

Production Technology



Jevon Jones - 1902309

Contents

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Introduction and the significance of light and sound

Since recorded history, people have been using components of the five senses to aid in storytelling. Most notably this is through sound and vision, but that detracts from the splendor - Since the spoken word and the observed movement of an actor is only half the battle. Truly, the colour, direction, and intensity of light; alongside the realism of emulated sounds, are the soul of any given visual performance.

“Unlike with film or television, the soundscape of a live theater production only gets one chance to get it right. A poorly designed or executed soundscape can ruin a live theater production, whereas a well-executed one can create a magical experience for patrons.” (Rothstein, 2020)

Though I have spent many hours volunteering at my local theatre, I never dealt with the light and sound pastimes involved with a production, as I was always building sets and props instead. Therefore I have little to no knowledge of these techniques and practices, but I am very interested.

In this module logbook, I will cover the significance of sound and light in the performing arts. Though I have largely not had the chance to use the lighting and sound equipment that the industry currently uses (Due to Covid19), I will still try to cover the bases. Thank you, and please enjoy.

Greek and Roman use of light and sound

As a major component of their cultures, the Greeks and Roman empires loved live performances. Within their theatres, they utilised natural light, and intuitive use of their respective architecture principles to optimise how sound would travel from the performer to the audience members.

Luckily for us, many of these ancient 'stages' are still standing. In the ancient greek theatre of Segesta, we can see how the natural backdrop allows for the audience to observe the performance with a perfectly positioned evening light - the ideal time for a show. Additionally the shape of the seating allows for sound to be slightly amplified and enhanced in a way that allocates for the further seating locations to hear better.

The Romans had many similar designs, albeit on a larger scale. Though strategic use of larger walls and seating, sound and light could be further manipulated for the ideal performing conditions. This can be seen in the ancient Roman theatre in Bosra.

For hundreds of years, sunlight was the primary source of lighting for plays. This of course depended heavily on weather conditions, so it only makes sense that eventually most entertainment would move indoors for more effective control of light conditions.

"Greek theatres were built to use directional sunlight and had no need of artificial sources. The Greeks organized their plays to run a course through the day, in order to use the different types of light available at different times." (Penzel, 2020, p.3)



(Hill, 2018)



(Anon, 2011)

Lighting and sound before the industrial era

With indoor productions no longer needing the correct weather conditions, artificial light becomes the norm. Most operas and theatres relied heavily on candles for lighting. The former also would start the tradition of having an 'orchestra' in the 'pit' to add music to the performance.

Candles as a light source for theatrical performances were a fickle source of light. They were both dangerous due to the fire hazard, as well as constantly in need of attention since every time the 'lights went down', every candle would have to be put out at the same time and vice versa for when the lights went up again. This required a lot of skill on behalf of the people who dealt with the pastimes of trimming the wicks, and putting out or lighting them.

Records indicate that Sebastiano Serlio (top right) was one of the first to try putting coloured liquids in clear containers in front of these candles to manipulate the colour of light in theatre productions.

Inigo Jones (bottom right), amongst his other numerous achievements, was an innovator of theatre technologies in his time. Through creative use of reflective surfaces, he enhanced the light sources at his disposal - adding to the already rich repertoire of his architectural career.

"At once bright and weak, intense and ephemeral, the golden dance of the candle flame casts a lyrical gentleness." (Jones, 2013)



(Anonymous, 2019)



(Anonymous, 2014)

The industrial revolution and lighting

Near the end of the 18th century, an innovation that would render all previous light source technologies redundant in both efficiency and safety was invented: the gaslamp. Up until now the popular light source for theatre was oil lamps, which were still much easier and safer to operate than candles. Additionally, since said lighting was fed by a system of pipes and valves, the first 'gas tables' were conceived by having all of the control valves located in a centralised position backstage. Gas lighting could be 'dimmed' in ways that was difficult or outright impossible for the previous technologies simply via restricting how much gas was going through the system.

William Murdoch (top right), the Scottish inventor, was a pioneer in his practical methods of distilling gas from coal for use in such gas lighting systems in the late 1700's. This technology was used for theatre as soon as 1803 by Frederick Windsor, in the Lyceum theatre in London. Gas did however, have its own set of drawbacks - including harmful airborne byproducts from the burning process.

