

The New Atlantis



The Story Of The BBC Radiophonic Workshop

Fifty years ago this month, the most celebrated electronic music studio in the world was established. We trace the history of the Radiophonic Workshop, talking to the composers and technical staff who helped to create its unique body of work.

Steve Marshall

I was 10 years old. As the last 'whoosh' of the *Doctor Who* theme dissolved into a wash of tape echo I sat transfixed by the light of the television, eagerly reading all of

the end credits. "Wow!" I exclaimed. "I want to get a job in the BBC Radiophonic Workshop when I grow up!"

"I'm sorry, son," said my father. "You won't be able to do both."

Although it never felt like a 'job', I did eventually get to work in the Radiophonic

Workshop. I was only there for three months, but I've never stopped going on about it. Wouldn't you too, if you'd been lucky enough to have worked in the most famous electronic music studio in history?

The story of the Radiophonic Workshop began half a century ago, in 1958. Britain in the 1950s was a bleak place, as the nation struggled to rebuild itself after the devastation of war. Food rationing had continued right up until 1954, when bananas finally came back on sale; anything worth having was still in short supply. We now think of the '50s as the rock & roll years, but the UK charts for 1958 tell quite a different story. Elvis was there for a few weeks; so was Jerry Lee Lewis — but



Delia Derbyshire, with Workshop co-founder Desmond Briscoe in 1965.

the chart is mostly dominated by the likes of Perry Como, Connie Francis and Vick Damone. It was a dull time for music, but things were about to get more interesting...

Defects Of The Brain

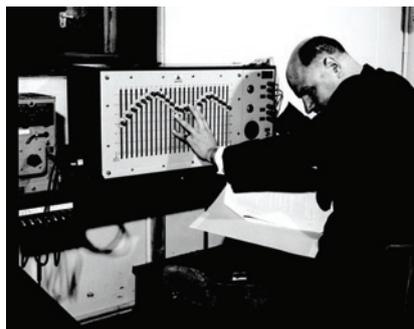
One of the few benefits of wartime had been that some women had an opportunity to work in jobs previously denied to them; Daphne Oram was one. Daphne had started working for the BBC as a 'music balancer' during the war, turning down a place at the Royal College of Music to do so. After her promotion to studio manager in the '50s, she began pestering the BBC to follow the lead of the French broadcasters, and to provide a facility for the production of electronic sound



Before the Workshop: Daphne Oram manipulates a tape loop at Broadcasting House, watched by Frederick Bradnum, 1956 or '57.

and *musique concrète*. Desmond Briscoe (1925-2006) was also a studio manager, with similar interests, so in 1957 the pair teamed up to produce some innovative programmes for the BBC Drama Department. Using borrowed test oscillators and tape-splicing techniques, they produced sounds that had never been heard before on the BBC.

Their nagging finally paid off, and in April 1958 Desmond and Daphne founded the Radiophonic Workshop in the BBC's Maida Vale Studios (a former ice-skating rink). They were joined later in the year by 'technical assistant' Dick Mills. Brian Hodgson came along in



Desmond Briscoe at work, 1960.

1962 and he eventually ended up running the place. Brian adds: "Workshop was then a very popular word among theatre 'types', and it gave away the Drama Department origins. It was originally going to be called the Electro-Phonic Workshop, but it was discovered that 'electro-Phonic' referred to some sort of defect of the brain, so it had to be changed! A board was set up to see that the place was run properly. Unfortunately, one board member had a doctor friend, who advised that three months should be the maximum length of time that anyone could work there, as staying any longer could be injurious to their

health; they'd go mad, or something. This problem recurred throughout the Workshop's history — just as a recruit was getting into the swing of things, they'd have to leave."

Daphne Oram was the first to fall foul of this rule. After three months in her new job, she was ordered back to work in a control room at Broadcasting House. But for some reason Desmond Briscoe was not required to leave: instead he was appointed as the

The New Atlantis

"Wee have also Sound-Houses" became the Radiophonic Workshop's motto. Taken from *The New Atlantis* by Francis Bacon, it was rediscovered by Daphne Oram, and for many years was pinned to the Workshop's office wall. It is an extraordinary piece of writing, seemingly a vision of some recording studio of the future; yet, incredibly, it was written in 1624.

"Wee have also Sound-Houses, wher wee practise and demonstrate all Sounds, and their Generation. Wee have Harmonies which you have not, of Quarter-Sounds and lesser Slides of Sounds. Diverse Instruments of Musick likewise to you unknowne, some sweeter than any you have; Together with Bells and Rings that are dainty and sweet. Wee represent Small Sounds as Great and Deepe; Likewise Great Sounds, Extenuate and Sharpe; Wee make diverse Tremblings and Warblings of Sounds, which in their Originall are Entire. Wee represent and imitate all Articulate Sounds and Letters, and the Voices and Notes of Beasts and Birds. Wee have certaine Helps, which sett to the Eare doe further the Hearing greatly. Wee have also diverse Strange and Artificiall Eccho's, Reflecting the Voice many times, and as it were Tossing it; And some that give back the Voice Lowder then it came, some Shriller, and some Deeper; Yea, some rendring the Voice, Differing in the Letters or Articulate Sound, from that they receive. Wee have also meanes to convey Sounds in Trunks and Pipes, in strange Lines, and Distances."



John Baker was another stalwart Radiophonic Workshop composer.

- ▶ Workshop's Senior Studio Manager. For the BBC's women, it seemed, the war was over. A lengthy and bitter row ensued, and eventually, Daphne left the BBC for good in 1959, moving to an oast-house that she'd bought in Kent and establishing her own Oramics Studios for Electronic Composition. She was replaced by Maddalena Fagandini.

Fag-ends & Lollipop

The Workshop's reputation grew over the next few years, and the ranks swelled with the addition of Brian Hodgson, Delia Derbyshire and jazz pianist John Baker. The equipment at their disposal was minimal, to say the least, as Brian recalls. "In the very beginning, Desmond had been given £2000 and the key to 'redundant plant' [*the BBC's junk pile*] and that was it! The place kept going for years on what we called 'fag-ends and lollipops'. 'Fag-ends' were the bits of unwanted rubbish that other departments had thrown away; 'lollipops' were the much

rarer treats that were occasionally sent down to keep Desmond quiet. Like the vocoder, for instance: it was very nice, but we hadn't asked for one and didn't really need it. It was like the icing on a non-existent cake!"

The Workshop's equipment consisted merely of a lot of old tape recorders and a few pieces of test equipment that could make noises. The tape recorders could be used for echo, and reverb was also available — it came from an empty room downstairs with a microphone at one end and a speaker at the other. Maida Vale Studios is an unusual building, long and thin with one of its two floors below ground. The Radiophonic Workshop's rooms were at street level, spanning an extremely long corridor.

One room was occupied by a succession of dedicated engineers who had the tools and the know-how to fix all the broken rubbish that arrived; they also built special equipment to order. First was 'Dickie' Bird; then came Dave Young, and finally 'The Two Rays' (White and Riley). Dave Young started a tradition of visiting the nearby Portobello Market every week to buy bits and pieces for the Workshop, and this continued long after he'd left. In the '60s, a lot of ex-military kit from the war was still being sold off; Dave would return with items such as a genuine aircraft's joystick!

Brian Hodgson plays a tune on the Workshop's home-made keyboard, controlling 12 individual oscillators.



