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ÉLIANE RADIGUE AND THE ARP 2500 MODULAR SYNTHESISER

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Abstract: This article considers Éliane Radigue and her use of the modular synthesiser, the ARP 2500, as a conduit for musical expression. It examines her seminal work *Trilogie de la Mort* (1988–93) and considers current reconnections to her work, including tribute concerts at the Electronic Music Education and Preservation Project, Philadelphia; Kali Malone's 2022 album, *Living Touch*, which uses Radigue's ARP 2500; and the author's own experience of recording on the machine. As the article points out, these reconnections complement both electronic music compositional methodologies and their future direction. Radigue's tactile and collaborative approach with the ARP 2500 is an interaction that embodies both the past and future.

Background

The tools for making electronic music are not impartial: true sound mediums are an interface to ghosts of technoscientific projects of the past. Tresch and Dolan consider that the 'life of an instrument, [highlights] its divergent histories and trajectories',[1] while Kirschenbaum suggests that 'materiality in technology is never lost and that such approaches encourage us to perceive new media in terms of specific versions, platforms, systems and devices'.[2] Our relationship with technology conditions us in many ways, and as Heidegger suggested, 'the will to mastery becomes all the more urgent the more technology threatens to slip from human control'.[3] Musical interfaces such as the modular synthesiser allow for far more interaction and can produce a more unrestrained sense of sonic exploration approach to electronic music-making.

The electronic medium of sound and its generation is less and less concerned with the pitch-centric domain, instead moving towards timbral and textural approaches. Selection of aesthetics and tools is a crucial framework and process for the composer, in the choices they make

[1] John Tresch and Emily Dolan, 'Toward a New Organology: Instruments of Music and Science', *Osiris* 28, no. 1, *Music, Sound, and the Laboratory from 1750–1980* (Chicago: Chicago University Press, 2013), pp. 278–98.

[2] Matthew Kirschenbaum, *Mechanisms: New Media and Forensic Imagination* (Cambridge, MA: MIT Press, 2008), pp. 122–23.

[3] Martin Heidegger, *The Question Concerning Technology* (New York: Garland Press, 1954), p. 289.

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and the musical problems they attempt to solve. Curtis Roads saw this as the process of choosing the right compositional problems to solve, leading to 'a question of strategy, tactics, tools and materials',[4] since all aspects of music are both enabled and limited by the available tools, from instruments to composing strategies.

During the 1950s, electronic music studios housed equipment that was primarily sourced from telecommunications and engineering and that had been repurposed for composers to use for both sound generation and manipulation. These machines were born without reference to musical tradition and 'without reference to human gesture'.[5] During these early stages of the development of electronically generated sound, Herbert Eimert reflected on what these machines would contribute:

> (Electronic Music) is not a cautious departure from certain traditional paths but rather, in the radical character of its techniques, gives us access to sound phenomena hitherto unknown in the field of music. This bursting open of our familiar world of sound by electronic means leads to new musical possibilities of a wholly unpredictable nature.[6]

As budgets for electronic music studios shrank during the late 1970s and the 1980s, composers began to migrate from hardware to computer-aided composition in the quest for the new, but the multifunctionality of these electronic music compositional systems can present a hindrance. The control of sound behaviour with just one process, on the other hand, can bring about a limited control of expressiveness and gesture, and this is a key aesthetic and framework of Éliane Radigue's *Trilogie de la Mort*.

While music technology may change dramatically each decade, musical aesthetics require a reflection and development that benefits from longer historical periods. The democratisation of technology, for example, is, as Lukas Foss has suggested, where progression takes place:

> The history of music is a series of violations, untenable positions, each opening doors. Progress in the arts: a series of gifted mistakes, perhaps. We owe our greatest musical achievements to an unmusical idea: the division of what is an indivisible whole, 'music', into two separate processes: composition (the making of music) and performance (the making of music).[7]

The modular synthesiser represents one of the most significant developments of both electronic and twentieth-century popular music-making. Methodologies within its design and architecture stretch back more than 50 years and exploit traditional signal-processing applications. These instruments were developed on the east coast of the US by Robert Moog and on the west coast by Don Buchla, both of whom began with a modular approach to synthesis; Moog, in particular, responded to the demand for more portable and affordable options by adopting a more consumer-based approach and using fixed architecture.