The british inventor Thomas Drummond would invent the Limelight (bottom right) in 1816 by subjecting a cylindrical block of lime to a sharp, small flame. This would be encased in a reflective container to direct the brilliant white light emitted.

"Coal gas included a rather lethal combination of hydrogen, methane, carbon monoxide and sulphur. Not only is this a highly flammable composition, but the occupants of any building with poor ventilation ran the risk of carbon monoxide suffocation." (Anonymous, 2011)



(Darling, 2016)



(Lauginie, 2015)

The industrial revolution and sound

For around 2,000 years methods and systems of sound manipulation in theatres had not changed much. Music was played by musicians live, and sound effects were created by personnel who mechanically recreated the sounds required for the show every performance.

“Cannonballs were sometimes used for thunder effects, rolled back and forth inside a wooden box or across the floor of the aforementioned Heavens above the stage.” (Bennet, 2017)

This all changed in the 1930's when the recording industry boomed. The technology used to record sounds became much more accessible, and as such it was only a matter of time before theatres would employ them. The first sound effect libraries were recorded onto low quality 78rpm tubular records, and would contain short recordings of many sound effects - such as dogs barking, or steam engines operating.

Much like the skill involved in the lighting/extinguishing of candles, these sound recordings required skill to use, as the operator backstage would have to accurately and carefully place the needle of the phonograph at just the right time to execute the sound effect properly. Thus, the consistency of the sound effects from these methods was often uneven.



(Anonymous, 2018)



(Anonymous, 2019)

Electrification of the theatre lighting systems

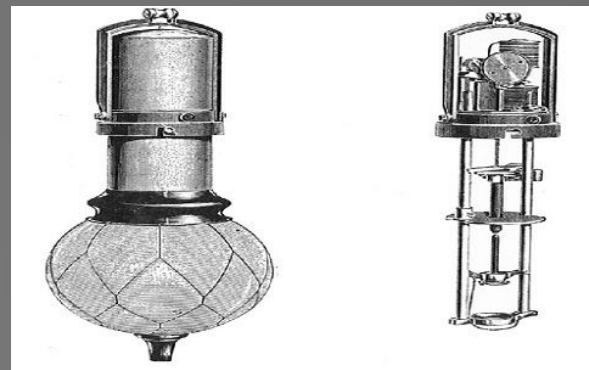
Sir Humphry Davy (Of which the famous safety lamp is named after) was one of the innovators behind the electric carbon-arc lamp (top right), exhibiting an experimental version in 1808. By running a high powered current through two carbon rods, an electrical arc is caused by the 'jump' of the current between the small gap. The byproduct of this effect is immense light - a much less flammable one than all its predecessors.

By 1846 the Paris Opera had used this technology to represent a beam of sunlight. They also are credited with the first spotlight using carbon arc technology.

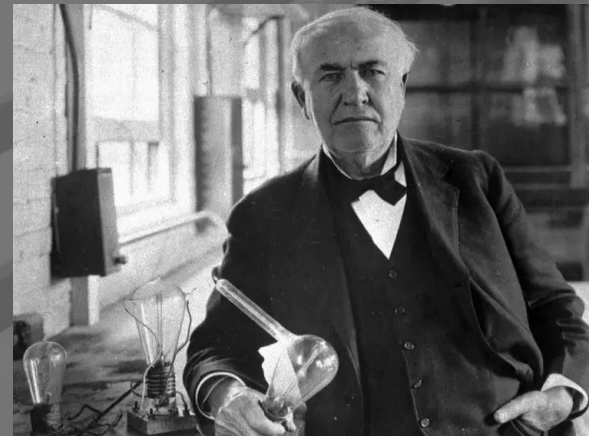
Thomas Edison's electric lamp (bottom right) can be seen as the beginning of modern era of stage lighting. Though invented in 1879, it quickly gained momentum as gas lighting technology was discarded in favour of it - The Paris Opera would install this new system one year later.

Incandescent lighting had all the benefits of its predecessors, but with very few of the drawbacks, as it did not emit harmful gasses, was much less likely to cause fires, was able to be switched off and on instantly, could be dimmed, and could be controlled with ease from a central control panel. Also, as opposed to gas pipe systems, the electrical cables could be easily changed and ran to ideal locations - Meaning the control panel for the lighting would start to be positioned in the rear of the auditorium - like we see today.

