# ‘LIBRETTISING’ SCIENCE: Using operatic narrative and performance to re-present scientific thought in an investigation of new methods towards developing contemporary opera.

ROXANNE KORDA

A thesis submitted to Birmingham City University for the degree of

DOCTOR OF PHILOSOPHY

APPENDIX 1-3

Royal Birmingham Conservatoire
Arts Design and Media
Birmingham City University
October 2023

## Table of Contents

## Figure List

# Appendix 1 - *The Flowering Desert* Creative Process

In this appendix I have chosen materials, reflections or transcriptions from key pieces of work, or workshops, that were carried out during the creative and performative process of developing the opera *The Flowering Desert.*

## AP 1.1 Cycle 1: January -April 2020

### AP 1.1 Notes from the Initial Discussion with Dr Amaury Triaud (January 2020):

In our first meeting with Dr Amaury Triaud many of the themes we carried on working with for the final piece were brought up and discussed. As such it was a pivotal moment in the creation of the work, inspiring the future directions of the narrative, characters and music.

Many of the themes and viewpoints I had already extracted from reading around the topic were reiterated in the meeting with Dr Triaud and the discussion of the TRAPPIST-1 discovery. There were some key points I made note of during this discussion which I then planned to make use of whilst putting the libretto together. These were:

- The TRAPPIST telescope is at the La Silla observatory in the Atacaman desert in Chili. Amaury was there to witness the flowering desert. He also told us about the percussive sounds of the ice in the trees. In addition, he found many ancient hollow stones with markings, which he believed to have been used as instruments by the previous civilizations in the region.

- The discovery of the first planet was actually an accident. The telescope had not been working so the scheduled viewing times were delayed. This meant that an unplanned later viewing was carried out when the telescope started working again. During this unscheduled slot, which was the first time this telescope had even been used to view a star, the first transit was seen. To back this up we were also told that at one point they observed and saw no transits.

- One of the main goals of the field is to find out if there is other life, or how common other life is. The discovery that the type of star that TRAPPIST-1 is – a cool M dwarf – can have a multi-planetary system, with planets within a habitable zone, has expanded the way that scientists see this search for life. These M dwarfs make up the majority of stars in our universe whereas our sun is a minority type star (G type main sequence star). This makes the understanding and studying of the M dwarf stars even more crucial to this work.

- Humans try and make solutions out of their experiences. Astrophysics should be a field in which we are open to thinking about understanding outside of the human experience.

- M Dwarf stars have far longer life spans than G type main sequence stars. Red dwarfs can exist within a main sequence stage for trillions of years. Our G type star will live one cycle across 9-10 billion years. This gives an M Dwarf system a different conception of time, as their life cycles are so much bigger.

- The planets around the TRAPPIST-1 star are tidally locked, meaning that one side is always facing the star and the other always facing away. This also has implications on the meaning of time in this system. The rim that is at constant sunrise/sunset is called the terminator. They are planets of dichotomies.

- There would be severe winds and weather systems on these planets (if they have atmospheres) due to the heat moving from the hot to the cold side.

- The TRAPPIST-1 system has an orbital resonance between the planets. This is the largest discovered system of planets with such a resonance chain.

- The TRAPPIST-1 system is comparable to Jupiter and its moons. Jupiter also experiences an orbital resonance and the sizes and distances of everything are similar.

- The orbital periods of the planets are always slightly changing as the planets have a gravitational pull on each other, affecting their orbits.

- Even though the planets in TRAPPIST-1 receive a lot of radiation it is possible for life to start in or underneath the crust.

- Scientists in Cambridge have been working on how certain exposures to specific UV radiations can actually lead to a creation of DNA through formation of hydrogen cyanide.

- Panspermia is a theory for how life could start on a planet: this is the idea that life could be precipitated by a collision with a rock that is carrying the materials and building blocks for life.

Following this discussion, I read the papers Dr Triaud had suggested and also read through as much as possible of the Exoplanet Handbook (2018) he had lent me, to get a better grasp of the topic. Alongside this scientific material I researched the existing artistic references to the TRAPPIST-1 system. I also found a series of very accessible handbooks on different exoplanet systems by Mathew Anderson, which helped in deciphering a lot of the technical language, as well as showing an example of how to discuss this topic with the general public.

# AP 1.2 Cycle 1: Short Story - The Flowering Desert

*I am lying on La Silla in the midnight Atacama, listening to the wind rush through the ice of the barren trees. A shower of percussion speckles my ears. Even here, one of the driest places in the world, chaotic weather sends a flood that fills the land with flowers. Every few years a rug of purple life appears out of something that seemed dead. I breathe in remembering the scent. It still seems to linger. This is our world, our system.*

*I should be working tonight, taking readings, but there are some extra colleagues with us working on the readings. So tonight I have off. I could have stayed at the base but when else am I going to be able to watch the stars all night without the observatory's lens? I don't want to close my eyes.*

*We've been asked to watch a system in the Aquarius constellation. Really, I don't think there is much hope for life there. It's a red dwarf and nothing like the Sun. Our turbulent, fast paced, destructive Sun. But we'll look anyway. After all, isn't that the job of a good scientist?*

*****

Approximately 40 lightyears from La Silla and the Atacama, the accelerating Xoe flies. Xoe is a comet, flashing with the brilliance of a magnesium ember. This furious and effervescing messenger knows a secret. As with all celestial messengers, containing this secret gives it a great and mysterious power.

The red star stands. It glows with a vivid brightness perceptible when sensing that heat beyond colour. It is parent, child and carer - a kind and endless source. Time spins around it, an axis of the eternal. It is young but much older than most. It is common and yet barely observed. But

there is plenty of time and space left for it to show its true self. To accumulate possibilities then shed them all.

Beyond this star lie seven orbiting bodies, each born with a different set of rules. One in particular is of interest to Xoe on its journey past the star. The experience of these planets couldn't be more different to that of the star. One side stays in perpetual day while the other stops in a frozen night. This story is only about planet E named Pantele. For Pantele, this has created a particularly difficult problem.

*****

*I close my eyes. The air is cold. Luckily I bought a blanket for warmth, woven by the Atacameños. I can still see the sky above me inside my eyelids. Suddenly I have a fear. Maybe life doesn't matter. Maybe it's not worth searching.*

*****

"Someone is watching you"

Xoe sings as it hurtles towards Pantele.

"Someone is watching you. Do you want to know why."

Awaking from the scorching day Pantele sighs. Coriolis winds sweep across its face and whip the sand up and off the stony features. As if it stepped into a cold shower the surface of the planet retracts and moans as the sky pulls the heat away and up.

“Good day Xoe, Good day. It feels like an age since you were here. And yet I hardly see you. Your brightness only shortly outshines my parent star. What news do you have?”

“I have great news indeed! Someone watches you Pantele. Beings made from something like dust. They watch and wait. They search the sky for possibilities. And they have stopped to look at you. Pantele - they are watching you!.”

“What can you mean Xoe?” Thinking to itself slowly with rising excitement. The dark and cold winds start to blow even faster and remind Pantele of something it already knew. Something it saw behind it somehow. The world there is so huge and dark and open. And someone is watching me! “Someone is interested in ME”

“Couple of problems . . .”

Xoe cheekily remarks.

“They are looking for life like them. You do not have conditions for life at all yet. Let alone a life like them. Sadly they will soon be gone. But nice to know they noticed you for a little bit. You can be another dot on their 2-D representations of the universe. Goodbye.”

And with that last remark Xoe turned to torment another planet. Such was the life of a comet. Those balls of ice and dust which burn fast until they crash into some stone or other. It might as well stir up the system as much as it could before that happened. At least that way it knows it will have left some kind of mark before it dies.

“You aren’t interesting enough to be watched.” Pantele talked to itself as it spun around its parent. Lost in its own self-doubt it almost wanted to cry. “If only I could change myself somehow. And become something else. Something other beings want to see. If only I could project what they are looking for. They might even reach out to be with me.”

*****

*What is all that commotion? Behind me at the observatory I hear some screaming. No - cheering? I get up and gather my blanket to head back to the base. Looking over my shoulder at the desert I am suddenly filled with a deep and wonderful nostalgia. As I breathe in one more time I feel like I can take in the history of the land. The oceans that used to be here. All the different creatures that have come and gone flying round and round past the sun. I am standing on plates balancing on oceans of lava, flying around a star. Almost immediately this sensation is succeeded by intense sadness as I remember humans are not all there are. The flowers showed me that.*

*****

“Mother, can you hear me? Mother?” Pantele calls to the Star with a quiet desperation. It knows it has to do something quickly. It needs to make use of this opportunity. Who knows when it will get this attention again? How often does someone take an interest in a silent and timeless red dwarf system? It is one of so many. Chance will not be repeated. But how can it make a suitable world for life?

“Xoe help! I need your advice. Tell me what to do to gain this life you speak of? How can I make myself better?”

“I am glad you asked!” answered Xoe. “You must first become something that life finds comfortable. And second you need to find a way to welcome life in.”

Pantele answered “Life wouldn’t be comfortable within me?

“You see your mother - the star. It is so much larger and more powerful than you. It has been stretching you. Just a little bit.” Pantele started to wince and wriggle. “But don’t worry -” Xoe added “this stretching was good. You probably noticed it causing some motion and bubbling under your crust. You need to continue stretching towards her. It’s going to help. The more you stretch the more you can protect yourself against her harmful violet glare.”

Pantele pondered. “So I must allow my mother to tug and contort me. To warm my tides and help them change my shape. To make my skin more broken and underneath active and sore? And only through this can I become something that protects from the harmful winds she is prone to?”. Pantele thought this over more and more. It seemed so contrary, so opposite, so unavoidable.

Then all at once Pantele heard another voice. It was carried in a storm and sounded both like it was coming from without and within Pantele:

“You cannot see it but I can - the universe is so wide. Seize this moment. Take the chance to let us be known. We want to bloom!”

This voice was not unfamiliar to Pantele. It had heard it before but often tried to block it out. In fact this voice was the shadow of Pantele. The place beyond the terminator (the line of eternal sunset). Without it would never be in its fullest form.

“Xoe wait!”, screeched Pantele. “I’ll do it. But what of the other thing?”

*****

*Finally back at the observatory I was struggling to see the data. Everyone was busy bustling around the screens. I felt like I was trying to view the Mona Lisa at the Louvre. “It's unbelievable! How lucky we looked right now! What were the chances!”. Finally my colleagues stepped back and I pushed my way through. There they were - clear as the stars I had just been looking at. Transits. And not just one. I didn’t dare blink. I didn’t want to stop looking. A system - a multiple planet system. And one that was nothing like ours.*

*****

“The other thing? That one is more dangerous.” Xoe spoke this sentence to the distance and looked out beyond the system.

As Xoe talked Pantele let out a loud and fearful wail. “I’m scared Xoe.”

“But you shouldn’t be. You have been doing this all along. I have watched you be stretched out and mutilated since both of us were born. You may have not noticed, and been blinded by your star. But don’t let the knowledge of your world scare you.

Pantele let out another loud wail, although this one ended in a softer cry.

“Be brave. You will be able to snatch the tools for life from your star and the system around you.” Xoe tried to comfort Pantele. But Xoe was also scared. Xoe knew that in order for Pantele’s world to be completely ready they would have to collide. Xoe was carrying all the water and molecules Pantele needed to complete an atmosphere.

“Come closer Xoe!” called Pantele. “I need you near me to help me through my mission.” Xoe’s path curved and it started to get closer to Pantele. As it got closer to Pantele Xoe saw their paths, their future, inextricably intertwined. Just a short time more and Xoe would be scattered across the surface of Pantele.

“Eeeaarghhhooooooo” Pantele was still pushing and stretching and changing. “I think it’s starting Xoe. I’m beginning to see a glow in my periphery. There is a rising wave - a coloured vortex. And my surface feels less seared and sore. Only my insides are still moving, but I can feel all the strength is born from within now.”

“My dear Pantele - that’s it you’ve found it! And now for one last wound . . .”

And with these words Xoe catapulted with assurance and speed, driving itself purposefully towards the newly proud Pantele.

“Xoe what are you doing? You do not need to be so close. Xoe wait . . . Be careful . . . Slow down . . . Xoe!”. As Pantele looked out in shock and wonder Xoe sped up. It almost seemed like Xoe was being pulled faster and faster towards it. But with certainty and a kind of wild and fantastic joy Xoe shouted out “It’s time for life to begin!”

With a burning speed and smarting plunge, Xoe smacked into the side of Pantele, giving out a resounding punch. The cold and hot winds that flew forward and back across the terminator (that line of eternal sunset) were flung away and thrown higher. With them they carried the splintered and shattered Xoe.

Pantele - silent now and in even greater shock, started to feel a warming density surrounding it. A sense of peace and softness spread around the circumference from sunset, to scorching day, to sunrise and icebound night. Pantele could hear Xoe surround it in a soft and comfortable hum. Now, in a moment of peace, it knew it was ready for life!

"Thank you mother and thank you Xoe" replied Pantele.

*****

*With pricking eyes I blinked. Within that blink I had seen it all. I suddenly knew how life could work in a world so different to ours. How life could be so full and strange in another world. "Thank you Xoe" I whispered out loud. You have reminded me I believe in life after all.*

## AP 1.2.a Feedback from the short story workshops and readers

In order to make best use of the story I sent if for feedback to some friends, my supervisor Gerardo Adesso, and Dr Amaury Triaud. Key feedback from the email responses I received can be found below.

### AP 1.2.a.i Gerardo's response below:

> The main question I have is about the comet itself, how can it maintain a connection all the way from Earth to Pantele, and know the humans were watching it. As the astronaut thanks Xoe at the end, maybe the dynamics is as follows: Xoe passes over Earth during that night when he is watching the stars in the desert and pondering on the meaning of life, the night while the colleagues at the observatory discover the exoplanet system. Then Xoe keeps travelling away from Earth and towards that system (comets have very long orbital periods so it's not unlikely that it covers the 40 light years distance), and it finally reaches there and does the impact etc. So

this would mean the two parts of the story are happening in very distant timelines: life on Pantele will begin much later than the moment the humans discover it with the telescope. Is that right?

If this is the case, am I right that this bit “With pricking eyes I blinked. Within that blink I had seen it all.” means implicitly that Xoe was just passing over the desert in that moment? In fact, the astronomer thanks it in the end.

Clearly Xoe’s role is fictionalised to embody life itself or, as they say in Jurassic Park, “life finds a way”. But I appreciate that you really don’t stray away from the basic science (compared to, say, entanglement which has some leaps of faith… yet again, even Interstellar who was written by Nobel Prize winning physicist Kip Thorne, featured artistic renditions of a black hole, so it’s nothing to be ashamed of :D).

(Adesso, 2020)

## AP 1.2.a.ii A friend (and scriptwriter) responds via email:

-It's very visual - it's clear that the imagery you're envisaging is very vivid

-The idea of exploring themes of life through the eyes of both living things and inanimate celestial objects is an interesting one, there's lots of potential in that both dramatically and philosophically

-The Atacama setting is great, and contrasting the life of a scientist with the life of the things they're observing, again, has a lot of potential

**Things I wasn't sure about:**

-I found the layout a bit hard to follow. I don't mind the technique of jumping between places and voices, but in something so short, and without more set-up at the start, it was hard to keep track of each bit, who's voice was speaking, and which setting I was in (this applies more to it as a short story, than as the basis for a script)

-The prose didn't have much in the way of narrative progression or sequential description - even though there were some very visual things, they didn't come in a clear sequence that created images in my mind. So it was difficult to conjure in my imagination what I was supposed to be seeing, and feeling

(Abramsky, 2020)

## AP 1.2.a.iii Dr Amaury Triaud's response:

Hi Roxanne,

Thanks a lot for the current story. It sounds quite good so far. A couple of reactions.

- I really liked how you weaved the discovery and life in the Atacama along with the planetary system.

- comets can provide more than an atmosphere/water. By entering into the atmosphere they create gases, notably Hydrogen Cyanide (HCN), which if it is irradiated by UV, particularly during a flare (and we know TRAPPSIT-1 does that), then HCN will transform into another molecule, called formaldehyde, which is an important prebiotic molecule. Formaldehyde is what chemist call a precursor to nucleobases (which make the letters of the DNA), as well as some lipids (which make the membranes of our cells), and can lead to a proto metabolism which what

powers our cells. Much of that research remains very new and linking it together is rather speculative, but it can help your comet and your star to create life together.

- At the moment the story starts you mention planet E, but it does not seem that necessary since TRAPPIST-1 is not mentioned either.

- from the story it is not so clear why life is not there to begin with.

- Is there scope to make the star a character too? Both Xoe and the star have negatives to bring to Pantele, but at the right time and right conditions, then both can be very positive.

(Triaud, 2020)

### AP 1.2.a.iv Short story workshops with students

The first workshop was with Oliver Farrow (Composer), Simon Paton (Composer), myself and Daniel. The second was with Hannah McDonald (singer), Maja Pluta (violinist), Laura Farre Rozada (pianist and PhD student), Daniel and myself.

During the first workshop we read through the story a couple of times and discussed how everyone responded to the characters differently. We also discussed where the weakest points were in the story. We then read through the sections of the story that are in dialogue. Oliver felt that Pantele was a very moany and grouchy character, and male. Pantele was thought to maybe be wearing pyjamas. Xoe would be dressed like a high-powered businessman in a suit with a briefcase. We discussed the addition of the character of the star itself, maybe as a group of people in a chorus, or also the possibility of it just being an object, or even an instrument. The majority of the participants felt that it would be better to have the star as a character with performer or performers. We discussed how the two timelines work and whether it is clear that the astronomer is taking a journey as well during the piece. I questioned the

participants on whether it was sufficient for the TRAPPIST planetary system story to be in the mind of the astronomer or if this was a form of narrative cheat. The participants disagreed that this was problematic and encouraged me that it would work for this to be the case.

In the second workshop we went much further into discussing the individual characters. Whilst reading it Hannah found that a lot of what happened with Xoe and Pantele was almost of a sexual nature - and if not that then it certainly represented a coming-of-age idea. Pantele was less moany and annoying in this reading of the character. She (for here she was a girl) was trying to generate a sense of self outside of the confines of her home and Xoe would help her do this. There is a lot of anxiety and innocence in the way Hannah read this character. Xoe also came across initially as a fast paced, crazy older sister on business trips around the galaxy. However later we discussed the possibility of Xoe being a more laid back and wise traveller type, almost as a grandmother or guru.

## AP 1.3 Cycle 1: Online workshops and outcomes April 2020-February 2021

I completed the first draft of the libretto in the second half of April 2020. Due to COVID-19 the process of working to realise the text was delayed. This gave me some time to make tweaks and update the text in the meantime. Once I received feedback it allowed me to work on more fine tuning. Two of my supervisors Aleksandar and Nicole gave me feedback over the formatting of the text and the stage directions. They suggested that as I was clearly writing directions for Dani and Tadas, so I should now adapt these so that it would be clear to anyone reading the piece, what I wanted to convey. I rewrote the libretto several times after gathering feedback from Dani and Tadas as well.

