# Curatorial > PROBES

{I/NI//E

RÀDIO WEB MACBA

With this section, RWM continues a line of programmes devoted to exploring the complex map of sound art from different points of view organised in curatorial series.

Curated by Chris Cutler, PROBES takes Marshall McLuhan's conceptual contrapositions as a starting point to analyse and expose the search for a new sonic language made urgent after the collapse of tonality in the twentieth century. The series looks at the many probes and experiments that were launched in the last century in search of new musical resources, and a new aesthetic; for ways to make music adequate to a world transformed by disorientating technologies.

**Curated by Chris Cutler** 

PDF Contents: 01. Transcript 02. Acknowledgments 03. Copyright note

At the start of the seventies. Chris Cutler co-founded The Ottawa Music Company – a 22-piece Rock composer's orchestra – before joining British experimental group Henry Cow, with whom he toured, recorded and worked in dance and theatre projects for the next eight years. Subsequently he co-founded a series of mixed national groups: Art Bears, News from Babel, Cassiber, The (ec) Nudes, p53 and The Science Group, and was a permanent member of American bands Pere Ubu. Hail and The Wooden Birds. Outside a succession of special projects for stage, theatre, film and radio he still works consistently in successive projects with Fred Frith, Zeena Parkins, Jon Rose, Tim Hodgkinson, David Thomas, Peter Blegvad, Daan Vandewalle, Ikue Mori, Lotte Anker, Stevan Tickmayer, Annie Gosfield and spectralists Iancu Dumitrescu and Ana Maria Avram. He is a permanent member of The Bad Boys (Cage, Stockhausen, Fluxus &c.) The Artaud Beats and The Artbears Songbook, and turns up with the usual suspects in all the usual improvising contexts. As a soloist he has toured the world with his extended, electrified, kit.

Adjacent projects include commissioned works for radio, various live movie soundtracks, *Signe de Trois* for surroundsound projection, the daily year-long soundscape series *Out of the Blue Radio* for Resonance FM, and p53 for Orchestra and Soloists.

He also founded and runs the independent label ReR Megacorp and the art distribution service Gallery and Academic and is author of the theoretical collection File Under Popular – as well as of numerous articles and papers published in 16 languages. www.ccutler.com/ccutler

# **PROBES #2**

In the late nineteenth century two facts conspired to change the face of music: the collapse of common practice tonality (which overturned the certainties underpinning the world of Art music), and the invention of a revolutionary new form of memory, sound recording (which redefined and greatly empowered the world of popular music). A tidal wave of probes and experiments into new musical resources and new organisational practices ploughed through both disciplines, bringing parts of each onto shared terrain before rolling on to underpin a new aesthetics able to follow sound and its manipulations beyond the narrow confines of 'music'. This series tries analytically to trace and explain these developments, and to show how, and why, both musical and post-musical genres take the forms they do. This second programme continues to explore probes into pitch, examining alternative tuning systems based on the naturally occurring harmonic series, opening up a potentially infinite series of customised Just Intonation scales.

# **01. Transcript. Studio version**

The natural harmonic series, reloaded.

#### [Gregorio Paniagua, 'Anakrousis', 1978]

All the probes we looked at in the last programme were launched from the base of 'equal temperament' – dividing twelve already harmonically compromised semitones into quarters, sixths and twelfths. The next probe into tuning territory was perhaps more rational – certainly more productive – and it had deeper roots, connecting with an almost universal human practice.

Let's be clear: there is a natural, objective, harmonic series - if you pluck a string, it will vibrate in a complex but uniform way, and these vibrations produce not only the fundamental frequency of the string, but also a series of overtones. These overtones sound at every frequency generated by 'whole number' divisions of the length: divide a string in two and the frequency will double, producing a note one octave above the fundamental; divide it by three and the frequency triples, producing a perfect fifth; divide by four and you will hear a note two octaves above the fundamental; divide by five - that's a major third, by six that's a minor third - and so on. And all these notes sound simultaneously alongside the fundamental so, unless we listen very closely, what we hear is the combined sound as a single rich tone. It's the strength and ratio of the overtones that create the colour of the notes we hear - that's why an oboe, a flute or a trumpet sound so different from one another: the physical structure of each instrument suppresses or accentuates different parts of the overtone series. The sum of all the harmonics that sound, we call *timbre*. And the higher one goes in this natural harmonic series, the more dissonant the sound appears to Western ears.