[4] Curtis Roads, *Microsound* (Cambridge, MA: MIT Press, 2001), p. 40.
[5] David Keane, 'At the Threshold of an Aesthetic', in Simon Emmerson (ed.), *The Language of Electroacoustic Music* (London: Palgrave Macmillan, 1986), p. 99.
[6] Herbert Eimert, 'What Is Electronic Music', *Die Reihe 1 – Electronic Music* (1955), p. 60.
[7] Lukas Foss, 'The Changing Composer-Performer Relationship: A Monologue and a Dialogue', *Perspectives of New Music* 1, no. 2 (1963), p. 45.

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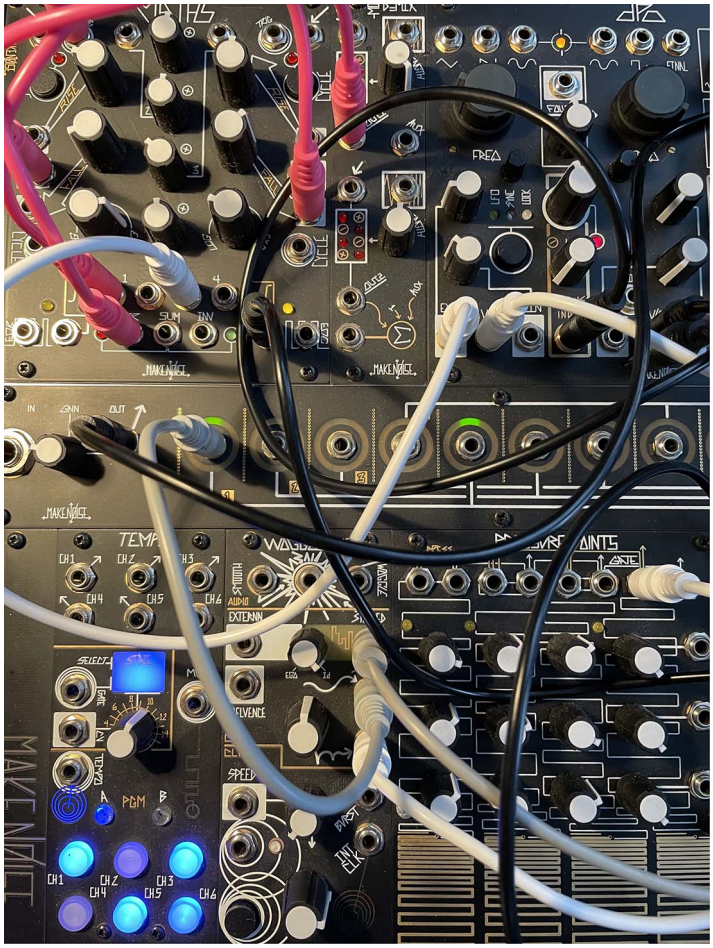

Figure 1:
ARP 2500 (photograph by the author).

In 1969 Alan R. Pearlman, an electronics engineer inspired by Moog and the Moog synthesiser, formed ARP Instruments, and in 1970 developed the model 2500 (see Figure 1). Only about 100 units were manufactured, many of which are still in operation around the world, including the one owned by Éliane Radigue. What was unique about the 2500 and made it different from modular synthesisers was that it did not use patch cables to route the signal between its modules. The 2500 uses a unique 10 × 10 matrix switch system (see Figure 2) to accomplish signal-routing. Modules are located in the centre row of the cabinet, with the matrix switches located above and below the modules; it was perhaps this simplicity in operational approach that enabled Radigue's development of the *Trilogie*.