By the 1900's, this incandescent electrical lighting technology would see almost universal use in theatres around the world.



(Anonymous, 2013)



(Feloni, 2014)

Pre-Digital Era lighting

After both world wars, with electricity abundant and mass production now much cheaper and more accessible than ever before, systems of lighting and sound in theatres became much safer and more accessible to communities who wanted to feature high quality lighting and sound in their own amateur theatre productions.

During the mid 60's tungsten halogen bulbs (top right) saw widespread adoption in both film and theatre. Through a reaction that returns the evaporated tungsten back to the filament, the bulb is both brighter and longer lasting.

The 80's saw an industrial bulb become widespread both domestically, and within the entertainment spheres. This bulb type is referred to as a HID (high intensity discharge), and is a sealed tube with two tungsten electrodes (bottom right). When a current is ran through the sealed tubes, and the gasses inside, it creates an arc between the two electrodes, the light accentuated by the tube itself.



The Digital Revolution

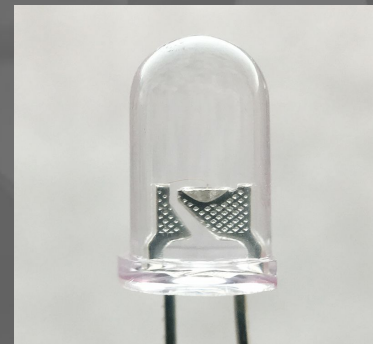
With the turn of the 21st century came new technological breakthroughs of computing that are still in use today. Most notably, computing capabilities enabled theatre light and sound systems to be streamlined in ways that were impossible before the advent of digital memory. Through complex algorithmic systems on operating systems with billions of lines of code and thousands of tiny electrical circuits, computers have swiftly outmoded all previous means of operation, with cheaper pricing as the technology has become more available.

Light emitting diodes, also known as LEDs (bottom right), have been in use as the current industry standard for theatre lighting since around 2008. Compared to the previous light sources mentioned, they are extremely energy efficient, and because of this they generate very little noticeable heat compared to the former lighting methods. This makes them even safer and longer lasting.

“High-intensity LEDs have found their way into accent lighting, spotlights and even automotive headlights” (Poole, 2016)



(Gillmore, 2018)



(Poole, 2016)

Light and Sound Now

In modern theatre productions both light and sound on the night of a performance can be delegated to one role - especially in smaller theatre companies. Thanks to how computers can process and control visual and auditory elements through the operator's inputs, the space requirements are also lower than ever.

“Back in the 1980s and even the 1990s with the ability to save only a limited number of settings, jumping between scenes and changes to positions or costume would have meant a break for the company as the sound operator reset everything manually. Now, it's a matter of a few clicks. What used to take weeks of technical rehearsals can be conquered in a few days.” (Gillmore, 2018)

Today lighting hardware is generally completely digital, relying heavily on LED based lighting technology to illuminate stages worldwide. Though some productions still use more archaic technology such as limelight, this is usually a deliberate bespoke touch that comes with a hefty price tag on the tickets - this being because it's much cheaper to use current technology, but people still like to see more traditional methods if they can afford it.

Sound has changed in some ways, but remained the same in others. Since sound has a relatively short history compared to lighting, technology such as the speaker cone has not changed much since its initial inception in the mid 1920's. However, what has changed is the advent of wireless microphone technology, allowing once tethered actors to suddenly be free of loose cables. Modern mics are split between sound quality, and subtlety. Compromises between one and the other depend on the nature of the show, i.e. a musical versus a concert. A very high quality sound mic will be much less 'stealthy' than a low profile one, but the latter will not deliver the same clarity of sound.

history of projectors/the birth of 'video design'

Just as niche skills and trades emerge from more generalist professions, so too did a niche for the projection of images emerge from the theatre artforms. This makes sense, as projectors have become so distinct and complex that the skills and knowhow involved in their use warrants its own personnel.

The oldest effect projector, dated to around the era of world war I, is known as a Linnenbach lantern. In principle, it is a deep black box with a bright light placed inside it. On one side of this box is an open face, with slots to allow for a painted glass slide to slot into it. The effect is a simple expansion of the painted image. Since there was no lens, the light has to be powerful - and the image simple and bold. This style of lantern would see different light sources used within it, with large incandescent lights replacing the previous carbon arc ones.