Although Pythagoras is credited with working out the math, musicians have been instinctively tuning to natural harmonics for millennia. And for the most part, choirs and barbershop quartets still do. $^1$ 

So why is there a problem? Unfortunately if you start from the natural harmonic series – which we call just intonation – you will generate a vast number of possible pitches within any octave. This is because the exact pitch of the harmonic is completely dependent on the fundamental tone. It's like this: if you find the natural fifth harmonic of, say, a C string, that's a G. The natural 5th of that G is a D and the 5th of that D is an A and if we proceed in this manner, moving a fifth at a time, we will pass through E, B, F#, C#, G#, D#, A# and E# – from which, one more fifth will bring us home to C. That's a cycle of fifths. On paper, the C we arrive at should be the same – except in a higher octave – as the C we started out from. But, unfortunately – in physics – it isn't, in fact it's a little higher. Not much higher, but higher enough to be inconvenient – and audibly





[Harry Partch]

dissonant. In pre- or non-literate practice, this is not a problem; because they derived their scales empirically and limited them to notes that were acceptable to their *ear*. But once the *eye* is driving, every A must be an A and every B must be a B, there's no place for a B and a bit – and all the harmonies should likewise ring true, because the page says they do. The trouble is, the convenience of notation is at odds with the facts of nature. You can either have a scale built out of natural harmonics, or you can have every note identical in every octave. But you can't have both.

#### [Tobias Hume, 'The Lord Dewys of Favoret', 1605]

You could avoid confrontation by writing modally, that is by staying within one of the accepted 7-note scales, tuning to make these notes harmonious, and avoiding the others. But writers could *see* the harmonic possibilities on the page – and they wanted those possibilities to work out in the world. What they needed was a universally acceptable tuning compromise; a way to work around the discrepancies. And that's why, in the equal tempered scale that we use now, every note except the octave, is slightly out of tune. Arriving at this compromise and others like it composers gained the consistency and fluidity they craved – and they succeed in making every note compatible, as well as more or less consonant, with every other note. Which meant that viable transpositions could be made between one key and another. At the price of losing the experience of stable harmonic resonance – and of being severely restricted in the palette of available pitches.

#### [Harry Partch, 'On the Seventh Day the Petals Fell on Petaluma' (excerpts), 1964]

It was Harry Partch, who took his inspiration from the expressive microtonality of human speech, who finally abandoned equal temperament altogether. In the early thirties, he burned all his 12-tone works and – looking back to classical Greece – began to compose with scales derived directly from the natural harmonic series. Arbitrarily, he chose to stop at the eleventh harmonic – which gave him a scale of 43 notes to the octave. Since few conventional instruments can reproduce these scales, he had to design and build his own.

Here's Partch's 1943 composition 'The Letter', based on a note sent him by a friend. It is performed by Partch himself accompanied by an adapted guitar, an adapted viola, a kithara and the chromelodion.

#### [Harry Partch, 'The Letter', 1943]

All tuning systems of this type, composed only of pitches whose frequencies are related to one another by ratios of small whole numbers, are called Just Intonation systems. Potentially, there is an infinite number of them, since the harmonic series itself is, effectively, endless. Partch's probe proved far more influential than further divisions of equal temperamant. This is from Lou Harisson's 'Cinna'.

