# Daphne Oram: innovator, writer and composer

JO HUTTON

32a Eynham Road, London W12 OHA, UK
E-mail: jo.hutton@bbc.co.uk

**The main focus of this article is the work of Daphne Oram, composer of electronic music, who founded the BBC Radiophonic Workshop in 1958 and went on to run her own independent studio from where she composed several significant pieces of electronic music, designed and built a new audio recording machine, and lectured and wrote extensively on electronic and *concrète* music. The paper will endeavour to show that Ms Oram is deserving of recognition as an innovative composer of electronic and *concrète* music, as well as possessing interesting and valuable insight into the practice and theory of this medium. It will critically examine her work, and methods for achieving completed pieces, and compare and contrast her compositional work and the thinking behind it, to the work of other significant composers of the time.**

## 1. DAPHNE ORAM

During the late 1940s and the early 1950s the people of Europe were starting to learn about new electronic music and *musique concrète* from Pierre Schaeffer, Luciano Berio and Karlheinz Stockhausen who all worked in their national radio stations. Major developments in sound recording and reproduction for radio during the war had pre-empted a new peacetime obsession with the infinite musical possibilities of the tape recorder. This was a time when home studios were unheard of and budgets for this equipment could only be found in national radio stations.

Throughout Europe, post-war depression had inspired a revolution in the arts. The development of electronic music in France, Germany and Italy, which preceded developments in Britain, took place as a result of demands from national radio networks for an added dimension to atmospheric sound effects which would accommodate new post-war 'surreal' play-writing styles from the likes of Samual Beckett, Jean Cocteau, Frederick Bradnum and Giles Cooper. The birth of the surreal in radio drama required an appropriate ambience that could no longer be achieved satisfactorily from orchestral instruments alone.

Also at this time, magnetic tape gradually came into common usage in broadcasting studios across the world. With this new medium came new approaches to making music. It was now possible to piece music together as a puzzle of 'pieces of sound' or 'sections of magnetic tape'. Sound sources could be anything at all, as music reached beyond the confines of traditional orchestral instruments, and conventional notions of form and structure. Wishart suggests,

> From the final quarter of the 20th century it now seems clear that the central watershed in changing our view of what constitutes music has more to do with the invention of sound recording and sound processing and synthesis than with any specific development within the language of music itself. (Wishart 1985 : 5)

In Britain, at the BBC, another important change had taken place during the war – women had proved themselves more than capable technicians, producers and broadcasters during mens' absence with the war effort. Composer Maddalena Fagandini explained, 'There was this tradition of using women as engineers and technical people in radio. This happened during the war when all the gentlemen went off to fight the war' (Fagandini 2000).

On leaving school, towards the end of the war, Daphne Oram was employed at the BBC as a 'music balancer', a job which involved music and sound mixing, mainly for classical music programmes. She was a skilled musician, playing piano and violin. She was also trained in audio engineering and acoustics and by the early 1950s secured the job of studio manager. Like Schaeffer and Stockhausen, she worked in broadcast studio operations for national radio and television. As a child she had always been interested in creating inventions for making sound, and according to her father, from as young as seven, planned to build a machine that would produce any sound she desired (BBC Radio 3 1972: *End or Beginning*). This machine was later realised in the form of her 'Oramics' machine, built for that purpose.

She developed an interest early in her career for electronic music, and was particularly interested in Schaeffer's *musique concrète,* his work on disk and with magnetic tape at the Radiodiffusion Télévision Française in Paris. Whilst Britain was noticeably dragging its feet with regard to acceptance of this new electronic music, Oram is known to have visited the Paris studios of the R.T.F. when working at the BBC and subsequently embarked on a relentless campaign for equipment to be made available to develop new techniques for sound design and electronic music. She recalled,

*Organised Sound* **8**(1): 49–56 © 2003 Cambridge University Press. Printed in the United Kingdom. DOI:10.1017/S1355771803001055

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

> I went along to the research department in Nightingale Square to ask one of the high up engineers there whether he would allow me some equipment and guide me technically towards this music that I was imagining. He reduced me to a very small height and said, 'Miss Oram, the BBC employs a hundred musicians to make all the sounds they require, thank you'. (BBC Radio 4 1979: *We Have Also Sound Houses)*

During the late 1950s, Desmond Briscoe was a well-respected BBC studio manager in the radio drama department, who was similarly interested in developing some form of electronic music equipment at the BBC. It was through the combined persistence of Oram and Briscoe that the BBC came to realise that this new style of surrealism in radio drama needed a new approach to sound design. Eventually the BBC conceded to the acquisition of a couple of Brunel magnetic tape recorders and valve oscillators for the purpose of making this new music.