In the 1950s interest in projection was reborn, Wieland Wagner (top right) for example flooded a stage in Germany with multiple overlapping projected patterns of basic shapes and colours, thus creating depth and texture. These ideas would be built upon and refined by the likes of Gunther Schneider-Siemssen, Josef Svoboda, Alwin Nikolais and Robert Joffrey (bottom right).



(Lebrecht, 2016)



(Caldwell, 2016)

history of projectors/projection now

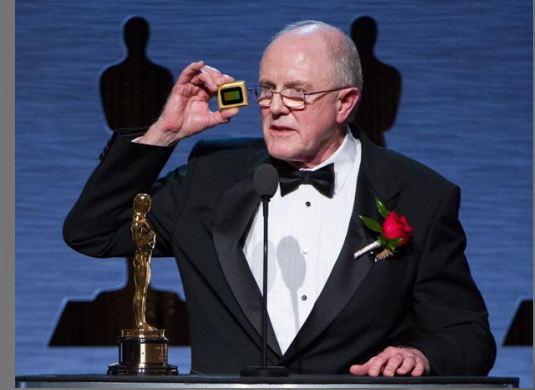
Though digital projectors can be traced back to the 80s, they were not bright enough for stage use then. Now however, digital projectors are the standard mode of projection in theatre productions.

Another setback of early digital projectors is that they could not display videos very well. In 1987 Larry Hornbeck (right) invented a kind of chip known as a DMD (Digital Micromirror Device). By having one tiny mirror be responsible for each pixel of a screen, allowing for great flexibility and control of the media being projected.

“Hornbeck began working on an analog version of the technology in 1978; he developed the digital device in 1987; TI sold the first chipset in 1996; and Hornbeck saw the first major motion picture screened using the technology in 1999. Today the vast majority of theaters that project movies digitally use DLP (The trademark for DMD technology)” (Perry, 2015)

The advantages of digital projection over its predecessors are many, the image can be still or moving image, the ‘slides’ never break or burn out from use or heat. The images can be created by hand or digitally, and thus the artist has never had more creative options at their disposal.

“...(The 4 cinema projector manufacturers) all use the same technology, known as Digital Light Processing (or DLP). They use millions of silicon micro-mirrors, one for each pixel, which allows them to create a picture with an incredible level of depth and detail.” (Stein, 2019)



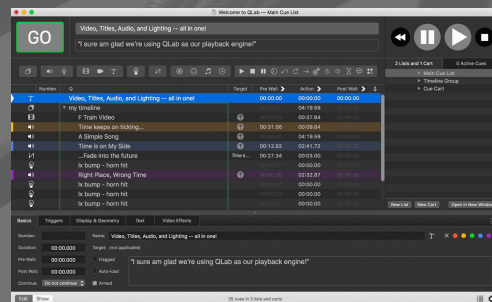
(Perry, 2015)

Light - Q lab

Qlab is a program designed for projections, available on the Macintosh operating system. Much like a Powerpoint presentation, it is capable of displaying images and video files alongside audio. What makes Qlab different from a standard video editing program or the former Powerpoint, is that it allows the user to have both automated, or manual transitions between 'slides' and visual media.

For example, if a theatre company needed sounds and background imagery to change in time of the performance, they would be in a sticky situation using a video file, as the actors would have to be perfectly in sync with it for any of the sounds to match up. And a similar problem arises if they were to project a powerpoint slideshow, for the lack of any automation between sequences would be an inefficient hassle for the operator of the program.

Indeed, the niche that Qlab fills is the one presented by the dilemma of having to sync up sounds and media with the human error of actor's timing. Thus, very few programs do a better job given the complex requirements of the task.



