

PLEIN AIR

THE BREATH OF TREES



Tim Collins and Reiko Goto

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PLEIN AIR | *The Breath of Trees*

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CONTENTS

Introduction	1
Upon Meeting a Tree Wallace Heim	4
Aesthetic Humility in PLEIN AIR Emily Brady	8
PLEIN AIR Plant Music Georg Dietzler	13
PLEIN AIR Trees and Empathy Reiko Goto and Tim Collins	19
Collaborators and Advisors	36
Project Team Biographies	38
Exhibitions and Publications	39



PLEIN AIR phase 2, fieldwork with a large elm tree. Union Terrace gardens, Aberdeen Scotland, 2010.

Introduction

Tim Collins

Artist and researcher

We believe that art does not fix things, solve problems, or predict change. It has a very particular kind of agency, one that creates space for comment and discussion, producing surprising changes to extant concepts and experiences. It is within this realm of human discourse, related to aesthetic perception and value, that art has its most inspirational and significant impact.

Anthropogenic climate change has its root causes (and responsibilities) in centuries of greenhouse gases emitted by nations that have benefited from the first and second wave of industrial development. Climate change is a driving force in the social and economic changes of this current century. One way these changes can be understood is through a narrative of global carbon dioxide data and a record of forest loss. Trees are the largest living things on earth. Forests are one aspect of the range of approaches necessary to sequester carbon with the potential to reduce the impacts of climate change.

Trees have been a topic of creative inquiry for us for over twenty years. We began by thinking about forests and river corridors as public spaces. These interests mixed research in art and science for 'Nine Mile Run' (1997-2000),

and then expanded to a regional planning scale with extensive computer map analysis for '3 Rivers 2nd Nature' (2002-2005). These bodies of work were completed while research fellows in the Studio for Creative Inquiry at Carnegie Mellon University, Pittsburgh, Pennsylvania.

Upon moving to the UK, we wanted to refocus and think about aesthetic, empathic, and ethical relationships with specific trees. The results, 'PLEIN AIR | *The Breath of Trees*' and 'PLEIN AIR | *Silva Datum Musica*,' are discussed at length on the following pages.

This catalogue opens with 'Upon Meeting a Tree' by Wallace Heim. She begins by reflecting on how she might greet a tree, what it means to recognize a tree as a being that is worthy of attention, one with perhaps some potential to return that interest. Wallace then carefully considers the experience of PLEIN AIR and attempts to secure some meaningful relations through a series of performative reactions with the work, while also considering the philosophical implications of interrelationship with a tree.

The second article, 'Aesthetic Humility in PLEIN AIR', is by Emily Brady. She considers the artists' intentions, the experience of the work, and its effect on other people in the room. Writing about empathic attention, focus, and the boundaries of aesthetic contemplation, she suggests that the work draws the viewer outwards, toward the tree, then inwards, toward the self, creating an imaginative bridge across the gap between species. Emily closes with ideas about what cannot be known and the value of new ways to comprehend other species.

The third section, 'PLEIN AIR Plant Music,' is by Georg Dietzler. He describes the development of the recordings and gives a detailed account of the spatial

settings for the work in Cologne and Glasgow and their differing influences on the production of the sound. From his interest in bio-acoustic music, he offers insight about the quality and structure of the PLEIN AIR sound experience. He closes with thoughts about art, science, data, and the links to intuitive experience.

The last section of the catalogue includes ‘PLEIN AIR | Trees and Empathy,’ an illustrated history of the work that expands on previously published work and conference papers. Here, we set out our ideas about empathy, things-versus-beings, and the relationship between art, science, and perception. We also describe the four phases of the work, from the earliest days struggling with the sensors and technology, followed by the effort to conceptualize and craft a portable outdoor easel. The third and fourth phases were about refining the voice used to sonify the tree, attending to pitch, timbre, and intensity to get at connotative meaning. We recount how we refined and tested the system through seminars and exhibitions. In our conclusion, we put our intentions for the work into context and consider the final round of refinement including the production of the vinyl LP album with Georg Dietzler.

The final section of the catalogue provides biographies of the people directly involved in the development of the final phases of the project. We will also provide a list of the names of those that worked with us throughout the project, after the biographies. We would like to express our appreciation to everyone that supported this effort throughout the years.

As we were finishing this catalogue, Reiko reflected on the many trees that are now part of our lives because of PLEIN AIR. Some we live with, some we visit. But they are always with us in ways we never expected when we began this artwork in 2008.

Upon meeting a tree

Wallace Heim

Writer on ecology and performance and independent academic

How does one greet a tree? What is the suitable comportment by the human? The etiquette will be different with every situation, whether teasing a tree out from its cohorts in a woodland, or when finding the singular tree in a place determined by human design, like a garden. Each tree, the Aspen, the Oak, the Yew, might require a different mode of greeting. If one is going to spend time with a tree, then how one recognises it, how one acknowledges the situation and oneself, will alter the meeting, or at least set the meeting off on a certain course.

A touch, a vocal sound, a silent movement of one's body may do. But what kind of etiquette applies when there are sounds emanating from the tree, beckoning one towards it, as if what is coming in to the human ear is, for the first time, the dissolution of the thin veil between animal and plant? As if all taxonomies which ordered the world need to be thought again.

For PLEIN AIR, Tim Collins and Reiko Goto set a semi-circle of saplings, rooted in pots, around the legged, wooden box that houses the sensing and audio technology that translates the metabolisms of one leaf of one tree into sounds

audible to the human. At the Glasgow Botanic Gardens, the trees stand in a glasshouse, the Kibble Palace, responding to the variations of light, heat, carbon dioxide, and moisture during the last days of summer sun. One chosen leaf is held delicately between the transparent plates of the sensors, as if by a hand, keeping it nearly touching the tubes registering its changes.