Background – *Trilogie de la Mort* (1988–93)

After initial studies in music theory and harp at the Nice Conservatory, Radigue was inspired by Pierre Schaeffer's *Étude aux chemins de fer* (1948). This led her to the Studio d'Essai in Paris, where Schaeffer took

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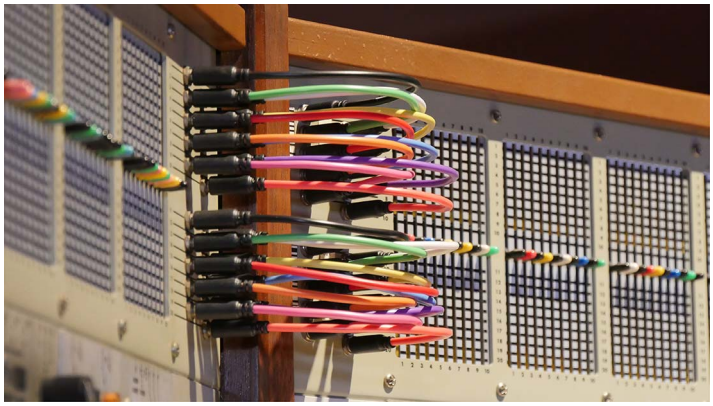

Figure 2:
ARP 2500 10 × 10 matrix switch system (photograph by the author).

her on as an intern from 1955 to 1958. After this period she embarked on a journey of discovery, particularly with tape and feedback. Later, during the years 1967–68, she worked as an apprentice to the composer Pierre Henry, who set her up with some of her own tape machines and equipment in her apartment. Having her own space and equipment eventually led Radigue to compose two of her seminal feedback works, *Elemental 1* (1968) and *Usral* (1969).

Like the ergonomic approach to working with the medium of magnetic tape, the Radigue process is a patient one: sonic transformation unfolds slowly as both partial harmonics and subharmonics combine. A period in America (1970–74), including work at New York University with Morton Subotnick in 1970, led to her discovering the expressive potential of the synthesiser. *Chry-ptus* (1970) was one of the first pieces created using a synthesiser (in this case, the Buchla 100); it developed as Radigue's interest, as her interest in translating her experiments with tape and feedback into the synthesised domain grew. Over its *Chry-ptus*' 93-minute span, Radigue's methodology allows it to explore overtones and subharmonics, appearing and reappearing to create an unfolding psychoacoustic effect.

> *Chry-ptus* is made of beating and pulsations close to feedback between two tape recorders. Nevertheless, with feedback, I could never have started with beating gradually, imperceptibly, reaching sustained sounds, which themselves occurred mostly with *larsen*. There is a logical continuity to what I did.[8]

The purchase of her own ARP 2500 (which she named Jules) in 1970 enabled Radigue to develop her own aesthetic with the synthesiser, using her experience with tape to develop an approach that explores the materiality of sound over long durations. She used the machine for over 30 years, developing longer, more complicated pieces whose scores are represented by technical and operational performance notes. Example 1 shows part of the 'score' for *7th Birth* (1971), the first piece Radigue composed on the ARP 2500.

Another significant event in the development of *Trilogie* was a lecture given at Mills College in Oakland, California by the minimalist composer Robert Ashley. The topic, Tibetan Buddhism, resonated

[8] Radigue in Julia Eckhardt, *Éliane Radigue: Intermediary Spaces* (Brussels: Les presses du réel, 2024), pp. 111–12.