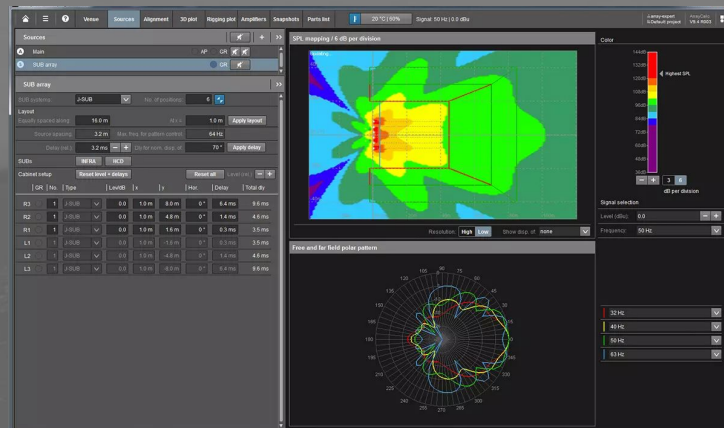
(Anonymous, 2021)

Sound - ArrayCalc

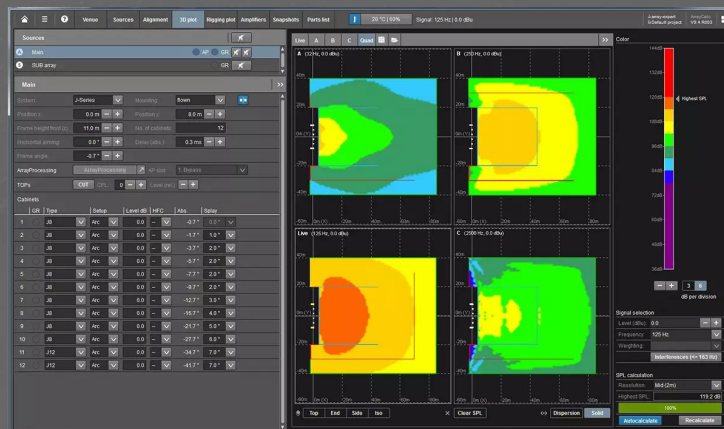
ArrayCalc is another industry standard program, though it is available on both Windows and Mac.

In pre-digital theatre, sound speaker layout was (and still is) an intense operation: sound waves must hit the audience in a believable manner in regard to on-stage actions, and the speed of sound plays a significant factor in where and how speakers play sounds. A large venue with many seats must account for the speed of sound when playing sounds to the back and front portions of the audience.

In simplified terms, ArrayCalc is a simulator of sound. By mimicking the size and shapes of any given auditorium the program can accurately display what sounds will travel where, and at what speeds. Though it now has many variations for different trades that deal with sound, primarily it was developed for stagecraft.



(Anonymous, 2021)



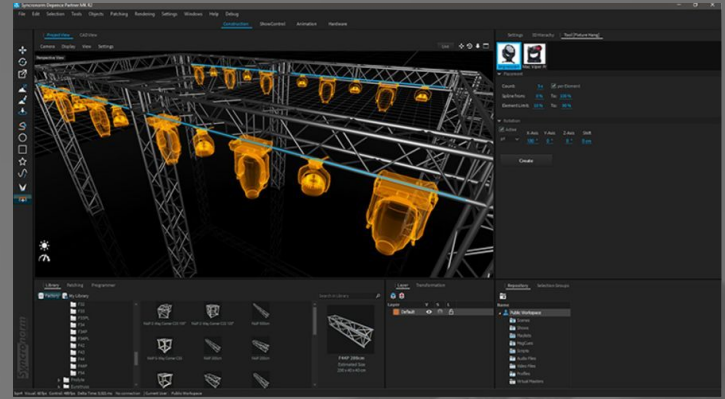
Light - Depence2

Depence2 can be thought of as a parallel to ArrayCalc, but for lighting instead of sound.

Available on both Windows and Mac, Depence2 simulates light within an environment, allowing the user to spend less time faffing around in the auditorium in order to achieve the perfect lighting. Its three-dimensional simulations can display light to an almost photo-realistic degree. This allows the designer to perfectly tune the hues and brightness of the lights they wish to use, before they even set foot on the real venue.

Though simple in concept, Depence2 has many skill boundaries that must be crossed to effectively use it - much like any three-dimensional program.

Just like ArrayCalc, most theatre venues in the world already have a virtual counterpart in the databases provided, meaning the program conveys a very accurate visual to the technical staff who then go and fit the lights as per requested by the designer.