Much of the Workshop's output then was produced simply by using the techniques of *musique concrète*: natural sounds were recorded and manipulated on tape by editing, pitch-changing, and very often by reversing the tape. There was a standing joke that a Radiophonic composer could enthusiastically churn out original compositions for several years. When the inspiration ran out, all their old tracks could be re-used (and improved?) by playing them backwards!

Wobblating The World

In the early '60s, synthesizers simply did not exist. Producer Joe Meek was using the monophonic, valve-operated Clavoline but the Radiophonic Workshop, oddly enough, never had one. What they did have, though, was all the test oscillators that they could beg, borrow or steal from other BBC departments. A method was devised for controlling 12 oscillators at a time, triggering them from a tiny home-built keyboard of recycled piano keys. Each oscillator could be independently tuned by means of a range switch and a chunky Bakelite frequency knob.

There was also the versatile 'wobbulator', a sine-wave oscillator that could be frequency modulated. It consisted of a very large metal box, with a few switches and one very large knob in the middle that could sweep the entire frequency range in one revolution. They were used in the BBC for 'calibrating reverb times in studios' apparently. And as far as the Workshop's electronic sound sources went, that was it!

Yet, curiously, it is the work produced in those early years that the Radiophonic Workshop's reputation still hangs on. The *Doctor Who* theme was first recorded in



The Radiophonic Workshop name would become indelibly associated with a certain long-running science-fiction TV series...

1963, and still there are fans who insist that the original is the best of many versions made over the years. What's more, some of the sound effects made for the first series of *Doctor Who* are still being used! When the newly revamped *Doctor Who* appeared in 2005, hardcore fans recognised the original effects and wrote to Brian Hodgson: "How nice to hear the old original Dalek Control Room



Brian Hodgson with dismembered piano, as used to create 'the Tardis sound' from *Doctor Who*.

again, after all these years!"

Brian's 'Tardis' sound, dating from 1963, is also still used. "I spent a long time in planning the Tardis sound," says Brian. "I wanted a sound that seemed to be travelling in two directions at once; coming and going at the same time." The sound was actually made from the bare strings of a piano that had been dismantled. Brian scraped along some bass strings with his mum's front-door key, then set about processing the recordings, as he describes it, "with a lot of reverse feedback". (By this, I assume he means that tape echo was added, then the tape reversed so that it played backwards.) Eventually, Brian played the finished results to Dick Mills and Desmond

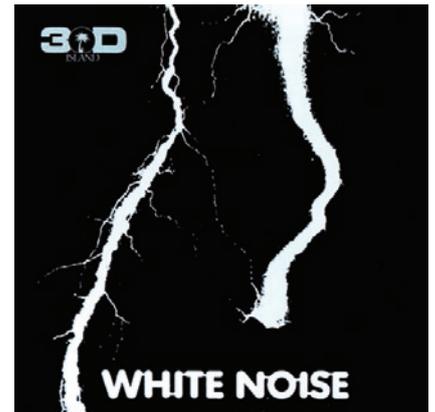
Briscoe; at their insistence he added a slowly rising note, played on the wobulator.

Working Up A Storm

Brian and Delia Derbyshire were, as he says, "best mates. We used to go on holiday together." In 1966, together with the founder of synth manufacturers EMS, Peter Zinovieff, they formed Unit Delta Plus, a band of sorts, and began performing on London's psychedelic underground scene. As one Workshop member

remembers it, "At the end of their day at the BBC they used to race off to the West End, changing into their kaftans in the taxi." Unit Delta Plus split in 1967, but some of their gigs sound like crackers: how about the two-day 'Million Volt Light and Sound Rave' at the Roundhouse? I'm sorry to have missed that one! In 1969 the pair teamed up with David Vorhaus as the White Noise, releasing the cult classic album *An Electric Storm*.

Meanwhile, the Radiophonic Workshop was going through some changes. The three-month rule ensured a steady throughput of staff, but some managed to become permanent. David Cain arrived in 1967, Malcolm Clarke in 1969; Richard Yeoman-Clark, Paddy Kingsland, Roger Limb and Peter Howell all joined in the early



'70s, just as Brian and Delia were leaving. The association with Peter Zinovieff had already led to the BBC buying three VCS3s, but in 1970 the Workshop took delivery of an EMS Synthi 100 modular system. It was the biggest voltage-controlled synthesizer in the world! Christened 'The Delaware', after the road outside the studios, it had 16 oscillators and even incorporated its own oscilloscope and frequency counter. As with the VCS3, there were no messy patch cords: instead were provided two 60x60-way 'pin patch boards'. There was a digital sequencer too, which could store up to 256 events. The massive control surface presented a sea of knobs to twiddle, but one of them, labelled 'Option 4' was actually a dummy. ▶

Recording The *Doctor Who* Theme

"We got a phone call from Verity Lambert, the first *Doctor Who* producer," says Dick Mills. "She said she had a little sci-fi series that would only run to six episodes, but she'd like some special electronic effects. So me and Delia went along to Ealing for a meeting with her, and we said we could do the effects, but we could probably help out with a signature tune as well, as we'd just been working with Ron Grainer — a composer who was coming quite into vogue (he'd done themes for *Steptoe* and other shows). So Ron was hired to write the sig, and us to record it. Ron had originally come to us first, so we were returning the favour. We'd done a TV show called *Giants of Steam* and Ron had got us to make loops of train effects and process them to different tempos for his musicians to play along to. He had great confidence in us — for *Doctor Who*, he just handed Delia one foolscap sheet of manuscript paper and said off you go! Then he cleared off to Portugal for a fortnight — he said it was for the sake of his health..."

So how was the theme recorded? "Well, we started with the bass line. You know those 19-inch jack-bay panels? You could get blank panels too, to fill in between them. They were slightly flexible, so Delia found one that made a good musical twang, and played it with her thumb. We recorded it then vari-speeded up and down to different pitches, copied them across to another tape recorder, then made hundreds of measured tape edits to give it the rhythm."

And what was the main tune played on? Was it

some early synthesizer? "No," says Dick, "it was just a load of oscillators — signal generators — that someone had connected to a little keyboard, one for each note. Again, we had to make lots of tape edits."

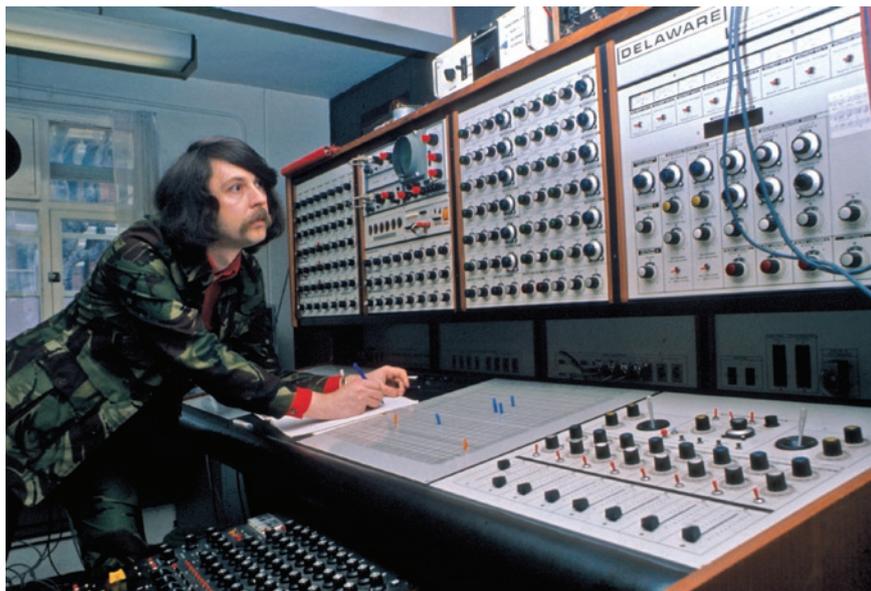
But what about that distinctive portamento? How could you bend the notes like that without a synth? Dick sighs: "Well you just twiddled the frequency knob, of course — how else? It was all done with actual knob-twiddling then — there was no other way! We did it in lots of little pieces, then joined all the bits of tape together."