In 1957, Oram composed music for a television play called *Amphytryon 38*. Using a bank of single sine-wave oscillators, a Motosacoche tape recorder and home-made filters, she composed the piece, the first of its kind, from entirely electronic sound sources. Daphne Oram explained,

> In 1957 I was asked to compose incidental music for 'Amphitryon 38' – a T.V. 'World Theatre' play. I did this by collecting together equipment from many studios (once they had come off the air at night), assembling it in a sixth floor Broadcasting House studio, and working with it between midnight and 4 a.m. . . . I could not, of course, use the very special equipment I needed . . . so, I evolved techniques, akin to Cologne and Paris, which could be achieved with the normal broadcasting equipment I had available. (Oram 1962: 9)

The piece received favourable reviews and during that year she and Briscoe were inundated with demands for electronic compositions for new radio plays.

The first of these, Frederick Bradnum's play, *Private Dreams, Public Nightmares*, was subtitled *A Radiophonic Poem*. Daphne Oram and Desmond Briscoe were commissioned to create the sound montage. This was the first radio play to include explicit instructions for sound montage within the script. The script for the opening scene appeared as follows:

| **Basic Effects** | **Dialogue** |
|---|---|
| A contrapuntal rhythm | *1st Voice*: Round and round<br>Like a wind from the<br>Ground . . . |
| A comet-like shriek<br>Acoustic change<br>Pulsating beat<br>Descending scale | *2nd Voice*: I fall through<br>nothing, vast empty spaces.<br>Darkness and the<br>pulse of my life blood<br>intertwined. |

(Briscoe and Curtis-Bramwell 1983: 21)

From this excerpt and continuing throughout the script, the language used to define the required sound effects contains specific musical terminology. Clearly what the script required under the heading 'Basic Effects' was more than just sound effects, because Bradnum's instructions assumed an understanding of musical language. Increasingly, playwrights were developing a style of writing for radio drama that demanded a new type of professional, someone who understood musical language, could apply musical art, a musical sound designer who had exceptional knowledge and expertise in the physics of sound and the science of electronics.

Bradnum's play was set in a mental hospital, and depicted various surreal experiences of its inmates. The music/sound design was both eerie and soothing, shifting dynamically from gentle rising swoops to stark square blocks of raw sound, or shrill screeching oscillators, swamped in reverb and delay, which for the first time gave an added acousmatic dimension to the sonic atmosphere. Listening back today, the music is lacking in structure or development, but the pure electronic sounds generated from simple oscillators retain a freshness and richness of timbre that is still quite ear catching. Such were the reservations held by the BBC towards this 'new music' that, just before the broadcast went out, a title message was sent out to all its listeners, by way of an excuse and warning,

> This programme is an experiment – an exploration. It's not a masterpiece, not even a minor one. We think it's worth broadcasting as a perfectly serious first attempt to find out whether we can convey a new kind of emotional and intellectual experience by means of what we call radiophonic effects. (Briscoe *et al.* 1983: 22)

As anticipated, many complaints were received. Prior to this broadcast, incidental music was almost always delivered in the form of light, traditional orchestral compositions, and sound effects were obvious *concrète* clichés such as door creaks or footsteps. Now, not only was the dramatic content of the written play probing the listener's intellect, but strange new sounds were stretching the imagination. For many listeners, this was at first an unsettling and unwelcome experience, but the reaction within the BBC was one of wide acclaim, and this added dimension to radio drama gradually emerged as a new art form labelled 'radiophonic art'. Arguably not a 'high art' form, radiophonic art was more musical than sound effects, more technical and operational than music composition. It was more challenging to the ear than incidental or film music. Timing and placement of sounds was paramount as was originality of source material and method.