Throughout the following sections the reader will find notes from the workshops and see elements in bold which are directly visible in the artefacts of cycle 1, or the performances of cycle 2 and 3.

## AP 1.3.a 30/04/2020

During this first workshop we discussed what sort of material to use for each character, based on Dani's study created from the data. We discussed their musical characteristics in relation to the text and science.

Before this workshop I researched some possible uses of extended vocal techniques. Particularly I was making use of Michael Edgerton's textbook on 21st Century Voice (2004). I recorded several examples of myself using multiple techniques which could be experimented with for the voice of the Measurer and sent these to Dani prior to our meeting.

This workshop was extremely useful in generating a collaborative understanding of how the music will be structured for each character and scene. We decided on the tonality and techniques which should be used in the composition of the music for The Measurer, Xoe and the Mother Star. This included testing some of the ideas during the session. This also led to feedback on the libretto as Dani was able to request some extra dialogue in sections where the Mother Star would be speaking and not singing.

Some key decisions are listed below.

- We will create videos for each character making use of the introductory arias for each character. These will be watched by the audience prior to attending the show. We could also add an epilogue for what happens to Xoe and Pantele after the collision.

- **There will be an overture with an introduction to each character.** They can just use the opening lines from their introductory arias.

- **Xoe will be a female, character soprano.** It is a light hearted character. Maybe a bit like a funky granny. **It will use the material from planets h and b** as it is travelling throughout the whole system.

- **The Star will not be lyrical and will explore many different vocal and sonic techniques. It will be an SATB chorus.** It has 3 chords made from the alignment material. It will not need to have melody as it is a static object. **It will make use of rhythmic recitation. During the Brutal mother duet it will speak the words and sing the numbers. The composition will make use of hocketing to create an interference and also to replicate the bombardment.**

- Pantele could be two singers or one. **It will be lyrical.**

- **The Measurer will make use of ASRM sounds, whispers, sprechgesang, muffled words (cupping the hand over the mouth) and more. They will use a microphone and move close or far away from it depending on the vocal technique in use.** This will all give the effect of being inside the mind of The Measurer. At the moments where The Measurer is clearly interacting with the outside world the text will be fully sung.

## AP 1.3.b 17/05/2020

During this workshop we discussed the music for Xoe, Pantele, the way we are collaborating and some ideas about the Mother Star chorus. The key ideas that came out of this discussion are listed below. Prior to the discussion on the material for Xoe Dani voiced some initial concerns about how to make sure the piece feels unified despite all the different harmonies and

melodies created through the data. Part of the discussion was also used up on ensuring the music will work cohesively for all characters.

- During the discussion on the material for Xoe we came up with a good solution to this problem. I suggested that **Dani could use the material from all the planets in Xoe's music as Xoe is passing by all of them at different points.** The position of Xoe in the TRAPPIST system at different parts of the story could be reflected in which material is being used musically at that point. Dani had already decided that Xoe should also always make use of planet b (as a representation of Mercury/Hermes) and planet h (as the outermost point of the system). In this way Xoe would be going on a musical journey which would culminate in the climactic moment where Xoe and Pantele collide. Up until this point Xoe's music would never be mixed with planet e (Pantele's) music. This will give more journey to the character of Xoe, as well as making the other characters appear more static, thus reinforcing the entrapped nature of Pantele within the system.

- Next we discussed how to make the audience aware of these different themes. **We decided that at the start of the piece (the introduction from each character), and throughout the overture, the audience will be shown representations of each character along with their musical theme.** This will signpost each character's music and so allow the audience to follow the whole piece more fluidly.

- We then turned our focus to Pantele's music. For this Dani had decided to **use the music developed for planet e.** Initially Dani had some fears that there might not be enough material to generate a score for the whole of the character's parts. However upon further inspection of his study he realised that there are in fact 2 chords and 2 inversions (4 chords in total). Of these as well there are both major and minor. This gives the perfect accompaniment for Pantele's two halves. We both felt that **the darker side**

**should be associated with the major chord, as this side is more open and has a broader, brighter experience of the universe. The light side will take the minor chord as this side is constrained to always face the star and as such is almost a prisoner of the star.** The music will move through these chords and inversions showing Pantele's internal psychological journey and growth, as opposed to Xoe's physical journey across the system. **Only at the point of trauma or anagnorisis, where the collision occurs, will Pantele's harmonic material be combined with Xoe's, signalling a rebirth.**

- After this we discussed the collaboration itself and the impact that these workshops were having upon the piece. Both Dani and I felt that in comparison to our previous experiences working together, this was creating a joint vision for the work. This would be valuable when it came to the actual production as we would both understand each other's poetic intentions.

- Finally, we had a quick discussion on the music for the Mother Star's introduction. In the initial draft I had suggested opening the chorus with a hum of the word M-Dwarf. Dani felt however that he wanted to open with some huge chords (like a Star Wars opening). We discussed the use of speaking and how this could be done at the same time as the chords to create a cacophony of sound. This would enable the audience to still grasp the sensation of filtering through until the text becomes audible and it is clear what the star is saying.

## AP 1.3.c 30/05/2020

This workshop was focused on working on the Measurer's opening aria, and practising and understanding all the sounds that Dani was imagining. Through this Dani was able to alter some

of the score and change some of the sounds. We also discussed which visuals might be used and how they are making use of the art-science interface in their work. Key points are listed below:

- Initially we had a long discussion about how the work we are doing is not purely experimental. It doesn't just take the data or science and translate it directly into text and music, but uses the science as a structure within which to make choices. In this respect there is a point at which it stops being just a representation of the science and becomes a more creative endeavour. The science is merely one of the tools being used to get to the final work. We also discussed out the science provides us with a nice joint end goal; however it is the personal and creative choices which will define how we get there.

- Many of the sounds I had imagined were not exactly as Dani had imagined, however this allowed Dani to hear some more sounds which he liked and then change various parts of the vocal line to include these. This was invaluable for me as well to understand what Dani really wanted to hear.

- We discussed the reasoning behind the characterisation of the Measurer in Sprechstimme and whisper. Dani was making a comparison to Schoenberg's choices of characterisation in Moses and Aron. The Measurer here doesn't sing, and is not operatic, as it is not as abstract as the other characters, however it is also not completely real as it is the voice of inside the mind of the Measurer. So, for this reason it is also not a clear speaking voice.

After these workshops Daniel sent the score for the Overture and I performed/recorded at the beginning of June 2020. We went back and forth a couple of times before Dani sent through his final version of the score at this stage. During this time we also enlisted the help of other musicians to record a first version of the overture. We also had discussions with Tadas Stalyga

who put together a film for the workshop using regular and drone footage of a local desert location. We presented this film at the M4C Research Festival in July 2020. Please find this film in folder Appendix 1 under the file name: 01_The Flowering Desert Overture - The Measurer.

During this period from August to October we attended several online workshops with myself, Daniel and Tadas, in particular with the focus of developing characterisation of each element of the TRAPPIST-1 system from the story. Initially we had planned to create films for each character. As this period of cycle 1 progressed we took on board Tadas's suggestion to make one piece of the whole system. This ended up with the creation of *The Triple Study* (see section 1.3.i). Below are details of the key workshops. In bold you will find elements of the conversation which progressed towards the output of the cycle or the subsequent cycle.

## AP 1.3.d 22/09/2020

- Tadas expressed that there needs to be a coherence between the three videos of the three celestial bodies. Then he suggested that this could be done with colours, e.g. that **Pantele could be blue** because of water. Dani also pointed out that the blue is related to things moving closer (blue shift).

- We discussed the gender of the characters. I explained my views on it being a mostly 'feminine' piece, but also still non gendered. **The Mother Star is both man and woman, Pantele could also be both man and women, and Xoe is a woman.**

- Tadas asked for some more information about the libretto, e.g. what a vocal fry is and what the final segment will sound like. I explained the sounds and also that the final part of the chorus would be spoken – similar to the moment of "Mayakofsky" in Berio's symphony for 8 voices.

    - https://www.youtube.com/watch?v=DQrvB8PJ8CE (The moment I was referring to is in the 3rd movement. It happens at about 20:20 but if you listen from 19:20 you can get a build-up. I have heard more dramatic performances of this particular line but this is just the first one on YouTube. The text there is Beckett.)

    - After posting this I also thought that “perhaps I should rewrite this section so there is far more text for the performers to recite. I could also give that a go before next time and see what it’s like working with lots of almost meaningless text like the Beckett stuff here.”

- Tadas responded by suggesting that in the moment of climax there could be a close up of an object – perhaps something that the scientist would dream in that moment. Tadas suggested some imagery of a liquid – for example pomegranate seeds crushed on a white cloth. To show the moment when we discover something and see it clearly.

- When discussing final steps and where to go from here Tadas was thinking about what colours the other characters might be e.g. **Pantele as blue, the Star as Orange/Red and Xoe as Brown.**

The images Tadas shared with us during rehearsal, as possible representations of Mother Star, are below.

*Figure 1 Images of Mother Star from Tadas Stalyga. Source: Tadas Stalyga*

After this workshop I rewrote the Mother Star's introduction and recorded an example of performance which can be found in section 2.5.f.i.

## AP 1.3.e 02/10/2020

During this workshop we discussed how we could present the next three pieces in one whole piece, in order to ensure that the representation of these three celestial bodies has a clear connection.

- **Tadas suggested presenting the next three character studies as one whole study.** This would help him to visually connect all three objects. The idea would be to repeat the same structure for the shots related to each character e.g. for the Mother Star the figure on the rocky background, for Pantele footage of a person wrapped in a white blanket on a boat in a lake and for Xoe footage of someone in another cloak/blanket with the

background of an autumnal forest with falling leaves (connected to age and things ending).

- Tadas posed to Dani the question of whether he is considering the anthropomorphising of the characters in his writing of the music. Dani responded saying that he is in a difficult position as he has to remain faithful to the data for his research, but also needs to find a new complex vision of the work. Dani also posed the question of why not just start working directly on the opera?
    - Tadas and I responded saying that the study and cycle is still an important part of us as a team getting to know the process. Dani then changed his mind and thought that if this is a study and not a perfected final piece then actually this would be a good way to proceed from here.
- Another thing Tadas was thinking is that **with the Measurer we never see the Measurer themselves, only their point of view, but with the system we see the characters and the objects as the dream of the Measurer seeing these things.**
- Dani was thinking in reference to mine and his previous conversation, that this piece could be representative of the genesis of the star, with the other characters interacting on top of this frantic genesis. So we would meet the other characters as they are being created in the system. **He suggested that he starts by sending me some material to sing which is randomly generated fast rhythmical singing.**
- Tadas then questioned whether the Measurer study which we have already completed would come before or after this section. He wanted to understand how this segment will fit within other sections.

- I responded by saying that it would be possible for me to go away and play with the text, cut it up and put the characters all closer together.

- Dani suggested we think of this a bit like “The Death of Klinghoffer” where there is the chorus of the Palestinians and of the Jews, which then sets us up for the rest of the story to come.

- Tadas suggested that we swap the pieces around so the System comes before the Measurer. This made me feel that this would work better as the System would be calling to the Measurer, and it would make the System the focus of the opera from the start.

- Dani suggested we could even put the voice of the Measurer on top of the music introducing the system. Tadas replied by saying that you have to be careful with film as jumping from character to character looks severe in a way it doesn’t do when it is integrated into text or music.

- I then mentioned the Dora Maar photos again, and how **having images collaged removes the sensation of groundedness that the Measurer has – Dani responded that this effect can also be achieved through layering of the music.**

- The discussion then moved into a general discussion about how this work is trying to promote the subjectivity of science, and relate it closer to human experience.

After this workshop Dani sent me some music which I recorded. The score and recording can be found in the folder Appendix 1 under the titles 02_Voice-texture-version-1-with-pitch-Score-1 and 03_tfdstarstudyroxpitch.

# AP 1.3.f 12/10/2020

Details from this workshop are below.

- Tadas would represent the opening (as some kind of activity in the universe) through footage of a bonfire. This would be followed by three different wide shots establishing each character. The first is silhouette in the white rock quarry, the second a boat in which Tadas will lie wrapped in a white (symbolic colour of innocence and childhood) blanket, shooting with a drone from above and the third will be Tadas sitting on a stool covered in a fabric with lots of patterns/patches, with a background of an autumnal forest.

- There would also be close ups of personal and scientific items. Tadas decided to arrange to go to the cosmology exhibition in Lithuania to **film the astrolabe** that they have there. **The use of a historical object gives more universality to the piece.**

- Dani suggested a personal item could be a travel magazine of Chile. Tadas replied saying that it could be inside a suitcase with personal objects inside it. The sequence would highlight the dream world of the scientist.

- I suggested personal items such as jewellery, photos or books.

- Dani suggested the photo of a baby which prompted me to suggest the photo of the Measurer as a child. Tadas followed this by saying that he has a photo of himself as a child at his grandfather's funeral. This would show life and death. Dani replied by saying that this would be representative of the Terminator line on the planet.

- **I said that I would rearrange the text for this cycle before the next session.** The shots that Tadas have set up would work well to be mixed together with a different structure of text.

- I then also suggested thinking about what mood to associate with each image and setting a meeting sooner rather than later to discuss this.

I then showed a small section of my recent recording of Dani's music.

- Tadas responded positively about the sound of the sun segment. We discussed how that section has an expansive and speckled space-like feeling.

- I discussed working with Alexander for movement and direction at a workshop in the next week. We had a quick discussion of maybe using the microscope images again. Perhaps also doing something with food imagery at the moment when Pantele is getting sustained by the sun. Tadas said he was also thinking of doing something to do with food. Perhaps a bubbling porridge – a bit like a primordial soup.

## AP 1.3.g 14/10/2020

Prior to this workshop I had met with designer/director Alexander Kaniewski and described the project and characters to him. I mentioned this to Dani and Tadas during this workshop and we began to discuss some staging elements that remained through to the final production.

- **Tadas suggested that the shot of the astrolabe would be an aerial view. There would be some hands coming into the shot from the bottom and manipulating the device. The hand would turn the dial to a certain position and then cut to a wide shot of one of the characters.** This could emphasise the science aspect more.

- Dani suggested showing the hands orbiting around the astrolabe so that every time they come from a different angle and also rotate.

- **Tadas also said that he would be using the three different fabrics from each wide shot to place under the astrolabe each time we come back to it. This would help us to connect the turning of the astrolabe to the next character being introduced.**

- I discussed how a lot of the mythology of creation had a lot to do with egg shaped things. For example an egg shaped locket with a picture inside it. Or also using an Easter egg box with something inside like a piece of jewellery.

- **Tadas suggested an addition to the shot of the fire. There would be a clothes line behind the fire with the three cloths of each character from the solar system hanging on it.**

- Dani said he was thinking about using a randomizer to create some of the musical material.

- Tadas showed us the Astrolabe online. See image below.

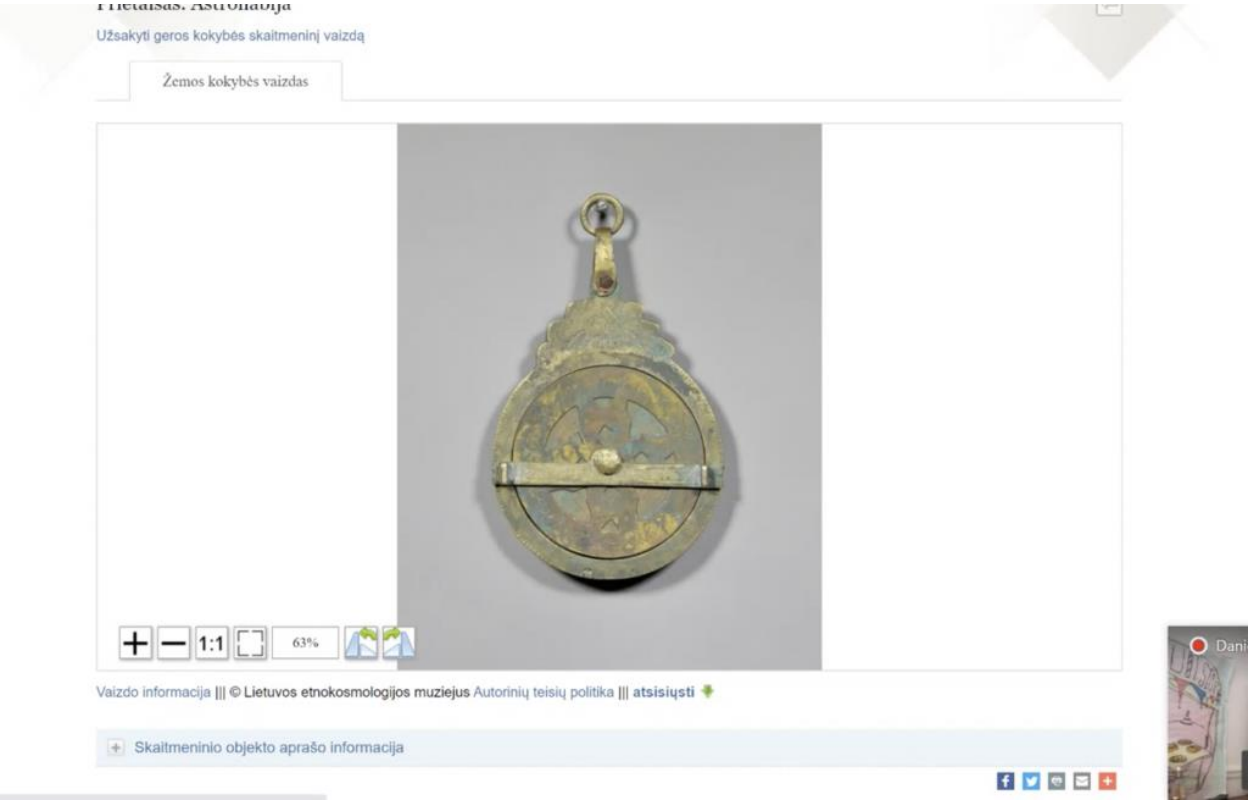



*Figure 2 Image of an astrolabe presented by Tadas Stalyga.*

- I discussed my meeting with Alexander Kaniewski (director) and described that he was considering **structural outfits for the star (with robes**), inspiration of “Andy Pandy” for the Pantele character, and using felting to create a mossy, wispy costume for Xoe to replicate the forest floor. **Alexander was also thinking of using very slow gestural poses.**

- Tadas suggested that Xoe can move in a circle and the star could remain constant.

- **I replied that I had recently drawn a plan in which Pantele is static and Xoe is moving to the star and back. The star itself was spread out and rotating, but coming together at some points.**

- We then decided to put the Measurer in the audience.

- I mentioned that if we connect the staging and the film then the film and staging can be synchronised in terms of where the focus is within the dome and the space.

