

Endless Series of Pitches. A Short Introduction by Manfred Bartmann

On the CD, two tracks incorporate endless continua of pitches, No. 1 *Living it up - folkish as well as Low German self-exotifications*, and No. 2 *Gremietsack (The scoundrel) - a Low German mouth music in an Irish groove*. For further information on these tracks please refer to the corresponding booklet entries. Please also refer to the sound files embedded in this document. Their playback requires an up-to-date PDF-viewer, such as © Adobe Reader XI.

Another adventure in perception: An auditory illusion that became famous ...

Using cluster chords and what the composer György Ligeti (1923-2006) calls 'micropolyphony', *Lux Aeterna* is a piece of choral music that focuses on timbre. Written in 1966, it became famous after having been included in the score of Stanley Kubrick's 1968 movie *2001: A Space Odyssey*. As interval combinations merge into one another, there is no melody or rhythm, thus evoking an auditory illusion of infinity.

Illusions show us that we do not perceive the world predictably – our perception will always follow its own rules. As a result, we cannot help but to interpret what we perceive, making assumptions about what we are seeing or hearing. As a branch of psychophysics, psychoacoustics is the exploration of the human perception of sound. As we listen to music, or to any other sound, psychoacoustics will always have an effect on how we hear. As this is true for every music history in the world, it comes as no wonder that psychoacoustic phenomena have been used intuitively and consequently in almost every musical tradition (Bartmann 2005).

The impression of an ever descending pitch characterises Jean-Claude Risset's 1968 composition *Computer Suite from Little Boy*. 'Little Boy' was the codename for the 1945-Hiroshima bomb. One year before, the Beatles had used two passages of orchestral upward glissandos to combine two musically completely different songs into their composition *A Day in the Life* issued as the last track on their epoch-defining 1967-LP *Sergeant Pepper*.

In 1995 the music theorist and historian Ira Braus gave "An Overview of Pitch Circularity and Shepard Tones in European Music, 1550–1990" (Braus 1995). The so-called 'Shepard tones' or 'Shepard scales' were named after Roger N. Shepard (*1929), who has worked on the "circularity in judgements of relative pitch" (Shepard 1964). Shepard scales refer to the illusion of continuously rising or descending chromatic scales. Later on Jean-Claude Risset (1938-2016) created a version based on a glissando rather than a scale. He used these so-called 'Risset tones' in several compositions of his. All these circular-pitch illusions go back to basic additive synthesis. One creates a number of equally ascending harmonics, making the amplitudes of the lower harmonics fade in and the amplitudes of the higher harmonics fade out (APP Larkin 2014). When listening to the complex sound in its entirety, one will focus on the most prominent harmonics, all of them causing the whole sound to rise in pitch. Then a cue will turn up to make us listen more analytically just before it becomes obvious that this infinite rise of pitch has limits, i.e. that our holistic hearing has become pointless. This cue is a new prominent harmonic which will make us perceive the rise of pitch starting all over again. As a rule, these cues make up a cyclic pattern, the cyclic nature being noticeable "if you know what you are looking for" (see URL Larkin 2012). Nevertheless cyclic cues underline the general impression of listening to something endless, edging towards infinity.

These perceptions are paralleled in many works of the Dutch graphic artist M.C. Escher (1898-1972), such as in his lithograph *Ascending and Descending* (1960). Other works of his were inspired by the architecture and tilings of the Alhambra in Granada (Spain) (Piller/ Broug/ Shatanawi/ Zoeter 2013). His visual illusions can be seen as a perfect coming together of mathematics and art. He was adept at merging different worlds as one. In much the way that M.C. Escher's visual illusions defy logic, auditory illusions give our brains a similar workout, making us reconsider how we hear and why.

When conducting ethnomusicology fieldwork in the Republic of China (then Formosa) as early as 1943, the Japanese musicologist Kurosawa Takatomo recorded a sophisticated polyphonic singing style common amongst the Bunun people (Kurosawa 1973). Kurosawa had sent his recording to the UNESCO in 1951. It is said to be 'almost overtone singing'. Although this turned out to be more of a misunderstanding at least it indicates that the Bunun prefer to focus on timbre rather than melody when performing *pasibutbut*. The *pasibutbut* is a prayer sung for a rich millet harvest, usually performed by 6 to 12 male singers.