'Radiophonics' was not a new concept exclusive to the BBC. It was first conceived by Pierre Schaeffer in (and before) 1948, even pre-dating the tape recording medium, using discs, as shown by John Dack in his article, 'Pierre Schaeffer and the significance of radiophonic art' (Dack 1994). The BBC adopted the name to

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

identify this new dimension in sound and music for radio drama. Music composers, sound engineers and producers worked together with dramatic artists to optimise the stimulation of the listener's imagination. Radiophonics employed manipulated natural sounds, inspired by Schaeffer's *musique concrète*, as well as pure electronic tones. It differed from the output of other electronic music studios, because of the specific visual and psychological context imposed by the spoken word. The drama of the piece remained the underlying force and purpose of its existence. Integral to an understanding of the potential of radiophonic art was an awareness of the acousmatic dimension of sound, which was a subject addressed at length by Schaeffer. John Dack states, 'This acousmatic situation must be extended to all those listening environments in which sounds are heard without any visual confirmation of their sources' (Dack 1994: 3).

In many respects, it was this 'acousmatic situation' which set radiophonics apart from other musical or sonic art. Michael Smee explained, 'We provide the basic scenery, the emotional climate, the temperament, the environment in which things are happening. In a really good radio programme, it's almost like going into a trance. It is in fact your skull that has become the theatre' (BBC Radio 3 1979: *Sound in Mind*).

At the BBC, radiophonic art was pioneered by Daphne Oram, in the early 1950s, but it wasn't until 1958 after a considerable increase in demand for the services of Briscoe and Oram that a budget and accommodation was found to formally open The BBC Radiophonic Workshop. The official press release read as follows:

> The BBC has set up a Radiophonic Workshop at Maida Vale in London, the first installation of its kind in this country . . . The BBC is now equipped to provide an aid to productions which neither music nor conventional sound effects can give. (Briscoe *et al*. 1983: 30)

Former Radiophonic workshop colleagues (Delia Derbyshire, Maddalena Fagandini and Brian Hodgson) have stated that Daphne Oram was the first Studio Manager for the Radiophonic Workshop. Yet she is rarely credited with that role and most printed word defers to Desmond Briscoe and Douglas Cleverden as the leading founders of the Workshop. Her name is not included in Asa Briggs' *The History of Broadcasting in the UK*, where there is an entry for 'The Radiophonic Workshop'. She is not included (nor is any other female) in Nick Brown's article on the history of the Radiophonic Workshop (Brown 1979). She was included in *The International Who's Who in Music* until the 12th edition (1991) and is thereafter omitted. What is confirmed is that Oram played an important leading role in the foundation of the BBC Radiophonic Workshop, and as such was a pioneer in the development of broadcast electronic music, although her contribution has been largely undocumented.

On leaving the BBC, Oram opened an independent studio in a former oast house in Kent. Here she worked on commissioned compositions for film, television, advertising jingles and more extensive music compositions. She lectured at many schools and colleges, including London University, Cambridge University and the Institute of Physics. Among the archived 1/4″ tapes which have survived from her studio, are pieces which have been edited and arranged specifically for particular lectures, and marked as such on the spools. Tapes also remain which include source material and various mixes of the music jingles for television advertisements for companies such as Nestea, Phensic, Horlicks and Anacin. Clearly the financial pressures of running an independent studio necessitated this commercial outlet.

Her early compositions, up to and including 1959, had been mostly radiophonic art pieces for BBC radio or television broadcasts, although she composed a number of instrumental compositions and songs during the 1940s. After leaving the BBC in 1959, she completed her first major composition, *Four Aspects*, which was performed at The Queen Elizabeth Hall in 1959, from two-track magnetic tape. The early 1960s was a busy time during which she composed music for the film 'The Innocents' (1961), *Episode Metallic* (1965), also mastered onto 1/4″ inch tape, and *Pulse Persephone* (1965), for the opening of the 'Treasures of the Commonwealth' exhibition at the Royal Academy of Arts. In this last piece, she took individual sounds of traditional instruments from each country in the Commonwealth, and altered the sound to create atmospheres and textures that imply the ambience of other cultures. *Pulse Persephone* pre-dated Stockhausen's *Telemusik* (1966) which is often claimed to be the first composition to use 'world music' sound sources in this way.