As do many others, I walk toward the trees with my mouth open, a human reflex of wonder and curiosity. The sounds emanating have a familiar techno-sound quality, but the rhythms and timbre do not. Like, but not like, a pulse, a breath, a fluctuating continuum of vitality.

These are not the sounds the tree is making; these are the sounds the technology is making as it translates the data, the measurement of differences in values, into sounds. These are the sounds of a technological sensitivity to the tree's respiration and adjustment to light and to the human exhalations around it. But the conflation of the sound with the tree is compelling; the human imagination is in play.

My eyes follow the tubing; my hand touches a branch – a greeting is begun. It feels as though the proper greeting needs to be an accompaniment, as if these sounds are close enough to human that I should match them with my voice, with a hum, a scat, or a drone; to vocalise the breath moving through my body in order to improvise with the carbon dioxide, the humidity, the light as they pass through the leaf's tender cells. I try, but I can't pitch it and can't get a rhythm. Our sounds don't meld; they don't take off. As I give up, the unsettling relations created by PLEIN AIR start working.

Beguiled by the sounds, my human faculties try to make a compositional sense of them, to find a repetition or surface order with which to improvise. Even though the pulses and exhalations seem to be variations in a narrow range, I cannot find a humanly musical pattern. The tree's sounds happen all in the present. The intervals and plishes are made, as if, for the first time. There is not enough shape in the sounds for my musical memory to hold on to, or to predict.

Placing my voice next to the sounds of the Oak offers an unnerving existential uncertainty. The ever-adapting responsiveness to conditions and elements as they pass through a living entity seems comprehensible, when the entity is leaf, tree, or plant, as if it is more cellularly entwined with the winds and fluxes than the neurological systems of an animal. But my animal body, too, is processing and adapting to light, chemicals, humidity. My vital signs may be more than the pulses and exhalations that can be recorded. What passes through me, what my cells are adapting to, may be more than my enquiring animal consciousness reports. It is as if my body has become transparent to the passage of the elements of the world through its animate life, in all its transiency and delicacy. What began as a way of showing how the tree may be akin to the animal, as if our sounds were similar, has become a way of showing how the animal may be akin to the tree; both as living entities inseparable from their surrounding conditions, or rather, through whom the surrounding conditions pass.

As I look at the trees in the room, I don't know what it is to be a tree any more than I know what it is to be a bat or an octopus. But to feel an affinity with an other is not confined to those with some similar characteristic, like an eye, a reaching arm, a song. The empathic response made available in PLEIN AIR doesn't extend human characteristics to the more-than-human, but alters the

human in its meeting with an other that is wholly strange. A greeting has been made, a companionship begun.

Wallace Heim writes on ecology and performance as an independent academic, from philosophical and other disciplinary perspectives. She also writes and produces theatre for audio broadcast and holds dialogic events on climate change.



Reiko and Wallace immersed in *PLEIN AIR / Live* at The Kibble Palace, Glasgow Botanic Gardens, Scotland, 2017.

Aesthetic Humility in PLEIN AIR

Emily Brady

Professor of Philosophy, Texas A&M University

*Be not afeard, the isle is full of noises,
 Sounds and sweet airs, that give delight and hurt not:
 Sometimes a thousand twangling instruments
 Will hum about mine ears; and sometime voices,
 That if I then had waked after long sleep,
 Will make me sleep again, and then in dreaming,
 The clouds methought would open and show riches
 Ready to drop upon me, that when I waked
 I cried to dream again.*

Shakespeare, 'The Tempest', (3.2)

Upon entering the glasshouse of Kibble Palace in the Glasgow Botanic Gardens, there is a marvelous pond filled with koi fish in colors ranging from ghostly gray to golden to bright orange. Closely observing their movement and interactions brings home how aesthetics has the potential to support interest, a sense of admiration, and even care towards the more-than-human world.

Turning right from the pond, you enter the glass room which holds PLEIN AIR – a wooden easel surrounded by small trees connected by tubes and wires to an assortment of technology. The artwork sits within this room dedicated to plants of hot and dry environments, a setting which accentuates our sense of the world stretching from the native Scottish trees (oak, ash, rowan) of PLEIN AIR to relatively exotic echiums and euphorbias.

Attention is given to both the plants and the technology by the people that I observe while I sit quietly among the PLEIN AIR trees. I hear at least one person say it is like ‘magic’ that the trees are producing sounds through the interactive device which monitors the reactions of the trees’ responses to changes in their environment.

Tim Collins and Reiko Goto write that it is their wish for ‘the sound exploration...to create an experience that allows the user and viewer to feel and share a momentary but heightened sense of environmental awareness as the tree responds to atmospheric changes.’ (Collins & Goto, 2017) Their art practice has emphasized the potential for an empathic exchange between people, places, and things, and how this relates to an aesthetics and ethics of ecology, environment, and the atmosphere.

PLEIN AIR, as I see it, evokes the potential for ‘aesthetic humility’. Both empathy and humility, at the very least, require sympathetic recognition of entities other than oneself. Aesthetic humility aligns with the sympathetic attention which philosophers have long-recognized as a feature of aesthetic experience of the arts, nature, the everyday, and everything in between. From eighteenth-century notions of disinterestedness, which emphasize not

indifference but sensory and imaginative attention beyond practical use and intellectual concern, to the twentieth-century idea of perceptual absorption that we find in the work of pragmatist John Dewey, the aesthetic response is marked by an other-regarding stance. This other-regarding stance contrasts with a self-regarding one that places the human at the center of the world; aesthetic engagement pulls attention in the direction of outward regard.

Already, it is possible to see how aesthetic experience relates to the ethical life. Multisensory aesthetic qualities grab our attention, drawing us out of ourselves, much as the philosopher Iris Murdoch has written:

I am looking out of my window in an anxious and resentful state of mind, oblivious of my surroundings, brooding perhaps on some damage done to my prestige. Then suddenly, I observe a hovering kestrel. In a moment everything is altered. The brooding self with its hurt vanity has disappeared. There is nothing left but kestrel. And when I return to thinking of the other matter it seems less important.