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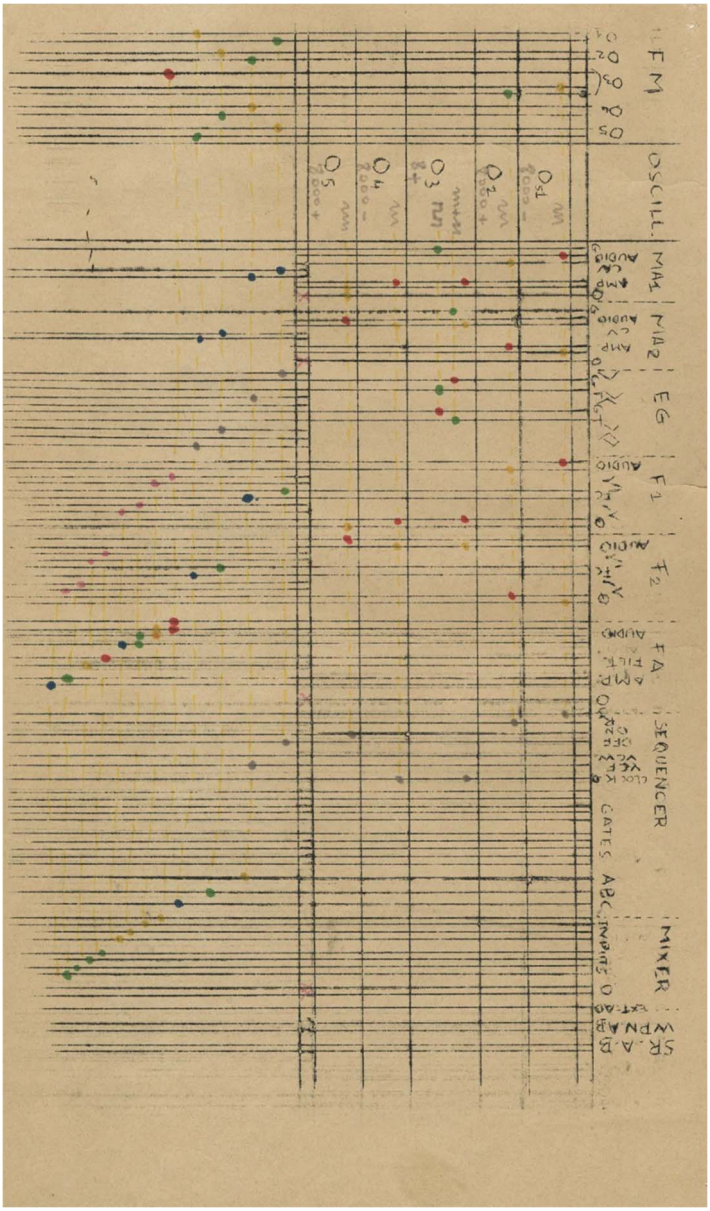

Example 1:
Extract from *7th Birth* (1971) (Photo: Fondation A.R.M.A.N. © Éliane Radigue).

greatly with Radigue, who found in it solace and inspiration for her work. She converted to Buddhism in 1974 and considers her spiritual path to be as important as her discovery of the workings of electronic music. *Jetsun Mila* (1986), released just before the composition of *Trilogie*, began as an evocation that comprises nine 'stages', preceded by a prelude, representing the great periods of the famous yogi's life. Radigue is now a master of the long format, guiding the listener through works filled with refrains, restraints and aural contemplation.

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Analysis: *Trilogie de la Mort* (1988–93)

Produced in her studio in Paris, *Trilogie* is an extended sonic meditation on death, informed by Radigue's engagement with Tibetan Buddhism and made up of three hour-long ARP 2500 synthesiser compositions: *Kyema, Kailasha* and *Koumé.* Inspired by the Tibetan Book of the Dead, *Trilogie* explores the full range of existence, expanding musical consciousnes, in a cyclical voyage through a myriad of tones and drones where the end is only the beginning. It explores and exploits 'deep listening', a process whose name was coined by American composer Pauline Oliveros, by investigating vibratorary spaces. Radigue says that the movements describes 'the subtle changes, the transitions that arise, as in life, in respiration. We're constantly in intermediary phases. Everything is transient.'[9]

Technology develops autonomously, propelling our culture at breakneck speed, but it has also facilitated Radigue's more functionary role within composition, enabling her to become a controller who allows the synthesiser and its control mechanisms to become the primary compositional voice or voices. Again, this is dependent on varying compositional approaches. For Radigue, her work with the ARP is, at its most fundamental level an example of Ockham's razor,[10] the principle that gives precedence to simplicity, so that, of any two competing theories, the simpler explanation is always preferred.