She also completed *Contrasts Essonics*, a four-movement piece for magnetic tape. In the 1970s, she completed three further pieces, *Broceliande* (1970), *Rockets in Ursa Major* (1962) for a science fiction play at the Mermaid theatre, and *Bird of Parallax* (1972) for a ballet named 'Xallaparallax' which was performed at the Edinburgh festival. Finally, she composed *Sardonica* (1973) for piano and electronics, a beautiful piece with striking Varèsian influence in its attention to space and silence, using long sustained modulations of groaning and reverberating valve oscillators and live piano performance, composed with Ivor Walsworth, and performed by his wife, Joan Davies. Oram shared with Varèse a preoccupation in her compositional style with the relationship between space and time in music. This is reflected in all her completed pieces, characterised by long pauses, observation of silence that is crafted into her work, and long sustain on single notes where 'timbre' evolves in real time as something that is articulated during performance with as much emphasis as the playing of notes in conventional music.

Oram introduced into the medium of electronic music

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

an ethereal quality, a sensitivity and sensual awareness of space, as well as an appreciation of acoustic instrumental sound which provided a more accessible compliment to the harsh tones coming over from Cologne, Paris and Utrecht. Hers was a more intuitive approach to composition, less guided by rigorous attention to serialism and later developments thereto which included serialism of tone, timbre and dynamics. She developed a distinctive style, rooted in a detailed knowledge of orchestral arrangement and expressed in her choice of waveforms and timbres that is often reminiscent of altered strings, or large de-tuned brass sections.

In *Electronic Music – The Present and the Potential* she addressed criticism of the (then) new fashion for electronic music,

> We have heard works by Stockhausen, Eimert, Maderna, Pousseur, Berio and others who . . . have usually allied themselves to the Post Webern school. Many of the criticisms which I have heard levelled at their electronic compositions have been of these composition techniques rather than criticisms of the medium of electronic composition itself. These blips, bloops and bathroom noises are the outcome of serial techniques applied in the spheres of timbre, pitch and duration . . . For those who are not convinced that serialism is the only answer, . . . let me say that this vast new field is there to be explored . . . (Oram 1960: 19)

In her criticism of serialism as applied to electronic music composition, it is possible that her frustration was with a prevalent masculist approach to electronic music, a representation of sound according to principles of logical patterns, an overstated need for compositional rules, control of harmonics, and cyclical rhythmic or motivic phrases within a defined structure. She stated,

> Where then are the rules? There appear to be none. You take with you what you consider necessary from the world of 'conventional' music. Personally I find this unsatisfactory. Why impose on one medium rules made for another medium . . . Does the ear and human mind comprehend such rules as complete serialism of timbre, pitch and rhythm? (Oram 1960: 20)

The collection of Oram's 1/4″ master tapes are kept by Hugh Davies and have been sorted, cleaned and listened to by Davies and Jo Hutton, awaiting further re-mastering onto CD. An excerpt from *Four Aspects* appeared on a two-CD set with *Leonardo Music Journal* **11**, 2001, and is available separately (EMF Media EM 136–2, 2001).

## 2. *AN INDIVIDUAL NOTE* (LONDON: GAILLARD, 1971)

> It seems as if theory and practice were ever to be at strife, for the man of science who never hears music and the musician, who never reads books, must be equally averse to each other, and unlikely to be brought to a right understanding . . . (Burney 1776: 116, in Oram 1971: 6)

In this, her only book, she demonstrates a writing style that is at once informative, detailed, direct and humorous. It represents a documented manual of extensive research, undertaken over many years, and forms the basis upon which she built the template for her 'Oramics' sound recording system (described here in subsequent paragraphs). In her book she articulates a wealth of knowledge of electronics and expresses her own philosophy of music, examining the word *music* and its many ramifications within this and other languages. Throughout the book, she compares the human process of music composition to the processes and stimuli contained in electronic circuitry. She invents two opposing concepts, the 'Cele', that which is at the outset apparently simple yet intangible and gradually emerges with increasing complexity over a period of time, and the 'Elec', the harnessing, or bringing into control over a period of time, of something initially complex.