- Dani said that he liked that the star might be separated because it means that the singers will have more freedom to not sing in a synchronised way.

- I then suggested that each singer could only be working with one chord to make it easier. Dani replied that the chords could change depending on the scene. Or perhaps the chords could change depending on the passive or active voice of the star.

- Tadas suggested that the characters rotate around the audience/space/measurer. However they would only walk when they sing. So the active character is moving, creating a kind of surround sound experience.

- Dani thought that potentially the star could be singing all the time as part of the background noise.

- **Tadas suggested that we use torches to light each character as a simple solution.** Each character would carry a light that they could switch on when they sing. Perhaps not even a light but a red globe. I suggested that perhaps the Measurer could be the one with the flash light or the other characters can be using their flashlights to shine on the main character.

- Tadas suggested that the final section of the Measurer could just be spoken. By dropping the music and the singing the human voice of the Measurer would help deflate the tension and identify the audience with the Measurer even more. This could be done alongside some very simple images. Almost like a moment of awakening.

- I mentioned that I had discussed the collision with Alex and we had felt that Xoe needs to disappear at that point. One option would be to use the dome and the film to direct the audience's attention away so that Xoe can leave. Tadas suggested just to kill the video and kill the light and use a moment of complete darkness so the main load of this moment would be in the music. Another option would be to do the opposite and use a very bright light. I replied that we had also thought of using a flood light which would blind the audience for a second.

- Dani suggested that the image in the dome could turn to the image of water as it is the material to host life.

- Tadas said that he was thinking of a shot to do with seeds e.g. taking an apple seed out of an apple. Dani suggested doing a time lapse of a seed sprouting. I then suggested a time lapse of flowers dying and then reversing it. This would also relate to Xoe.

After this workshop I shared Alexander's costume ideas which can be found in folder Appendix 1 under the name 04_The-Flowering-Desert-Costume-ideas.

I also sent out the text for the triple study, which can be found in folder Appendix 1 under the name 05_Opening-TFD-Spliced.

By the end of this period we had decided to reorganise the character studies into one longer piece which we named *The Triple Study.*

During this period we began involving Alexander Kaniewski in our workshops and progressed towards developing the film of *The Triple Study.* Below are details of notable workshops and materials created in the progression of this work.

During the period from the second half of October onwards we began involving Alexander Kaniewski in our workshops and progressed towards developing the film of *The Triple Study.* Below are details of notable workshops and materials created in the progression of this work.

## AP 1.3.h 05/11/2020

For this workshop Daniel, Alexander and I met in person at the conservatoire to do a socially distanced mapping of the triple study. The aim of this was also to help Daniel get a sense of the other elements of the piece before finalising the music.

We started the workshop by thinking about the Measurer and decided on the following elements:

- The Measurer will be standing when they are performing, on a chair in the middle of the Planetarium (in the audience). As the Measurer piece will now come after the Triple Study we decided that they will stand up when Xoe starts talking about being the two tailed messenger.

- When they stand **they will use a mechanical old-fashioned ruler** to point to things on the dome and on the stage.

- **The Measurer must not be too grandiose** (not too much like a master of ceremonies). This involves making sure that the arms are never raised too high so as to avoid the musical theatre/cabaret manner.

We also discussed how the star could be represented physically.

- The piece starts in a fire of creation. This can be represented by the 4 members of the star creating strong angular poses, moving every x number of bars into a new pose. With

energy creating a strong profile. All would ideally be standing together in one block whilst doing this although this may be rethought with social distancing restrictions.

- **This also led Daniel to consider having the star chorus singing a series of chords,** rather than singing in the rhythms dictated by the system. These could be sung using different phonic parts of the words in the libretto.

We spent the rest of the time mapping out the path of the characters throughout the triple study, and then a potential staging for the whole of the opera.

- **The moment of collision will involve the passing of something or of some part of the costume of Xoe.** This moment will involve Pantele and Xoe being with each other. Perhaps with Xoe behind Pantele. **There is still the possibility of removing Xoe at this point but this may not actually be necessary.**

- There is a moment where the measurer looks at the transits. For this we will see a tableau created by all the characters at the front of the stage.

- A video of the blocking, created by Roxanne after the meeting, can be found in folder Appendix 1, file name 06_TFD blocking.

We also discussed Xoe's movement and costume. The findings for this were:

- **Xoe will move in slow defined poses.** She will be always crippled and pained in one part of her body and will use this to deform her posture as she moves around the space.

- **Her costume will have sails hanging down from each arm.** These will allow her to create more defined and extreme looking poses. It will also allow her to potentially envelop Pantele in the moment of collision.

- We discussed that she could open one side of the sail on the journey to the star and the other side on the return. She could also lose part of the sail or a ribbon from her costume when she passes past the star.

## AP 1.3.i The triple study

I continued to work online with Daniel, Tadas and Alexander throughout November and some of December. During December I recorded and learnt all the vocal parts of *The Triple Study.* I wrote this short summary of the discovered vocal characteristics.

> During December and over the Christmas break I developed an understanding of some of the vocal characterisation of each character in the triple study by recording all parts myself. This also gave us a test audio in place of the final recording, which Tadas could use to build the film.
>
> Xoe: The vocal characteristics are light, steely, flexible, dramatic, playful. I was using full voice but not in a fully operatic manner, mixing a bit between a more musical theatre style voice and operatic.
>
> Pantele: Pantele has 2 sides to her personality which are represented by two different tonalities in her voice. The *shadow* is a very full, round and dark operatic sound while the *self* is much lighter, has less vibrato and is a more choral/childlike sound.
>
> The Star: The tonality of the star in the triple study is very neutral until the final dictation which is far more dramatic and pompous. The character will be pompous throughout the rest of the piece, apart from those moments where it is being used as part of the ensemble sound.

This work will help in directing the singers who are going to be recording the different parts for us.

My own recording of the music helped to inform the way I related the characters to the other singers for the recording process towards creating the film of *The Triple Study.* This was completed in February 2021. Find the film in Appendix 1, file name 07_Triple Study.

# AP 1.4 Cycle 1: Explorations through Performance and Film - March-June 2021

After completing this stage of the work unfortunately Tadas was no longer able to take more footage and create films due to his own PhD deadlines. We did however have the ability to work with the students that had been assigned to our COVID-19 'bubble' by the university. This pool of students comprised of the composition students, the experimental performance students and other PhD students. We sent out a call for workshop participants and from the people that responded began to hold workshops to explore the movement and costumes for each character.

In this period we held movement and costume workshops during March and April, and filmed the performers in May. I then collected recordings from singers and edited the footage, whilst Daniel collected and edited audio recordings from the instrumentalists and created a mix of the music for scene 1, mélodrame 1 and scene 2.

## AP 1.4.a Overall outcomes of the movement and costume workshops

Mother Star:

We explored performing the text alongside the movement and added the use of a ball to engage the performers in a constant activity. This was to represent the constant process of fusion and

developing metallicity which is explored in the libretto during scene 2. We also explored movements which would replicate the protonic bombardment. All of the performers were instructed to perform without direct relation or acknowledgement of Pantele, especially in those moments when they are circling her (or reaching her with the stellar radiation). During these workshops we recited various elements of the text used the recording of the Triple Study as well as some recordings I had already made of the new music written for scene 1 and scene 2.

The costumes for the star consisted of various different tones of red and included structural circular neck pieces to reflect the colour and shape of the star itself.

Pantele:

We found a few key movements which would represent Pantele's tidal locking, the two halves separated by the terminator, and the probable strong winds. These were to be repeated actions throughout the whole piece. We also decided on her costumes as a white dress with a red sash to highlight the hold that the Mother Star has over her. We added a hat which we were considering using as a tool in the moment of collision in scene 4. The costume itself was very structured and had a clear form.

Xoe:

At this stage we were exploring movements that would make Xoe lighter than Pantele, and we also explored a costume which would float in contrast to Pantele's more structured dress. We explored movement patterns that might replicated the gravitational pull of both Pantele and Mother Star. At this stage we were working with a dancer so the movement was tailored to them. When we would be allowed to work with Hannah McDonald, the singer for this character, the movement would change drastically.

### AP 1.4.b Scene 1, Mélodrame 1 and Scene 2 Film

During the editing of this film I continued to use the concept of layering as had been discussed in the workshops, in order to create a sense of Pantele's submission to the star, and to show more of the dream like nature of the system, along with the internal thoughts of the Measurer. I made use of Tadas's footage from both the earlier film of the overture, and the Triple Study.

You can find the film in folder Appendix 1, file 08._The Flowering Desert Scene 1 , Mélodrame 1, Scene 2

## AP 1.5 Cycle 2: Leading to the performances in May 2022

During this cycle we worked with A/V artist Leon Trimble and Birmingham School of Art (BSA) students to create the projections from the dome. We also liaised with University of Birmingham to become part of their Commonwealth Games programme which provided the funding for the final work to be completed. This culminated in two performances at the ThinkTank Planetarium during May 2022. We worked in collaboration with Colin Hutcheson, the planetarium lead, to enable the work to be performed in this unusual performance venue/space.

### AP 1.5.a Below find extracts of the work created with the BSA students.

1. A design which was used in various forms throughout the work, from the tabard to the projections. This design was based on the chrysanthemum flower which flowers in the Atacaman desert during the desierto florido.

*Figure 3 Flowered side of tabard (top left), mountain side of tabard (top right) and chrysanthemum pattern (bottom) by Amy Bradley. Source: Infinite Opera*

Footage of wood cut out in folder Appendix 1, file 09_Flower cut out footage.

2. Stop motion footage created with flowers by Niambi Robinson and animation by myself in folder Appendix 1, file 10_Flower set slow animation.

3. A short animation created by myself of 64 frames to be used as an input for modular synthesis. Based on designs by Amy Bradley in folder Appendix 1, file 11_Xoe 64 frame animation.

## AP 1.5.b Footage from the performance

1. In Appendix 1 you can find an edited selection of the videos with Leon Trimble created for the Planetarium performance in May 2022. File name: 12_TFD Showreel not VR June 2022

2. In Appendix 1 you can find an excerpt of the recording from the performances in May 2022. This includes scene 4 and mélodrame 4. File name: 13_The Flowering Desert – excerpt.

AP 1.5.c Performance Programme, Information Sheet and Cast List


*Figure 4 Front cover of The Flowering Desert Programme with poster designed by Amanda Smith*

## WELCOME

Infinite Opera is thrilled to present you an opera about astrophysics and the search for life created specifically for planetariums.

*The Flowering Desert* is a surround sound immersive experience, with a tailor-made music of the spheres, which puts the audience inside the mind of a scientist and the recently discovered TRAPPIST-1 solar system, exploring the border between fact and imagination. With live performers, stunning projections, and celestial music this will be a beautiful night with the stars.

Infinite Opera

*Art and science, two different facets of the same question, finding out what we are and who we are.*

Dr. Amaury Triaud.

**Première - 18th and 20th of May 2022**
**Thinktank Planetarium, Birmingham**

Creative Team at the première

Produced by Infinite Opera
Music by Daniel Blanco Albert
Libretto by Roxanne Korda
Projections by Leon Trimble
Planetarium lead - Colin Hutcheson
Movement Direction and Costumes by Alexander Kaniewski
Designs by Amy Bradley, Niambi Robinson and Yuan Wang

thinktank
Birmingham science museum

Infinite Opera

UNIVERSITY OF BIRMINGHAM

BIRMINGHAM CONSERVATOIRE | BIRMINGHAM CITY University

Midlands4Cities
Doctoral Training Partnership
Birmingham Coventry Leicester Nottingham

*Figure 5 Page 1 of The Flowering Desert Programme*

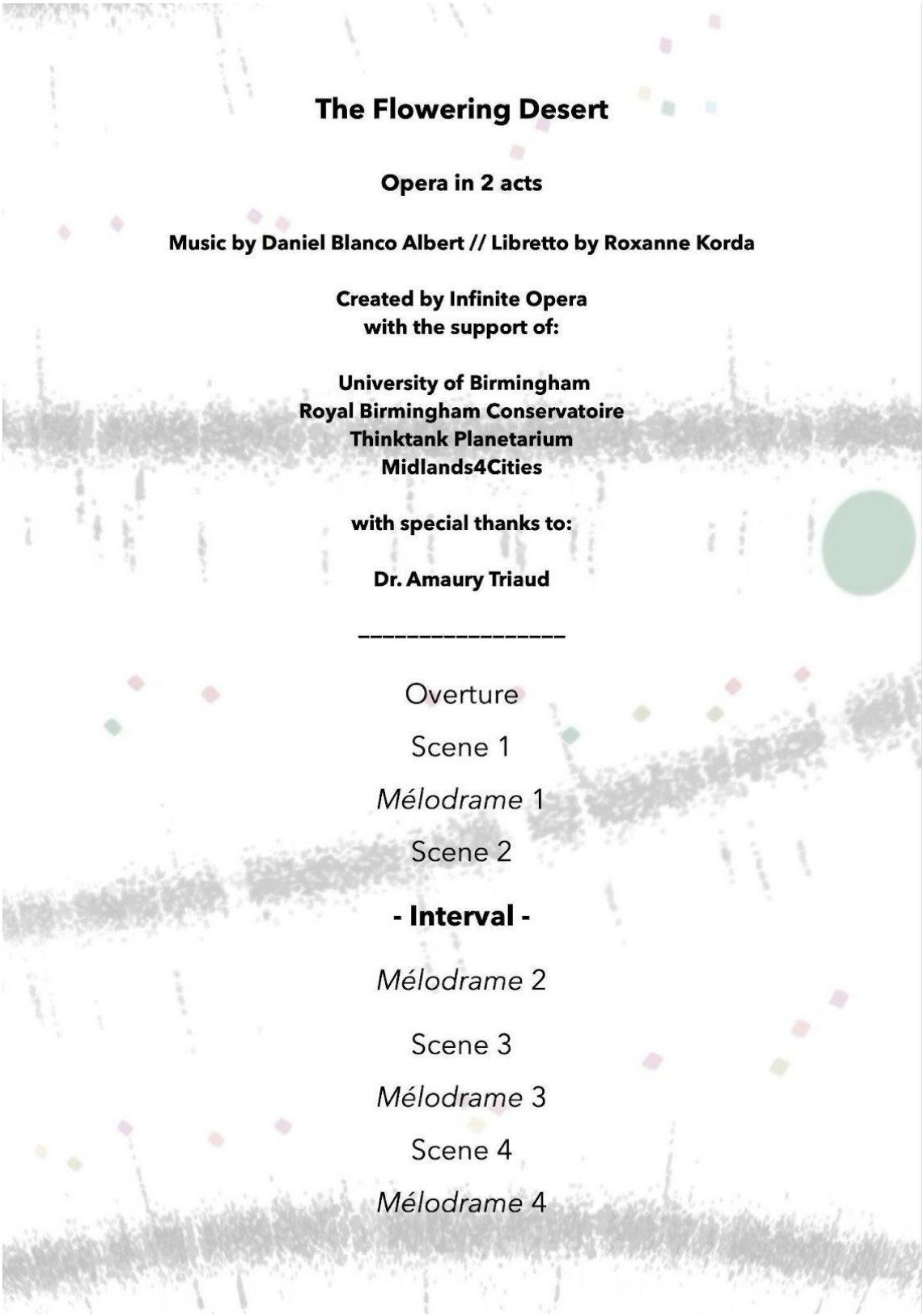



*Figure 6 Page 2 of The Flowering Desert Programme*

## Characters

**Pantele -** Planet E from the TRAPPIST-1 system. It is tidally locked with its Mother Star. Therefore, one half of the planet faces the star and is constantly lit, while the other, in constant shadow, faces the immensity of the universe.

**Xoe** - Exocomet that after eons of wandering across the universe, returns to TRAPPIST-1 with a vital piece of information.

**Mother Star** - A red dwarf star in an almost sempiternal process of combustion.

**The Measurer** - A scientist temporarily living in the observatory of La Silla, Chile. In the breakthrough of a discovery, and after witnessing the phenomenon of the flowering of the Atacama desert, they wonder about the possibility of life in the universe.

## Synopsis

**Overture -** The Measurer lies down at night observing the flowered Atacaman desert and its sky, wondering about the universe.

**Scene 1 -** Xoe, the comet, returns to the TRAPPIST-1 system. It tells Pantele that it is being observed looking for life. The two halves of the planet reflect about themselves, finally deciding to become that what is being searched.

***Mélodrame* 1 -** In the desert, the Measurer is doubtful over the search for life.

**Scene 2 -** Pantele asks its Mother Star for help.

***Mélodrame* 2 -** News from the observatory. The Measurer, however stays looking at the sky and at the Earth.

**Scene 3 -** Pantele asks Xoe for help. The planet needs to generate a magnetic field through tidal heating to defy the power of the Mother Star.

***Mélodrame* 3 -** At the observatory, the Measurer witnesses a unique event, a triple transit of the planets C, E and F.

**Scene 4 -** Xoe proceeds to make Pantele a habitable planet.

***Mélodrame* 4 -** The Measurer realises that life could be possible in TRAPPIST-1, and therefore, in the whole universe.

*Figure 7 Page 3 of The Flowering Desert Programme*

# LIBRETTO

## OVERTURE

**Pantele:**

I the planet Pantele

*(self)* One side never night
*(shadow)* One side never bright

With a shadow as strong as my self

*(self)* A dusky cage of persistent sunrise
*(shadow)* The terminator where light dies

I the planet Pantele

*(shadow)* Formed just as my mother star
*(self)* From the rubble of her welding parts

With a shadow as strong as myself

(shadow) Every three years I see my neighbour twice
(self) Every two years I see my neighbour thrice

I the planet Pantele
With a shadow as strong as my self

**The Measurer:**

Though it seemed dead,
The ground tonight is now a purple field.
Our atmosphere's chaos made a flowering spread.

We are watching
Through a robotic eye to chart things hidden.
They may lie in plain sight but at first glance we never see them.

**Mother Star:**

I the Mother Star
Parent, child and carer
Kind and endless source
An axis of the eternal
Young but older than most
Common but barely observed
I the Mother Star

**The Measurer:**

As I lie
Facing the Atacaman sky
The stars like the data on the screens of La Silla.
Which new worlds might we explore?
The stargazed Aquarius constellation brings us the dim glow of Trappist 1.

It is
Nothing like our sun.
Turbulent and destructive enough
To create an active world, the desierto florido I lie on.
A red dwarf could never make a world like ours. There is little hope for life.

**Xoe:**

I am the comet Xoe

I am the two tailed trickster
Dropping via counter steered descent
Towards a mother star skirt's brim

Frozen stone exterior
Radiate rays effervescent
Excitement begin

**The Measurer:**

Yet
I will search
Like all good astronomers should.

**Xoe:**

I am the comet Xoe

I am the two tailed messenger
Travelled far beyond this system's edge
In an ever wiser spin

With a motion pendular
Path perturbed by planetary dredge
Secret's I've within

---

## SCENE 1

**Recitative**

**Xoe:**

Pantele!
Someone is watching you Pantele!