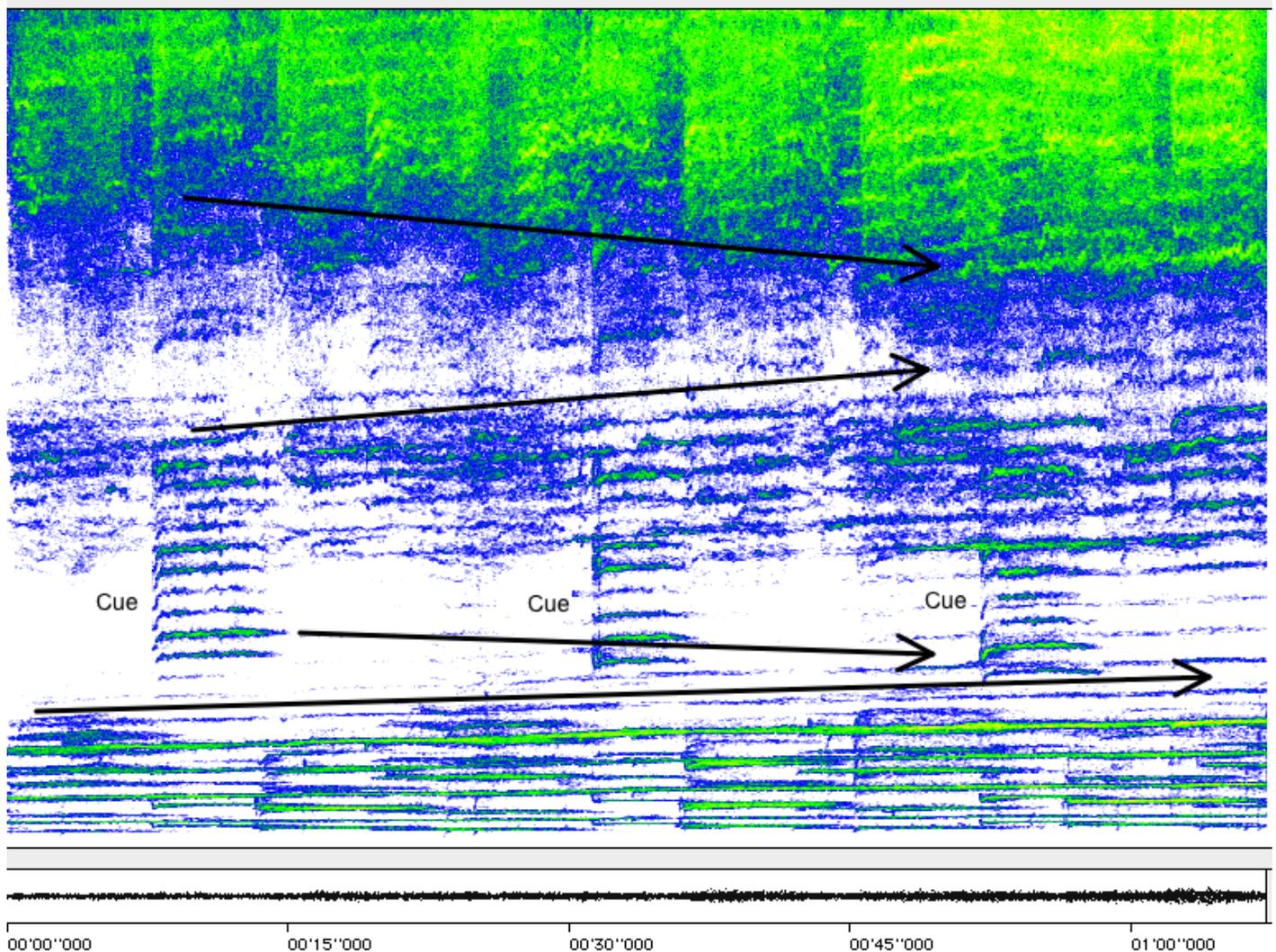


Fig. 1: The Bunun people have perfected a Shepard-Risset glissando - an acoustic illusion created from a series of overlapping ascending scales performed by approximately 8 male singers at a time. One singer, who appears as soloist, provides a cyclic cue pattern (see 'Cue'). It is almost as if he knows how to fit into a so-called anti-formant, i.e. into a region of the spectrum in which hardly any other partials are prominent. The arrows show that the sound image also reveals some sort of spectral counter-movements. Higher partials gradually fade in. At the same time, the cue-singer's most prominent harmonics descend, although his individual pitch is rising. The degrees of amplitude are represented white- blue- green- yellow (white = no energy, yellow = lots of energy). The vertical frequency axis is linear. The sample is taken from the CD Darling 2004, track 8, *pasibutbut*. A different but very similar recording can be found in Hugo Zemp's anthology of vocal expression (CDs Zemp 1996; see CD III, No. 6 Taiwan (Bunun)). That recording shows a very similar spectrogram (not shown here). © Manfred Bartmann 2017.