Eventually, after some pre-mixing, the elements of the entire composition existed on three separate reels of tape, which had to be run somehow together in sync. "Crash-sync"ing the tape recorders was Delia's speciality," says Dick. "We had three big Phillips machines and she could get them all to run exactly together. She'd do: one, two, three, go! — start all three machines, then tweak until they were exactly in sync, just like multitrack. But with *Doctor Who* we had a bum note somewhere and couldn't find it! It wasn't that a note was out of tune — there was just one little piece of tape too many, and it made the whole thing go out of sync. Eventually, after trying for ages, we completely unwound the three rolls of tape and ran them all side by side for miles — all the way down the big long corridor in Maida Vale. We compared all three, matching the edits, and eventually found the point where one tape got a bit longer. When we took that splice out it was back in sync, so

we could mix it all down."

Ron Grainer returned from his holiday and famously asked if it was the same piece of music that he'd written. The theme was an instant success, as was the programme. But success brought its own problems, as Dick remembers. "The trouble was, because it was a hit show, every producer wanted to put their stamp on it, so they'd ask us to record another version. We did loads and no-one ever liked them. One was laboriously done on the Delaware. The sounds were great, but no-one liked it. I remember Delia did one version herself, where there was very heavy tape echo on the rhythm that gave it a new and different groove. The first time it was played in a dub all the technicians complained. 'Oh no — what's wrong with that?' they all said. 'Let's have the old one back!' And we also had to make a 45-second version when the show got popular. Anyone who's worked in TV music knows how difficult it is to turn a 30-second sig tune into a 45 — it's a very unnatural thing to do, musically."

As a footnote, there is still a difference of opinion on how the *Doctor Who* bass sound was created, 45 years ago. Dick Mills remembers Delia twanging a blanking panel in a rack, while Mark Ayres offered two versions — a plucked string and a rubber band (he heard both from Delia!). Peter Howell, meanwhile, told me: "The bass twang was a plucked bass string on a home-made electric pickup device (a piece of wood with a string on it). That sound appears on several early Workshop recordings."



Radiophonic Workshop composer Malcolm Clarke (1943-2003) with the EMS Synthi 100 modular synth known as Delaware.

- ▶ Not connected to anything at all, it was occasionally tweaked to appease awkward producers who wanted to get 'just the right sound'.

Desmond Briscoe's retirement in 1977 saw Brian Hodgson returning as Workshop Organiser, after five years away. Brian finally managed to prise a reasonable annual budget out of the BBC and he set about systematically renovating the place, eventually providing a customised studio for each of the five composers. Apple Macintosh computers were introduced, and a lot of the new kit was identical to what could be found in any studio of the time; there were growing mutterings about the Workshop having somehow deviated from its original purpose to become a 'music-writing factory'. This was not really

true: the Radiophonic Workshop had been founded because the equipment needed for electronic music production was not generally available. Mass-produced synthesizers did become affordable with time, but remember that when the first 8-bit digital sampler, the Fairlight CMI, appeared in the early '80s, it cost over £30,000: you could buy a house for that! The Workshop's composers were all producing work in their own styles, using equipment that may have been available to outside composers, but was prohibitively expensive for most. Elizabeth Parker joined in 1978 and her trademark sound came from the pricey and unreliable PPG 2.2. Richard Attree, who, in 1987, was the last composer to be taken on, made good use of the Yamaha TX816, which was effectively eight DX7s in a rack. Just one DX7 cost £1200 when it was new.

Peter Howell told me: "There's still this prevailing idea that we were somehow almost traitors for using modern gear and computers! Some people still believe that the original Workshop, with virtually no equipment, was the only incarnation that mattered. But we were there to do a job. With the Fairlight I could play something live, in real time; why on earth should I spent three weeks chopping up little bits of tape to get exactly the same result? We had to catch up with the real world — otherwise we'd never justify the time and cost."

Dick Mills (left) and Brian Hodgson compare the lengths of two sections of tape; watching is Desmond Briscoe.



The Cost Of Everything

Ultimately, it was costs that killed off the Radiophonic Workshop. The controversial appointment of John Birt as the BBC's Director-General in 1992 was the writing on the Workshop wall — for Birt brought 'producer choice' to the BBC. The asylum would be run by lunatics no longer: the accountants were taking over.

With 'producer choice', staff producers at the BBC could now either use the BBC's carefully costed in-house facilities, or they could choose to go outside — all that mattered was the cost. And everything in the BBC was costed. So what happened? In London, staff producers and directors cleared off to Soho in droves, to work with their old mates who'd already taken redundancy and gone freelance. For about a year, many BBC buildings felt empty. Everyone was eventually recalled and producer choice was 'modified', but the damage was done — it resulted in a catastrophic lowering of morale within the BBC.

Brian Hodgson struggled for a long time to keep the Workshop alive, but it was a losing battle. Under the Birt regime, every BBC department was assessed for profitability, and if running costs were found to be greater than profits, extermination followed swiftly. The Radiophonic Workshop had been doing a fine job providing quality music for many programmes that didn't have big budgets — schools programmes, in particular. But now the Workshop was expected to compete on the 'open market' with freelance composers like myself. Brian spent many months calculating the cost of finished music per minute and searching for ways to reduce it. I didn't even bother costing my music per minute: I didn't have to. If a director asked me for a quote, I could just say "Well, it depends... How much have you got?"

Despite this approach being the most obviously competitive, it was not permitted under BBC rules, and so in 1998 the Radiophonic Workshop finally closed its doors. John Birt was awarded a Life Peerage, by the way, and now sits in the House of Lords.

Daphne Oram (1925-2003)

There would have been no Radiophonic Workshop without Daphne Oram, despite the fact that she worked there for less than a year. She was a remarkable woman and a true pioneer, whose achievements have never been fully recognised. As well as her work in electronic music she also composed many orchestral pieces, all of them as yet unperformed. This year though, Sonic Arts Network (www.sonicartsnetwork.org) are to mount an exhibition and concert celebrating her life and work. Details will be announced in



Daphne Oram with the wobulator (centre of shot), 1958.

SOS, or see www.daphneoram.org.

Daphne left the BBC in 1959 and moved to Tower Folly, a Kent oast-house that she had already started converting into a home and studio. Here she produced music for film and theatre, using the techniques of *musique concrète* and primitive electronics. Over the next years she was to develop her own Oramic Synthesis, an extremely novel way of producing electronic sounds.

At that time, the most advanced electronic instrument in existence was the RCA Electronic Music Synthesizer Mark II. Built in 1957, it consisted of a huge array of steel racks and was bigger than the average living room. The machine (which still exists) was controlled, or 'programmed' by means of a roll of paper, punched with holes. It also offered an alternative: the parameters could instead be drawn onto transparent film that passed over a series of photo-cells. Daphne's Oramic system was similarly controlled by drawing, but for each parameter there was a separate roll of 35mm transparent film (known as 'clear leader' in the film industry). The 10 rolls of sprocketed film were mechanically linked, and passed over a horizontal 'drawing table' where the operator could make marks on the film to control pitch, envelope, intensity, and so on. Additional rolls of sprocketed recording tape or 'mag track' could be used to record the results; this section was referred to as the 'multitrack' recorder.