With reference to a public performance of Bach's 'Matthew's Passion', she explains that the 'Elec' might refer to the note-perfect reproduction by virtuoso musicians of Bach's score, which may or may not still result in a dull performance (Oram 1971: 53). The 'Cele' might refer to the intangible interaction between audience, composer and performer, and all that is taking place in the collective individuals' minds at the time of performance, which determines whether or not it is a success in terms of collective audience appreciation. This concept is also expressed by Steve Reich, who makes a similar observation in his discussion of music as a gradual process:

> . . . mysteries are the impersonal, unintended, psychoacoustic by-products of the intended purpose. These might include sub-melodies heard within repeated melodic patterns, stereophonic effects due to listener location, slight irregularities in performance, harmonics, difference tones, etc. . . . That area of every gradual . . . musical process, where one hears the details of the sound moving out away from intentions, occurring for their own acoustic reasons, is *it*. (Schwartz and Childs 1998: 423)

Oram shared with Delia Derbyshire a stated concern with the interaction between performers and *performees*. She explained, 'Maybe, by pursuing . . . analogies between electronic circuits and the composing of music, we will be able to gain a little insight into what lies between and beyond the notes; we may be able to glimpse forces at work within the composer . . . which seem to have counterparts in acoustics and electronics' (Oram 1971: 5–6).

It is the 'between and beyond the notes' and between and beyond the boundaries of art and science, that form the focus of her book, and the source of inspiration for her 'Oramics' invention with which the book concludes. Throughout her writing she draws on influences such as Alexander Pope, Michel de Montaigne, William Gilbert, Hertz, Helmholtz, Fourier, Francis Bacon and Charles

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

Burney. Musical observations and comparisons include detailed reference to works by Bach, Mozart, Webern, Schaeffer, Stockhausen, Varèse, Cage . . . (references to women composers are conspicuous in their absence). Her ideas, some eccentric and amusing, are given credence by the extent of her knowledge of the subject, informed as it is by classic works in literature, science and music.

The first chapter describes in considerable detail the basics of audio-electronics, capacitance, resistance and inductance, and their use in 'tuned circuits' using hand-drawn diagrams that portray a comprehensive understanding. She is able to explain complex processes in direct terms, where more 'sober academic journals' written by scientists, to which she refers on page 1, might fail. Subsequent chapters give a lecture in the physics of sound, acoustics and psycho-acoustics. She explains the principles of building sounds according to precise mathematical calculations of formants, related harmonics, and harmonic intermodulation.

Her writing is delivered in a unique style which, in its straightforward presentation, is noticeably sensitive to, though not necessarily aimed at, women readers. She also wrote several articles on the subject of electronic music. The British library's extensive catalogue of early editions of popular hi-fi and professional sound industry journals has revealed that there was a lot of interest, amongst 1950s housewives in particular, in the magnetic tape recording medium as a 'hobby', and it is significant that much advertising and publicity was invested in a female market during the 1950s. With this in mind, Oram wrote articles including 'How to make this new music' (Oram 1959) and 'How to make musique concrete' (sic) (Oram 1958) that are light-humoured and presented in the form of a recipe for making music using magnetic tape. Her writing nonetheless contains detailed and specific information about recording *concrète* sounds, and how to arrange them in a musical composition, as well as the use of filters and microphones. The latter article, for example, includes measurements of tape length and speed, and the useful formula:

$$60/m \times S = L,$$

where $m$ is the metronome marking, $S$ the speed of the playback machine and $L$ is the length of tape required for a given note (Oram 1959 : 625).

Oram's thinking favoured the lucid flow of sound over time, elasticity of rhythm and tone, allowing the sound freedom and space to take its course. She shared with Varèse (twenty years earlier) the idea of developing a machine that would render redundant the notion of musical interpretation by performers. Oram equated the art of electronic music composition with painting:

> Imagine yourself a 'painter in sound'. Your blank 'canvas' is a piece of magnetic recording tape . . . The whole evolves just like an oil painting . . . You can use any colour of sound that you can imagine, for any duration, with any rhythm and at any pitch. But the ear must be capable of comprehending it and your electronic technique must be capable of producing it. (Oram 1960: 20)

## 3. ORAMICS (1962 . . .)

In 1962, twenty years after the invention of the tape recorder, Daphne Oram realised her life's work in the form of her 'Oramics' machine. She received two consecutive Gulbenkian Foundation grants in the region of £3,500, a sizeable sum in the 1960s, to develop her research. The following statement from Oram gives a concise introduction to her aims and objectives at the outset of the Oramics project:

> I visualize the composer learning an alphabet of symbols with which he will be able to indicate all the parameters needed to build up the sound he requires. These symbols, drawn . . . freehand on an ordinary piece of paper, will be fed to the equipment and the resultant sound will be recorded onto magnetic tape. (Oram 1962: 9)