> Technically, it was quite complex. But as we know, technique is made to be forgotten. Firstly you study, then when you start to learn, you're inside and can let yourself go intuitively. It's the same when you learn to drive. There are a lot of checks to incorporate, but you're driving properly when you forget them and implement them naturally.[11]

Instead of cutting and splicing analogue tape, the ARP allowed Radigue to work in a much more immediate way; thus her methodology could become more meditative, something that is profoundly evident in her work with the machine. Another compositional methodology, hinted at in Eckhardt's book, informs Radigue's attitude to melodic progression: she has said that, after experimenting with the machine's arpeggiator, she found that 'it was too abrupt. I had already given up on the idea of making melodies or rhythms.'[12]

The final mixing and sequencing of *Trilogie* was carried out in the digital domain. This created compositional difficulties because of the unlimited scope of the digital audio workstation: Radigue has remarked that 'analogue sound is continuous, so you can make it evolve in the texture of the track. But digital sound is by nature, discontinuous, produced by bits.'[13] This transition point was significant for Radigue: later in her career she would abandon both analogue and digital synthesis approaches and turn to acoustic instruments. The process of working digitally became too distracting for her: 'I was alone practising my various listening techniques; distracted listening, where you let sounds fly by, observing what the ear holds on to; listening that waits

[9] Radigue in Eckhardt, *Éliane Radigue*, p. 136.
[10] Attributed to the fourteenth-century friar William of Ockham.
[11] Radigue in Eckhardt, *Eliane Radigue*, p. 111.
[12] Radigue in Eckhardt, *Eliane Radigue*, p. 143.
[13] Radigue in Eckhardt, *Eliane Radigue*, p. 143.

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for sounds to call out; technical listening – to the works – can be devastating.'[14] Kyle Gann's 1998 review of *Trilogie* considers its gradual approach, commencing:

> Overtones of gently pulsing drones are Radigue's themes, but her sweep is symphonic. Booming bass tones test the limits of your loudspeakers, and within them string orchestras and bagpipes seems to play dirges but everything is analogue electronics. When the music goes from sweet to sad, or from roaring climax to pure quiet in the final half-hour, the change is so imperceptibly gradual that it sweeps you along all the more. You have to slow your day down just to begin appreciating this, and that's not a bad idea.[15]

Aesthetic Frameworks

Technological Determinism

A number of aesthetic frameworks are presented here to discuss *Kyema*, the first part of the *Trilogie*. Technological determinism, for example, seeks to understand how technology influences human action and thought. Marcuse considered freedom in relation to the commodification of technology and the extent to which technology is independent of social influence or is determined by human will, suggesting that:

> Technological rationality, which impoverishes all aspects of contemporary life, has developed the material bases of human freedom, but continues to serve the interests of suppression. There is logic of domination in technological progress under present conditions: not quantitative accumulation, but a qualitative leap is necessary to transform this apparatus of destruction into an apparatus of life.[16]

For Marcuse, technology and humans are co-evolutionary: 'our understanding of natural and social environments are wholly a product of our cultural, political and technological means of organisation within the capitalist mode of production'.[17]

Musical performance has always been inextricably linked with the body, and Radigue used the synthesiser's control interface and its tactile approach to music-making to influence the types of sounds and gestures that could be obtained from it. She realised that controlling sound with just one or more functions of the ARP 2500 (the oscillators' frequency cut-off and their ranges) gave her a limited control of expressiveness and gesture, elements sometimes lost in translation within the use of digital processing, and that this was a form of determinism, as a meditation on the pure nature of electronic sound.

Agency

Agency is defined as the intersection of power, from which power is distributed into different hands and directions. According to Dafoe,

> A central issue in the study of technology is the question of agency. To what extent do we have control over the tools we use – and hence also our systems of production, social relations, and worldview. To what extent are our technologies thrust upon us – by controlling elites, by path-dependent decisions from the past, or by some internal technological logic.[18]

[14] Radigue in Eckhardt, *Eliane Radigue*, p. 143.

[15] Kyle Gann, '*Trilogie de la Mort* (Review)', *Village Voice Magazine*, 1 September 1998: https://www.kylegann.com/VV-ConsumerGuide-9-98.pdf (accessed 2 July 2024).

[16] Herbert Marcuse, *One-Dimensional Man* (Boston: Beacon Press, 1964), p. 111.