**Pantele:**

Xooooooeeeeee! *(Pantele sings in a windy fashion)*
Good day Xoe
You are back from your wanderings
What news did you bring?

**Xoe:**

Great and mysterious news!
I think that something watches from afar
It searches a sky for discoveries
And now it searches for you Pantele!

**Aria for two halves of the self**

**Pantele:**

*(self)* What does Xoe mean?
*(shadow)* What does Xoe mean?

*(shadow)* I can see the world outside
Kaleidoscopic distant eyes
I spied to them and now it seems
That one is spying back on me

Dark winds blow to wake my soul
And carry thoughts to make me whole

*(self)* These smarting Coriolis winds
Whip up the sands, make thoughts spin
I never dreamt I'd ever be
Known out there in the galaxy

Another star-bound family?
Someone there is watching ME!

**Recitative**

**Xoe:**

Steady on now Pantele . . .
Couple of setbacks deary
They seek a life like theirs, and that cannot be you.
Soon their gaze will drift, you are not one of few.

Cheerio, tally Ho, out I trot, off I pop!

*Figure 8 Page 4 of The Flowering Desert Programme*

**Recit**

**Pantele:**

*(self)* Silly Pantele! Nothing could look upon you. What could they see? One side scarred another side bruised.
*(shadow)* But no . . . Maybe I can change, project some majesty – become the things they want to see!

---

**MÉLODRAME 1**

**The Measurer:**

My eyes now closed
Covered by an Atacameñon blanket.
Stars pricking underneath my eyelids.
Cold air currents inspire through my nose.
Why do we search for life at all?
Is that all the universe is there for?

---

**SCENE 2**

**Brutal mother and forgotten child duet**

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

If they find their reflection
They flee in the other direction

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

Oh, Iron I say
You look feral today

**Pantele:**

Mother, can you hear me?
Something happened to us.

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

Lithium is missing
Hydrogen is kissing

**Pantele:**

Mother I'm ecstatic
There's something so fantastic!

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

Out struts Titanium Oxide
The cool M Dwarf guide

**Pantele:**

Mother, can you listen?
I discovered my ambition

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

Vanadium Oxide - so amorphous
Rather dense and rather formless

**Pantele:**

Mother, can you hear me?
This might be momentous!

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

Good evening mistress silicon
You've almost reached the central dome

**Pantele:**

Mother listen to me!
You're being so unruly.

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

Such metals make a chill
Through round rouge ruddier fill

**Mother Star:**

Hydrogen 1 meet Hydrogen 1
Hydrogen 2 meet Hydrogen 1
Helium 3 can't meet Helium 3

**Pantele:**

Mother don't ignore me!
Your child has so much anxiety
Mother, for once - please hear me!

---

**MÉLODRAME 2**

**The Measurer:**

Screaming? No cheering!
Really I must go back.
It's coming from the observatory.
Let me experience this moment a little longer.

This desert smells nostalgic.
Millennia of worlds who stood here before.
We humans are small - the flowers showed me that.

---

**SCENE 3**

**Recit**

**Xoe:**

Back I trot, out I pop.

**Pantele:**

Xoe can you help?
Send me some advice?
How can I be life like them?

**Xoe:**

I'm so glad you asked
But it will be hard to do

**Aria**

First –
Your mother's grasp is strong
She holds and governs you.
But you can start to tame her-
Turn her weaponry to armour!

Second –
Alone you cannot manage
You need some added magic
That only comes with luck

Habitability is hospitality and so far, you have none.

**Pantele:**

I have neither one?

*Figure 9 Page 5 of The Flowering Desert Programme*

**Tidal Heating Trio**

**Xoe:**

Your mother has been tugging
Within you is a friction
The outward eccentricity
Now dissipates internally
And caused a deformation
While underneath a bubbling

**Mother Star:**

Look there, and there and there -
Another spot!?
A darkish flare?
This mournful magnetic mass
In constant repair.

**Pantele (Self):**

As I let my mother pull me
My skins crack to release a moan
Active and sore to my core
A heated tidal bulge

**Mother Star:**

Now what is that I hear?
Something buzzing at my ear?
This proton punishment you'll see
For failing to just leave me be!

Paaah ha ha ha
Pohhh ho ho ho
Peeee he he he

**Xoe:**

Your shield is coming
A violet glow is humming

**Pantele:**

*(shadow)* Aurora's at my rim
*(self)* My mother's glare gets dim

**Recit**

**Pantele:**

*(shadow)* Let me be known I want to bloom

*(self)* Xoe wait! Help me with the second task.

---

**MÉLODRAME 3**

**The Measurer:**

It smells dusty in here
Everyone crowds at the screens
Waiting my turn then at last I see them
Transits
(Planet C, Planet E, Planet F)
I don't dare to blink
A system and planets b to g

---

**SCENE 4**

**Recit**

**Xoe:**

The second task is harder.
More dangerous and painful than the first.
It is not just you who will be hurt.

**Pantele:**

*(self)* You've made me so afraid
*(shadow)* But this coloured peripheral vortex
Is soothing all my scars.

**Xoe's triumphant aria**

**Xoe:**

Be brave Pantele.
You are seeing clearly.

At last, you found your magnetism
I am so proud of how you listened
This final journey past Mother star
I noticed my tail burning out fast.

I cannot brightly shine forever
There's more that we can do together.
And so it is with this last plunge
My adventures all will be expunged

All elements for life can form
Though first they may seem toxic
Embrace your star and be transformed
Once inert now biotic

**Recit**

**Pantele:**

Xoe don't come so close
Be careful - slow down
Xoe!

**Xoe:**

And now for the final wound
I'll meet you on your winds.
It's time for life to begin!

**Pantele:**

Aaaaaawhooooooooo
Whooooooohaaaaaaa

**Xoe:**

Z-O-E

**Hymn**

**Pantele:**

The airs I blow have hope
A field protects my face
Thank you, Mother,
Thank you, Xoe,

---

**MÉLODRAME 4**

**The Measurer:**

Through smarting eyes I have to blink
I think I've seen it all.
My mind has found how life could be so strange and full in other worlds.
Thank you Xoe
You reminded me - I believe
In life after all.

*Figure 10 Page 6 of The Flowering Desert Programme*

## INFINITE OPERA

Infinite Opera is an innovative small-size experimental opera creation company based in Birmingham. They are the proud creators of the first ever Beer Opera and many science-related works. They are interested in subverting the traditional genre by collaborating with businesses, institutions and professionals from different practices.

### LIBRETTIST
### ROXANNE KORDA

Roxanne is an opera singer and librettist. She likes to explore; presenting new opera, on esoteric subject matter, in unique spaces, to different audiences. She co-founded the company Infinite Opera in order to combine her love of science, philosophy and music.

She is currently enrolled on practice-based PhD with the Midland4Cities Doctoral Training Partnership at Royal Birmingham Conservatoire, exploring how to use science in creating new operatic characters and narrative. She has a MMus in Vocal Performance (Distinction) from RBC, and previously studied Physics and Philosophy BSc.

She is a varied performer whose previous roles and concerts include classical (Norina - Don Pasquale, Fiordiligi - Cosi Fan Tutte) to romantic (Vier Letzte Lieder, Rosalinda - Die Fledermaus) to contemporary (Entropy - Entanglement! An Entropic tale). Her libretti include Besse: Water, Rye and Hops, and Entanglement: An Entropic Tale.

### COMPOSER
### DANIEL BLANCO ALBERT

Daniel Blanco Albert is a composer and conductor. He is Infinite Opera's co-artistic director and resident composer, for which he has written the music of the physics dissemination opera *Entanglement! An Entropic Tale*, the operatic beer trilogy, *Besse*, the folk masquerade *Autohoodening: The Rise of Captain Swing*, and the planetarium opera *The Flowering Desert*.

He has also worked for theatrical productions and artistic installations across Europe, collaborating with directors such as Aleksandar Dundjerovic, Stephen Simms or Lise Olson. He often collaborates with the Welsh National Opera's engagement programme in the Midlands.

Daniel studied Composition in Spain and in the UK, getting the Extraordinary Prize at Valencia Conservatoire and a BMus (First) and Masters (Distinction) at the Royal Birmingham Conservatoire (funded with a Leverhulme Arts Scholarship). He is currently pursuing a PhD in Performing Arts at Birmingham City University as part of the Midlands4Cities Doctoral Programme.

**More information and contact:**

www.infiniteopera.com // infiniteopera@gmail.com

www.roxannekorda.com // www.danielblancoalbert.com

*Figure 11 Page 7 of The Flowering Desert Programme*

**Exoplanets**

Exoplanet is the term given to planets which orbit stars other than our sun. They are typically hard to see directly with telescopes. Astrophysicists have been using the phenomenon of planetary "transits" to capture information about other solar systems in the universe. These transits are viewed when a planet passes directly in front of its star. Whilst the planet makes this transit, the light the telescope captures from the star slightly dims, showing that there is "something" blocking a part of its brightness from reaching us on earth. This "something" is the exoplanet. Information about the planet's speed, mass, radius and likely atmosphere can be inferred from the frequency of the transit and the light captured on earth.

**Red Dwarf Stars**

Red dwarf stars cover a group of stars including both K and M dwarfs. Our TRAPPIST-1a star is an M dwarf star. Red dwarf stars are the most common type in the universe, however they are generally too dim to be seen with the naked eye. They range from 7.5% to 50% the mass of the sun, and burn at a much lower temperature. Due to their coolness they burn through their supplies of hydrogen (fuel) far slower than the sun. So instead of existing for billions of years, they can exist for trillions of years, They are slow and steady, especially considering the universe is only around 14 billion years old itself.

**TRAPPIST-1**

Named after the telescope it was discovered with (Transiting Planets and Planetesimals Small Telescope – located in the Atacama desert in Chile) in 2016 the star TRAPPIST-1a was found 40 light-years away. In 2016 3 exoplanets of the system were discovered, expanding to 7 in 2017. All are roughly earth sized and they orbit in a repeating harmony. They are likely to be rocky and the system is possibly twice as old as our solar system. This pivotal discovery marked a change in perspective on red dwarfs, making them worthy of study due to the potentially habitable planets found in this system. Planet e (Pantele) is one of these and possibly the most likely to host life, with the right temperatures and the chance of water. It is tidally locked to the star meaning one side is always facing it and light, while the other is always facing outwards.

**Tidal heating**

Some red dwarf stars send out bursts of angry flares which would sterilise nearby planets with protonic bombardment and radiation. One defence against this would be a magnetic field, which could shield the planet's surface and atmosphere from these powerful rays. In the Jupiter system (a close analogy to TRAPPIST-1) the moon Io is subject to a lot of gravitational pull from both Jupiter, and its neighbouring moons. The orbit of these moons are also in harmony meaning sometimes they will align and exert stronger gravitational forces on each other. This will affect the internal tides of the moon and cause it to be extremely volcanic in nature. A similar effect could happen to the planets around TRAPPIST 1. However, if they are far enough away from their star the tidal heating may be at the right level to not just cause a bulging and deformation but also to help generate a magnetic field around the planets through a dynamo effect. This may make them even more habitable.

**Panspermia**

This is the theory which suggests that life may be carried around the galaxy on interstellar objects. Biological material may be brought to planets through the collision with objects such as an exocomet. It is not only possible that the exocomet might carry molecules (like water) but also that the energy generated through the collision could spark the formation of life building molecules. It can promote the formation of gases, particularly Hydrogen Cyanide, which will transform into the pre-biotic molecule formaldehyde when irradiated by UV light (quite likely on TRAPPIST 1e).

*Figure 12 Information Sheet inserted into The Flowering Desert Programme*

# The Flowering Desert

Produced by Infinite Opera
Music by Daniel Blanco Albert
Libretto by Roxanne Korda
Projections by Leon Trimble
Movement Direction and Costumes by Alexander Kaniewski
Designs by Amy Bradley, Niambi Robinson and Yuan Wang and Lina Mbaa
Planetarium Lead - Colin Hutcheson

Cast

Xoe - Hannah Flynn
Pantele – Roxanne Korda
Mother Star – Megan Artemova (Soprano), Dalma Sinka (Mezzo-Soprano), Ed Harrisson (Tenor), Teddy Woolgrove (Baritone)

Ensemble

Conductor - Daniel Blanco Albert
Violin – Ricardo Brown
Viola – Alicja Humeniuk
Cello – Lucy Samuels
Piano – Dominika Blatt
Percussion – Aidan Hammond
Clarinet – Will Hammond
Flute – Arjun Jethwa
French Horn – Jose Miguel Lluna,

With special thanks to Dr. Amaury Triaud, University of Birmingham, Thinktank Museum, Commonwealth Games 2022, Royal Birmingham Conservatoire, BCU Media Department.

*Figure 13 Cast list inserted into The Flowering Desert Programme*

## AP 1.5.d Performance feedback

One key outcome from this research was the feedback collected in response to the performance. As we had two nights of shows this meant that we were able to collect a larger amount of feedback than for other productions. The responses to the questionnaires can be found below.

The results of this first set of performances was very positive and showed a general trend towards a successful outcome of embedding the science into the operatic form in a way which imaginatively engaged the audience with the subject matter. We could see that for most of the audience who responded to the questionnaire this was not the first time they had attended an opera, and that roughly two thirds attended at least one scientific event every year. Interestingly those three participants who had not attended opera before also did not attend scientific events in the year (10% of responses). This brings up the question of how they had heard of this event, and why in this case they decided to attend something that they had shown no prior active interest in for this year. All these three participants described their experience of the opera as being “satisfactory” with one leaving a detailed comment on what specific elements of the production they would like to see developed. This same participant agreed that the show helped them to empathise with the concepts of planets and astrophysics presented, but the other two were neutral to this.

There was one response which disagreed about the show enabling them to empathise with the subject. This responded also commented that they felt they needed some more rest throughout the opera and that there could have been a ‘break in the pattern of the opera’. I speculate that this refers to the dual timelines (the use of the scenes and mélodrames) and that perhaps this audience member felt that this was becoming repetitive. I also received feedback about this as element which could be potentially boring. Overall however the average response to the

audience's increased ability to empathise with the subject was positive, with an average of 2.2 ("agree"). Out of the 29 participants who responded to this question: 8 strongly agreed; 9 agreed; 1 were neutral; and 1 disagreed. Despite the fact that the majority of opinions were either to agree or strongly agree, the 11 neutral showed that there was plenty of room for improvement in this area. One of the key elements of feedback which I felt would make a huge difference to this was the lack of subtitles. We had provided the libretto in the programme, however we had run out of time to make videos which included subtitles. Ultimately this would provide the audience with a much greater understanding of what is being said, especially by the Measurer, and so provide that final element towards having that hyper-immersive experience we were looking for. There were also some elements of the projections that people did not enjoy and which we could focus on changing, such as the rotating text in the overture.

In general, we could also see that the performance helped to increase people's interest in, and understanding of, science and opera, with an average score over 3 (neutral) for all of these questions. According to the data the show was more successful at increasing people's interest in opera than in astrophysics; however, the fact that the performance took place in a planetarium, and so was playing to an audience that was most likely already very interested in astrophysics, may have had an impact on this. Also, we can see from the responses that those who were already aware of the scientific information presented were many of the responses for whom it did not also increase their interest. Interestingly, however, these participants reported either agreeing or feeling neutral about the ability of the show to help them empathise with the concepts, with most of them stating they agreed, showing that this embodied performance of the subject can have an impact even on those who are already deeply engaged with it. It is also likely that much of the audience for these performances were made up of people from the Royal Birmingham Conservatoire as we had discussed the event with many of our colleagues there.

I also gathered feedback from the director/costume designer Alexander Kaniewski on his reflections about the piece and the process. He was generally happy and positive about the production and our outcomes. He had understood the aims of the production to be about creating a show for the ThinkTank Planetarium which utilises all the unique aspects of what a planetarium has to offer, as well as to take a topic which is not particularly narrative driven and to explore and convey various aspects of it through music and theatre. He felt that we:

> were successful in translating the material into the medium and I think we were also successful at utilising the planetarium space, whether that the story or the nature of the material was conveyed to an audience without needing the program notes is another. (Kaniewski, 2022)

He did, however, go on to say that he particularly likes theatre which is not so clear and obvious in how it will be received, stating that:

> the making of this theatre had its influences in these areas and was on a journey. We created the piece from that stimulus. But what was received at the end was again open to interpretation and an own take of it. . . if anything, things are more interesting to me, if there it isn't straight down the line, this is what I just watched. I totally understand it. If there's an air of ohh I can sort of understand that bit and or I can piece it together. Or maybe if I watch it again I might get a little bit more about it or something else might speak to me or I think it's about this but you think it's about that. (Kaniewski, 2022)

Alexander said that he had found it a shame that there was such limited space for action in the planetarium, and that really the singers' movements had to become a periphery to the dome, at which the audience's seats are angled for better viewing. Another element he felt had detracted from the movement and created a more static environment was the limited lighting, as we only had 2 spots where we could shine lights on the performers.

When asked about working with the various other participants he said that he felt the bulk of the work had really been done at the beginning with Tadas, and that we had succeeded in creating costume and visuals which felt like a unified work and matched the narrative and concepts behind the piece. He did, however, feel that a lot of the work produced by the art students in this round was unnecessary, and that the costume element used to express the crash of Xoe at the end was not large or bold enough to show this. We both felt that instead of relying on costume to show this moment we should also consider making better use of the dome. Daniel had also shared the view that this moment was not impactful enough and so was something we should reconsider in our next version of the work.

See results of audience feedback in Appendix 1, file name 14_Audience Feedback May 2022 The Flowering Desert.

### AP 1.5.e Interview with Alexander Kaniewski – Transcript

See interview transcript in Appendix 1, file name 15_Feedback with Alexander Kaniewski (Kaniewski, 2022).

## AP 1.6 Cycle 3 – Final Performance

This final cycle included the work done towards the final performance. For this we made an addition to Xoe's costume, through working with students from BSA, of a hat and torch. We did this in the hope that it would add more humour and presence to the character, allowing the performer to move out of the spotlight for various moments.

## AP 1.6.a Audience response for the third cycle

Questionnaires were handed out at this performance (ThinkTank Jan 2023). Despite the fact that tickets were sold out, I received far fewer responses. The feedback from this can be seen below. We can see from this limited response that the updates and reviews made for this production seem to have had an impact on the audience's experience. In the space for extended feedback we did not receive any comments suggesting ways to change or enhance the production itself. We also received a fully positive response on the show's ability to enhance empathy with the science in the show. It was also mostly viewed as a highly satisfactory experience. It also seems to have been fairly successful in increasing the audience's interest in both opera and astrophysics. We received one piece of feedback from an unknown audience member on Instagram after the show saying:

> I attended The Flowering Desert at the ThinkTank Planetarium yesterday and I just wanted to say I loved it so so much!! I honestly went into it not knowing anything about opera or science but it just seemed really interesting to me and it ended up being even better than I expected!! I will definitely have to check out more opera after this - thank you all for such a great and memorable experience . . . I find it so cool how much you've managed to integrate into the piece, it's like not a bit of science was wasted! I also loved the costume design as well, like Pantele's make-up showing how the atmosphere in a transiting planet is observed. . . I'm glad I was able to take it all in despite being unfamiliar with opera and astrophysics. (Serryade, 2023)

See results of audience feedback in folder Appendix 1, file name 16_Audience Feedback Jan 2023 The Flowering Desert.