Another recording (origin unknown, perhaps Kurosawa's) was to appear in 1981 (LP Hsu Tsang Houei 1981), then reviewed by the ethnomusicologist Tran Quang Hai (Hai 1983). Hai compared the *pasibutbut* to what he calls the diphonic singing in Mongolia (*xöömij*), and Tuva (4 different styles: *xomej*, *sygyt*, *bordannayr*, and *kargyraa*) (Hai 1983: 195). Spectrographic analysis of a segment taken from the CD 'David Darling and the Wulu Bunun. Mudanin Kata' (CD Darling 2004, track 8 *pasibutbut*) reveals that the technique of the Bunun people, though, is different from the others (**Fig. 1**). The spectrographic analysis of another recording (not shown here) has confirmed this finding (CDs Zemp 1996; see CD III, No. 6 Taiwan (Bunun)).

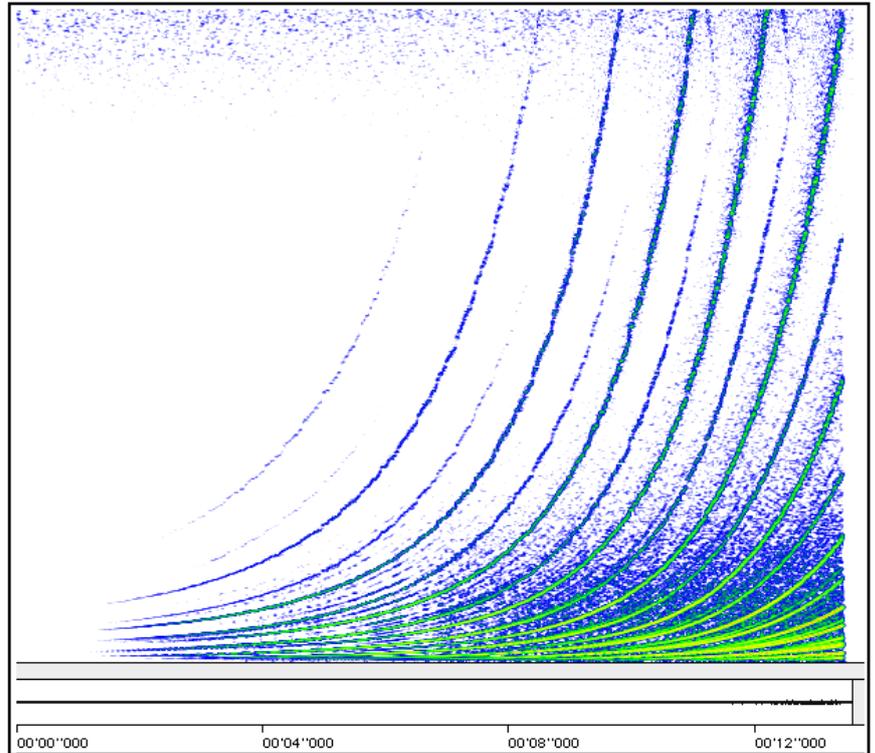
No. 1 *Living it up - folkish as well as Low German self-exotifications*

This song comes with an introduction that relies on atmosphere recordings I conducted on a platform in the railway station of the East Frisian town Emden as well as inside the regional train. The imagined scenery goes like this: a train arrives and comes to a stop. A band is playing on the platform. The train leaves the station. To characterize its acceleration, a Risset-glissando has been programmed, using the software 'Endless Series' (APP Larkin 2014).



Fig. 2 Spectrogram of a Risset-glissando. The vertical frequency axis is linear with a maximum of 6800 Hz. Although this sound image does not reveal any cues, a cyclic pattern of cues is clearly audible, indicating a more analytical, rather than a holistic mode of hearing.