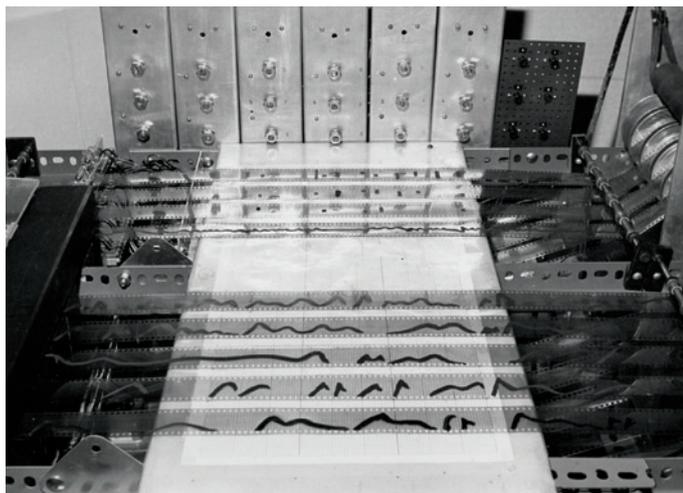
Daphne seems to have preferred to draw onto the film using a brush and special ink, but felt pens or sticky tape could be used. Her machine

had several oscillators with variable waveforms, again controlled by photo-electric cells. This part of the machine was even more bizarre: a selection of glass plates, each with a cut-out pattern, could be fixed to 'cathode ray scanners' to change the waveforms. It was effectively an oscilloscope in reverse! Reading contemporary accounts of how the Oramic system worked is confusing nowadays [see *photo and diagrams, courtesy Sonic Arts Network, overleaf*], as the words analogue and digital are used, but not in the sense that we know them. Continuously variable parameters were regarded as analogue, while

those that could only be switched on or off were 'digital'. However, Daphne did eventually go digital in the modern sense.

I met Daphne Oram once, in 1989, and inquired whether she still used the Oramic system. Surprised and delighted that I'd even heard of it, she laughed "Oh no, not that old-fashioned thing!" She then explained that her old Oramic system had been swept away and replaced by something far more modern! She'd been working with 'some clever young chaps' who had helped her to build a new, computer-controlled synthesizer. "It's a huge improvement!" she said. "Now, when you draw the parameters, they're digitally scanned into a micro-processor..."

Yes, it still used rolls of 35mm film! ▶



Delia Derbyshire (1937-2001)

Although her name will be forever associated with her 'realisation' of Ron Grainer's *Doctor Who* theme, Delia Derbyshire (pronounced 'Darbyshire', by the way) proved herself to be an extremely original and sensitive composer. She had a degree in Music and Maths from Cambridge that may have accounted for her unusual and analytical approach to sound: she is reputed to have always carried a book of logarithm tables that she used in her work! During her time at the BBC, the Workshop composers were not always properly credited, so consequently there is no complete catalogue of her music. She also 'moonlighted', producing library tracks under various pseudonyms. Some of her music is available on CD, though, and she has a MySpace tribute page. *Blue Veils & Golden Sands* and *The Delian Mode*, two pieces that she made in the Radiophonic Workshop, are particularly outstanding, featuring organic sounds that seem to 'shimmer' as their harmonics slowly change. She claimed to have made the sounds by analysing the partials of her favourite metal lampshade and replicating them with sine-wave test oscillators! Before Delia, electronic music had a reputation for sounding 'ugly'; she proved that it could also be extremely beautiful.

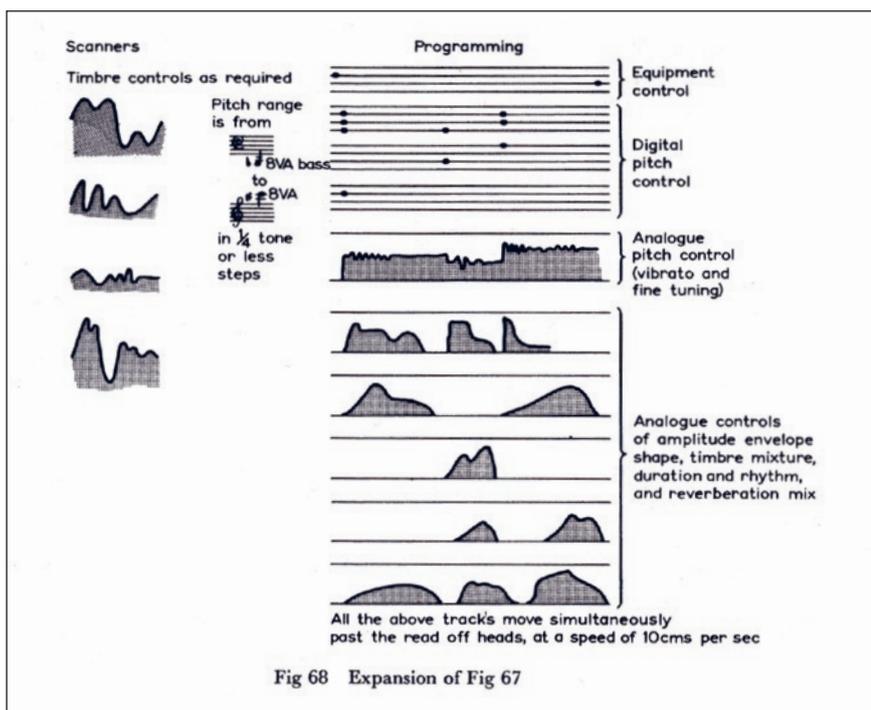
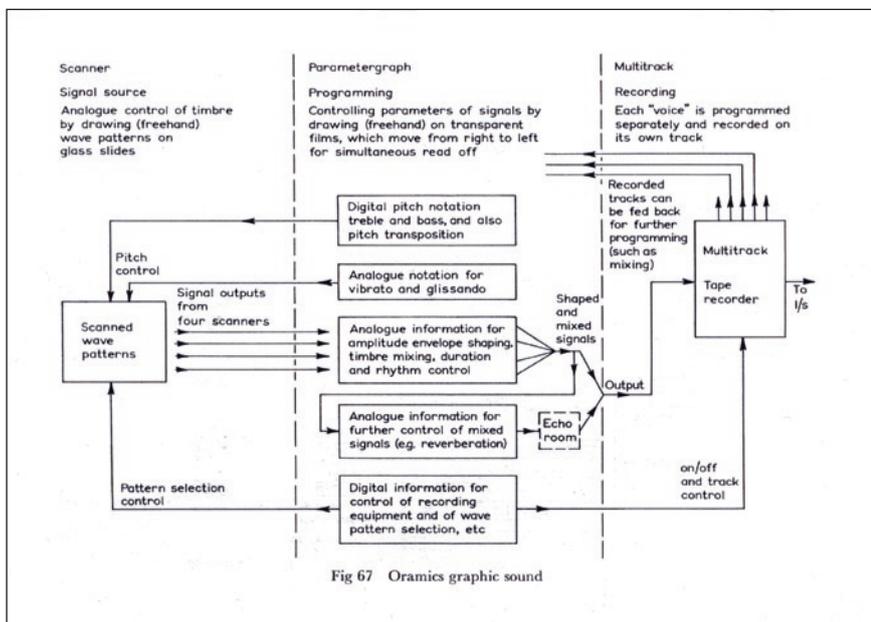
The unique Oramics synthesizer was controlled by drawing onto 35mm photographic film.