Murdoch, 1970

Where does aesthetic humility feature in PLEIN AIR? Aesthetically appreciating the natural world involves a relationship between one's attention and the focus of that attention, be it a particular place, phenomenon, object, process, animal, ecosystem, etc. These experiences, and the meaningful relationships they can engender, have the potential to humble the hubristic self.

The artwork draws our attention outwards – and then inwards; drawing outwards to the trees, to their remarkable physiology, and then translating the trees' experience of environment into something to which we humans can relate. That is the first moment of an aesthetic experience which involves sensory elements (the trees' aesthetic qualities, the music, the whole setting,) a vague

understanding of the science which makes this translation possible, and a sense of wonder and magic. Together, these elements form the basis of an aesthetic-ethical relationship. The artists have created a way to sympathetically experience the lives of trees in the fullest way, a route to imagining their lives and how they are affected by sunlight, carbon dioxide, and other atmospheric agents.

Scenic views of landscapes, mountains, waterfalls, and seascapes are beautiful enough, but they can have the effect of distancing the aesthetic agent from the natural world. The way of relating to environment supported by PLEIN AIR is akin to other forms of close attention to environment. When my companion draws my attention to the sound of the dawn chorus while walking through my neighborhood in early spring, this is a similar way of relating, albeit in a different aesthetic situation. Here, my attention is drawn close in to the marvelous music of birdsong, coming from different species and individuals all at once. We might refer, then, to a continuum of ways of attending to the more-than-human world, and how different situations afford closer and more distant forms of relationship. In these cases, our attention is focused on the multisensory surface, with scientific concerns backgrounded (though not necessarily absent) (Saito, 1998)

PLEIN AIR quite rightly demands sensitive, sympathetic attention. With that attention we are drawn into the world of these trees, discovering similarities and differences between the vital needs of human and more-than-human lives. With such attention comes an ethical recognition of the place of humans among other species, of what we can know and cannot know (epistemic humility), and how we might find ways to comprehend when other routes fail us. To make such an effort to appreciate and understand other species – to grasp the sound of trees through aesthetic humility – is a crucial step towards addressing the environmental crisis.

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Emily Brady holds the Susanne M. and Melbern G. Glasscock Director's Chair at the Glasscock Center for Humanities Research, and is Professor of Philosophy at Texas A&M University. Previously, she was Professor of Environment and Philosophy at the University of Edinburgh.



Emily and Reiko talking about *PLEIN AIR | Live at The Kibble Palace*, Glasgow Botanic Gardens, Scotland, 2017.

PLEIN AIR Plant Music

Georg Dietzler

Producer for PLEIN AIR | *Silva Datum Musica*, and Cologne-based artist, author, curator, and consultant.

Visiting Glasgow in 2014, I had a chance to see and hear PLEIN AIR in Tim Collins and Reiko Goto's studio. I was impressed by its audio-visual richness. I then decided to present this trans-disciplinary project within a 2015 sound-art series called 'Visual sounds – Bioacoustic Music'. A short residency was provided for the artists, funded by ON – Neue Musik, Cologne.

I decided to present PLEIN AIR in a small, intimate music room that we titled the 'Tree Sound Study Chamber' (Baumklang-Studien-Zimmer), making references to historical chamber music. The square-shaped room had one, large, west-facing window. Reiko, Tim and I visited local tree nurseries that offered native regional trees and bushes. We decided to buy a mix of large potted plants for the exhibition: a butterfly bush, elderberry and juniper bushes, and a German heritage pear tree. The plants in the music room created a visual dialogue with the older plane trees on the streets. During the presentation, we had long, hot, sunny summer days; the plants needed lots of care and watering. Reiko paid significant attention to the well-being of the plants, taking care that they were not stressed in this environment. After the project presentation, all have been replanted in private gardens.

Before the opening, I had the pleasure of sitting quietly by myself listening to the sounds of PLEIN AIR. As the opening finished, a young music journalist asked if he could come back and have a private viewing to write his review while listening to the tree sounds. A classical flute player asked if she could return with her instrument to improvise with the tree sounds and we did this as a special closing concert.

After the opening, Tim, Reiko, and I discussed making recordings. They borrowed my ZOOM H2n recorder and started to record hours of sound at various settings, working from early morning to sundown and when the gallery was quiet. I worked with them often and found myself thinking about the changing timbre and pitch of the music in relation to changes within and outside the room. Light intensity and carbon dioxide from visitors' breathing would change each tree's response and the sound quality. At the end of the day, too, changes to light quality would affect the trees and the sound was very different to when the trees were under full light at mid-day.

It was a unique chance to be able to listen live to PLEIN AIR for hours and to make the Cologne recordings. I found an impressive richness of sounds, comparable with a minimal music: steady pulses slowly changing, gradual transformations, phase shifting, consonant harmony – music that was easy to listen to. One could hear plants getting tired, stressed, hear the difference in tones in the morning, noon, afternoon, evening. Reiko, Tim, and I met and talked each day, often eating together, discussing the range of sounds and the public reaction to the work. Tim was struck by the time people spent listening. I asked them if they had considered an artist edition vinyl, and we discussed a new plan – an exhibition and more recordings at the Kibble Palace, a historic glasshouse in the Glasgow Botanic Gardens in Scotland, in 2017.

Different venues and different listening environments for aural arts shape what we hear. Architectural scale, shape, and building materials create specific spatial acoustics. Qualities of intensity and frequency, temporal effects, and tonal attributes - all contribute to the sound experiences across the two sides of PLEIN AIR | *Silva Datum Musica*. Cologne offered a more sheltered, quiet room, a reverberating cube with one window. Outside we had bright, blue skies, warm days and, at night, no clouds. In Glasgow, PLEIN AIR was presented in a curved, Victorian-era glasshouse. The plants chosen were all native deciduous trees of Scotland. We could only record when the public left the building at the end of the day. The weather conditions were dramatic: a mix of sunny and rainy days, very intense sunlight interrupted by fast moving clouds, lower temperatures and longer days than in Cologne. The recording device was a Zoom H4n using two external microphones facing towards the half-dome shaped end of the glasshouse.