#### [Lou Harrison, 'Cinna (fast movement)', 1957]

It was Partch's book<sup>2</sup>, that led Harrison, in the early fifties, to explore the possibilities of Just Intonation. Many composers, of many orientations, have taken the same path since and by the early sixties, Just Intonation had become the alternative tuning system of choice. More than just a probe, it had become a credo in the early form of minimalism being explored by a small group in New York which included Tony Conrad, La Monte Young, John Cale, Angus MacLise, Billy Name, Marian Zazeela, and John Hassell – all of whom passed through Young's Theatre of Eternal Music – an ensemble that explored, at high volume, single – or very small collections of perfectly consonant pitches.<sup>3</sup>

#### [Theatre of Eternal Music, 'Day of Niagara' (excerpt), 1965]

Here is an extract from Young's 1964 masterwork 'The Well-tuned Piano' - for a piano tuned in Just Intonation. Performances of this piece are rare - and always long - lasting up to six hours. Recordings are even rarer, there are none currently available.

#### [La Monte Young, 'The Well-tuned Piano', 1964]





[La Monte Young]

Young is also legendary for his massive sine-tone installations, some of which explore pitch space up to the 2,304th harmonic.

This is by Dave Seidel, working like Young and here using Young pitch sets.

#### [David Seidl, 'Penumbral', 2010]

Driven purely by his ear, another American, Ezra Sims, who had been working with quarter tones in the sixties eventually, evolved his own 18 and 24-tone scales, projected out of 72-tone per octave just intonation tuning. This flexibility is one of the attractions of just intonation systems. Not only are they based on universal and natural phenomena but, through judicious selection and design, composers can customise their own scales – effectively without limit – each of which, like the ancient modes, will have its own character and possibilities to explore.

#### [Ezra Sims, 'Quintet for Clarinet and Strings', 1987]

#### [Ellen Fullman, 'Harmonic Cross Sweep', 1998]

Ellen Fullman evolved her long string instruments in Brooklyn in the early eighties. These were large-scale installations consisting of two planes of strings, 50 to 100 feet long, mounted at waist level and parallel to the floor. They are played by walking between the rows, pressing down on the strings with rosined fingers. At these string lengths, the natural harmonics become extremely audible, building rich clusters of partials that swell into a chorus of perfectly consonant sounds. To amplify the effect all the strings are carefully aligned in Just Intonation.

In fact, Just Intonation is, in effect, a global tuning default: singers instinctively settle to the low number ratios for simple harmonies – because that is where they feel most stable. The same applies to fretless stringed instruments or to the pitches produced by an open pipe blown at different strengths. The anomaly is equal temperament. Although in the age of writing – and the eye – it played a vital part in the liberation of the organisational power of stave notation, in the age of recording – and the ear – it has become just one of many options. What is new today is how far into the natural harmonic series we are able – and prepared – to navigate. In a world of constant, complex noise our ears have changed.

#### [Tuva, overtone singing extract, details unknown]

These are the natural harmonics produced by a single human voice.

And here are two voices: Natascha Nikeprelevic and Michael Vetter:

#### [Natascha Nikeprelevic and Michael Vetter, Youtube extract, details unknown]

Like all vibrating materials, human vocal chords produce overtones. And a handful of cultures has learned to isolate and accentuate them. In particular, Mongolia, Tuva and Tibet, though the technique is known disparate locations around the world.

#### [Mongolia overtone singing extract, details unknown]

It's a living tradition, here's some Tuvan pop.

#### [Koon Goor Toog, 'Koon Goor Toog',1994]

There is even an example, admittedly a unique example – in cowboy music. It's worth playing this because it's so unusual; how did Arthur Miles, a Texas cowboy, discover this technique? And what did his audiences make of it? I'm afraid I don't know. This is Miles' 'Lonely Cowboy', recorded sometime in the twenties.

#### [Arthur Miles, 'Lonely Cowboy' (excerpt), ca. twenties]





[Black and white print of a painting of Leo Ornstein by Leon Kroll]

It was Karlheinz Stockhausen who introduced overtone singing to the European art world. The way he tells it, he stumbled across the technique completely by chance. He was composing late one night, and didn't want to wake his children. So he was humming the parts he was writing quietly to himself, and suddenly began to hear the harmonics. From this insight – and a lot of work – he wrote 'Stimmung', a voice composition based entirely on overtone singing. It was premiered in1968 and these are first few minutes.