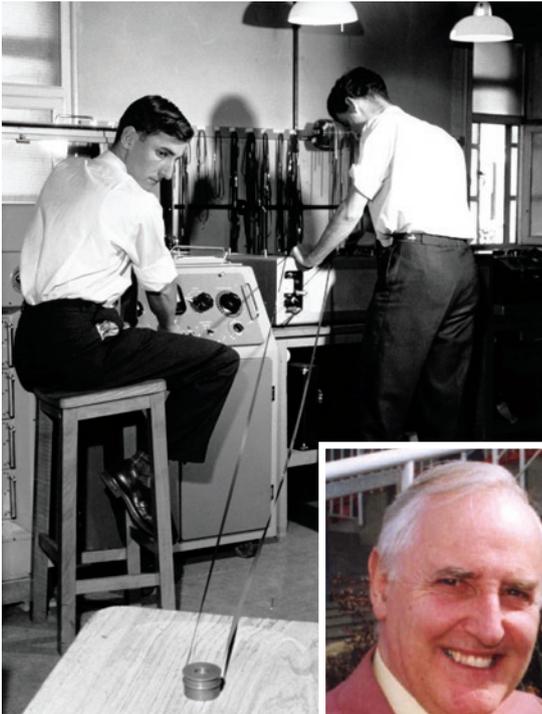
In 1973 she left the BBC and gave up composing, working for a short time with Brian Hodgson at Electrophon Studios. Then followed a series of curiously directionless moves: she went to Cumbria to work as a radio operator on the gas pipeline; was briefly married; she ran an art gallery, and made a disastrous attempt at teaching music in York. Eventually she settled with a partner who brought much-needed stability. In the late '90s her interest in electronic music returned and she began working on an album, but sadly, it was never finished, as she died at the age of 64 after cancer treatment. In a 2001 obituary Brian Hodgson wrote of her: "One night many years ago, as we left Zinovieff's studio, she paused on Putney Bridge. 'What we are doing now is not important for itself,' she said, 'but one day someone might be interested enough to carry things forwards and create something wonderful on these foundations.'"

Dick Mills spent virtually his entire career in the Radiophonic Workshop and holds the record for the most *Doctor Who* credits. Now retired, he finds himself increasingly in demand for *Doctor Who* and sci-fi conventions.

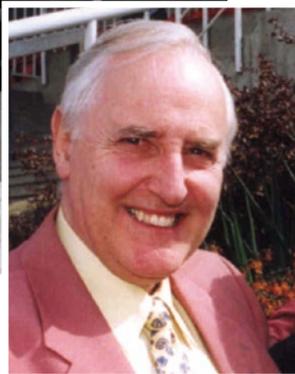
Dick Mills

"I joined the Workshop in November of 1958, after it had been going for only about six months, so I'm now the oldest surviving member. As a duty engineer, I'd worked once with Desmond Briscoe on a very silly drama thing he'd done, which was set on the moon! It was about a couple of astronauts who went there and fell in love with a moon woman and when they got back to Earth one of the men was pregnant... It had weird sound effects and was great fun to do. So when I saw a notice





Dick Mills (left) and studio manager John Harrison attempt to control a very long tape loop!



Dick Mills today.

asking for someone to help out at the new 'Radiophonic Workshop' I jumped at it. I stayed there until I retired in 1993."

Dick's speciality at the Workshop was sound effects — not just sci-fi ones, but outrageously funny ones too. I asked Dick where his interest in effects came from. "From the early '50s there used to be a Saturday night DJ called Jack Jackson who did amazing things with records — cutting and mixing between music, comedy and sound effects. He was much appreciated by those in the business. Then there was the Goons — remember, all that stuff was done live, with a studio manager spinning in sound effects from 78rpm records."

For the Goons, Dick famously produced one of the best comedy effects of all time: 'Major Bloodnok's Stomach' was an outrageously long impression of a tortured digestive system. It has appeared on several BBC FX discs and was even sampled by the Orb! Dick remembers recording it: "I always wanted to work on the Goons, but Desmond Briscoe was in charge and he said no, because he thought they'd be unreliable and a nuisance (he was probably



Roger Limb, 2006.

Roger Limb attacks an empty tank with a mallet.

right). Anyway, Desmond was away on holiday that week... A producer came in and asked if we could do something for the Goons, so I just said yes! The finished thing was hysterical, and originally even longer, all cut-up burps, gloops and explosions. We just fell about laughing every time we played it. The producer sat and listened in silence, then said 'Well, it's all right, but we've only got half an hour for the show. We can't spend 30 seconds on one effect!' So we had to cut it down to 10 seconds for him."

Because the Workshop had a couple of in-house technicians, some of Dick's experiments would involve them building custom pieces of equipment. "I got obsessed with crossfades at one time," he laughs. "I wanted to be able to do longer ones, so I got them to make me a splicing block that was 18 inches long! No, it didn't catch

on... We tried all sorts of variations on tape loops: I once tried splicing a Moebius strip. That didn't work either. The tape changed sides at the splice, so half of it was bright but the other half had top-cut because the tape was now upside down. Someone else invented a vibrato unit for tape! It consisted of a gramophone motor, attached to a biscuit-tin full of sand, to make it heavy enough; the motor had some sort of gearing, probably Meccano, to make an arm press periodically

against the tape and give the vibrato effect. It worked, sort of."

Eventually, the Workshop began to be seen as uneconomic and unnecessary. *Doctor Who* had finished and there was no need for sci-fi effects any more. What could the Workshop provide that couldn't be found in studios anywhere else? The answer turned out to be intelligent noise removal: it was new and extremely expensive in the '90s (even hard drives cost a fortune then). So Dick's last few years at the Workshop were spent running a Sonic Solutions No-Noise system. No-Noise was a useful tool for TV production — from one small sample it could automatically remove hiss, camera noise, hum, and so on. Dick was set up in a brand-new new computer studio and was kept busy with archiving work, remastering video sound for DVD. "It was very interesting and satisfying work," says Dick, "but quite ironic really. I started my career with the BBC paying me to add horrible noises to their programmes; then in the end they were paying me to take them off!"

Roger Limb

"I'm 67 this year," Roger declares, "but I like to keep busy. I play keyboards with a rock & roll band and we gig regularly..." Roger Limb has always been busy: with his phenomenal output from the Workshop he must count as one of the most prolific composers in history! He spent his first few years with the BBC as a TV announcer. Then, some time in 1972, he bumped into Paddy Kingsland in the street outside Broadcasting House.

"Paddy and I had been studio managers together," he says. "He told me he was working at this fantastic little department in Maida Vale and that I should apply for an attachment — so I did! What they were



The Voice Of The Daleks

One of the most famous Radiophonic Workshop effects was the voice of the Daleks in *Doctor Who*, which was created by Dick Mills and Brian Hodgson. "We used a ring modulator," explains Dick, "the old-fashioned type, with two centre-tapped transformers and four diodes. Same as a bridge rectifier. They were 'improved' years later with a transformerless design, but the old ones could be distorted better. We spent a long time finding the right frequency to modulate the voice with, and eventually settled on 30 Hertz. But it's not as simple as all that, because they needed the actor who did the Dalek voice to perform live as they filmed. We set them up with a ring modulator in

the studio (which they eventually lost!) and provided a reel of tape with a 30Hz tone on it. They'd run the tape, the actor spoke into a mic, both went through the ring modulator, and it sounded like a Dalek.