You will note the differences in the trees, the venues, and the sound between the two sides of the vinyl recording. The plants and context in Cologne produced a minimal music, slowly changing, a steady pulse, soothing sounds. Glasgow was much more dramatic, with fast changes of light and cloud, producing an extreme and dynamic range of sounds frequently close to shrillness, not at all like minimal music. Recordings were only possible in the evening. We worked to a maximum of 30 minutes per take; the Cologne recordings were up to three hours. The cities of Cologne and Glasgow are as different as the sound we hear on the vinyl.

PLEIN AIR is a touching and impressive artwork, a sound piece embedded into a carefully-crafted wooden painting easel. Whether sensing the leaves of native Scottish trees, or regional German trees, the music software converts data

from photosynthesis, transpiration, and light-intensity into specific bass lines and melodic sounds.

Musically, I think of PLEIN AIR as bioacoustic music, as data sonification, and as plant bioacoustics. Plant data sonification is computer music. PLEIN AIR is a sort of plant-driven synthesizer, an instrument that generates and modifies sounds electronically. The software programming imitates a range of musical instruments and sounds. The PLEIN AIR controller devices are scientific sensors measuring plant data and real-time leaf / environmental data, with the software converting the calculation of mathematical equations into codes that represent musical notation. All of this is PLEIN AIR plant music.

The PLEIN AIR sound system has the potential for long-duration concerts lasting for hours, days, weeks or seasons as it produces ongoing continuous changing tones. It can be an electronic instrument for improvised concerts, musicians performing live within a PLEIN AIR setting, possibly in different time zones, or working with real or artificial light.

Each plant species – each individual plant – has its own acoustic signature related to its external leaf structure as it reacts with wind and local climatic conditions. Plant physiologists have known for decades that sound can be heard within the body of plants. Primarily ‘crackling’ or ‘whispering’ sounds, they are hydraulic in origin and are related to the micro-conditions of the circulation of water and air within the plant as part of the transpiration process. Hearing this kind of sound is the domain of science. What Reiko and Tim have accomplished with PLEIN AIR opens up this rigorous sensor data to an immediate and intuitive experience through sound. Over time, the changes of light, humidity, and carbon dioxide are all revealed in relationship to the tree and to the venue

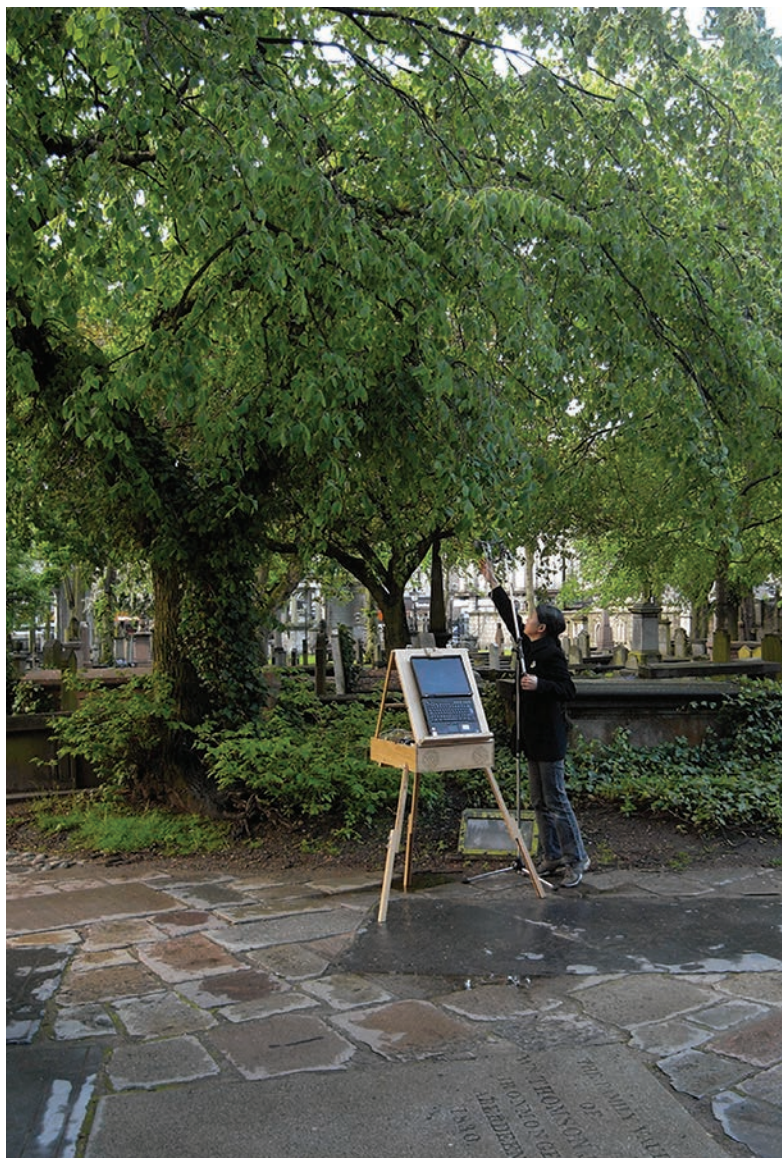
it is presented in, to the work's spatial positioning and to its relationship to the audience.

This is very a promising area for more generative artworks that bring us face-to-face with the sound of the breathing of a tree.

Georg Dietzler, producer for 'PLEIN AIR | *Silva Datum Musica*' – the recordings is a Cologne-based artist, author, curator, and consultant. As a socio-political and conceptual artist, he works on ecological future visions linked to social and political change.