(Anonymous, 2021)



Sound - Audacity

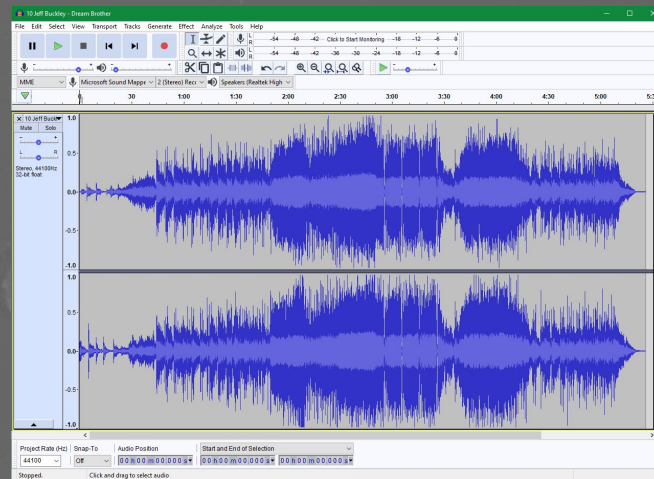
Audacity is an open source audio editing/recording program.

Available on GNU/Linux operating systems, as well as windows and macintosh, Audacity is a completely free, and an all in one solution for modifying audio clips.

Supporting hundreds of formats, and intuitively designed by thousands of volunteers over two decades, audacity is accessible and free of any superfluous visual prestigiousness.

Because I felt like the song being used (pictured right) in one of the following tasks sounded more haunting and ominous at a slower pitch and tempo, I simply loaded the file into audacity and within seconds I had exactly what i wanted. I also edited the length so it would fit, and had the end fade out.

Being non-proprietary, it is a shining beacon of light within industries such as the entertainment sector, this being because so much of the software used by industry professionals has them completely dominated by large corporations who buy out any alternatives to their monthly subscription based business models. I'm talking about tech giants such as Adobe. Audacity can be downloaded and run off of pretty much any computer, and the user can edit the source code without any fear of prosecution from said corporations. I've gone out on a large tangent here, because Audacity is the **only** program on this process workbook that follows this philosophy. We must protect our software freedoms, and support those who do.

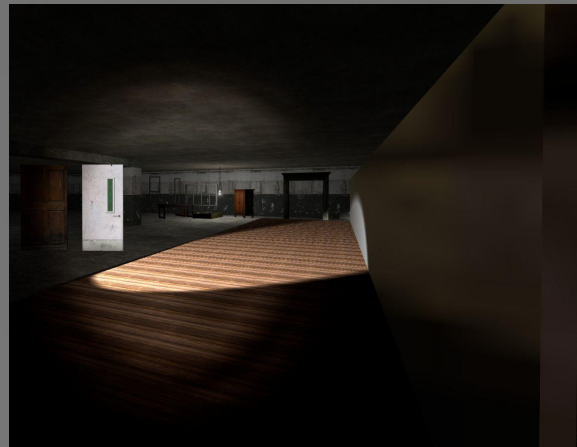


Light - The 'Journey' Exercise

During our module, we were asked to demonstrate how the use of lighting and sounds can create mood and atmosphere. I opted to make a short video by recording a 3D program made in 2004. By controlling every light source I was able to create a space where every shadow was deliberate, and once I had the footage I wanted I recorded my guitar playing some simple chords to emphasise the atmosphere.



The *journey* of my task would be a simple physical journey through the space I had created from scratch. I found a completely pitch black space within a map, and then generated floor panels, wall panels, and the furniture needed.



Light - The 'Journey' Exercise final product

As a final product, I am very pleased with it. By having the camera pan to the right for each of the three clips, I could make it seem as though the three sequences are a continuous space. If I was to do this task again, I would have spent more time recording the musical part, perhaps used more instruments. But the sound was never the focus, and always more of an afterthought at the time.

Despite its positives, the graphical fidelity of the program I was using was a little lackluster. If I was to do this again, I would also learn some professional grade program - such as Blender. Saying that, it would take much more time.



Light - Q lab - The Crucible exercise

For this task we were asked to use Qlab to make a series of visual cues to be projected onto a background of our choosing, while also taking inspiration from the play *The Crucible*. The overall aim was to demonstrate an ability to make the visual aid to accompany a live performance - the kind seen frequently in some contemporary plays.