# Appendix 2 - *Lipote: An Interconnected Journey*

# Creative Process

## AP 2.1 Cycle 1

The development of this piece started in lockdown where I was lucky to be living with a composer who was able to collaborate with me in person allowing us to engage in direct and important conversations over how we wanted the text and music to come across. We were able to do so through ongoing workshops which explored the performative, scenic and dramaturgical elements of the work.

We began by first composing scenes 1 and 2 which we then workshopped after further reflection made it clear more work would help us to get deeper into the topic and the story. Below the reader will find the reflections from these workshops.

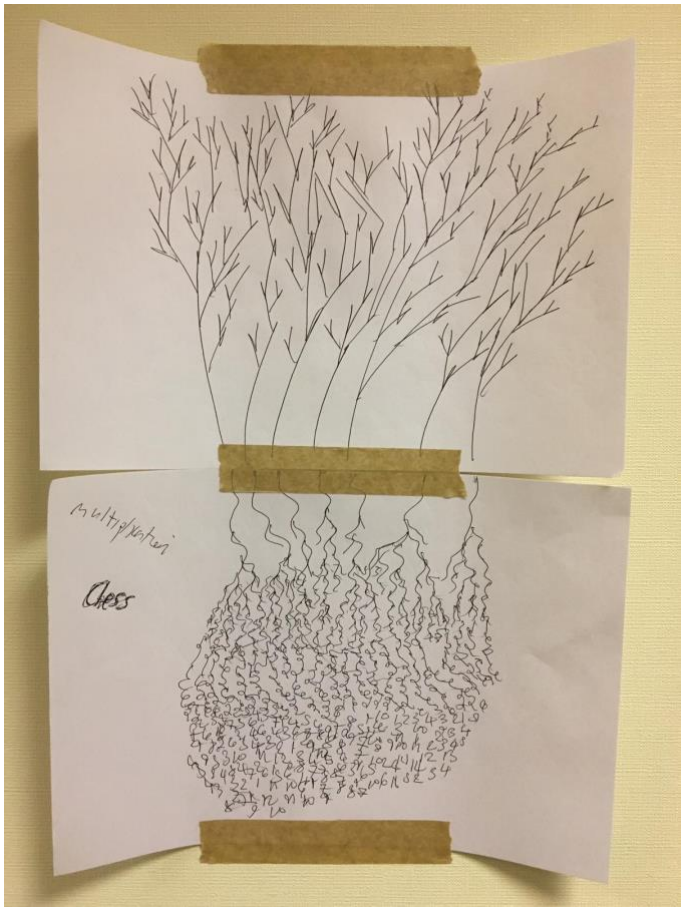
### AP 2.1.a Workshop for Scene 1: 31/10/2020 - 01/11/2020

#### Task 1 – physical visualisation

The first task of the workshop was to start by drawing what the representation root networks was to us. This helped to get both of our perceptions out of our heads and on to paper - there for all to see. It was interesting to see that we both approached the topic from very different perspectives in our drawings. Mine was a focused, but messy depiction of the many voices that are passing across synaptic bridges, whereas Oliver's focused more on the paths of each signal. This exercise clarified how we were both looking at the network and showed us that there a three clearly different viewpoints which we should be reflecting in the musical expression of it.

**The forest as a whole.** This can be seen in Oliver's drawings of the whole forest/network (Fig. 14). Here the network is viewed in a column as a whole, where once underground you cannot differentiate which root came from which tree, and would therefore be acting as one overall voice.

**The cacophony of voices.** This is visible in my visualisation (Fig 15) as it shows the many different signals which would be passing across microscopic barriers, from plant to plant to mycelium etc. These are all voices carrying separate messages (shown but they yellow highlighter), travelling along complex paths. Each axon has the ability to generate several different nodes and so connect to many other organisms in the network.




**The individual voice.** This is shown in Oliver's drawing Fig 16. Here we see a representation of a single voice – it emulates an electronic signal that is distorting and travelling along a wire.

*Figure 14 Oliver's depiction of "The whole forest"*

*Figure 15 Roxanne's depiction of the cacophony*

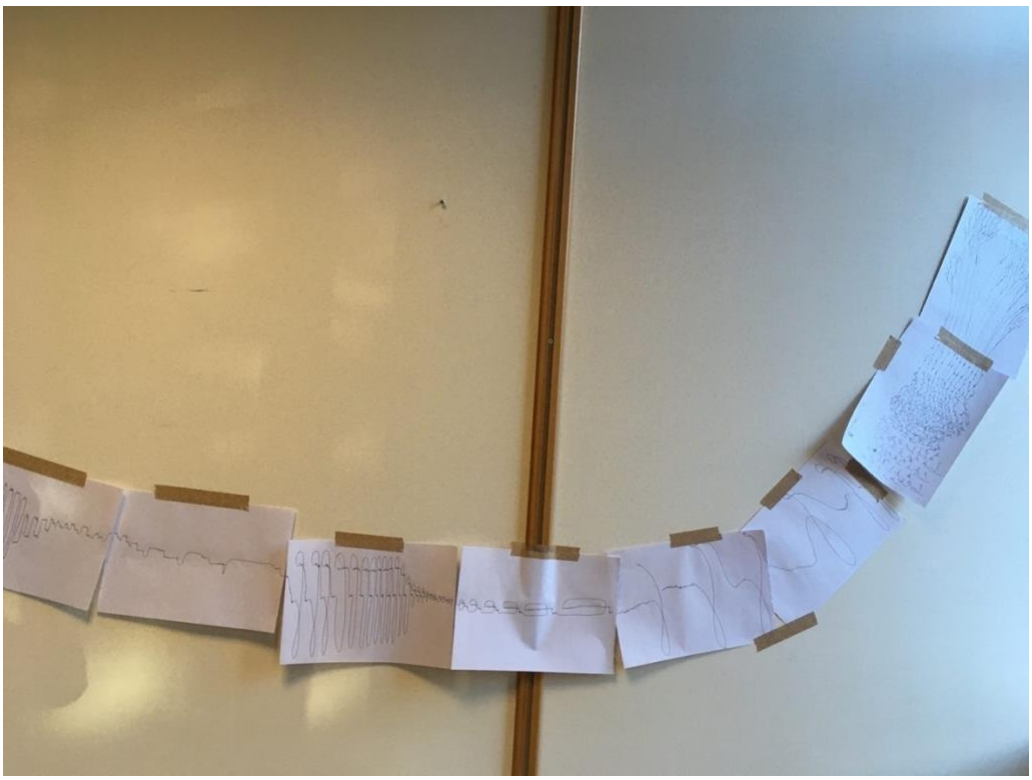


*Figure 16 Oliver's depiction of the individual*

## Task 2 - Performative

The second part of the first workshop involved making use of a mental exercise to try to put ourselves in the mindset of the trees. The first scene involved a traumatic experience within the forest. The main (mother) tree which supplies a lot of the forest with nutrients and support is hit by lightning.

At first, I asked Oliver to stand against a wall. I then asked him to imagine being a tree by imagining that he had roots which were extending into the other rooms next to and below ours. I then went to stand at the opposite side of the room and did the same thing. I then told him to imagine that his roots were meeting my roots in the room underneath us. I then told him that I would be hit by lightning and the electrical impulse would travel all the way through my roots to his. I instructed him that in a moment this would happen and then we would have to describe how this made both of us feel.

Oliver experiences Roxanne struck by lightning:

- I experienced this as a feeling of going from a solid form to a feeling of powerlessness and jelly. After the strike it was like I had gone from being fully conscious to being half asleep. The strike itself was extremely fast – much faster than anything I had experienced before and very bright then very dark.
- Oliver reacted to this strike as by feeling a sensation of going from red to blue. Almost like becoming white hot – a heat without actual heat, reflected as colour. The nodes on my (Roxanne's) roots had gone blue and inaccessible. Oliver also felt a sensation of being drained of energy and warmth, as if there was suddenly a leak that needed to be fixed. This did not happen straight away but was a slow sensation.

Roxanne experience Oliver struck by lightning:

- When Oliver was struck he described feeling euphoric. There was a moment of intense energy which was scary and lead to a sensation of laughter and terror all at once – almost like being tickled to death. After the euphoria and immense energy began the comedown. This was a sensation of throbbing, like a horrible hangover.
- I reacted to this by feeling instantly nauseous. I felt a kind of internal recoiling, trying to get away from the trauma but not being able to move. It felt like a sickness was entering my roots, I was also becoming damaged from the lightning strike.

This was as close as we could safely get to understanding the experience of a forest network being attacked by an electrical storm. From this we decided that along with the three viewpoints (whole forest, cacophony, and individual voice) there would also be three chronological sections to the scene. These are; **1. Before the impact 2. During the impact and 3. The hangover.**

Developing this understanding and sensory vocabulary for the events of the scene was very useful and would help us in the second day of the workshop.

### Task 3 – research into mythology

The last part of the workshop involved reading about mythologies from the Philippines that are connected with forests. There are many of these and many different creatures who reside in the forest. The mythology that I found most connected to our experience in the rest of the workshop was that of Santelmo. This is the existence of two balls of fire in places where there have been accidents, arguments or on land borders. Santelmo also comes from the term St. Elmo which describes an electrical weather phenomenon which turns the sky violet during a lightning storm.

After reading about this I quickly sketched out the image in fig. xx where we can see two interlinked balls of fire at the centre of the forest, underneath the largest tree. These signify the “throbbing” trauma experienced by the tree after being struck by lightning. It also occurred to me that as Santelmo were found at land boundaries and places of argument, it would make sense

for there to be Santelmo present where the rainforest had been cut down to make way for plantation. In this sketch I have encircled the rainforest in Santelmo as well.

*Figure 17 Roxanne's depiction of Santelmo in the rainforest*

Whilst I did this Oliver began drawing some depictions of the trees in the plantations. As we can see from these sketches he has depicted the plantation trees as a root ball hanging in a room of mirrors. As the image is reflected back on itself it becomes more and more distorted. This will reflect how the trees in the plantation see themselves. I will discuss this more after the next workshop on scene 2 (The Plantation).

After reading about Santelmo and seeing Oliver's depiction of the plantation trees I went on to make one more depiction of the forest.

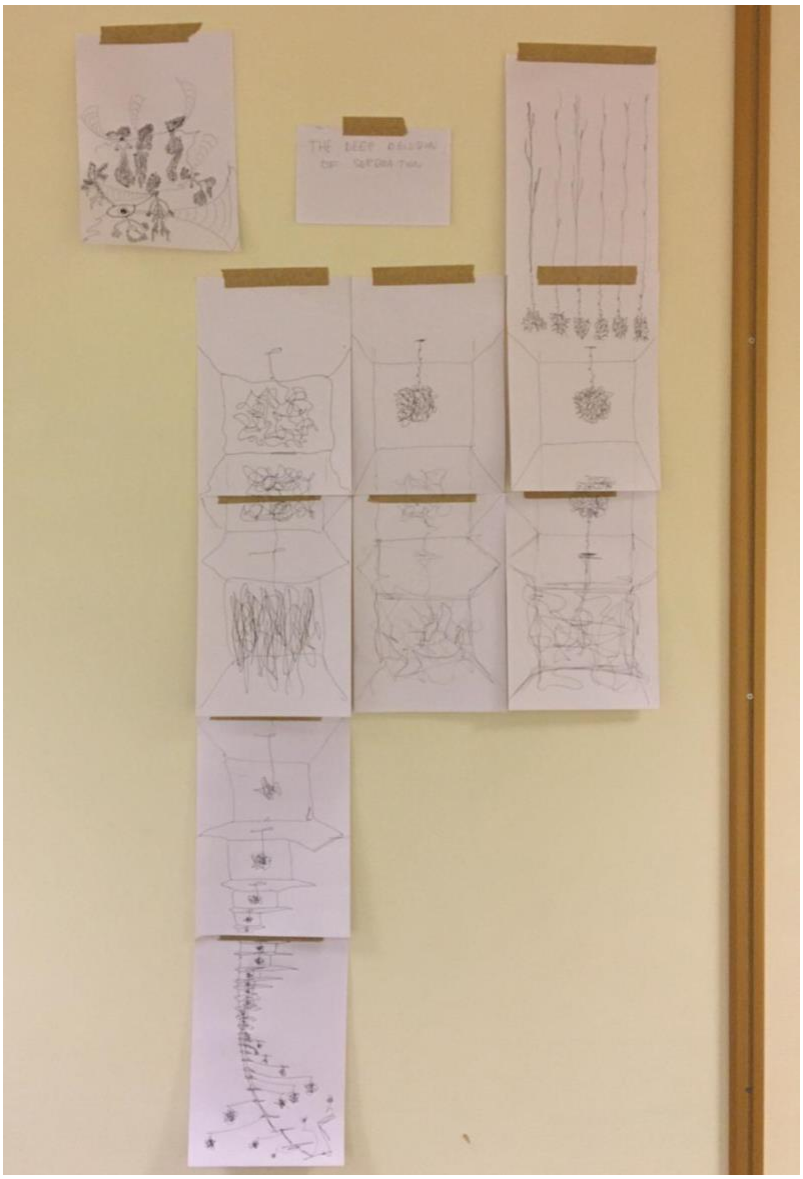


*Figure 18 Oliver's depiction of the Palm Trees in the plantation*

In this depiction of the rainforest (Fig 19) I experimented with different ways to show the way the network connected the trees together, but also that the central tree was connected to them all. Around the edge of the picture is the plantation. This area of land is inaccessible to the rainforest tree roots. They cannot communicate with the trees there and when they try to it is almost just like a white noise signal (the distorted reflection).

We also discussed the difference between the network in trees and similar networks in our human societies. It seemed that the most striking difference was that the network for the forest was one of giving and support, whereas the networks in our western societies, being based around consumerism and a capitalistic structure, often feel more like taking than giving. The altruistic act of giving is seen to us as charitable – something of the ordinary and something special to be done infrequently, not as a daily part of life. Of course some of the trees in a rainforest won't be able to give in the same way as others, however there is a balance in the amount of giving and taking that we could learn from in our societies.

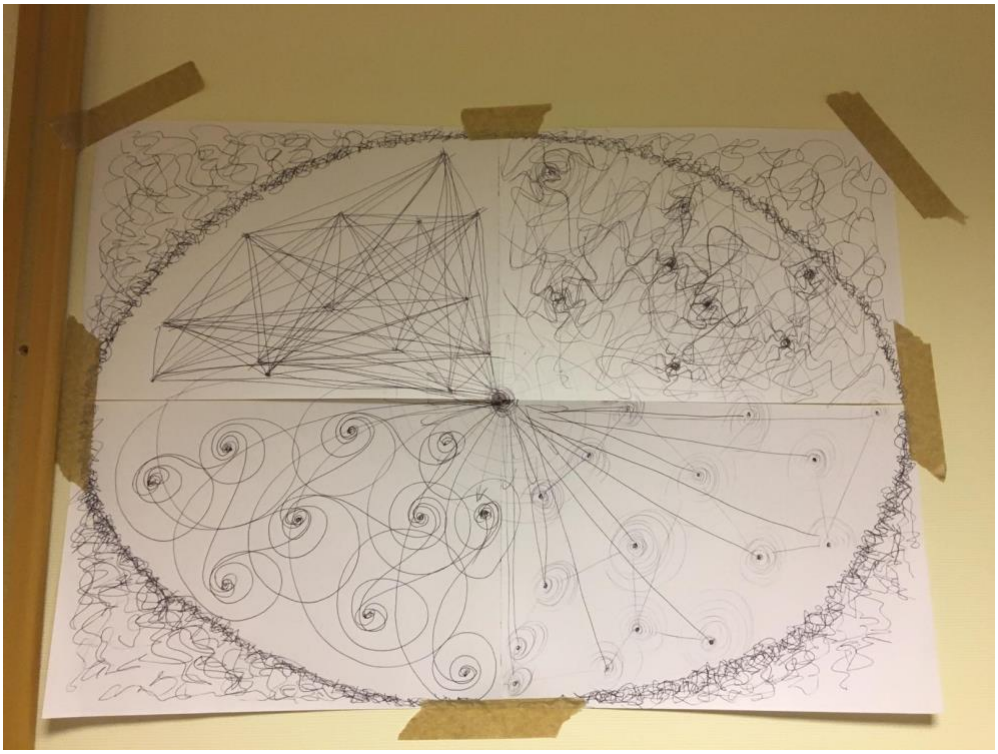


*Figure 19 Roxanne's depiction of the whole forest.*

## Day 2

On the second day of the workshop we put aside the tasks for generating an expressive language. We started by listening to our pre written material. With a score in hand we both circled sections which we felt were relevant and reflective of the work from the previous day. Many of the sections that I felt were representative of the network were those that showed a

kind of dissemination of information through a repeated motif, or a call and response. I felt that each tree would have a single message. This message would then be sent through all of the roots, meaning that one tree could say the same thing many times (through many different roots), in different distorted ways and directions. After doing this we discussed our choices and decided which sections of the music now seemed irrelevant in light of our recent work and discoveries.

Next we listened again and went through the score labelling sections A, B and C. These numbers corresponded to whether we thought that section represented **A. Before the impact B. The impact or C. The hangover**. After doing this we again discussed our choices, this allowed for us both to have conflicting opinions about the value or meaning of certain parts of the music. These were resolved and the sections were written out onto three sheets of paper. Each sheet of paper addressed one of the sections (A, B or C) and contained a table splitting the score into three further sections; whole forest, the cacophony and the individual voice. Having decided on which parts of the score related to specifically which part of the scene I cut up a score, and we stuck the different parts of the piece on the wall in three columns corresponding to sections A, B and C (Fig 20).

From there we made more refinement and started to develop a timeline for the scene. Whilst sticking and arranging the sections of score on the wall Oliver also rearranged the score in the Sibelius file on the computer. We decided that some sections would act as a background, representing the viewpoint of the whole forest. Then on top of and within that there are moments of single voice and moments of cacophony.