The concept of drawn sound was not new, as shown by Hugh Davies (1984, *New Grove Dictionary of Musical Instruments*). The technique of drawing patterns by hand onto the thin strip at the edge of 35 mm film that represented the soundtrack, had been in existence since the 1920s. Russian film-makers Arseny Arraamov and Yevgeny Sholpo created soundtracks from intricate ink drawings on thin strips that were 1.93–2.5 mm in width. Norman McClaren used drawn sound in many films, including 'Book Bargain' (1937) and 'Loops' (1940). South African electronics engineer Johannes van der Bijl, working in the 1940s, developed a method of recording sound using photographed waveforms on 35 mm film, which were passed across and interrupted a steady beam of light, and thus generated an electronic impulse to represent sound. At this time also, the 'Composertron' was developed in Canada, using similar technology that included drawing patterns on a television screen which were picked up by cathode ray tubes. Components from all these different electronic experiments are present in the 'Oramics' system described below. Comparisons can also be drawn with the Bell laboratories' 'Visible Speech' machine in 1948 and the punch-roll system of the well-known RCA synthesizer (Davies 1984: 598–9).

Perhaps Oram drew inspiration from the work of these other pioneers. Her machine certainly bears striking resemblance to the machine imagined by Varèse. In 1939, he predicted:

> . . . (My machine) . . . will work something like this: after a composer has set down his score on paper by means of a new graphic notation, he will then, with the collaboration of a sound engineer, transfer the score directly to this electric machine . . . The advantages of such a machine . . . (are) . . . liberation from the arbitrary, paralyzing tempered

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

> system; . . . the formation of any desired scale . . . the possibility of obtaining any differentiation of timbre, of sound-combinations; new dynamics far beyond the present human-powered orchestra . . . (Varèse 1939 in Schwartz *et al*. 1998: 200)

Each of Varèse's 'advantages' are addressed by Oram in her book. Her product was nonetheless unique and offered finer nuances of sound manipulation, greater flexibility and simultaneity in the creation of sound than its predecessors. Concentrated listening to compositions using the Oramics system reveals a more lucid, free and at the same time more precise analogue of sound waveforms than the more mechanical characteristics of other recording machines that were being developed at the time. According to Peter Manning,

> The ability to draw the dynamic shaping of pitched events not only allows a readily assimilated audio-visual correlation of specifications, it also overcomes the rigid attack and decay characteristics of electronic envelope shapers. (Manning 1985: 155)

The Oramics system has survived as an array of separated pieces, drives, motors, valves, cogs, gears and various switches and cables, in the back of a farmyard barn, the responsibility of vintage audio equipment collector, Peter Forrest. It is currently being restored in France for display in a vintage audio equipment museum. Visiting the machine in person has provided a first-hand image of the parts and functions referred to by Peter Manning (1985) and Alan Douglas (1973) and a useful checklist to the processes described by these two, as well as by Oram herself in her book *An Individual Note*. Oram explained:

> I am interested in being able to manipulate every subtle nuance of sound. There is no system for notating electronic music . . .What one has to do is pick out each parameter separately. You need to have a graph for how loud it is at any particular moment and how the vibrato is giving a wavering to the pitch. I have a number of film tracks going by and on these I draw the graphs for the pitch. I write what we call digital information, a dot, for example, rather like a crotchet or quaver, but the dot does not say how long the note is to be. It's all done by measurement. (BBC Radio 3 1972: *End or Beginning*)

The main body of the machine is a steel-framed table, across which a centre strip of graph paper is placed at right angles. Waveforms are drawn freehand onto this paper (these are still in place) and then traced, or marked out with masking tape, onto transparent, sprocketed loops of 35 mm film. There are ten looped strips of film in total, arranged in five banks, and each passes clockwise from right to left operated simultaneously by a common motor. The near group is individually and directly looped around the clutch mechanism and drive wheel, and the far group is looped around a wheel that is slaved to the main motor. Clutch and gears control speed of rotation, which normals at 10 cm per second, although a handwheel enables the user to turn all strips simultaneously more slowly if desired. The near group of four control waveform shape, duration and vibrato, the raw ingredients of the desired sound, and the far group control the finer nuances of timbre, intensity, amplitude and frequency.