As somebody who tries to stray from the first most basic impulse of ideas, I tried to think of a visual narrative that would fit the themes of this play, while still not being too obvious or distasteful - especially since the event itself (the Salem witch trials) is not fictional. Many people (mostly women) were put to death, as a result of baseless, superstitious fear.

I opted to simply juxtapose footage of peaceful nature, violent woodwork, and biblical architecture/objects to the sound of Jeff Buckley's *Dream Brother*. The song itself is not related to the play in any way, but it's contrast of calm and violent sounds felt right as an accompaniment. I found the song to be slightly more hollow and haunting when slowed down, it allowed for the right part of the song to hit the 3.00 minute mark. Additionally, the lyrics have some references to biblical iconography.

"It is important to recognize, however, that Miller took significant artistic license with these historical events in order to craft the story he wanted to tell. For instance, the affair between Abigail and John Proctor, a key plot point of The Crucible, never actually happened. The real Abigail was about twelve at the time of the trials, whereas Proctor was in his sixties" (Cordell, 2021)



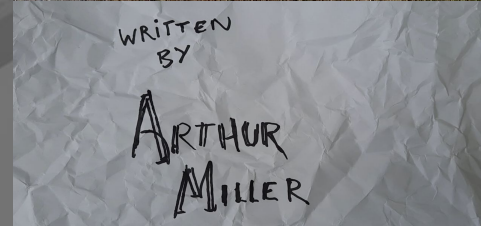
The Crucible exercise Pt II

For my footage I drove to a quiet part of Gower, called Ilston Valley. There is a church there, so that's where I started. The Yew tree located in its yard is an ancient creature, along with the church itself being very old. Together with that and the surrounding woods and rivers, I got at least two thirds of my footage from that.

Next up, I went to my workshop and recorded lots of close up shots of wood being cut, chopped, and drilled into. It was hard to believe at the time that it would look any good afterwards, but I'm very glad with the footage I got.

Finally, I cut the title out of cardboard and recorded the surface it shone onto. It was a total 'happy accident' that it looked so ghostly and ominous, I was only trying to centre the image with the camera. After I watched it, I decided to go with that shot. I also burned a piece of paper giving credit to Arthur Miller, it actually took me multiple tries to get the paper to burn in the way I wanted.

Other footage that made it in was: A clip of our rescue dog digging a hole (She looks like a wolf, and I liked how ferociously she dug the hole), me playing the accordion, and a shot of one of the halls in Carmarthen campus.



The Crucible exercise Pt III

The object I would project onto was quite the cause of fuss for me.

I wanted initially to have an elaborate system of two surfaces, one transparent in front of the other. As the scope climbed however, I realised I would never meet the deadline if I pursued two separate projections onto multiple surfaces at funny aspect ratios.

So in staying true to the 16/9 ratio of the videos I had captured, I opted to make something that was better than a wall, as in a perfectly fitted surface. This to me at least made it seem like the right reason to stick to the native aspect ratio of my digital work.

I built a canvas from scratch, in the above mentioned ratio. I had never made a canvas before, so I was surprised how well it turned out. It is a functional canvas, and therefore none will go to waste when it is painted on later in it's life. I'm very aware of the wasteful nature of the entertainment industry, and I thought this would redeem my creative choices. Nothing went to waste.

Additionally, I think it was a good demonstration of having to learn the methods surrounding trades and crafts you are not familiar with, as that is par the course with being a jack of all trades type set/prop maker.



The Crucible exercise Pt IV

On the day of the projection, I was actually very surprised with how my outcome looked when the projector hit the canvas. It was like a floating bright image in the darkness, a window into my vision. I wish I had access to a better sound system to emphasise the bass guitar in the song, but that was out of my hands by then.

Overall I'm very pleased with how my task outcome went, and if I was going to do it again, I would have recorded the tool videos in the 'slowmo' setting on my phone. I would have taken more care to match the framerates between the clips too, as that's something that I notice a lot when I watch it back.

If you are wondering where you can observe my final outcome yourself, I regret to inform you that it is currently located on a usb that is with Ceri, I forgot to ask for it back and now I'm unable to provide it here.

I'm very sorry, and I really should have backed it up. Seriously. I've learned my lesson and I will backup my files next time.



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