"But if the tape was supposed to run at, say, seven and a half inches per second, they'd sometimes run it at 15ips by mistake, or at three and three quarters. So that's why, for all you *Doctor Who* anoraks, the Dalek voices are slightly different in some episodes — if so, it was a mistake! I did other experiments with modifying the tape containing the tone — distressing it and removing bits of the oxide. It was a good effect, but was never used."

▶ doing was what I'd been dabbling with at home for several years. I'd been dangling microphones inside pianos and just playing with interesting noises. It had never occurred to do me that this could be a career." Roger had been with the BBC for over five years, but before the Radiophonic Workshop he'd never heard of such delights as tape loops. "What impressed me the most," he says, "was vari-speed. I'd never thought it possible! There was 15 ips [*inches per second*], seven and a half, three and three-quarters — but it hadn't occurred to me that there could be anything in between!"

Roger was yet another victim of the dreaded three-month rule: after his allotted time he duly left, and was only able to return when a place in the Workshop was advertised (internally, of course) in 1974. Roger remembers the instruments of the early '70s: "There was the VCS3 and the Delaware, both of them certainly ground-breaking, but not terribly reliable. The VCS3, in particular, used to drift out of tune all the time. I was told that this was due to their being made with poor components. But you must remember that although we now call them all 'keyboards' they were often played, or controlled, without a keyboard, just by twiddling knobs. I do remember there was an attitude back then that using keyboards as controllers was probably just an interesting cul-de-sac, almost a passing fad! I did love the ARP Odyssey, though — it had a decent keyboard and it was very musical. It felt like a real instrument."

Roger says that the mid-'70s saw crucial changes in the way that the Radiophonic Workshop was run: "The original tape-splicers, John Baker and Delia Derbyshire, both left and it became much less experimental. With the likes of Paddy and myself coming in as musicians, it became more of a music-making factory."

The equipment was changing, too.

Paddy and Roger began recording their tracks onto the Workshop's two eight-track recorders, which speeded up the business of making music considerably. "In 1985," says Roger, "the Fairlight arrived, and I think that one instrument changed music, and the way it was to be made, forever. I was a big fan of the Fairlight, and once when I travelled to Australia I called in at the factory to meet one of the inventors, Kim Rylie."

I asked Roger if he had any other favourites. "The Yamaha CS80 was a lovely instrument — very expressive. I had an Oberheim that I was very fond of; I loved the Prophet V. The Delaware was an amazing instrument, but so labyrinthine that you could disappear for weeks just making sounds! We never had any Moogs, you know — although I believe that Mr Moog himself once visited. We did get an awful lot of visitors, particularly musicians who were working in the other studios. One day I was leaving my studio for a coffee break and as I opened the door I almost knocked over Marc Bolan, who was listening outside! He looked very sheepish and apologised. 'I've always wondered what went on in here,' he said, so I invited him in to have a look around. He had an appointment and said he'd love to have a tour the next time he was at Maida Vale, but it never happened. Two weeks later he had his fatal car crash."

So how would Roger sum up his time at the Radiophonic Workshop? "I feel very fortunate that I had the best job in the world for 20 years — I'd have done it for nothing! Well, maybe not *absolutely* nothing..."

Peter Howell

Now a lecturer in Screen Music at the National Film & Television School, Peter Howell started his musical career in the late '60s, playing 'psychedelic folk' with Agincourt and other related bands. Peter

▶ eventually got a proper job as a BBC Studio Manager, but after a few years he managed to become a full-time member of the Workshop. "I started in '74 — the same year as Roger Limb," says Peter. "John Baker was still there, but we sort of crossed over. It was a funny period, really. I saw how to do the tape-splicing techniques, and had a go myself, but this was just when synthesizers were becoming available, and that was what really interested me."

Peter later became known for his work on the Fairlight, but he was happy to be the guinea pig for any new gear that came into the Workshop. "What I really found satisfying," he laughs, "was making beautiful sounds from ugly, clinical-looking machinery. The Fairlight was one of the ugliest instruments ever! I enjoyed using the VCS3 a lot; with the eight-track recorder I could make a whole piece using only the Odyssey, which I was very keen on."

"Then polyphonic synths appeared. I tried the Polymoog and really didn't like it; I liked the Prophet V, but my favourite was the Yamaha CS80. When I did Jonathan Miller's TV series *The Body In Question* I really wanted one, as I'd just seen it demonstrated. There was no money for one at the Workshop but we got the programme, which did have a decent budget, to hire one for me. It became a hit series, so later the BBC was later shamed into buying me one. It was a wonderful machine: polyphonic, though only eight-note; it was so expressive, with soft-action pads, and a great long pitch ribbon that you could play like a violin string. My party piece was to



Peter Howell today.



Peter Howell with his beloved Fairlight.

play the hornpipe just on the ribbon! I used the swell pedal constantly and this became crucial to my technique. Later, when we got MIDI

sequencers, I used a volume pedal in the same way — so I ended up with files that were huge with all the Controller 7 changes."

Peter was an early convert to making music with computers: "I did love having a room full of actual things that made noises, but what appealed to me most about computer instruments was the fact that all the settings could be memorised. Previously, I used to dictate all my studio settings into

a cassette recorder, especially if there was a chance that someone else might come in to use my studio and change something. People would call in as they were leaving at the end of the day, and I'd be crawling around on my knees, calling out 'Attack seven; decay three; sustain nine...' It could take me 20 minutes to do the whole studio!"

Paddy Kingsland

Of all the composers who passed through the Radiophonic Workshop, Paddy is possibly the best known, because of his prominent credit on the end of each episode of *The Hitchhiker's Guide To The Galaxy*. Paddy was originally a guitarist, playing in several semi-pro bands; after several years as a Radio 1 Studio Manager he joined the Radiophonic Workshop. "When I started in 1970 there were three rooms — 11, 12 and 13 — plus the 'Piano Room' and an 'Organ Room' that housed a great big electronic organ that someone thought might be useful. It wasn't. John Baker was in room 11: he had three Phillips tape machines and the room was lined with hooks that had hundreds of tape loops hanging from them. John had a playback machine (a Leavers-Rich?) with vari-speed, and the speed control had been marked up in semitones. He would play his original loops on this, change the speed and run off copies onto a standard 15ips machine. In this way he'd make all his notes first, then splice them together to make the music. And he used to listen to Radio Four while he did it! I tried his technique myself and really enjoyed it — one track I made used DIY effects like hammers and drills.

"Next door in Room 12 were Brian Hodgson and Delia Derbyshire with a VCS3. They had Electrophon Studios and a connection with EMS, so they'd persuaded

The Radiophonic Workshop's Greatest Hits

When asked for a discography of the best ever Radiophonic Workshop releases, Mark Ayres came up with his top seven 'in no particular order'.

- *BBC Radiophonic Music* (aka 'the Pink Album')

Early Radiophonic wonderfulness from Delia Derbyshire, David Cain and John Baker. Originally released as a mono vinyl album in 1971, catalogue no. REC 25M; now also on CD (BBC REC25MCD), remastered with two extra tracks.

