seamless webs?

B. Aesthetic experimentation and embracing shifts in the medium–Virtual production gives rise to much consideration around what future aesthetic possibilities might do for the narratives and stories emerging from incredible worldbuilding. While a mimetic potential is certainly enticing, what other fantastical and imaginative worldbuilding possibilities could emerge from the affordances of the virtual production technologies?

C. Power–Sarah Ahmed's essay on atmospheres is particularly important for introducing interventions in how atmospheres, situations of negotiation, attunement etc. either replicate the same systems or replicate existing prejudices. "Diversity work is thus often atmospheric work: you have to try and eliminate the tension caused by your own arrival," she writes. (Ahmed) Discourse at the intersection of power and atmospheres can only expand the potential of atmospheric thinking so newness does not necessarily reproduce

systems of oppression. Winston may contest this but I find this contestation filled with potential for theorizing and dare I say, positive change.

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