[17] Marcuse quoted in T. K Luke, 'One-Dimensional Man: A Systematic Critique of Human Domination and Nature-Society Relations', *Organization & Environment* 13 (2000), 95–101.

[18] Allen Dafoe, 'On Technological Determinism: A Typology, Scope Conditions, and a Mechanism', *Science, Technology, & Human Values* 40, no. 6 (2015), p. 1048.

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Radigue's agency is represented by her relationship between the synthesiser; her capacity, condition, or state of acting or of exerting power, and the extent to which she has power or can achieve her goals. The type of synthesiser used in a recording often determines or limits an agent (the player or controller) and their decision-making. It is also important to recognise the utilisation of agency as a fundamental human quality, as it has the power to direct and regulate the conditions of music-making. From analogue to digital synthesis, synthesisers' functionality is contextualised by technological change, as Mayr observes:

> The defining characteristic of technology is its *functionality*, not its specific materiality. Technology, thus, (1) denotes those entities – artefacts, techniques, institutions, systems – that are or were functional and (2) emphasises the functional dimension of those entities.[19]

Cybernetics

This article proposes that *Trilogie* is a work that uses cybernetic processes, a transdisciplinary approach for exploring regulatory systems, their structures, constraints and possibilities. The term is often used rather loosely to imply the control of any system using technology, or the scientific study of how humans and machines control and communicate with each other. It also opens up questions about technology and its unknown effects. Wiener questioned the idea of progress, considering that 'progress imposes not only new possibilities for the future but new restrictions'.[20] Cybernetic systems are used to model phenomena from factories, to societies, from machines to creative ecosystems. Beer provides an insight that is valuable in considering the relationship of music to the synthesiser: 'instead of trying to specify it (a system) in full detail, you specify it only somewhat. You then ride on the dynamics of the system in the direction you want it to go'.[21] Eno has argued that the theory of cybernetics allows the composer to think differently about the creative process, conceptualising it as a compositional strategy:

> The technologies we now use have tended to make creative jobs do-able by many different people: new technologies have the tendency to replace skills with judgement – it's not what you can do that counts, but what you choose to do, and this invites everyone to start crossing boundaries.[22]

Radigue uses such an approach in *Trilogie*: the modular synthesiser becoming a 'system' so that the composer can entrust the synthesiser to make creative decisions, based on both environmental and behavioural responses. This article suggests that cybernetic elements had direct implications for the compositional process of *Trilogie*, and that these can be defined through the following features of a cybernetic system:

> Control Systems: regulating and maintaining a desired state or behaviour;
> Information Processing: regulating the transmission of information within a system;
> Feedback: circular processes in which the output of a system is used as an input, allowing for self-regulation.

[19] Erasmus Mayr, *Understanding Human Agency* (Oxford: Oxford University Press, 2007), p. 153.
[20] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Boston: Da Capo Press, 1954), pp. 46–7.
[21] Stafford Beer, *The Brain of the Firm* (London: Allen Lane, 1972), p. 69.
[22] Brian Eno, *A Year with Swollen Appendices* (London: Faber & Faber, 1996), p. 394.

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Radigue's compositional approach models 'systems', and her decisions are regulated through the ARP. She uses it as a form of measurement, never exceeding auditory thresholds in the aural spaces that the piece creates. *Trilogie* is, in many ways, an exploration of limitations, or as cybernetics would define it, their regulation. Much of Radigue's work with the ARP uses only its basic modules, the oscillators and filters, and does not implement the sequencer module. It is also worth noting that Radigue purchased an ARP 2500 without a keyboard, thus further limiting and/or controlling the behaviour of the synthesiser, both timbrally and melodically.

Cybernetic systems allow Radigue, through the tactile movements of her hands, to express and modulate sounds in real time. Unlike her experiments with tape feedback, the synthesiser allowed her to regulate musical material without being subject to chance: 'I could accept (sounds) them as they were. This period taught me what I consider to be a respect towards sound.'[23] 'Feedback' in the *Trilogie* becomes Radigue's own response to the ARP. During the compositional process, Radigue composed while listening, responding to the machine's feedback throughout the duration of these long-form pieces, self-regulating a more circular response to the instrument and the musical material.