- *The Radiophonic Workshop*

Compilation of material from the early '70s, released as a stereo LP (REC 196) in 1975; remastered CD (BBC REC196CD) includes two additional tracks.

- 21

Don't be put off by the terrible birthday-cake cover, this is a quality compilation of material from the Workshop's first 21 years. Released as a stereo LP (REC 354) in 1979.

- *Fourth Dimension*

Theme and test-card music from Paddy

Kingsland. *The Workshop goes lounge*. Stereo LP (RED 93S) from 1973.

- *Through A Glass Darkly*

Peter Howell's solo album from 1978 (stereo LP, catalogue number REC 307). Side one is 'a lyrical adventure' (ie. one long track, done 'after hours' for the fun of it). Side two is comprised of shorter tracks, including Peter's classic *The Astronauts*.

- *Doctor Who At The BBC Radiophonic Workshop, Volume One: The Early Years*

CD compilation of *Doctor Who* music and sounds from the '60s. Originally released by BBC Music, later re-released on the Grey Area sub-label of Mute.

- *Doctor Who At The BBC Radiophonic Workshop, Volume Two: New Beginnings*

Continuing from *Volume One*, this dives into the '70s. Includes Malcolm Clarke's music for the 1972 story *The Sea Devils*. In effect: 43 minutes of Malcolm fighting with the Delaware. The jury is out as to who won.



Paddy Kingsland, at the Radiophonic Workshop in 1980 (left), and today.

so Dick Mills and Harry Parker came in and took over." Producer Simon Brett had put the first episode together and introduced Douglas Adams to the Workshop. The writer immediately saw the potential. "The first



series was a big hit," says Paddy, "and I came back on board for the Christmas Special — you know, the one where the robot falls down a lift shaft... This time I made the music too [apart from the Eagles' signature tune]."

Paddy went on to make effects for another radio series of *Hitchhiker's* and then the TV series. "My biggest mistake when I did the TV series," he admits, "was to add squiggledy 'computer' noise to the book sequences as the letters drew across the screen. It looked great, though! I did it for the first episode and the director loved it. 'Great effect,' he said. 'We must have it for all the other episodes,' So I was stuck with the laborious task of cutting the sound to picture, using 16mm magnetic track, for the entire series! It took ages, doing it all by hand using an old-fashioned film splicer."

Paddy left the Workshop in 1981 and set up his own PK Studios in London (www.pkstudios.co.uk), where he now works. "It's a great mix," he says. "My son works with me and we do TV post-production, some music, a lot of film dubbing. What I enjoy most is Foley work — making sound effects, live to picture. I could happily do that all day."

Mark Ayres, Radiophonic Archivist

A life-long *Doctor Who* fan, Mark Ayres first visited the Radiophonic Workshop as a schoolboy! He kept up contact and eventually returned years later as a freelance composer, now working on *Doctor Who* himself. Mark is now a member of the BBC's unofficial 'Doctor Who Restoration Team' — a group of dedicated fans, some of whom are BBC staff. The team has been responsible for restoring 'lost' episodes and remastering many DVD releases. Mark Ayres has done much of the audio restoration, and was also

responsible for rescuing the Radiophonic Workshop's tape archive when the place was closed in 1998. "I suddenly got phone calls," says Mark, "from Brian, then Peter Howell, then Paddy... They all said 'Someone's got to get in there and save the archive before it ends up in a skip!' — so I did."

Doing so took a great deal of time and effort, almost costing Mark his career. "I'd just done my first feature film score," he says, "and I should have been out promoting it and trying to get another. But instead, I spent 18 months in Maida Vale, cataloguing tapes."

The Radiophonic Workshop was unique within the BBC, as it was the only department to hold its own archive. Absolutely everything was kept. When DAT tape came along in 1988, composers were ordered to continue making quarter-inch copies, as no-one knew then how long DAT tapes would last. The tapes were all stored in three cold, dark, tomb-like rooms. "The Workshop had closed and no longer existed," says Mark, "but they had a system whereby it was still being charged rent by the BBC for storage! So all the tapes were taken out of the three store rooms and crammed into Dick's old studio. And they were now all out of sequence." Mark was told that some of the later tapes had been thrown out to save space, but that wouldn't matter, because "it will all be on DAT anyway".

"So," says Mark, "having messed up the archive, the BBC paid me (not very much, I might add) to sort it all out again." He started with the oldest tapes and worked his way through the pile. When he got up to 1983, all the rest of the tapes were missing. "They'll be the ones that are on DAT," he was told. Pointing out that DAT had not yet been invented in 1983, he set about scouring the building. The tapes, he discovered, should have been put in a skip, but by some fluke the paperwork had not been done — so they must still be in Maida Vale somewhere. "It took a whole week," he says, "of borrowing keys and opening rooms that no-one had been in for years. Eventually I opened a room labelled Band Store and there they all were!"

The tapes are now safely stored in the BBC's main archive, but are 'non-accessioned', meaning that no-one apart from Mark really knows what is there. "They all need properly digitising and cataloguing," he declares, "but it takes forever to do. There are three and a half thousand reels of tape. Ten of the reels are John Baker's sound sources — his sample library, if you like. But they're 40 years old, and full of splices that are either dry and falling to bits, or gone sticky. You have to copy a little bit, clean the heads, copy another bit..."

He started by concentrating on the *Doctor Who* tapes. "There are about 250 reels of sound effects," he says, "each up to

► the Beeb to buy some VCS3s. I always found them great for effects but not very tuneable. Then in room 10 there was the Delaware. Composer Dudley Simpson used the Delaware a lot for *Doctor Who*: he would arrive with an eight-track tape he'd recorded with live musicians in Lime Grove Studios, then, working with Dick Mills, he'd somehow sync up to the Delaware and add extra electronic tracks. He used the sequencer a lot."

Paddy, though, along with Roger Limb, was largely occupied with getting as much finished music out of the door as possible — every day. "I enjoyed it, but as I wasn't really into 'weird', I didn't feel I was doing anything that couldn't have been done anywhere else. Not until I started on *Hitchhiker's*, that is! Then suddenly I thought the Workshop came into its full potential: it was using the place properly."

The first episode of *The Hitchhiker's Guide To The Galaxy* was actually a one-off pilot to test the idea. Actors' voices were recorded onto eight-track tape in the studios at Broadcasting House, then sent over to the Radiophonic Workshop to have the effects added. Paddy really went to town and created some extremely original sounds, many of them using his latest gizmo: the Eventide Harmonizer. "I did use it a lot," says Paddy. "For processing voices, mostly. Marvin the Paranoid Android used it; Eddie the Shipboard Computer, the Vogon Space Captain... It was the first real-time digital pitch-changer. The Vogon voice was treated with an echo that went up in pitch with each successive repeat, as the Harmonizer had been patched into a delay line."

Douglas Adams' witty script and Paddy's innovative sound effects proved to be a great combination; the pilot was a success and a further five episodes were commissioned to make up series one. But there was a problem: "All of this took ages, and I'd been moved on to a radio series that was to take six months — I just wasn't available to do it,

40 minutes long and containing about 100 sounds. It's an enormous task."

Mark has remastered four CDs of Radiophonic music so far. He started by pulling out the quarter-inch masters for the first two albums that had originally been released on vinyl, and discovered that they came with extra unreleased tracks. He hopes to continue, but as he says: "The funding just isn't there. I started remastering them as a labour of love, really. I'd work slowly on remastering an album, then deliver it to BBC Music when I'd finished. I phoned them up one day and said that I'd got another album ready for them, after several months of work, and there was an embarrassing silence. 'Sorry,' they said, 'we don't have a label any more!' Mark hastens to add that this problem has been resolved: BBC releases are now licensed to other labels, and he also has the support of an enthusiastic music department. "What this project needs, though," he says, "is lots and lots of time. And some money!"