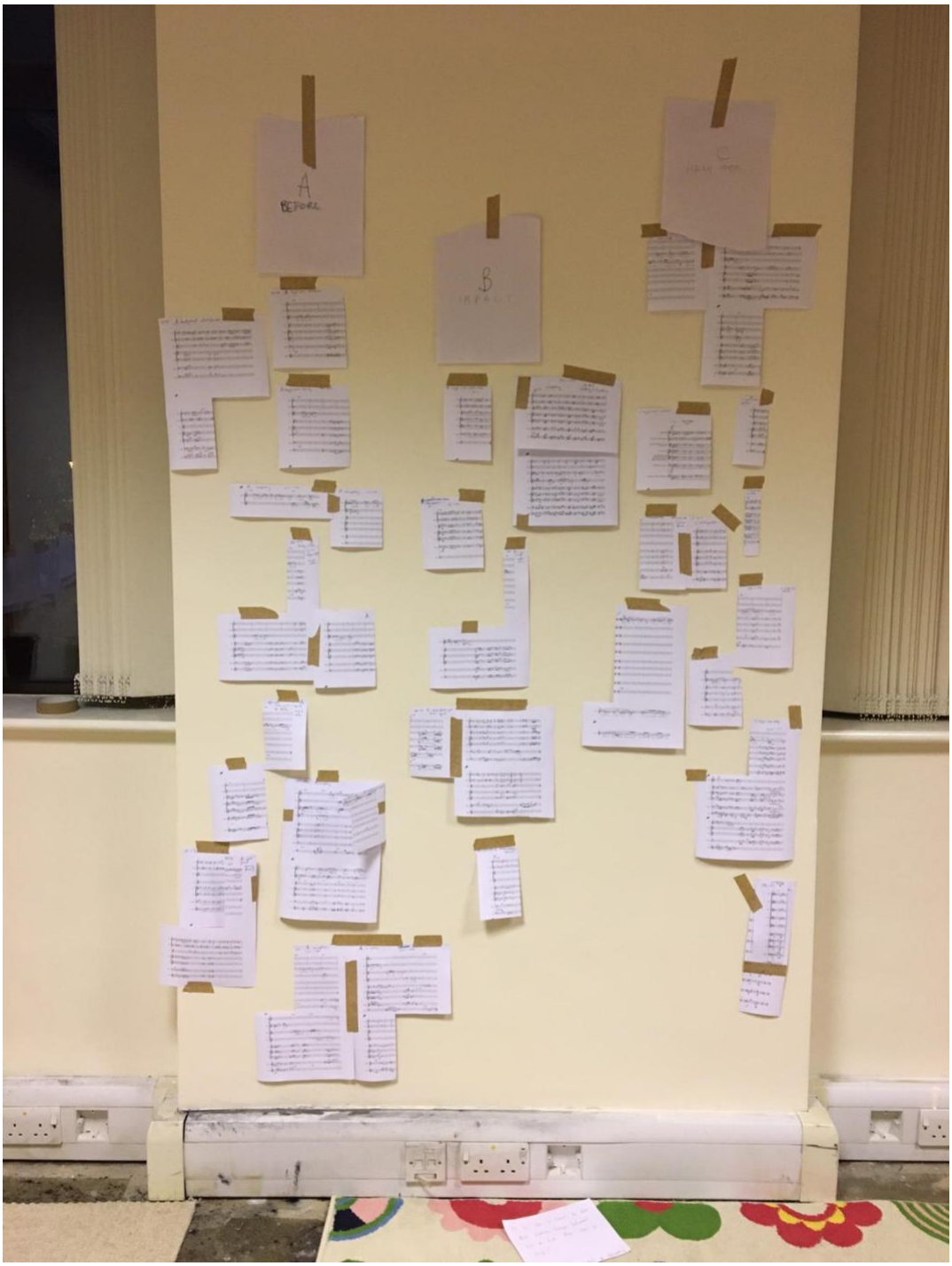



*Figure 20 The cut up and restructured score for scene 1*

During this process we also started to get to know some of the characters in the piece. The text I had originally written for this scene was very broad and could be used to indicate characterisations in a number of ways. Through analysing the score, and understanding more about the different sections and viewpoints of the scene some characters started to emerge.

The next task for myself and Oliver was to recompose the first scene in light of this new timeline. and develop the emerging characterisations as can be seen in fig 21.

*Figure 21 Final restructuring of the score for scene 1*

## AP 2.1.b Workshop for Scene 2: 22/11/2020

The approach to this scene was very different to the last one. The material we already had to work from was large but much less focused than what we had created for scene 1. This meant that at first it was important for us to discuss what we were trying to really achieve in this scene. This scene is also much harder to connect with as there is no real narrative to the scene, it is just a description of the plantation. We began by making a word list on what we thought described the plantation. This is below:

> Mirror, Isolation, Vanity, Slave, Repetition, Fragile, Brittle, Regular, Decontextualised, Domesticated, Prisoner, Immigrant, OCD, Traumatised, Stockholm Syndrome, Constructed Reality, Hypnotic Factory.

This word list, combined with Oliver's visual explorations from the previous workshop, the libretto, and the music already written gave us the ground work for a conversation over what this piece should include. Key decisions over the style of the piece were:

- There should be no polyphony. The plantation has many voices talking but they are all saying the same thing, disconnected from each other.
- The music should make use of homophony, canon and synthesis.
- There should be elements of distortion – the plants are constantly mirroring back on themselves leading to a distortion/echo chamber, and the also cannot hear the other plants around them clearly due to their roots being cut –> distortion.
- There will be a beat, it will be in 4/4. In this way it will emulate a nightclub/factory feel.
- There is no narrative but we will look to develop the sensation of running out of water – a kind of winding down before being fed/watered again.
- The piece will not have a beginning/end but be a cyclical process. It will loop back on itself.

We also discovered through online research that the edge of land, between rainforest and plantation, is an area of research. It is a particularly tough habitat and the prevalence of these edges (segmenting of rainforest) has a strong impact on potential biodiversity. This is already in keeping with the ideas generated about the edge of the rainforest from the first workshop. These were that the edge would be impenetrable to the rainforest. They would not hear or understand the sounds coming from there and it would be more like a white noise. We listened to some different pieces of music and sound design from Oliver's catalogue, our own piece and other artist's. We focused on the idea that the opening to this scene would include this white noise. Almost like being on the outside of a nightclub which would then suddenly turn into a very clear song, as soon as the audience's perspective enters the plantation.

After listening to what Oliver had already written for the plantation, we decided that the best parts to keep were the vocal lines, but that they did not need to be developed so far or have so much variation. To retain this sense of repetition we cut some of the final verse vocal lines and decided to replace them with a repetition of previous lines.

# AP 2.1.c First Narrative

The first narrative for this piece involved 7 scenes but the story was different during scenes 5, 6 and 7. Below is the narrative originally described for these scenes in the first treatment I sent to my supervisors and collaborators in January 2021.

**Scene 5: Palm Tree Exits the Cave**

> The palm tree root will be plugged into the network and see the whole way of life of the collective. It will see seeds grow to old trees, seeds be planted where they fall. Trees relying on other trees for help and guidance, a knowledge of the soil, how deep roots can grow, and death from natural cause (not being chopped down).
>
> Having seen all this the palm tree cannot just go back.

**Scene 6: Recruiting**

> The palm tree root returns to its plantation and seeks to recruit other plants to go with it to the main network. It encounters the same problems that the network did, however it manages to persuade at least one through the knowledge it has gained.

**Scene 7: Revolution**

> The two palm tree roots begin their own network as well as plugging into the rainforest's network. They make a deal with the rain forest to support it when it needs help (such as right now) by passing nutrients from the soil fertilised by humans. In return when a palm seed falls in the forest the rainforest network will nurture it until it is full adult. In this way palm trees will become a flourishing part of the rainforest network as well.
>
> Palm trees pledge to set up initiative to connect as many of the plantation roots as possible to the network to strengthen both groups. Revolution has begun.

As discussed in section 3.4.e this narrative was altered after discussing it with the key scientists.

## AP 2.1.d Second Workshop for Scene 2: 21/01/2021

During November/December 2020 Oliver and I had already workshopped Scene 2 and created an initial idea and structure for the composition and sound of the scene. However neither of us were fully satisfied with what we had achieved and so we decided to schedule this next workshop to rethink the compositional aspect of the scene, as well as to create some imagery which would both help us to define the form of the composition and as an idea for digital imagery which could accompany it.

I started by drawing some pictures of how I imagined the plantation to look both from without and from within. We did this whilst listening to our initial composition. I felt there were some elements which clearly represented images related to soil, and the passage of water and fertiliser through the soil, while other elements represented the voice of the plants in the plantation. It became more and more obvious as we continued to draw that there was a distinction between two spaces in the plantation. These were:

- The plantation as a whole – in this case what I really mean is the tilled soil and manmade structures e.g. sprinklers, around the trees.
- The experience of the individual trees themselves.

After making these drawings I also wrote down a list of descriptive words which helped to describe the different sensations that I wanted to be represented in the scene. These were: distortion, squeezing, singular, regular, background, trickle, naive, erotic, consumable, mindless, empty, tilled, clone.

We then split these words up into different sections which could be used to section different parts of the music. These were:

| Regularity | Human | Production | Solitary | Brainless |
|---|---|---|---|---|
| Singular, clones, regular, DNA | Tilled, trickle | Erotic, squeezing, consumable | Distortion, naive, echo, singular | Mindless/full, empty, consumable |

Having discussed these different sections we then decided that we would have a structure in which we would be coming in and out of the “human” sound world (a bit like leaving the matrix) and the tree roots sound worlds (regular, producer, solo, brainless).

Having done this, I began working on developing some animations and graphics based on the imagery we created in our drawings. Whilst I did this Oliver did some more composing and formatting of the score. Once Oliver had created some more rhythms and progressions, we did some improvising together on the synthesiser and electric guitar, to find a sound world for the sections which represented the world outside of, and in between, the trees in the plantation. After we found a good idea of the sound for this Oliver used it to compose further.

Across the following 4 days we worked together on putting together a new version of the music and graphics based on the ideas created from this workshop. We were aiming to get a final video completed for the Inside//Out Festival on 27th January. We achieved this and you can see this video in Appendix 2, file name: 01_Scene 2 Animation.

## AP 2.1.e Workshopping movement for scene 1 – March 2021

Due to COVID this piece is being worked on digitally as a first round, in preparation for the eventual live performance. The materials created to digitally represent the piece will be potential source material for scenery and movement in the live performance. This is an initial round of the process in creating the piece.

On 1st March I went to the LAB and recorded myself doing some movement to help find a way of representing the signals in the roots through physical movement. I wanted to find a way to physically express the roots and signals so that I can move the piece closer to a sense of theatricality through the use of the human body. The plan was to then take these films and adapt them with After Effects to generate footage that could be an abstract representation of the roots. In order to achieve an environment where the footage would be clear enough for me to manipulate I ordered a white morph suit so that my body could be seen as a series of clean lines. This would make it easier to work with in After Effects. This process would also require an exploration of After Effects and some time in learning how to use it. When in the lab I recorded 3 key types of movement as an initial test. These were: 1. fluid movement across the floor, 2. wobbly upright movement, 3. forceful pushing across the space.

In performing movement 1 I was concerned with making my body move as an amoeba, or a morphing electrical ball. To achieve this I thought about the changing shape of the probabilistic path of an electron. For movement 2 I was focusing on the reflection of the effect of lightning on the roots that myself and Oliver discussed in the first workshop on scene 1. This was a jellifying feeling. For movement 3 I was imagining pushing large amounts of resources, similar to an ant rolling some food back to the nest. I also imagined pushing through a dense fluid, reflecting the movement of electricity and resources through packed passages.

The first test below using movement 1, involved using the find edges/posterize/echo effects on After Effects. The outcome of this video generates the sensation of a multilimbed creature struggling through a space. See Appendix 2, file name: 02_Morphsuit film test 1

The next video used movement 3. To enhance the feeling of pushing through a dense space I added a light trail effect. This also replicates the idea of a trail being left behind by the signal, or a wave passing through the space. To achieve this I used the rotobrush/particle playground and other colour enhancing effects: ee Appendix 2, file name: 02_Morphsuit film test 2

The final video made us of movement 2. In order to achieve this I used the rotobrush/turbulent noise and find edges/posterize. The noise is layered so the performer can move through the space. I choose this noise as it looks like molecules of water and sugars that would be present in the network: ee Appendix 2, file name: 02_Morphsuit film test 3

## AP 2.1.f Interviews with Dr Leah Band, Dr Markus Eichhorn and Prof. Adrian Newton

Below are the transcribed notes and reflections from the interviews with these three key scientists. These interviews happened March-April 2021.

### AP 2.1.f.i Dr Leah Band (Reflections and notes) (Dr L. Band, 2021, personal communication, 30 March)

Before meeting with Leah on Teams she had made me aware that her particular line of work was probably not exactly what I was looking to discuss in relation to the piece. However, I reassured here that there are definitely elements within the piece, for example its focus on roots, that would be in line with her work.

I started out by describing the project and then asking her if she knew anything about how mycorrhizal fungi attach themselves onto root tips of plants in forests. This was not something she knew about as her research was not related to these aspects of root development. Her work is particularly focused on hormone generation within plants and how this impacts root growth.

I also asked her about the impact of fertiliser on root growth, and whether a constant influx of nitrogen from distribution of fertiliser has a strong effect on root growth. Leah was able to tell me that even though fertilisers are placed on top of the soil, the nitrogen still always sinks too deep in the soil, so it is unlikely that there would be that much of a difference in how and where the roots grow in the soil.

Next, I asked Leah a bit more on her work. She described a bit about the generation and synthesis of hormones in the plants. I asked her what external factors could affect the generation of these important hormones. She said the most common affecting factors were light, salt, cycadean rhythms, water status and temperature. Interestingly plants can be equally affected by light pollution.

Leah then went on to describe to me some of the importance of the root tip, and how some processes in the root tip will cause it to always grow in the right direction. This is called the gravitropic response. She described how the cells in the root tip have a handful of small starch particles called statoliths. These statoliths are responsive to gravity and so will fall to a different side the cell when the root tip is horizontal rather than vertical. The position of these statoliths generates a signalling cascade which in turn affects the amount of the hormone auxin that can pass through the root membrane. The more auxin is present the slower the growth in that area. This will allow a faster growth on one side of the root, and a slower growth on the other, causing it to bend. This process shows a very nice mechanical explanation for how root tips are able to respond to gravity and position in the soil.

I then went on to ask Leah about how the soil is affected by the plant or vice versa. She told me a bit about the rhizosphere which is the region of soil around a root. Roots are able to release different chemicals into this soil to adjust its properties. Better understandings of these plant-soil interactions will be extremely valuable for agriculture. It is possible that we are not making best use of the interactions between microbes in the soil and the plant, or that some of what we do to the soil is permanently damaging or destroying important organisms that the plant would normally interact with.

We discussed how there are specific hormones for specific functions, just as in the human body. The hormone related to stress response in plants is called jasmonic acid. These could include abiotic stress factors, such as light, drought, $CO_2$, or temperature.

Finally, we discussed the difficulty in studying roots and how scientists are finding ways around this through the use of scans and X-Ray imaging. In this link you can find graphics created of these X-Ray images to show roots in the soil. These images also show the structure of the soil. The plant used in most of these experiments is called Arabadopsis as it is quite simple and therefore easy to work with. These plants are grown in cylinders 50cm in diameter and 1m high. They are all grown in a large green house which is part of the Hounsfield Facility in Nottingham.

I had already seen the images created here which had inspired some of the previous work done on digital artifacts from the workshop for movement in scene 1.

### AP 2.1.f.ii Dr Markus Eichhorn (reflections and part transcriptions) (Eichhorn, 2021)

Prior to the discussion with Markus he had asked me to send him some questions to consider before we had our discussion. These were:

1. What impact does plantation spacing of trees have on the relationships between them in comparison to the natural forest systems?
2. What sort of impact does the loss of land, due to plantation, have on the remaining regions of forest?
3. How do you feel about plants being described as intelligent?
4. In a more general sense what do you want our relationships with forests to look like going forward?

I started the discussion by explaining a bit more about the piece to Markus. This included the story and the influences from the scientific community, and the types of societies found in rainforests.

Beyond that I also went on to explain about the project and work I had done on looking at google earth photographs which showed that a lot of supposedly forested areas were in fact

palm plantation. Markus agreed and went on to confirm that the Malaysian government are claiming a lot of land to be forest which is actually, oil palm, fruit tree or rubber tree plantation.

I went on to mention the work of Suzanne Simard and the Wood Wide Web. As soon as I mentioned this phrase Markus responded by saying that the idea of the Wood Wide Web was particularly annoying to scientists as it has created quite a strong misrepresentation. So I asked him what it is that he is most worried about by the use of this term.

Markus said that there are really 2 problems and misconceptions here.

1. People really like being able to project a moral high ground onto nature, to feel like nature is better than we are. However when we project that onto forests we are really badly misunderstanding what goes on inside them. Firstly – trees are not friends – they are constantly in competition. They try to grow on top of each other to get to the light or colonize the soil to reach the nutrient rich areas. They are constantly squeezing each other and trying to win in a battle to reach the canopy. He then likened the ways forests grow to the luggage collection section of an airport. If everyone stayed behind the line when collecting luggage then you would be able to see yours clearly and step forward when you needed to. But everyone steps in front of the line anyway. The trees like this are always jostling with each other. Why would they have trunks otherwise? The trunks are only there to beat the other trees. Why do they need to be tall? Ultimately they are under a vicious competition.

2. I asked about how some trees are helping to promote their own species. Markus described that it's not the trees talking to each other or sharing things underground, it's the fungi. And the fungi are doing it for their own reasons and own interest. They are doing it because they want to do it. It could be that certain species of fungi are more associated with certain species of tree so they are more likely to pass carbon into those species. There also isn't really much reason for one species to favour its own members.

Markus went on to say that there is still a common interest in the forest. If you get gaps in the forest then everything is exposed making it at risk. However trees don't see very far so they might not realise that. The trees don't feel a community interest. They are not doing things for each other even if there is an aggregate support generated by what they are individually doing.

Markus apologised for shattering any preconceptions. He said trees are much more like ourselves than we want them to be. They do not have access to an ethical sense that we don't. They are also life forms like us.

I then asked if the plantations have the same fungal networks. Markus said they do but there is far less diversity as there are far fewer species. The same interactions are at play. They are still jostling to get into the canopy. It doesn't matter how many trees you plant, you still end up with the same numbers of trees. The ideal spacing of trees is focused on getting the ground covered quickly to avoid erosion, however it is assumed 2/3 of them will die. When you see tree planning schemes for lots of trees it is likely only 10% of them will ever get to adult height. The number of trees is irrelevant – it is the area that tells you how many trees you will really get. In forestry you deliberately thin stands – start with too many trees and then thin them out. In temperate forestry this helps them to go tall and straight. For example if I went to a park in Birmingham an oak tree would be spreading outwards and covering a large area, however in a forest e.g. in North America it would grow straighter. This would lead to better wood for future uses.

I asked after if the roots would grow differently due to that as well. Markus replied that the challenge with growing the same species is that the roots grow in the same way. In a diverse forest you get a much more even coverage with the roots but if all the same species then the plants are competing with each other a lot more and butting into each other. I asked if there was any possibility that the roots might interact and cut each other off. Markus replied that what happens underground with the roots is still very mysterious and hasn't really been discovered yet. I went on to ask if the way the roots are treated in nurseries can have an impact on

plantations. Markus said that most trees don't have tap roots, and in fact they have quite a low density of root in general (especially compared to the size of the tree above the ground).