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No. 2 *Gremietsack (The scoundrel) - a Low German mouth music in an Irish groove*

The track *No. 2 Gremietsack* is based on an Irish reel. My inspiration to combine this piece of Irish music with some endless series traces back to the seventies.

The Sailor's Bonnet. One of the first Irish reels to make an impression on me ...

In September 1974 the Irish folk band Planxty had joined forces with singer and guitarist Paul Brady (*1947) (O'Toole 2006). Brady was (and still is) known for his energetic guitar playing. Making full use of his open or half-open tunings, Brady gave the tunes a new feeling of energy. So this new Planxty line-up was very promising and was soon to play the Jahrhunderthalle Hoechst in Frankfurt, Germany. The concert was recorded and aired by German public radio Hessischer Rundfunk (hr2), which gave me the opportunity to make a private reel-to-reel copy.

The band started off with a set of 3 reels: *The Tarbolton*, *The Longford Collector*, and *The Sailor's Bonnet*. That was a very popular set of tunes in those days. I was completely taken by Planxty's powerful arrangement. Later on I was to find out that this set of tunes had already been recorded and popularised by the legendary Sligo fiddler Michael Coleman (1891-1945) who had died in the United States (CDs Bradshaw 2011).

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So I wondered how to give Irish tunes some more energy, 'a lift' so to speak, whether following them note for note or rather by accentuating them rhythmically or otherwise. At least it had become obvious that mandolins, guitars or Irish bouzoukis (DLR Bartmann 1999, Bartmann 2013) usually would not follow the ornamentations that fiddles, Irish flutes or uilleann pipes are famous for.

When exploring the musical riches of Northumberland in 1976 at Easter time, I had the chance to buy a copy of the trail blazing Irish LP *The Bothy Band 1975* which comes with another set of reels as its last track: *The Salamanca*, *The Banshee*, *The Sailor's Bonnet* (CD *The Bothy Band 1975*). Whilst listening to the whole LP for the first time, eagerly waiting for *The Sailor's Bonnet*, the very last tune, the potential of the band and especially its energy brought me to realize that this band had opened a new chapter in Irish music. Certainly I had not come across a band like this (DLR Bartmann 1999, Glatt 1997).

When Triona Ni Dhomhnaill (on clavinet and vocals with the Bothy Band) once said: "There was something special about the sound. When we were in full flight, there were a couple of minutes there, when we almost levitated." (TG4 Brennan 2011), I immediately knew what she was talking about. As I had been taken by the Bothy Band's *Sailor's Bonnet* right away, I wondered whether I would be able to find a detail of that arrangement that would help me to understand the impression of being levitated by the sound. Maybe this is the reason why I ended up delving into Oli Larkin's software 'Endless Series' (APP Larkin 2014), the highlights of Islamic architecture in Europe, especially the Alhambra in Granada (Spain), the works of M.C. Escher (Piller/ Broug/ Shatanawi/ Zoeter 2013), and the Penrose stairs (see Escher's 1960-lithograph *Ascending and Descending*).