#### [Karlheinz Stockhausen, 'Stimmung' (Paris, short extract), 1982]

In 1981, Johnny Reinhard founded The American Festival of Microtonal Music, joining a handful of specialist organisations dedicated to bringing the whole gamut of pre- and post equal temperament tunings into a coherent body of practice. He also established a huge collection of scores, recordings and theoretical writings that dealt with the minutiae of tuning issues. Apart from his own considerable compositional work, Reinhart – working closely with the composer's comprehensive notes and sketches – undertook, in the mid nineties, the assembly of Charles Ives' visionary 'Universe Symphony', a remarkable work that, amongst other distinctions, employs a whole range of different pitch systems, including quartertones, just intonation and extended (53 to the octave) Pythagorean tuning.

# [Charles Ives/Johnny Reinhart, 'Universe Symphony' (extract from Part IV of *The Birth of the Oceans*), commenced 1913 by Charles Ives, completed 1995/6 by Johnny Reinhard]

#### [Leo Ornstein, 'Wild Men's Dance', 1913]

Perhaps because of its historical status, perhaps because of its place at the heart of Western art music; certainly because of its polyphonic powers of simultaneous chordal and melodic exposition, the piano was wooed by nearly all the early microtonalists, in spite of the fact that it presented them with enormous logistical problems - not least its basic arrangement of black and white notes, which are only divisible by twelve. On the other hand, it's a one-man symphony orchestra in miniature - with an even wider pitch range than a real orchestra. So it's hard to abandon. Because normal pianos are all but impossible to adapt, dedicated instruments have to be built. Julián Carillo, for instance, had a whole family of them made - in third tones, quarter tones, eighth tones and one whose entire keyboard - all 98 keys - spanned only a single octave. Similarly, for his 'Welltuned Piano', La Monte Young had a Bosendorfer Imperial specially constructed.<sup>4</sup> For many years, this piano was maintained and tuned by Michael Harrison, who was the co-owner of one of America's largest high-end piano companies. Finally, in 1986, Harrison designed and built - for his own use - a seven-foot concert grand that could accommodate 24 notes to the octave. He called it the Harmonic Piano, and he tuned it in what he called Pure Intonation, a variant of just intonation that accentuates the 'commas'. When I spoke earlier about the discrepancy between a fundamental C and the slightly higher C produced at the end of a cycle of natural fifths - that small discrepancy is a comma. The ratio of difference is tiny – 63:64, but it's still very audible.

This is 'Vision in the Desert' from Harrison's *Revelation: Music in Pure Intonation*.

#### [Michael Harrison, 'Vision in the Desert', 2007]

Today, the list of composers who exploit one or various systems of Just Intonation – especially in the electronic realm – is pretty long; and familiarity with the theory and the mathematics are so widespread that, in the world of alternative tunings, the mixing of different systems – as was the case with Reinhart's realisation of lves' 'Universe Symphony' – is becoming increasingly common. In this extract from Annie Gosfield's 'Four Roses' (1997), three of the cello strings are tuned conventionally, while the A string is tuned 80 cents flat (that's a little less than a semitone), creating microtonal intervals between the open A and the other strings. The accompanying piano samples, on the other hand, are tuned in a 32 note scale.

#### [Annie Gosfield, 'Four Roses' (excerpt), 1997]





[Wendy Carlos]

Programmes don't rely on mechanical properties to arrive at specific pitches. And by the eighties, computers and synthesisers were offering – at least to programmers – the means to customise any scale at all. This meant that users no longer had to think of composing as way of manipulating known sets of pitches, but could instead compose the pitch sets themselves – and then explore them. Wendy – then Walter – Carlos, who became famous for her early Moog hit 'Switched on Bach', took exactly this path on her 1986 *Beauty in the Beast*, a CD that explored various different customised tunings and reflected a relaxed – though rigorous – approach to pitch space design. In the piece that follows, which is kind of poppy film-music – it's certainly not difficult in any way – she mixes two very different scales, one splitting a perfect fouth into eight equal steps other slicing a minor third into eight equal steps.