Tim Collins, Reiko Goto, Chris Malcolm and Georg Dietzler pre-exhibition recordings, PLEIN AIR | *Live at The Kibble Palace*, Glasgow Botanic Gardens, 2017.



PLEIN AIR phase 2, fieldwork with trees in the Kirk yard of St Nicholas Uniting, Aberdeen Scotland, 2010.

Plein Air | Trees and Empathy

Reiko Goto Collins and Timothy Martin Collins

Collins & Goto Studio, Glasgow, Scotland

Background

The impetus for PLEIN AIR goes back twenty years to when we were artists-in-residence at the McColl Center for Art + Innovation in Charlotte, North Carolina. We were thinking about aesthetics and ethics, about science and art in relation to issues of environmental change.

We were interested in forest studies that explored the impact of an increase in carbon dioxide on trees. One of these was a Free Air Carbon Enhancement (FACE) experiment at Duke Forest, the Duke University Teaching and Research Laboratory, also in North Carolina. Ecologists and biologists raised the carbon dioxide concentration in a specific area of forest, then wired the forest to measure the effect on plant and tree growth.

Outdoors and four stories up in the canopy, while watching the instrument sensor displays, we realized we were ‘seeing’ the invisible breath exchange and changing sap flow of a tree. We felt a simple, intuitive leap precipitated by a flow of data. We experienced an epiphany of sorts: a sense that we had engaged with the essential nature or meaning of a tree. This amazing experience led to

the initiation of our project – to develop a sculptural instrument using sensor technologies that would enable an exploration and exchange with plants and trees.

Theories of empathy

PLEIN AIR focuses on an empathic exchange with trees by means of a system for measuring plant physiological changes and a system for translating those changes into sound, extending our sensory response to the tree and to its response to the environment.

The word empathy comes from the Greek word *empathis* (em + pathos), referring to passion, feeling, and emotion. In the late nineteenth century, the theory of empathy became a philosophical concern. The English word ‘empathy’ was translated from the German ‘*Einfühlung*’, meaning ‘feeling into’. It was not a literal meaning of going inside the other person, but meant relying on careful observation and nonverbal communication such as facial expression, eye contact, body gestures, and other behaviors and experiences beyond one’s intellect.

In the twentieth century, Edith Stein further developed the concept of empathy.

Empathy...is the experience of foreign consciousness in general, irrespective of the kind of the experiencing subject, or of the subject whose consciousness is experienced.

Edith Stein, [1917] 2002, p. 11.

For Stein, empathy is a practice that can be developed and refined through intimate attention to people and things over time. It is an act of perceiving in which we reach out to the other to grasp his / her / its state or condition. Empathic experience is focused toward something foreign rather than something familiar. It motivates something within the other that is more than what we could know on our own, and enables different forms of expression to be made. It adds something to the world that would not otherwise exist. In contrast, sympathy, according to Stein, is assuming a feeling in another based on what we already know about our self and our interests.

Our epiphany at the FACE experiment was based upon a relationship between a tree, the sunlight, clouds, and human interventions, expressed symbolically through plant physiology equipment. The experience gave us a sense of lived connectedness. Stein calls this connectedness the ‘phenomena of life [that includes] growth, development and aging, health and sickness, vigour and sluggishness’ (2002, p. 68). She extends this idea further, ‘...we not only see such vigour and sluggishness in people and animals, but also in plants. Empathic fulfilment is also possible here’ (2002, p. 69).

With empathy, we not only understand, but we feel the other’s health, well-being, or emotional state. It helps us to imagine ourselves as if the other is looking at us and judging our behaviour. Lakoff and Johnson define it as an ‘...imaginative experience of the other’ (1989, p. 566). This specific imagination is cued by the empathic relationship between what is perceived and the perceiver. Imagination works through metaphor to enable our understanding of the other and the environment. This is key to an empathic approach to non-human living things.

Can a tree understood as a thing become a being of value?

The idea of plants and trees as sentient or sensory-aware subjects with memory remains controversial. Until recently, mainstream science has been unwilling to consider ideas like sensory perception, communication, memory, agency, and knowledge in plants. But there are some cracks in that armour. Biologist Anthony Trevawas writes on ‘plant intelligence,’ arguing that plants are territorial and competitive, forever changing their ‘architecture, physiology, and phenotype’ in the intelligent pursuit of resources for growth and reproduction (2005, p. 413). Daniel Chamovitz argues for ‘awareness’ rather than ‘intelligence’ in plants (2012, p. 167-176). He makes a case at the bio-chemical level for specific sensory perceptions and for a form of memory enabling responses to changes in the environment. The tree, then, is a ‘being’, expressive, if not sentient in the same way as humans, sharing in the value of living beings.

This work has vociferous critics. Richard Fern rebuts Trevawas, and demands limitations on what he calls an ‘anthropocentric’ description, seeing human qualities in the non-human (2004, p. 345-351). In reply, we would argue that anthropocentrism can, indeed, obfuscate the differences between the human and the more-than-human, but that there is not a hard line of qualities separating humanity from everything else in the world. Too, as Stein shows, an empathic relation is towards the unfamiliar, and not dependent on attributing familiar human qualities to the more-than-human. These scientists push plants towards intelligence and awareness, opening up ideas of plants as consciousness and sentient beings.

Art, science, and perception

PLEIN AIR is an easel-based system of connected elements. A tree leaf is held in a chamber mounted on a stand. A port on the back of the easel collects air, which is then measured by four sensors and pumped into the leaf chamber, it is then pumped back out of the leaf chamber and through another bank of sensors to be measured again. Reduction in carbon dioxide (by the leaf) is one of the factors used to indicate photosynthesis. Increase in humidity indicates leaf transpiration. A light sensor is also mounted on the leaf chamber.