Fig. 3: Carlos Yoder (ARG, SLO) working with us in Bernie's studio <www.obaxe-music.com> for No. 2 *Gremietsack (The scoundrel) - a Low German mouth music in an Irish groove*.
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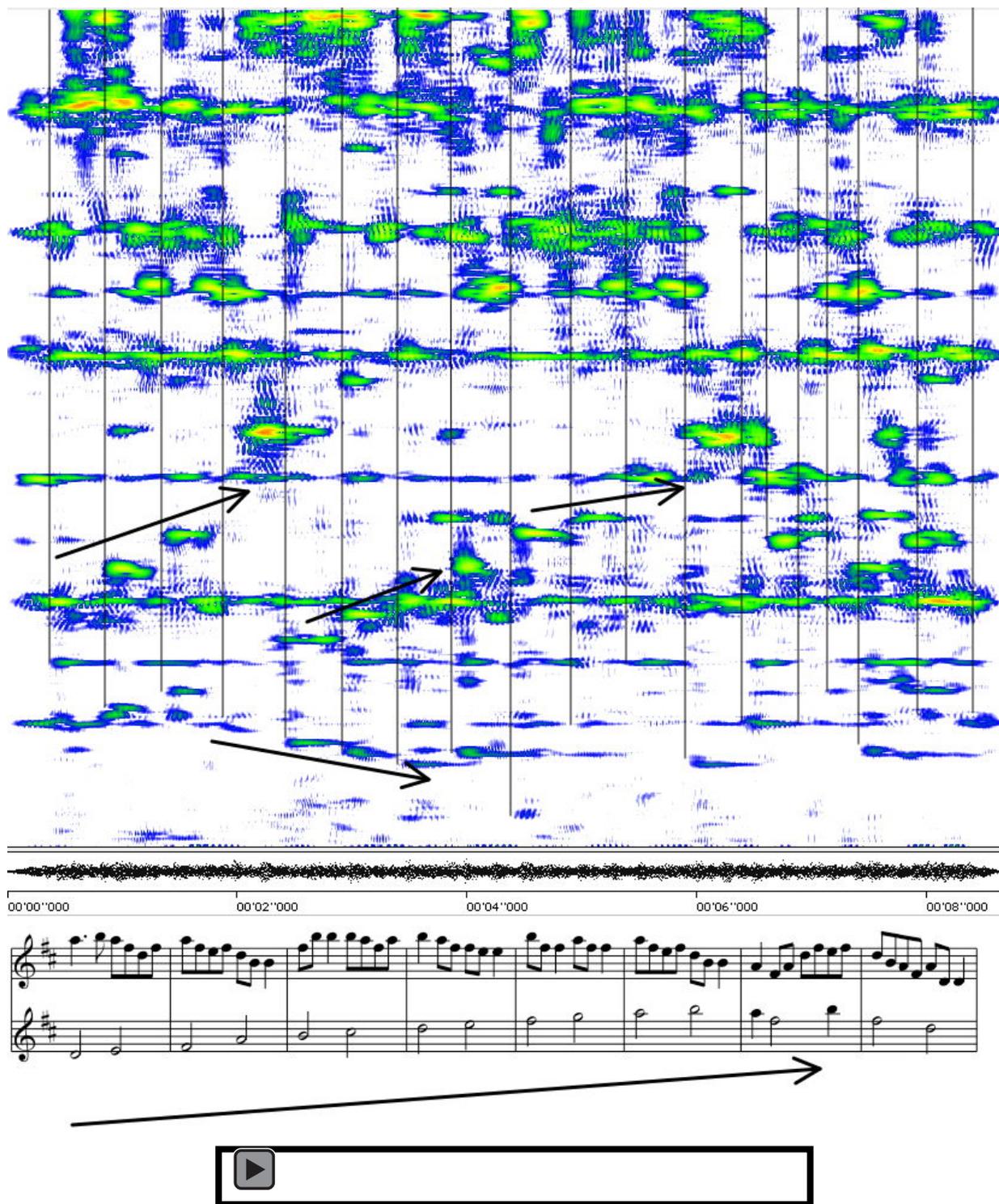
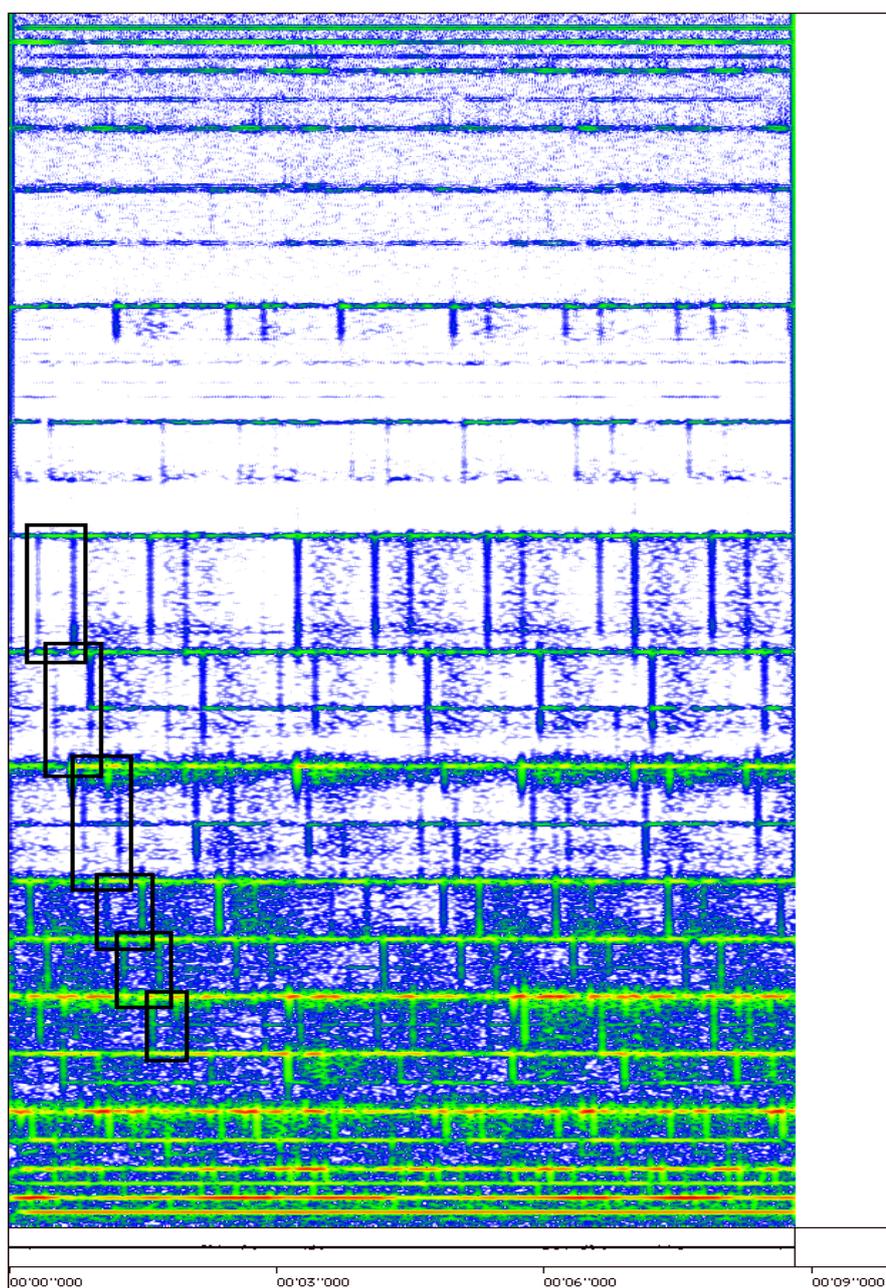