Markus reassured me that nothing he has said is a surprise to foresters or other people in forestry but it is always a surprise when he is communicating to the wider public about what he is doing. People always wish to find something more noble in trees. Trees look out for themselves and their own offspring. I asked if it's possible for the trees to act as a group rather than individuals when it is being put under stress such as deforestation. He replied that they have no means to act as a group. A forest doesn't know that it is being cut down. A tree 100m away from the edge doesn't know what is happening. The trees on the edge will detect changes in environment. They will have to adjust to a different climate. When you do create an edge, particularly in a rain forest, it seals up. This is not deliberate but the open light environment generates a wall of green which fills the edge. In a couple of years that helps to restore the climate within the forest close to the edge by providing a protective wall of green material. It's not that the community has decided this, it's just that there is an opportunity. The side effect is that it does protect the forest's interior as well.

I then asked if the trees on the edge might spread out into the plantation. Markus replied that yes they should spread out as this type of disturbance creates a lot of nutrients and opportunity for the trees there.

All the discussion above led me to explain how this has strong impacts on the story I am writing. I don't wish to participate in a false representation of the science, or a perpetuation of misconception, so there is certainly more to consider about how the story is formed.

Markus went on to decide emergent properties. These are a combination of decisions that have been made by selfish individuals which can still lead to a net benefit for the community. This does not have to mean they are doing it for the community, but that the community still benefits. There is a system of regeneration – a set of processes that allow the community to restore itself.

An aggregate effect of lots of little decisions that brings the ecosystem back to its former state. He likened this to the economy recovering after the 2008 crash. This was not because everyone said we must build the economy back up again, but just that people needed to start trading. We use many of the same models to understand economics and ecological systems. They even come from the same Greek word oikos meaning household. Oikos logos – study of households, oikos nomos – numbers of households. The way that ecosystems and economies sustain themselves are very similar. There are lots of individual actors leading to a stable whole.

So, I suggested there is no long-term picture to what they do. They just act.

Markus then said that I should not feel too disillusioned as what he has said to me so far is a very global north, technocratic scientist's view of the forest. If I were to sit down with an indigenous person who lives in a rainforest, ask them about their understanding of how it works, they would give me an entirely different image of how it works. He suggested that from my perspective it might be worth decolonizing the view a little bit and maybe thinking about how indigenous people view the forest and interactions between the trees.

For example, Markus works with an indigenous group called the Chet Wong who live in a rainforest called Pahang in peninsula Malaysia. They believe that each of the tree species is occupied by a spirit. They know them by name, they are their ancestors, and they are connected to them. They are surrounded by a community of spirits which are represented by the trees. The Chet Wong don't talk in the daytime because the spirits are asleep in the daytime. At sunset they sing songs to the spirits, and you can chat. As they go through their day they note what is happening to each tree – is it flowering, is it sick? At the end of the day the shaman goes through a ritual chant where he prays to the trees and mentions each of the species by name and says what they did today. There is a two-way interaction between the shaman seeing the forest and communicating with the spirits, that is a lifelong conversation between the people and the trees. They are at one with the trees and integrated with the greater whole that is the rainforest.

Overall, I should remember that natural selection is not the only valid perspective on viewing forests. Markus suggested that I look at Signey Howell's books to find out more about the cosmology of the forest from the Chet Wong. Markus reassured me that I should not be disillusioned that science might be my only way into the project, and that there are plenty of belief systems which could marry with what I am hoping to do.

I moved on to say that I am really trying to mark the distinction between plantation and forest. Markus replied that that isn't really the case and that there are many diverse plantations. People have been managing forests for various purposes for 10's of thousands of years. something that has really transformed our understanding of rainforests over the last 20 years is the realisation that pretty much all the rainforests have been inhabited by people. For example, in South America the reason there are so many brazil nut trees hanging around is probably because people put them there. People moved the Brazil nut and the Palm species around the amazon basin. All of the rainforests that we as global north outsiders go into and think wow – this is a pristine state of nature – have been moderated for a long time. There are very few rainforests that haven't been affected by humans. When you go to the scale of an oil palm plantation then that is an extremely managed single species system. It still has diversity in it but there is a spectrum, and the intensity of management gives you different outcomes depending on whether you want a single product system, or whether like the Chet Wong you like some tree species more than you like other tree species.

I asked why they like some more than others. Markus said that for the Cheq Wong it is mostly because they like to plant fruit trees. A lot of southeast Asia is described as a fruit desert so people deliberately plant fruit trees whenever possible. As for other species there are some, they like better than others but he didn't know how old this preference is, if it is personal or generational. I commented that the Cheq Wong are treating the trees as individuals, giving them separate spirits etc. Markus replied that they do however understand that they function as a whole. I mentioned that indigenous societies often discuss forests as a whole/as a one. A bit like

our societies now where we are trying to function but are always still acting as individuals. Perhaps it's because we can see the forest from the outside that we can see the whole. Just as we cannot see the whole of humanity. Markus replied that trees can only see their neighbours, so they do not see the whole.

I went on to describe the opening trauma of an old and established tree dying from a lightning strike. I wanted to know: if a tree gets hit by lightning can that affect the roots and mycorrhizal, and do we know how it might damage trees or systems around it. Markus agreed that lightning strikes are a large cause of death for tropical trees. He said that once the tree dies it will reorganise everything underground. There will be no more input from stuff above so a lot of the connections to the tree will wither. The network will be readjusted. Then bits of it will fall which is a serious risk to the neighbourhood. When it falls many more trees will fall with it. But then it releases dead wood. This will change the composition of the fungi into decomposers which break up the wood tissue, and then other tree roots will grow into that. Old logs on the rainforest floor that you break up with your fingers are full of hyphae and other tree roots. Other trees are taking resources out of it as it breaks down. It spreads its resources and a patch of light that can be colonised.

I asked if it is a worry that climate change will contribute to more large tree death through lightning. Markus said that that has been suggested and there was some speculative evidence to show that a few years ago. People are working on that in Panama at the moment and it has been suggested that an increased frequency of lightning strikes might be a problem but it is too early to tell right now.

I asked Markus how he feels about plants being described as intelligence. He replied that he doesn't think intelligence means the same thing in plants. I agreed. He said it annoyed him when people say trees are talking to each other. He said they don't communicate in a way that animals do so it's a bit of a meaningless use of the word. I asked him then about whether they are communicating in that case. He replied saying that if you ask a zoologist what

communication is, they will say there are three elements: 1. a signal – an individual that wants to send a message. 2. The signal gets sent and detected by another individual. 3. The second individual acts upon it. In plants you get stages 2 and 3. For example when a plant gets damaged by an herbivore it releases volatile chemicals which are detected by other plants which up regulate their defences. The natural history books will say that plants are warning each other. But what we know is stages 2 and 3. We have no evidence for stage 1. It's a bit like doing a fart and someone moving away from it. But that is not really communication. I commented that this seems to really be a question of consciousness. Markus agreed that we just don't really know this yet. I asked if this would be an area of research that people will want to explore but Markus said that this does not really get much traction in the scientific community.

Finally, I asked the last question on my list. Markus said: "As a society we need a more holistic awareness of what trees and forests do for us and it's not just about the splendour of rainforests or the fact that they create oxygen and rainfall, but also, we need timber, we need fruits, we need wood products and papers. And we need to not just learn to live with forests better but also do understand that all types of forests have a value, and all have a place."

### AP 2.1.f.iii Prof. Adrian Newton (notes and reflections) (Prof. Adrian Newton, 2021, personal communication, 12 April)

We started by discussing some other events and projects that Adrian has seen and participated in. He particularly wanted to tell us about the "Evolving the Forest" book which is a collection of essays and art from an event held in Dartington in 2019. From this he was particularly concerned that many of the artists seemed to not really be fully considering the environmental impact of their work. E.g. using non recycled materials which would be disposed of after the event, or painting on the surfaces of trees and destroying the microbiome which exist there. He mentioned the example of artist Aviva Rahmani who painted some trees blue. Adrian pointed out that he was focused on the environmental side in the artistic approach to the science. He

wanted to see that the art was motivated by an ethical value and ecological stand point. Something which promotes the “Deep ecology” perspective.

Adrian saw 2 key issues with the plot and outline of the story presented so far.

Firstly he wanted to know how the title “Delusion of Separation”, really refers to the oil palm. He was concerned that it would imply too much connection and kinship between the rainforest and the plantation. In particular he wanted to make us aware that the plantation has led to the loss of an entire system, causing ecosystem collapse. This is a key point to be made in the opera and something that I now need to rethink in the whole story telling of the piece. For example replacing forest with plantation will take that area of land from a system of 1000’s of species to a system of just 1 or 2 in the plantation. In relation to this he also wanted to see more use of the word “system”. He also wanted to see a greater relationship to the terms “complexity” and “diversity” coming across in the text.

Secondly Adrian wanted to point out that the networks are really fungal networks which are connecting the trees. Some people could view this fungal network as something which is even enslaving the forest. He also wanted to point out that it is only the Dipterocarp trees which can really form mutualistic connections to the ectomycorrhizal networks specifically in Borneo. The Palm trees would not be able to connect to the network as they are too alien (from Africa). They have not been developed or adapted to the land. This made me thing that there is something to do with time scale here which is having a strong effect. We are bringing these foreign species across the world far faster than they would ever travel themselves. From this he then emphasised that mutualism is a key concept to focus on here. That there are many ecologists who view forests as purely competitive spaces but that it is possible to also see this as mutualism. We then continued to talk about how the forest and plantation might integrate. Adrian said new seedlings would only be allowed to recover if the plantation were abandoned and that planting oil palm is really destroying one system in favour of another. He said that “the only way to get the forest back would be to destroy the plantation”.

We then went on to discuss the Forest Garden system also known as Taungya. This is a system through which plantations are made within the rainforest and managed alongside the existing ecosystem. Adrian suggested I look up “Taungya agroforestry in Indonesia” for further resources. This way of farming provides complexity, resilience and diversity.

We went on to discuss some other artistic and musical applications of these networking networks across landscapes. For example Adrian mentioned and exhibition he had attended where the artist was doing live improvised crochet alongside the live modular synthesiser. We also discussed the growing field of acoustic ecology or bioacoustics. In particular Adrian pointed out how you can tell the diversity of a forest from its frequency bandwidth. The more diverse the fuller. This made me think of the forest as a series of radio stations. It is also an interesting way to think more on the orchestration of the forest, and how to implement another line into the music (perhaps something which completes the bandwidth). He went on to mention Bernard Krause and The Great Animal Orchestra Symphony. He also mentioned Omri Cohen and his work on modular synthesisers and mushrooms. He then went on to talk about his own work where he had placed contact mics onto trees and recorded the inner sound of the trees. This is an album called Heartwood. I have since found some other artists who are also making work through the use of contact mics and synthesisers. For example the Dutch group Talking Trees, who can be seen performing at the most recent Be-Coming Tree online event.

## AP 2.1.g Developing a visual representation of scene 1

Having explored and recomposed the music and dramaturgy for scene 1 I then created an animated film to express the work at this stage. This work was done during April 2021. You can view the film in Appendix 2, file name: 05_Scene 1 video.

# AP 2.2 Cycle 2

Following on from this we began the second cycle which involved working with the designer Wanshu Li during spring 2021 and choreographer Jingya Peng in summer 2021. Our aim was to explore the piece through a series of workshops making use of Wanshu's UV reflective materials and Jingya's and our (mine and Oliver's) response to them as performers.

## AP 2.2.a Rehearsal/Workshop videos

Before inviting other musicians and performers to work with us we recorded some of the outcomes of the workshops. A video collecting some recordings from our various workshops can be found in appendix 2 under files: 06_May workshops with wanshu, 07_Scene 1 Jingya and 08_Scene 2 Jingya.

## AP 2.2.b August 2021 Open rehearsal

At the point of entering the workshop towards the open rehearsal, in August 2021, we still had 3 scenes left to write and wanted to bring the choreographer and designer in at this early stage, alongside the experience of performing our current work to a live audience, so we could incorporate their ideas and responses into the creation of the final 3 scenes of the work. We fully immersed ourselves in Wanshu's material, exploring various scenic set-ups, and spent a week with her and Jingya, playing with the music and materials, to find a way of performing with Wanshu's work.

After we had done several explorations ourselves, we spent a further two days rehearsing the music with a full ensemble two more singers, and an extra dancer, to perform for an audience at an open rehearsal of scenes 1-4 with half of scene 5. Please see the results of the feedback forms and the participant feedback from this performance in folder Appendix 2, file names:

09_Lipote-Open-rehearsal-feedback-forms and 10_Transcription from participant feedback (Blatt et al., 2021)

Much of the feedback was as we expected from such a rough performance of an in-progress work, after such a short period of rehearsal with the whole team. It was very valuable to have the comments of the audience and to start to understand our successes and failures. There was a lot of positive feedback, but in particular we were able to see that a lot of the movement needed to be more clearly defined, and we needed to reconsider how we placed the ensemble and the singers. We also needed to begin considering how we would make use of microphones and amplifications for the singer's voices. In the open rehearsal we had two dancers performing with the materials and presenting the characters, whilst the singers sat with the ensemble and sang the story. Several people mentioned that it might be nice to have the singers on stage as part of the work as well. Ultimately this led us to decide to not involve dancers but to ask the singers to be much more active and learn elements of choreography and to explore more physical movement. We also condensed the text and music in scene 1 so that we could employ only 4 singers for performing this work (due to budgetary constraints). Many of the design elements and materials used in this open rehearsal were dropped before moving on to the next stage of development. We also changed some of the music due to difficulty in learning and singing it at this rehearsal stage.

## AP 2.3 Cycle 3

After the open rehearsal in August 2021 we then completed the script and score for the whole piece. Jingya had had a strong influence on the direction of the script, suggesting that we might involve a forest fire in the forest garden scene. I later changed this to a man-made deforestation, with the forest garden being dug up by machinery. Having applied for funding from Help Musicians UK we were successful and therefore able to plan a research and development period with Wanshu and Jingya where we hoped to finalise the various visual

aspects of the work still left to explore. We worked together for a total of 2 weeks in person, with 4 days of rehearsal. We had two extra singers (Dalma Sinka and Clint Lesch), myself and Oliver (the composer) as performers. In this time we put together a full production which was showcased to a small audience in December 2022. We also invited Leon Trimble to participate at this stage, providing sound design and music for the scene changes. He did this with the use of his modular synthesiser which he hooked up to a plant to trigger different voltages and aid in the live creation of the music. This element remained as a key part of the work and came with us in the final cycle to Nozstock and Edinburgh. From the showcase, audience feedback and participant feedback we gained a lot of understanding of the parts of the work that needed attention dramaturgically, musically and on design.

Please see the film of the showcase in Appendix 2, file name: 12_Lipote December 2022 Showcase, with the limited audience feedback in file name: 11_Show case - December 2022 Lipote An Interconnected Journey - Audience feedback(1-5).

We then held a meeting with all the cast and collaborators to gain feedback from everyone. The feedback gathered here was put into use as we moved forwards into the fourth cycle. Mostly we focused on making some edits to tighten up the dramaturgical structure, redesigning scene 1, and making use of projections during the performance. The transcription from this feedback can be found In Appendix 2, under file name: 13_Lipote Feedback 2022 (Evans et al., 2022) .

## AP 2.4 Cycle 4

Much of our focus after the showcase was to ensure the dramaturgy of the work flowed well from scene to scene. This involved a careful edit of the score, allowing the action to move without breaks, and some minor restructuring. We also redesigned the scenic and performative elements of some of the scenes to engage better with the characterisations and drama. With each performance comes new opportunities of understanding the work and so we continued to

edit the piece after performing at Nozstock, and before performing at the Edinburgh Fringe. Having the flexibility with the composer and performers to do so, and to prioritise the dramaturgy of the work, paid off in the final showing, where the audience in particular praised the dramaturgy and flow of the piece, saying that they really felt connected to the story and characters on stage, and that this was a story about themselves, as much as it was about the rainforest. For more information on the final outcomes of the cycle and access to the full work please see Chapter 3 of the main thesis.

# Appendix 3 – Other Related Works

Throughout the whole time frame of the PhD I was conscious to allow the reflections and learnings from all of my artistic activities relating to opera creation and performance, to influence the subsequent work I produced. The impact of the COVID restrictions right at the beginning of my data collection stage also meant that I had to seek to broaden the kind of work I was producing, so as to be able to work within the lockdown restrictions. This meant that I became involved in some projects which will not be used as key case studies in this PhD, but which nevertheless contributed greatly to the ongoing development of my method and understanding of the efficacy of my creative process and aims.

## AP 3.1 Entanglement: An Entropic Tale

This work was created prior to the PhD, during my Masters in Vocal performance from September 2017 - April 2018. This opera encompasses a large amount of the physics from the 20th and 21st centuries, from quantum entanglement, to black holes, to gravitational waves. Creating this work began my journey towards this research. This preface from our 1st edition of the score and libretto states my intentions in creating the work and shows the beginning of my explorations into the ideas presented in this PhD:

> Having spent so much time planning and waiting for an opportunity to leave the world of science and begin a life of music I soon began to realise that it was not going to be quite so easy to leave the beautiful realm of physics and philosophy behind me. Luckily for me I met Daniel Blanco Albert on a warm summer evening at a bonfire by a lake. Having ascertained that we both liked theatre and we both liked science I promptly asked if he would be interested to write a non-naturalistic opera about physics. Dani's enthusiasm and excitement for the project enabled me to tie all the loose ends together in my mind to begin to create "Entanglement! An Entropic Tale".

> Putting the story together was easy. It became clear to me that these concepts were not just confined to the realms of Maths and Science, and that they were related to things that philosophers and theologians had been discussing for centuries (if not more). The inspiring thought that this story might even help to connect science deeper to philosophy in a way not normally discussed spurred on the decision to develop this libretto. Are matter and antimatter an expression of yin and yang? Can our struggle for the understanding of free will be calmed by a knowledge of quantum mechanics? Does the way in which we conduct scientific enquiry mean we will be forever trapped in the logical pathways of our own mind? I was never able to answer such questions yet through the writing, producing and performing of this opera I have come to a much deeper acceptance of my ignorance, and have been reminded how much fun can be had, not in understanding, but just through asking the questions. (Infinite Opera, 2018: v):

It is a 90' opera written for 3 soprano, 1 mezzo, 1 bass and an ensemble of piano, violin. viola, cello, clarinet, flute and trumpet. This opera illustrates the anthropomorphic qualities of the physics in the characters during the opera. The original idea was to create a structure similar to a baroque opera, and the libretto was set out in this way. I also made use of mythological narrative. In this work the particles were equivalent to humans and the laws and forces equivalent to gods. Below I have inserted some sections from the libretto to illustrate how the characters act as physics, humans and gods.