Trilogie focuses on a perceptual process, the decay and rebirth of musical material, losing and regenerating ideas over time, presenting us with the gradual transformation of recognisable musical approaches, drones, beating and shifting frequencies. Cybernetics provide a model for Radigue's compositional approach, informing her creation of pieces that could go on forever, static in terms of musical movement yet never repeating exactly. In a landscape dominated by digital musical machines and synthesisers, cybernetics inform the compositional restraint and discipline of the *Trilogie*. Current electronic music production methods offer a creative utopia, with access to unlimited possibilities, tonalities and a total control over every imaginable parameter of sound. Radigue's work, on the other hand, considers the notion that it is often possible to say more with less musical material; that when the parameters of music-making are limited, artistic restraint can offer a more expressive aesthetic language.

Reconnections

The design history of modular synthesisers can be traced back to Moog and Buchla's work in the early 1960s. Methodologies within current instrument design and architecture exploit traditional modular signal-processing applications, but add to these the emulation of processes from the past such as time stretching and granular synthesis. What remains compelling about modular synthesisers, however, is that, by having sound generation and filtering modules close at hand, it is possible to navigate the histories of computer music-making in an instant and to compose with history. The instrument can be absolutely passive, with the performer or composer in charge of every smallest detail, or fully autonomous, human-independent. Thus it supports the establishment of new sensibilities and a reconsideration of compositional approaches.

Radigue's music and legacy have become better known, and her works made with the ARP 2500 have featured in a number of streamed

[23] Radigue in Julia Eckhardt, *Eliane Radigue*, p. 111.

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concerts and Radigue-influenced performances at the Electronic Music Education and Preservation Project (EMEAPP) in Philadelphia. There have been reissues of recordings on the INA-GRM label and Bandcamp, and in 2022 Kali Malone's *Living Torch* LP paid homage to the history and genealogy of the ARP 2500, using Radigue's own instrument on the recordings. A growing number of manufacturers have been emulating machines, and in 2022 the Germany company Behringer launched a range of ARP 2500 module clones, which allow users to rebuild the system used by Radigue at a fraction of the cost.

Conclusion

Musical performance has always been inextricably linked with the body. This heightened sense of interaction was most notable at the cusp of the 1980s, when music technology was changing dramatically, altering the ways in which musicians interacted with their instruments and recordings were produced and sounded. Our relationship with technology conditions us in many ways and, as Heidegger suggested, 'the will to mastery becomes all the more urgent, the more technology threatens to slip from human control'.[24] Radigue's approach to the ARP in *Trilogie* is a demonstration of a more restrained sonic approach to electronic music-making.

Virilio highlights the loss of restraint and physicality in art today:

> The demise of the relative and analogue character of sound samples in favour of the absolute, digital character of the computer, following the computer, following the synthesiser, is thus also the loss of the poetics of the ephemeral.[25]

Reconnections to the past, however, are restoring outlets for gesture, feedback and physicality in composition and performance. Throughout the history of synthesis, obsolescence has put machines and devices into the backrooms of studio and research labs; yet, because modular synthesisers are independent from operating systems, they become immune to the rapid pace of technological change, their architecture and inbuilt circuits fixed and autonomous, unresponsive to change.

This article has attempted to examine Radigue's use of the APR 2500 and the effects it had on her composition and development of *Trilogie*. The resurgence of interest in both Radigue's work and the modular synthesiser means that it is possible to listen to and navigate histories of the past and, with the emulation of the ARP 2500 modules, we are close to being able to make electronic music with history. Such processes bring wider audiences to Radigue's work, allowing it to grow, reinvent itself and reference its own history.

[24] Martin Heidegger, *The Question Concerning Technology, and Other Essays*, 1st ed., trans. William Lovitt, (New York: Harper & Row, 1977), p. 331.

[25] Paul Virilio, *Art and Fear*, trans. Julie Rose (London and New York: Continuum, 2003), p. 222.

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