Fig. 4: A detail of the Bothy Band's arrangement of the reel *The Sailor's Bonnet*. Spectrographic analysis of a sample taken from the right channel of track 14 (CD Bothy Band 1975). The last stave shows how the Irish bouzouki (DLR Bartmann 1999) contributes a very regular, consequently upward movement. These notes only show fundamentals, although Dónal Lunny is playing a series of chords here. In fact his chord-notes provide spectral counter movements similar to those in **Fig. 1**. *The Sailor's Bonnet* is often called a 'marching reel'. Maybe this is another reason why Lunny's almost endless series of a quasi-Shepard scale fits in so well. The embedded sound file comes with imaginary extra grace-notes. As they have been added by MB, they neither appear in the spectrogram nor in the last stave. © Manfred Bartmann 2017.

Endless series as drone effects in No. 2 *Gremietsack (The scoundrel)* ...

Drone elements play a major role in Irish dance musics. Please note some continuous and very constant lines of partials in **Fig. 4**. However, the drone doesn't have to be that prominent all throughout, as the effect is also driven by the so-called continuity illusion (Dreier 2011, URL Dreier 2011). As a result, a drone element may also be present all the time even if there is no instrument to provide a constant drone-sound.



Very often special tunings of stringed instruments such as the Irish bouzouki (GDAD) or a so-called DADGAD-guitar will provide drone elements, and from there, 'give the tune a lift' by paying respect to what Dónal Lunny calls 'the intelligence of a tune' (personal communications in 2001 at the Rudolstadt festival; see also DLR Bartmann 1999, Bartmann 2013, Hoerburger 1966, Yoder/Bartmann 2017).

Inspired by Dónal Lunny's work with the Bothy Band (**Fig. 4**), painstaking inquiries into Oli Larkin's software 'Endless Series' (URL Larkin 2012, APP Larkin 2014) were to offer new insights and perspectives. By the end of the day I was to find out: due to the so-called continuity illusion, it is all about momentum (see Dreier 2011, URL Dreier 2011).



Fig. 5: Downward Shepard scale in the beginning of No. 2 *Gremietsack*. Slight return at the very end of the track. The vertical frequency axis is linear with a maximum of 3800 Hz.