#### [Wendy Carlos, 'Beauty in the Beast', 1986]

Now that public exposure to more exotic tunings is increasingly commonplace – especially through recordings of so-called World Music – renewed energy has been thrown into universalising the piano. The latest proposition was premiered in the United Kingdom in 2009. Its inventor, Geoff Smith, calls it the Fluid Piano, and it's an acoustic grand with koto-like moveable bridges that can be set to any tuning system at all. It takes no effort and it can be done in real time – before or even during playing. Although the focus is on its compatibility with Iranian and other non-Western tunings, it could spark interesting new approaches to pitch manipulation, since it not only offers instant and infinitely variable pitch adjustment but also, for the first time, real-time portamento on every string.

Here are Matthew Bourne and then Utsav Lal finding their way around it:

#### [Matthew Bourne, fluid Piano improvisation (youtube)]

#### [Utsav Lal, fluid Piano improvisation (youtube)]

Very few tuning probes have been launched from planet rock – there's Charles Carpenter, for instance, who uses the Bohlen-Pierce system, and Jon Catler, who's a tireless evangelist for Just Intonation. I have nothing very remarkable to play, but Youtube is full of rock pieces in different tunings, including demonstrations of electric guitar chords, first in equal temperament and then in just intonation; first with and then without distortion – so that you can contrast and compare. But, perhaps because of the nature of the sound – or the nature of the music, so far at least, you do need the comparisons to hear the difference. I will play the beginning of 'Joint' by Jon Catler. It's not from his rock repertoire, but it's still more rock than art or jazz.

#### [Jon Catler, 'Joint', 1994]

#### [Root, 'Tight Out of Sight', 2001]

The world of jazz, of course, is full of microtones – it's a common expressive practice. But it's not probed as a system. There is one group that makes a formal point of using quartertones, and that's Nils Wogram's Root, so I'll close this section with them. I suspect, mainly, you'll just notice that it sounds like jazz. That's because a hundred years of blue pitching has already adjusted our hearing. A lot of folk music does this too. It may have grated on the ears of nineteenth century musicologists, but a hundred years of sound recordings has broadened ours. We are beginning to lose our grip on straight Western pitching; and it's certainly beginning to lose its hold over us.

#### In part three we will look at radical glissandi.

 $^1$  When two notes in equal temperament sound together, they beat – you hear a pulse that is produced by the waves being slightly out of synch. When a true harmony sounds, there is no pulse; it is perfectly stable.

<sup>2</sup> Harry Partch, *Genesis of a Music: an Account of a Creative Work, its Roots, and its Fulfillments,* Da Capo Press, 1949.

<sup>3</sup> What really opened me up to Just Intonation was when Tony Conrad joined my group, The Theatre of Eternal Music, sometime in early 1963. I was playing sopranino saxophone at the time, and Marian and Billy were singing drones, and Tony joined the group on violin, and he had a background in math and the sciences. And he pointed out to me that with the integers you could analyze all of the ratios that were in the harmonic series, all of the ratios that were otonalities. (Note: This unfamiliar term originates with Harry Partch who said that an otonality was a collection





[Annie Gosfield]

of pitches that could be expressed in ratios with equal denominators – so 1:1, 5:4 and 3:2 form an otonality because they can be written as 4:4, 5:4, 6:4) And suddenly, I just took off, it just all went on like a light bulb and from that time on, I was just totally, completely captivated by Just Intonation. And I really felt that it was the most incredible revelation I had had in music. It became the key to my understanding of the relationship between sound and feelings, and to my development of my theories about universal structure, and our perception of time, and our understanding of our relationship to time and universal structure.

<sup>4</sup> At a cost of \$17500.

### **02. Acknowledgments**

With thanks to Nicholas Collins, William Sharp, Charles O'Meara, Udi Koomran, Jack Vees, Nick Hobbes and Simon Emmerson.

# **O3.** Copyright note

2012. This text is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License.

Ràdio Web MACBA is a non-profit research and transmission project. Every effort has been made to trace copyright holders; any errors or omissions are inadvertent, and will be corrected whenever it's possible upon notification in writing to the publisher.