The drawn waveforms pass over photocells, illuminated from above by a steady stream of light, to the right of the flat surface. The dark patches on the transparent film strip modulate the rays of light, and these are picked up as voltage measurements by the capacitors in the photocells. The electronic signal triggers oscillators and filters and the envelope shape can be manipulated in fine detail. The signal is also passed to a separate sealed light box which houses four cathode-ray tubes. A flat plate of glass slides into a slot in the light box. The glass plate is partially covered by an opaque mask, selected from a number of pre-set shapes which correspond to the desired effect. This partially covers the tube output which is picked up by a photomultiplier inside the light box and conveyed to the output of the various oscillators.

Actual sound recording takes place at the end of the process, once the drawn sound has been manipulated and created according to mental and mathematical specifications, and not monitored at the outset by aural observations. A separate unit houses another motor, across which four strips of oxidised 35 mm film are tensely looped. The output signal from the multitrack magnetic recording is passed to a stack of four Mulla 323 amplifiers, and from there to a pair of home-made speakers.

Ultimately, the actual recording quality of some of Oram's compositions created using Oramics that have been salvaged from her studio compare unfavourably with recordings by composers such as Tristram Cary, Robert Moog, Raymond Scott Stockhausen, Berio and Schaeffer of the same, or earlier periods, which offer much cleaner representations of sound. It is also interesting that the Oramics machine has an overall appearance that is ugly, impractically large, and physical details such as switches and other practical components appear neglected and unfinished. Robert Moog recently observed, 'I remember thinking that it must have been a job and a half to make music with . . .' (Moog 2000).

It is also a consideration that Oramics, as a compositional tool, was fundamentally flawed in its design, since hearing – the vibration of the composer's eardrums – is the last link in the Oramics process. Sound is drawn, and the hearing of it takes place in the imagination during the actual composition. Recording the sound, and converting it to acoustic sound energy takes place only after it has been graphically defined. This had drawbacks, as Delia Derbyshire pointed out: '. . . My attitude was that the ear is a better judge of what it hears than the eye can be in constructing a sound . . . I personally wouldn't approach making a sound from any visual parameters,

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

I'd rather do it from mathematical parameters and then rely on the ear to change it' (Derbyshire 2000).

Peter Manning observes that the beauty of Oramics lay in its simplicity and potential as an educational resource:

> One great advantage of the Oramics system is that the mechanics are relatively simple, being a good engineering project for a university or similar institution . . . The teaching facilities are extremely good, especially for harmony and counterpoint, because perfectly conventional methods of composition can be displayed as well as the limitless parameters of electronic music . . . (Manning 1985: 97)

Clearly Oram was much motivated towards the educational potential of her machine, but she ideally sought its wide use by composers and this was not achieved, although she did some work with Thea Musgrave, Hugh Davies and Tristram Cary, amongst others. The finished product was too complex, comprising several separate housings and units for the different processes, to achieve commercial productivity, or even professional use by other composers. It would seem that, in her work with the Oramics system, Oram was more motivated to explore the technological process relating to the sound, than pure music composition. She was more concerned with the complexities of electronic sound parameter manipulation, than perfecting the quality of ultimate acoustic output. It is unfortunate that the timing of its completion left it overshadowed by the developments in voltage controlled oscillator technology. Timing, i.e. talent for recognising and, more importantly, anticipating the needs of an era, is integral to the art of invention. Oramics was superseded by the Moog synthesizers, the synthi VCS3 and other more compact electronic sound creators, and as a sound recording medium by more compact and practical portable tape recorders such as the early Revox A77s. The finished Oramics product remained in need of further investment.

Oram was nonetheless the first (and only?) woman to design and build an entirely new sound recording medium. She was also the first person to compose electronic music for a broadcast television drama. It should also be noted that independent studios were virtually unheard of at this time, particularly one run by a woman, and to maintain a living in this field was a significant achievement in itself. Oramics became redundant, but Oram persisted and in the 1980s through to the 1990s up until her retirement, was working on computer software that would incorporate drawn sound. This was not completed although it is hoped that her ideas inspired later developments in computer software for drawn sound.

During the 1990s, she was working on outdoor sound installations in private gardens prior to her retirement and she died on 5 January 2003. She left behind fifty years of pioneering activity at the frontline of technological developments in sound recording and music composition, and has become posthumously a well-respected representative of women's contribution to the history of music technology.

The important fact about Daphne Oram is not whether she was a great composer or musical genius, which she herself might argue against, but rather that she was an innovator of new techniques for making and performing, as well as listening to music. Without her presence at the BBC one can be confident that the development of electronic music in Britain, and the building and acquisition of unique sound recording equipment for electronic music-making, would have taken a very different course, almost certainly much delayed.