The system is comprised of high quality sensors¹ embedded in a traditional, wooden painting easel housing a computer that processes equations that measure and sonify photosynthesis and transpiration. The measurements indicate the cause-and-effect of tree-leaf stomata, the thousands of small pores on a leaf, opening and closing in response to the needs of the plants and with changes in local atmosphere and weather and light conditions. What is ‘heard’ is the sonic representation of tree leaf photosynthesis and transpiration data.



Image top: The first iteration included the project as a table-top experiment.

Image middle: A mock-up development of the easel in California.

Image bottom: Detail of the leaf chamber.



Image: top: PLEIN AIR phase 2, fieldwork with a birch tree, upper Deeside, Aberdeen.
Image bottom: Installation detail of PLEIN AIR | *The Ethical Aesthetic Impulse*, at Peacock Gallery, Aberdeen (2010).

With this artwork, we sought to explore human-tree interrelationship. Our focus was on revealing reactions to shared environmental conditions such as sunlight, temperature, humidity and the amount of carbon dioxide in the air. Trees are alive, yet perceived as non-reactive entities, operating within a timescale at the edge of human perception. Humans affect our shared environment through the anthropogenic production of carbon dioxide as a by-product of industry, transport, and development, as well as by breathing. Yet humans have little sensitivity to the impact of increases in carbon dioxide². With sensors we can perceive a tree, as it reacts to atmospheric change and small shifts in the amount of carbon dioxide in the air. PLEIN AIR is an experimental approach to a relationship with another species that shares our everyday context. The research, in both its technical and artistic forms, is focused on the reactions of trees and on creating conditions where attention, guided by aesthetic experience, enables the potential for empathic exchange in real time.

The phases of PLEIN AIR

Our intention was to develop a portable sculptural instrument that would support an attentive, empathic experience with trees. We were working with the speed of reaction by a tree leaf responding to changes to carbon dioxide, temperature, humidity and sunlight. And, we were working with a temporal, sensory, sound-symbol output. The constantly changing environmental conditions and physiological response of the leaf needed to be closely synchronized with the sound interface if the sensitivity of plants to atmospheric change were to be revealed. The sculptural interface needed to work in real time.

PLEIN AIR has progressed, like an experiment, through phases or iterations of research and production.



Eden 3: Trees are the Language of landscape. The third phase of the project at Tent Gallery at Edinburgh College of Art, Edinburgh, 2013.

The first iteration: (2008-09)

The project was conceptualised in 2008 as Goto was undertaking doctoral research at Robert Gordon University, Aberdeen, Scotland, and as Collins had a research grant from the University of Wolverhampton in the West Midlands, England. This first iteration involved a table-top filled with equipment to collect physiological data and a separate software sound system. We devised a series of creative experiments within these limitations during a residency at the Headlands Center for the Arts in California. Returning to the UK, we undertook a residency at the University of Wolverhampton Crop Technology Unit, working with agricultural scientist Trevor Hocking and doctoral researcher Mat Dalgleish to refine the system.

The second iteration: Wolverhampton and Aberdeen (2009-10)

The focus of the second iteration was to produce a real-time field instrument, a laptop-based, folding sound-easel with small speakers, all run by batteries. The Crop Technology Unit provided input from a plant physiologist and access to light and climate-controlled chambers, as well as a greenhouse. There, we were able to refine and re-engineer the components to create a real-time sound system based on the Windows OS sound synthesizer. It was tuned and tested by an engineering consultant. A custom-made, portable, hardwood easel was hand-crafted. PLEIN AIR had become a complex portable instrument and a sculptural interface.

The easel was used outdoors for fieldwork in urban, public spaces in Aberdeen. As we were both present, most people wanted to hear an explanation of what was going on. The form and function of PLEIN AIR engendered curiosity, but

little sustained interest. Maybe half would listen to the sound and consider the environmental context. These were indications of sympathetic engagement, in Stein's sense, where there was sensitivity to the experience, but it was processed through what was known, rather than the relational, imaginative projection that we were hoping to encourage.

Installing the sculptural interface in a gallery, within a self-contained greenhouse with trees planted in pots, was more effective. The exhibition was 'PLEIN AIR: *The Ethical Aesthetic Impulse*' at Peacock Visual Arts in Aberdeen, Scotland (2010). Without someone present to explain things, viewers would sit in a chair and relax as they took in the experience. There was more potential to engage with the tree and the imagination at the same time.

The system worked but remained somewhat tenuous and experimental. A woodwind and a piano were chosen from the standard synthesizer library as the 'voices' for sonification. The piano voice was chosen for its data clarity. However, it was criticized during the exhibition for its sound dominance, compromising an empathic relationship with the tree. The woodwind was less jarring, but its data clarity was ambiguous. The visibility of the technology was also called into question.

The third iteration: Edinburgh (2011-13)

Changes were made for the third iteration improving the musical quality. Sound artists Michael Baldock and Clare Cullen sampled specific woodblock and forest sounds for percussion and used a complex programme to create an integrative, data-driven rhythm track. It was beautiful and captivating. We spent a year working with it, but found it difficult to sense the changing physiology of the tree.

We met Chris Malcolm, a software developer with over twenty years' experience in interactive systems and sound design. He decided to abandon the sampling idea and work with data-driven custom sound synthesizers and banks of resonators. Working closely with Goto, he approached the work like a jazz musician trying out different programming riffs and refining them to hear the changes occurring with the tree over time. We developed a data / sound library that the tree could play, testing and calibrating his programming with different live tree data. This began with a distinctive data-driven bass line that would reveal increases and decreases in photosynthesis and transpiration. Malcolm then developed a complex set of accompanying tones 'shaped' by subtle changes in specific sensor data. The final product was robust, providing the listener with a sense of the changing conditions. It also required a new computer, new speakers and a new dedicated, live leaf / data display, that, in turn, required changes to the easel.