Example 1: Electron's Aria: Act 1 scene 1 (Infinite Opera, 2018: xi)

**Aria**

Electron: Ah!
I was a part of all these things
A cat, a flower, a star and more
But still I have not found a way
To feel grounded at my core

Entropy please help me see
Through all this negativity

Ah!
This empty endless shade I surf
Or perhaps I **am** this sea's white horse?
I always wondered if it's real
That everything is me of course

I'd live without duality
To generate a certainty

In the aria above we can see Electron struggling with its identity (due to its quantum existence). There are references throughout the poem to the properties of an electron (e.g. negativity, grounding, wave-particle duality, the one electron theory). The question of identity is something most people struggle with throughout their lives and is often related to feelings of anxiety and insecurity. This electron is initially presented in this state due to the properties of subatomic particles.

Example 2: Positron decides to save electron from the black hole: act 1, scene 2. (Infinite Opera, 2018: xiv)

**Recitative**

Positron: Electron! You have left me here!
Millenia may pass before you return and to you no time at all (crumpling to the floor)
Ah! Am I doomed to live this half-life?
(Triumphantly taking a heroic stance)
Even as my constitution squares I will accelerate towards your dying light.

Entropy: But what is this I see?
Strange! Charm! I call you to arms!
Come here! Why are you so lazy?
Ah but you make me proud.
Blackhole has Electron now, but will not always.
(snarling)
Though Positron flies with direction and hope one slip and both are gone forever!
They feel they live in chaos … but I will still show them how determined their lives can be!

Gravity, Electron and Positron:
Aaaah Ooooh Aaah Noooooooooo

Entropy: Stop watching it.
You're never going to see it happen!
Ugh fools!

In the recitative above positron describes the inevitable time difference that will happen due to general relativity. It is also in this moment that Positron becomes heroic and even references to the speed of light (Even as My Constitution SQUAREs). The Positron, as an entangled antiparticle, is able to feel the opposite of everything the electron experiences. As the electron grows more anxious the Positron becomes more certain.

## AP 3.1.a The Introduction of the Narrator

As a creative practitioner I went through several cycles of development with this work although as I had not begun focusing on research they were not as thorough as the work done in this PhD. The most recent of these was the performance of this piece in November 2019 at the Attenborough Arts Centre, Leicester. This was a concert performance rather than fully staged which allowed us to focus more fully on the nuances of the music and text, without having to worry about stage directions. For this performance I added the characters of two mad scientists, who would narrate the whole story as they watched the path of an electron in their laboratory. The reason for this was that opera as a form can be alien to a lot of audiences. Without some kind of go-between from the audience to the performance, I worry that I will lose some people's interest or understanding in the alienation of both the physics and the operatic soundscape. I wanted something there to reassure the audience that they have successfully followed the narrative and that they do not need to worry or feel anxious about their own ability to understand the more complex aspects of the subjects being presented. The short narration, which fits in between scenes, was as follows:

Entanglement! Mad Scientist Narration

End of Overture:

Pah! Entropy you say?
Look at me! A wondrous bag of organised thought and activity.

I could stop Entropy with a single thought.
You don't scare me - *Baron Entropy*
Ooh I forgot to switch off my gas ioniser . . . I don't want too many loose electrons bobbing about!

End of Scene 1:

I knew it - the electrons *themselves* don't even know what they are! But what have I just seen? An existential and excited electron trying to touch its Positron pair. Doesn't it realise how foolish that is?

And now the Positron has sent it off to a black hole. I shall be interested to observe what happens there!

End of Scene 2:

Poor Positron. Pure panic and pain!
All it can see is the infinite red glow of the electron's trail.

But Gravity and its spaghettification is a sight to behold.

Baron Entropy must feel annoyed. Now there is one less particle to take part in the chaos.

End of Scene 3:

This all seems quite familiar to me. Learning more about yourself through ghostly visions? And so near to Christmas too?

In any case I'd better hurry up and find the Graviton or this poor Electron might be searching in vain.

End of Scene 4:

I didn't realise that such a Deus Ex Machina could occur in real life!

It seems these entangled particles are cleverer than I am at communicating through time and space.

And that horrible Entropy. All life seems to be gone. It is indeed the end of the world as we know it.

## AP 3.1.b Reflections and feedback from Leicester

This proved successful with our audience, and greatly added to the performance, allowing the non-physicists to feel as part of the show and as engaged with its story, as the physics experts

in the audience. A subsequent Facebook comment posted on the Infinite Opera page can be seen below:

> Entanglement. Wow! A unique, amazing, multifaceted physics opera. Never seen anything quite like it. Brilliant concept with excellent characterization, beautiful singing and magnificent music. And a bit of light comic relief from the silly scientists. A thoroughly entertaining evening!

The outcome from the questionnaire can also be seen in this table in Appendix 3 under file name: 01_Leicester Data

The success of the narrator in easing the flow of the narrative, and engaging more directly with the audience is a plot device and character voice that I then decided to take further and explore in other for subsequent work. This was something I had been considering to use for some time prior to the PhD, in order to help the audience to integrate themselves with the science. The use of a different type of voice to the sung operatic quality is useful in providing that gradient between the more easily understood voice of theatre in plays and musicals, and the slightly more obtuse and extended sounds of the words in opera. It also provides some space in the work where the audience can take in a bit more of what they have just experienced theatrically. In this case in Leicester I made explicit use of the narrator in a rather self-conscious and tongue in cheek manner. Having two men walk onto the stage posturing as the stereotypical scientist and declaring the absurdity of what we are seeing on stage served as a useful tool to remind the audience that even though this is an opera, and a great deal of skilled work and preparation has gone into the performance, we are still aware as creators and performers that the work we are presenting has many elements of the absurd and ironic about it.

# AP 3.2 In Response to Naum Gabo's Linear Construction in Space No. 1

The creation of the mini operatic performance on the work of Naum Gabo for the Barber Institute in March 2020 also impacted on choices I made for future works. Philosophically, researching Gabo's work and manifesto led me to rethink my own approach to science and the presentation of knowledge to an audience through theatre. The libretto for this work can be seen below.

Thinking about Gabo in relation to Aristotle's concept of form helped me to consider the way in which I can manipulate elements of form to create the right overall impression in my work. In this I mean experimenting with ways to impart information to the form of the work without overwhelming the work with too much or too little detail (e.g. information of each and every brick making up the whole wall or a blurry image of what might be a brick wall but could equally be a barrier of any other form). By working in a multimedia artform with collaborators such as a visual artist a composer I am dealing with expanded elements of form that can store the information. This compounds the necessity to maintain frequent direct contact with all collaborators, so that we can maintain as clear an understanding of the information we are conveying as possible.

Parts of the Gabo manifesto also highlight the inefficacy of superficial elements to really inform the perceiver of the essence of an object. For example the first statement of the realist manifesto:

> Thence in painting we renounce colour as a pictorial element, colour is the idealized optical surface of objects; an exterior and superficial impression of them; colour is accidental and it has nothing in common with the innermost essence of a thing.
> We affirm that the tone of a substance, i.e. its light-absorbing material body is its only pictorial reality.

(N Gabo & A Pevsner 1920)

This highlighted to me the importance of going beyond the surface level interpretation of the science I am working with. For example, I had initially experimented with creating poetic metre based on the data and sequences generated from the telescopes. Upon further reflection and having found the metre created to be highly complex, I decided that it is far more important to seek to embed the principles behind the data collection, and processing, rather than embedding the data itself.

Both of these works influence how I would begin to construct the libretto for *The Flowering Desert*, the details of which can be found in following sections. The positive feedback from the use of narration also impacted how I would work with the libretto for *Lipote: An Interconnected Journey*, which involves a narrative voice which is entirely external to the action.

## AP 3.2.a Libretto

# In response to Naum Gabo's Linear Construction 1

## Element 1: Promenade around the gallery

*Begin in the space outside the entrance to the Barber gallery, upstairs in the small vestibule. Before starting, inform the audience of the existence of the manifesto and ring the bell.*
*The singer can fit as many or as few of each word onto each block of melody. The singer is also allowed to improvise around this text and embellish or remove parts as they feel necessary with the audience present. For this first section stand at the front of the gallery near the paintings of Daphne and Apollo.*

*<u>Part 1</u>*
*Sung.*

An armature of reality
Space forged from time
From Plato the constructed chair
To which our thought is directed
The energy of mind looking outside of itself

But what of the informed?
Where is the information in form?

*Ring the bell.*

*Spoken - delivered in a high energy manner. Presented as a rhetorical question to the audience. On the affirmation of depth lead the audiences' eyes to look down the gallery.*

**Manifesto Statement 3:**

**We renounce volume as a pictorial and plastic form of space; one cannot measure space in volumes as one cannot measure liquid in yards: look at our space… what is it if not one continuous depth?**

**We affirm depth as the only pictorial and plastic form of space.**

*Ring the bell.*

*Part 2*

*Sung in front of the first alcove where there is the trumpeter. Look at the paintings to think about colour:*

What say you Aquinas?
You hereby grant the accidental form.
The chosen properties - colour, angles, material
Let them not define our quality

*Ring the bell.*

*Spoken:*
*Use hand gestures to emphasise the "light absorbing body":*

**Manifesto Statement 1:**

**Thence in painting we renounce colour as a pictorial element, colour is the idealized optical surface of objects; an exterior and superficial impression of them; colour is accidental and it has nothing in common with the innermost essence of a thing.**
**We affirm that the tone of a substance, i.e. its light-absorbing material body is its only pictorial reality.**

*Ring the bell.*

*Part 3*
*Sung in the entrance to gallery 2:*

Interesting
But what of Kant?
Who disagreed with Plato.
Form cannot be abstract, form must be man-made.
Mind made.
Just a projection of collected thought?

*Spoken:*

**Manifesto Statement 2:**

**We renounce in a line, its descriptive value; in real life there are no descriptive lines, description is an accidental trace of a man on things, it is not bound up with the essential life and constant structure of the body. Descriptiveness is an element of graphic illustration and decoration.**
**We affirm the line only as a direction of the static forces and their rhythm in objects.**

*Ring the bell.*

*<u>Part 4</u>*
*Walk into the next gallery and sing this next section in front of the violinist.*
*Sung:*

Then perhaps there is some truth in Schopenhauer's Will?
The driving and mindless irrational impulse, aimlessly energising everything.
Our movement, nothing but a manifestation of the Will.

*Ring the bell.*

*During this next speech address the audience as both engineers and sculptors.*
*Spoken:*

**Manifesto Statement 4:**

**We renounce in sculpture, the mass as a sculptural element.**
**It is known to every engineer that the static forces of a solid body and its material strength do not depend on the quantity of the mass… example a rail, a T-beam, etc.**
**But you sculptors of all shades and directions, you still adhere to the age-old prejudice that you cannot free the volume of mass. Here (in this exhibition) we take four planes and we construct with them the same volume as of four tons of mass.**
**Thus we bring back to sculpture the line as a direction and in it we affirm depth as the one form of space.**

*Ring the bell.*

*<u>Part 5</u>*
*Move to the final gallery*
*Sung:*

But if we take everything down as far as it goes

Continuously cutting
A progressive diminution
Maybe Einstein - you might be right
“Forces are permitted to become mass
Matter is permitted to become light”
All that is left are the strings

*Ring the bell.*

*Announce this final statement very emphatically.*
*Spoken:*

**Manifesto Statement 5:**

**We renounce the thousand-year-old delusion in art that held the static rhythms as the only elements of the plastic and pictorial arts.**
**We affirm in these arts a new element, the kinetic rhythms as the basic forms of our perception of real time.**

## Element 2: Sculpture ritual

*A sung jigsaw - During this sing the words which are in the part of the image that has strings. As soon as you come to a word in the gap, ring the bell and speak them. Then ring the bell to signify that you will carry on singing words.*
*The image is cut into a jigsaw and arranged during the performance to look like the Barbara Hepworth study in the exhibition.*


AP 3.2.b Film

See the filmed performance of this work in Appendix 3, file name: 02_In response to Naum Gabo Linear Construction 1 in Space No 1.

## AP 3.3 Autohoodening: The Rise of Captain Swing

The work towards creating this piece was carried out between myself, Infinite Opera and Postworkers Theatre from December 2019 to December 2021. I participated as collaborative script writer, performer, director, choreographer and film editor. The final film was recorded in Vivid Projects in August 2021.

The piece is based on the testimonies of workers in Amazon fulfilment centres, in particular around the poor conditions, intense pressure and precarity they suffer whilst working there. We

based the form of the piece around Amazon's 3 warning system, with each Act being marked by the first two warnings and then the firing. The character of Captain Swing is raised from the past by the Lead Picker, who badly hurts their hand in a machinery-based work-place accident. This means they have to stop working and leads to a series of warnings and ultimately being fired. Captain Swing at first attempts to fight the Molly Bot (the shelving unit that hurt the Lead Picker) but is overwhelmed by the might of Alexis (the scanner that controls the pickers and manages the Algorithm). When all the pickers and packers defeat the Molly Bot with the help of Swing's 'bugs' Alexis fires the Line Manager. Swing then gives the Line Manager an SD card that will reprogramme the algorithm inside Alexis and give the workers back their rights.

I first began working on this piece when I was visiting tutor with Goldsmith's design MA, helping them put together staging for a preliminary version of this story. Using what we had created in that session, along with the scaffolding of using the format of a Hoodening play, we began working with the Infinite Opera performers on redeveloping the work for a protest. We did this during the lockdowns in 2020 – 2021. A Hoodening play is a traditional theatre from the nineteenth century (in the Kent region) where one of the characters was an old workhorse, which was always represented with a hood and wooden mask. These plays would be performed at Christmas by local farm workers to raise money for beer and food. They involved some stock characters and were religious in theme, with the narrative trope of a death and resurrection.

The character of Captain Swing was introduced when Postworkers Theatre began work with Infinite Opera. Captain Swing is an older figure from the 1830's Swing riots, in which the farm workers rebelled against the farm owners to try and stop the growing use of machinery. Captain Swing was the name used to sign letters of complaint and protest to the farm owning classes. This is comparable to and reflective of the growing use of AI technology today to potentially replace many jobs (such as is exemplified by the writer's strikes of 2023). But also in this situation the use of algorithmic and data driven target setting is largely what causes many of the poor working standards present in Amazon factories today.

We collaboratively developed the script through a series of online workshops with and without the performers. It was jointly written by myself, Dash McDonald, Demetrios Kargotis and Nicholas Mortimer, making use of testimonies from the GMB union and that had been found online. We decided to reverse the roles of the machinery and the humans anthropomorphising the machines to magnify the power they hold over the workers. Through doing so we were also engaging in an anthropomorphising of the tyrannical and poor working practices that have been able to thrive in the largely profit drive online commerce sector today.

## AP 3.3.a Libretto and Film

Find the libretto and film of this work in Appendix 3 under file names: 03_Autohoodening The Rise of Captain Swing Libretto and 04_Autohoodening The Rise of Captain Swing.

# AP 3.4 The Monk of the River and The Monster of Gao

Whilst working on the projects for the PhD I also began collaborating with the composer Anna Vienna Ho on a series of short opera which present some small sections from the Chinese epic novel – Journey to the West (attributed to Wu Cheng'en). This novel is an account of the journey of the pilgrim Xuanzang to the Buddhist monastery in the West, to collect the ancient scriptures and Tripitaka from the Buddha. On the way Xuanzang encounters several friends and enemies, and faces a series of potentially deadly challenges.

As this had been a long-term dream of Anna Vienna Ho to write, she had already decided on the sections of the novel she wanted to compose. Therefore the task was to me to pull together the complicated and eventful narrative into a short and concise text. I did so using as many translations as I could find, in order to adapt it as close as possible to the original text, as well as to be able to make informed decision on the wording and inherent intentions of each character.

## AP 3.4.a The Monk of the River

The first of these operas, *The Monk of the River*, was written during 2020 and performed at the Tête Á Tête Festival in September 2021. The production was funded by Arts Council England. This part of the novel tells the story of Xuanzang's parents, and describes how he came to be a monk of the Emperor Tang. There are many characters, each with their own plot, and so it was a very dense story to portray in a one hour show. If I were able to go back and rework this I would ask Anna if we could cut out some characters and streamline the story to fewer key events. The libretto for this opera can be found here in Appendix 3, file name: 05_The-Monk-of-the-River-Libretto.

## AP 3.4.b The Monster of Gao

In September 2023 *The Monster of Gao* premiered again at the Tête Á Tête Festival. After having worked on such a complicated story for the previous instalment I asked Anna if we could focus on a less complicated element of the journey, which involves fewer characters and would allow us to explore each character more fully. We decided to focus on the introduction of the Pig character *Zhu Bajie*. The libretto for this work can be found in Appendix 3, file name 06_The Monster of Gao Libretto.

# References


Serryade (2023) *Feedback on The Flowering Desert January 2023 performance.* [Instagram] (personal communication, 24 January).

Adesso, G. (2020) *Feedback on The Flowering Desert short story.* [email] (Personal communication, 24 February).

Abramsky, D. (2020) *Feedback on The Flowering Desert short story.* [email] (Personal communication, 26 February).

Blanco Albert, D., Farre, L., Flynn, H. and Pluta, M. (2020) *Workshop on The Flowering Desert short story.* Interviewed by Roxanne Korda in person at Royal Birmingham Conservatoire, 26 February.

Blatt, D., Evans, K., Farrow, O., Flynn, H., Hammond, A., Kemshell, D., Li, w., Sinka, D. and Uken, K. (2021) *Feedback on Lipote: An Interconnected Journey open rehearsal.* Interviewed by Roxanne Korda in person at RoguePlay theatre, 30 August.

Edgerton, M. (2004) *The 21st-century voice: contemporary and traditional extra-normal voice.* Lanham, MD: Scarecrow Press.

Eichhorn, M. (2021) *Interview with Dr Markus Eichhorn.* Interviewed by Roxanne Korda on Zoom, 6 April.

Evans, K., Farrow, O., Lesch, C., Li, W., Peng, J. and Sinka, D. (2022) *Feedback on Lipote: An Interconnected Journey Showcase.* Interviewed by Roxanne Korda on Teams, 22 December.

Infinite Opera (2018) *Entanglement! An Entropic Tale.* Edited by Infinite Opera.

Kaniewski, A. (2022) *Feedback on The Flowering Desert.* Interviewed by Roxanne Korda online via Teams, 5 December.

Perryman, M (2018) *The Exoplanet Handbook.* 2nd ed. Cambridge: Cambridge University Press.

Stocker, C. (2019) Chris Stocker recommends Infinite Opera. *Facebook,* 22 November. Available at: https://www.facebook.com/InfiniteOpera/reviews [Accessed 28 September 2023].

Triaud, T. (2020) *Feedback on The Flowering Desert short story.* [email] (Personal communication, 27 February).