## REFERENCES


Bosma, H. 1996. Gender and electronic music. *Switch* **2**(1): Sound. www.hum.uva.nl/~hannah/genelmus.htm

Briscoe, D., and Curtis-Bramwell, R. 1983. *The BBC Radiophonic Workshop*. London: BBC.

Brown, N. 1979. Musica ex machina. *Radio Times*, 29 March 1979. www.elektronik.co.uk/hist-elek.musicexmachina

Cary, T. 1961. New music on a shoestring. *Amateur Tape Recording* **3**.

Dack, J. 1994. Pierre Schaeffer and the significance of radiophonic art. *Contemporary Music Review* **10**(2): 3–11.

Davies, H. 1968. *Electronic Music Catalogue*. London: MIT Press.

Davies, H. 1984. 'Drawn sound', 'Oramics'. In S. Sadie (ed.) *The New Grove Dictionary of musical instruments*, Vol. 1, pp. 598–9. London: Macmillan.

Douglas, A. 1973. *Electronic Music Production*. London: Pitman Publishing.

Douglas, D. 1961. Miss Daphne Oram: maker of electronic music. *Glasgow Herald*, 6 September.

Manning, P. 1985. *Electronic and Computer Music*. Oxford: OUP.

Oram, D. 1958. How to make musique concrete. *Hi Fi News*, April: 623.

Oram, D. 1959. How to make this new music. *The Tape Recorder*, June: 213.

Oram, D. 1960. Electronic music, the present and the potential. *Musical Events* **XV**(December): 20.

Oram, D. 1962. *Electronic music. The Composer*, No. 9 (Spring).

Oram, D. 1971. *An Individual Note*. Norfolk: Gaillard.

Sadie and Samuel. 1994. *The Grove Dictionary of Women Composers*. London: Macmillan.

Schaeffer, P. 1952. *A la recherche d'une musique concrète*. Paris: Editions du seuil.

Schwartz, E., and Childs, B. (eds.) 1998. *Contemporary Composers on Contemporary Music*. New York: De Capo.

Wishart, T. 1985. *On Sonic Art*. York: Imagineering Press.


## INTERVIEWS


Derbyshire, Delia, with Jo Hutton, 24 February 2000 (Hutton, J. July 2000 Radiophonic Ladies. Sonic Arts Network: Diffusion: 2).

Fagandini, Maddalena, with Jo Hutton, 23 March 2000


https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press

(Hutton, J. July 2000 Radiophonic Ladies. Sonic Arts Network: Diffusion: 2).

Moog, Robert, with Wendy Pilmer, 27 September 1994. WCQS Radio broadcast. BBC sound archive.

Moog, R. 2000. Personal e-mail to the author.

*Electronic Tunesmiths*, BBC Radio 4, 21 December 1971. *About Radiophonic Workshop. Includes interview with Oram*. National Sound Archive.

*End or Beginning*, BBC Radio 3, 26 September 1972. Presented by Thea Musgrave, with Tristram Cary and Daphne Oram. National Sound Archive.

*The Space Between*, BBC Radio 3, 4 October 1973. *About Radiophonic Workshop Using Early Stereo*. National Sound Archive.

*We Have Also Sound Houses*, BBC Radio 4, 11 March 1979, 7.45 p.m. *Interviews and discussion with members of the Radiophonic Workshop. Includes interview with Oram*. National Sound Archive.

*Sound in Mind*, BBC Radio 3, 27 March 1979. Devised and produced by Desmond Briscoe with various Radiophonic Workshop personnel. National Sound Archive.

## DISCOGRAPHY

*Four Aspects* (excerpt). 2001 Not necessarily 'English music'. *Leonardo Music Journal* **11** (two CDs incl. with journal). Two-CD set also issued separately, EMF Media EM 136–2, 2001.

*Daphne Oram: 'The Innocents'* (electronic sounds and treatments for feature film). 1996. 20th Century Fox (videotape, NTSC only, in USA and Canada).

The entire archive of Daphne Oram's studio work on 1/4″ tape resides with Hugh Davies, who is currently preparing a CD of her work.

https://doi.org/10.1017/S1355771803001055 Published online by Cambridge University Press