To celebrate the 50th anniversary of the founding of the Radiophonic Workshop, Mark is compiling a two-CD set of Workshop music. It will comprise the two classic Workshop compilations *21* and *Soundhouse*, as well as an hour of previously unheard material. Details will be announced in *SOS*, and you can find out more at Mark's web site: www.markayres.co.uk.

Ray White, Engineer

"I had several attachments to the Workshop," says Ray, "They interviewed me a few times for a permanent job, but I was very bad at interviews. Desmond Briscoe really wanted me to stay, so eventually he just fiddled it! We had a 'rehearsal' for the interview and sure enough, next time I passed."

Ray spent most of his BBC career as an engineer in the Radiophonic Workshop, fixing, building and modifying anything electronic. Arriving in the early '70s, he stayed for 20 years. "In the early days it was almost like a club," he says. "It was great fun, going to work. If they thought you were right, the management would welcome you in — then recommend that you join the Union! That would just not happen nowadays."

Ray is proud of his association with the Radiophonic Workshop but points out that not all the music produced there was good. "There was some awful dross came out of the place at times," he says, "and no-one mentions that. I think it was at its most successful when it combined electronic innovation with something more traditional. Like a tune... The *Doctor Who* theme is the best example. Could you imagine anything like that ever coming out of, say IRCAM in Paris? They've produced so much stuff in that place that is clever, and pushes the limits of

Ray White, whose engineering expertise made many of the Workshop's experiments possible.



music technology, but it all sounds horrible! You wouldn't want to listen to that in your lounge, would you?"

In 1993

Ray decided to take early retirement. "As soon as Birt was appointed, I could see what was to come," he says, "The Workshop had gone as far as it could and it had served its purpose. Looking back, it was so difficult for those early pioneers to achieve what they did." Ray cites film composer Tristram Cary: "He was making electronic music in his home studio in the '50s - building his own gear too. He'd get stuck halfway through a composition, then have to get out his soldering iron and build some new machine, just so he could finish the track! By comparison, it's so easy to make electronic music today. But that means it's even easier to produce rubbish!"

Ray White's web site contains the most detailed account of the Radiophonic Workshop and its equipment: <http://whitefiles.org/rws/index.htm>.

Better Late Than Nedder

My own three months in the Radiophonic Workshop in 1988 were spent in Malcolm Clarke's Studio C, which was at the end of a short corridor running past Dick Mills' Studio D. I was covering for Malcolm, who was off sick, so I never got to know him (Malcolm died in 2003). Dick's approach to sound work was extremely practical and no-nonsense: his small studio was brightly lit with fluorescent tubes and resembled a laboratory. Malcolm's studio, on the other hand, was dark and moody; decorated entirely in red, at his insistence (something to do with the primal nature of creativity, apparently). Some witty technician had installed a tie-line box on Malcolm's studio wall; it included a dummy jack socket embossed with the words Fine Art Output.

One morning, Dick showed me his party trick. "Have you ever seen this before?" he chirped, producing a full 10-inch NAB spool of quarter-inch tape. In the centre of the hefty aluminium spool was a large circular hole, with three more sharp indents. Holding the spool balanced on the flat of his left hand, he deftly laced the tape into a Studer A80, winding it onto an empty take-up spool. He jabbed a button and put the Studer into

fast-forward. The Studer is a huge, heavy beast of a machine, mounted flat on its back in a wheeled caddy. The enormous size of its reel motors means that 'fast forward' is terrifyingly fast. As the machine whizzed into action, Dick gently patted the full NAB reel into the air and kept patting to make it hover just above his hand as it spun faster and faster. As the spool emptied, it began spinning even faster still. "Now the tricky bit!" shouted Dick above the whooshing and whirring sounds that rose steadily in pitch. The tape had almost all come off the spool; it was spinning dangerously fast already. The last bit of tape came off and whipped the spool like a top. With that, Dick tossed the reel up into the air above his head, then suddenly clapped his hands together and caught the empty spool between them. The spinning and the noise immediately stopped. "You do have to be careful not to catch your fingers," he said.

Finally, an opportunity to work with Dick Mills came with a radio sci-fi show for BBC Schools called *Slambash Wings Of A Compo Gormer*. Dick was to make the sound effects and I was to start with the music and make some effects if I had the time. Eventually, schedules slipped and all I managed was a signature tune. One of the effects was the sound of 'a galloping Nedder'. A 'Nedder' was a six-legged horse, in the alien world in which the series was set, and Dick and I agreed that whoever had some free time first would make the Nedder effects. I kept thinking of complex and sophisticated ways to do this, most of them involving samplers and/or coconut shells.

One day I saw Dick as I passed his studio. "I've done the Nedder," he said, and proceeded to play me it. It was perfect — exactly like a six-legged horse.

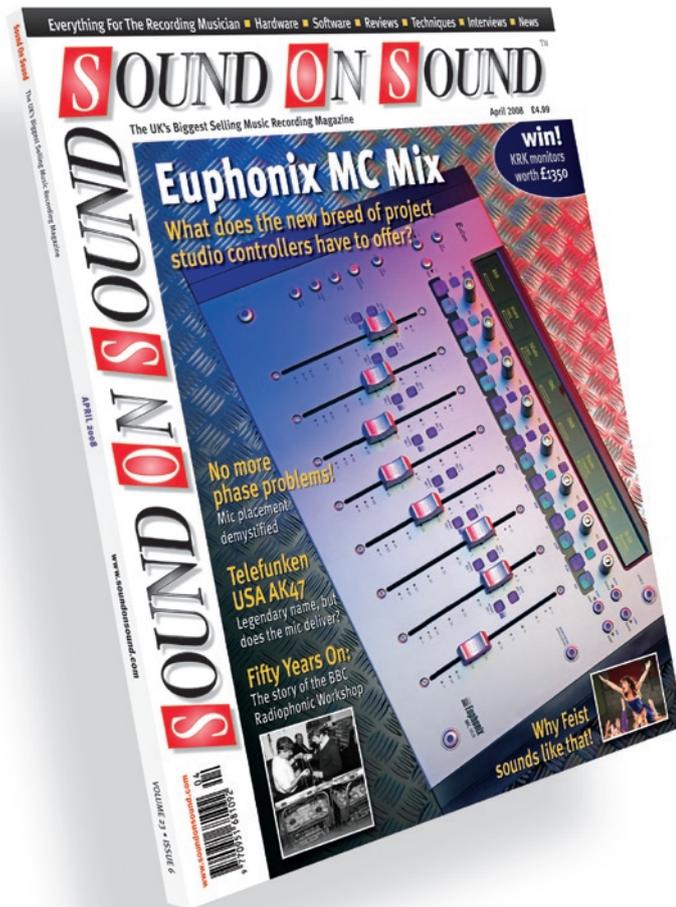
"How did you do it?" I asked. "Samples? Library discs?"

Dick reached out to his bench and picked up an empty plastic cassette box. He held it close to my ear, then rapidly drummed his fingers on it.

"Voila!" he said. "There goes a Nedder!" **SOS**

SOUND ON SOUND

The World's Best Music Recording Magazine



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