The project was the centrepiece of the exhibition '*Eden3: Trees are the Language of Landscape*' at the Tent Gallery at the Edinburgh College of Art (2013). The project was shown on a raised platform with four trees; documentation of its development was presented on the walls. With the laptop replaced by a mini-computer, a graphic image could be presented on a flat screen. The audience could logically link the sensor display to the sound data, but this elicited more interest in the scientific meaning than the experiential immersion we were looking for from the audience. Without the greenhouse enclosure, the audience had less impact on the atmospheric chemistry, so that aspect of the experience was not as variable and somewhat less effective.

PLEIN AIR had become less portable, but the sound was fantastic. More importantly, the output reflected the changes to tree physiology while retaining



The final phase, *Sound of a Tree: Cologne*, Curated by Georg Dietzler. In *Visual Sounds: Bioakustische Musik*, ON - Neue Musik, Cologne Germany (2015).

musical integrity. We came away with a clear sense of another series of changes that could be made to the form, function, and graphics. By then, we were based in Glasgow. As curators, producers and artists came to look at the work in our studio, we started to think about the final exhibitions.

The final iteration: Cologne and Glasgow (2015-17)

In 2015, we made refinements to the light sensor and the sound system. A new live-leaf video programme was produced for a residency and week-long performance, '*Sound of a Tree: Cologne*,' in a music venue, Neue Musik Köln, in Cologne, Germany. PLEIN AIR was set in a plain, square music room with a high ceiling. The audience included artists, musicians, and composers. They sat with the instrument and the trees. They seemed to listen longer and more carefully than a typical visual-arts audience. There was a lot of discussion about the trees and attention given to the subtle complexity of the sound and the range of the instrument. Too, there was interest in the programming; some asked if anyone had tried to notate the ever-evolving composition. These were most welcome responses. We recorded many hours of the presentation.

We secured Creative Scotland funding in 2016 to upgrade the sensor system and organize a series of final exhibitions. Engineer Dave Russ worked closely with Chris Malcolm who refined the sound and video software to take best advantage of the new sensors. We then began to redesign the easel and monitor and the external leaf chamber systems.

In 2017, the work with its final changes was exhibited at the Kibble Palace, a historic glasshouse in the Glasgow Botanic Gardens. More than six hundred people attended the exhibition, '*PLEIN AIR | Live at The Kibble Palace*'.



PLEIN AIR | *Live at The Kibble Palace, Glasgow Botanic Gardens, Scotland, 2017.*

They would stroll through some sat with the work and engaged with us as we were present for the duration of the exhibition. The glasshouse afforded rapid changes in weather, light, and temperature made the sound changes clear and recognisable. Not everyone liked the sound and some questioned the validity of the methods that produced it. But the number of repeat viewers and those that came back with friends and family provided new insights about the work and a higher level of engagement than those during previous exhibitions. We announced each day which tree was ‘playing’ the instrument. Some people came back and asked to hear the same tree again.

The sounds in Glasgow were recorded with assistance from producer Georg Dietzler, a vinyl LP record album was produced with tracks from Cologne and Glasgow, ‘PLEIN AIR | *Silva Datum Musica*,’ was the final scope of work. The system that was initially conceived as a simple group of sensors had grown into a complicated array of electronics. Planned as a light-weight sculpture with a laptop computer, it evolved into a robust musical instrument, that required mains power. Our practice / performance moved from a dynamic outdoor environment to a stable indoor environment in order to achieve the clarity of function and purpose tied to the pursuit of an empathic practice with trees.

Conclusion

We return to our key question: can artwork contribute to changing the perception of a tree from a ‘thing’ to a ‘being’ of value. The responses to date are more cultural and subjective than scientific. We argue that science, generally, contributes to our understanding of what a set of things are in form and function, while art focuses our attention on the individual qualities that set people, places, and things apart from common truths.

The tree is commonly understood as property, as a utilitarian resource and as a non-sentient thing. The presence of trees in our daily lives and their biochemical agency can be construed as more public than private. Where moral duty is afforded to a tree it is normally due to radical species loss, as with the common juniper of Scotland and Wales, or because it has unusual cultural value. An example is the Chinju no mori or sacred groves around Shinto shrines which are protected as the dwelling place of the kami spirits.

We shaped the project to become a sculptural instrument that sits between ourselves and the individual being of one leaf, one tree. The experience produced by PLEIN AIR, mediated by sensors and software, lets us hear the otherwise silent sound of this one leaf, one tree breathing. It is a simple instrument for a tree to play. Does our sense of moral duty change as we listen? Empathy is the leverage point with which we have chosen to work. We have produced an experience that focuses the audience on what Goto calls 'a sense of lived connectedness' (2012, p. 94-95). This experience is designed to insinuate empathic attention and perhaps suggest an ethical duty that might be owed to a live tree that shares our breath.

Theodore Adorno writes, 'Art is not an arbitrary cultural complement to science but rather, stands in critical tension to it' (1997, p. 231). With PLEIN AIR, the tree becomes the sensual other that we seek empathic interrelationship with in order to extend our experience and perception of the environment. The work follows ideas in science, and expands current theory and practice in our own artistic discipline. Working in the realm of imagination and metaphor, it offers a small challenge to the instrumental relationships we have to more-than-human life. The epiphany is to art, as discovery is to science.



Chris Malcolm testing a new sound and video programme before the first recordings at the Kibble Palace, Glasgow Botanic Gardens, Scotland, 2017.

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End Notes:

1. The system includes two carbon dioxide, temperature, and humidity sensors; there is one air flow and light sensor.
2. Carbon dioxide is invisible, colourless, odourless and without taste. Increased levels of carbon dioxide can cause drowsiness. Significant levels of carbon dioxide effect eyesight, hearing, shortness of breath and increased heart rate and blood pressure. Because it is heavier than air it can displace oxygen and cause death by asphyxiation.

Collaborators and Advisors

Phase One

Prof Carola Boehm, Staffordshire University
Dr Mat Dalglish, University of Wolverhampton
Prof Anne Douglas, Robert Gordon University
Prof Trevor Hocking, Emeritus, University of Wolverhampton
Dr Stephen Hunt, CEO, Qubit Systems

Phase Two

Michael Baldoch, iOS specialist, Telegraph Media Group
Clare Cullen, Musician and Composer
Pete Richards, Solutions for Research

Phases Three and Four

Nicola Chambury, Artist
Georg Dietzler, Artist
Noel Hefe, Artist
Chris Malcolm / Chris Binarystar
Dave Russ, Campsie Creative

The Final Project Team, our Biographies

Collins & Goto Studio: Tim Collins and Reiko Goto have developed long-term, socially engaged environmental research (SEER) that examines the cultural meaning of semi-natural ancient forest: *Future Forest* (2013-present); *Sylva Caledonia* (2015); *Caledonian Decoy* (2017); PLEIN AIR: *The Ethical Aesthetic Impulse* (2010); *CO2 Edinburgh* (2013); *Sound of a Tree: Cologne* (2016); PLEIN AIR | *Live at Glasgow Botanic* (2017); *Nine Mile Run* (1997-2000); and *3 Rivers 2nd Nature* (2000-2005). Outputs include artworks, exhibitions, seminars, workshops, and publications that embrace an arts-led dialogue method of research-and-theory-informed public practice. They have worked with other artists, musicians, planners, communities, scientists, and technologists as well as historians and philosophers to realize work for over thirty years.

Sound Programmer: Chris Malcolm is a Scottish computer programmer and software developer with over twenty years of experience writing computer code with vector graphics, sound and interactive systems for industry clients. He also has an extensive background in experimental music developing innovative tools and instruments for studio and live performance. Malcolm is recognized within the electronic music scene for his use of retro-computers and consoles to generate unexpected interactive audio and visual experiences. The work with Collins & Goto Studio is driven by a curiosity about human relationships to technology as a tool and as an interface to bio-events. The PLEIN AIR system and software opens up new programming challenges and levels of expression not available with traditional electronic instruments and methods.

Producer: Georg Dietzler is a Cologne-based artist, author, curator, and consultant. He is recognized as an active producer of cross-disciplinary cultural projects, exhibitions, seminars and conferences, audio-visual concerts, media, dance, improv-theatre, and more. As a socio-political and conceptual artist with an international reputation, he works on ecological future visions linked to social and political change. His latest art work is a concept for an inner-city citizens' heirloom orchard, introduced at 'Ecovention Europe' at De Domijnen, in Sittard Netherlands in 2017.

Artist: Reiko Goto Collins was born in Japan and has lived in both the US and UK. She is a principal in the Collins & Goto Studio. She has been a research fellow at the Institute for Advanced Studies in the Humanities at the University of Edinburgh. She participates in an international climate change network, Council on the Uncertain Human Future, and is currently involved in the working group 'Living Organisms and Their Choices' at the University of Edinburgh. She is a distinguished research fellow at the STUDIO for Creative Inquiry at Carnegie Mellon University in Pittsburgh, Pennsylvania.

Artist: Tim Collins is from the US, an artist, author, and planner; a principal in the Collins & Goto Studio; and an honorary research fellow in the School of Social Science at the University of Aberdeen. He works across science, technology, and philosophy to develop projects related to nature, culture, and to changing ideas about ethical duty and public space. In 2017, he was on the development committee for the 'Art and Artists in Landscape Environment Research Today' seminar at the National Gallery in London. He currently serves on the board of directors for the Landscape Research Group and Glasgow Sculpture Studios.

Exhibitions and Publications

- 2017 PLEIN AIR | *Live at the Kibble Palace*. (exhibition). At The Kibble Palace, Glasgow Botanic Gardens. Glasgow, Scotland.
- Goto, R., Collins, T. 'Imagination and Empathy - Artists with Trees.' *In Participatory Research in More-than-Human Worlds*. Eds. Bastian, M., Jones, O., Roe, E. Oxford: Taylor and Francis.
- 2016 Collins, T., Goto, R. 'PLEIN AIR at Common Ground.' (conference presentation). For the *Creative Commons: Common ground*, UK Arts and Humanities Research Council, University of York. York, England.
- 2015 PLEIN AIR | *Sound of a Tree*. (exhibition). Curated by Georg Dietzler. At *Visual Sounds: Bioakustische Musik*, ON-Neue Musik Köln. Cologne, Germany.
- 2013 *Eden3: Trees are the Language of Landscape*. (exhibition). At Tent Gallery, Edinburgh College of Art. Edinburgh, Scotland, UK.
- Goto, R., Collins, T. 'Imagination and Empathy - Artists with Trees'. (conference presentation). At *Landscape and Imagination*, Uniscape. Paris, France.
- 2012 Goto, R. *Ecology and Environmental Art in Public Places, Talking Tree: Won't you take a minute and listen to the plight of nature?* Thesis (PhD). Robert Gordon University. Aberdeen, Scotland.
- 2011 Collins, T., Goto, R. 'Emancipation and Freedom: Art with Living Things, People and Place'. (conference presentation). At *Making Meaning and Context: A Radical Reconsideration of Arts Practice* Goddard College. Vermont, USA.
- Goto, R. *Calendar Variations*. (installation and performance). Curated by Prof A. Douglas and Prof K. Coessens. At Lang Byre Gallery, Woodend Barn. Banchory, Scotland, UK.
- 2010 PLEIN AIR | *The Ethical Aesthetic Impulse*. (exhibition). Curated by Angela Lennon. At Peacock Visual Arts. Aberdeen, Scotland.
- 2009 Collins, T. 'Eden3 and the Ethical Aesthetic Impulse'. (conference presentation). The Arts and Forestry Commission Conference, London, England.



PLEIN AIR | *Live AT The Kibble Palace*, Glasgow Botanic Gardens, 2017.



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