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All in all, track No. 2 *Gremietsack* comprises 3 endless series, one in the beginning of the track (**Fig. 5**), and 2 more in the end (**Fig. 6** and **7**), all of them developed using Oli Larkin's software 'Endless Series' (URL Larkin 2012, APP Larkin 2014). The idea was to combine a constant rise of pitch with sustained and repeated sounds, thus bringing attention to a climax by condensing the soundscape (**Fig. 6**).

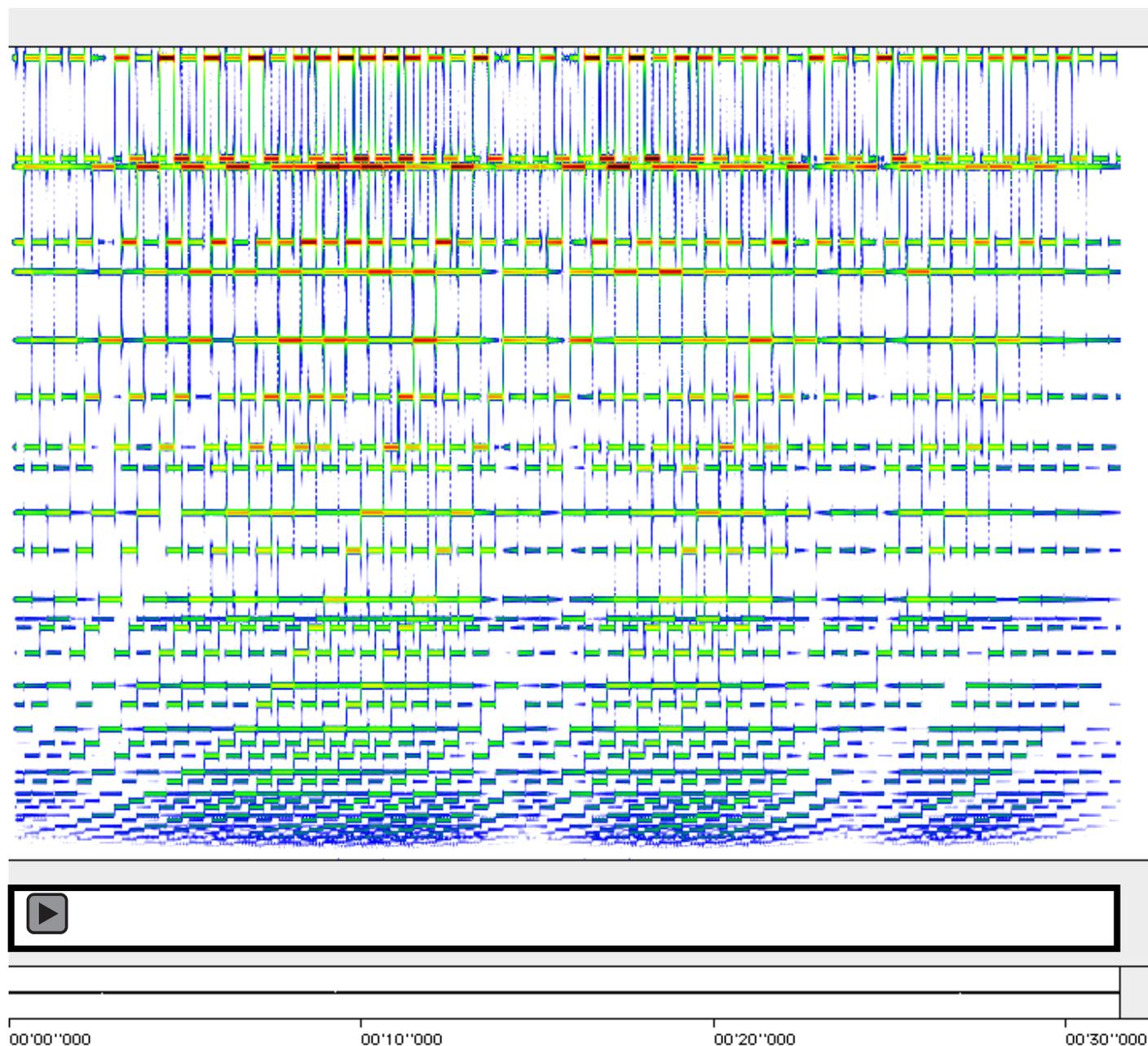


Fig. 6: Another endless upward movement of pitches. Please note the many constant lines of partials which make a drone-like tapestry of sound. © Manfred Bartmann 2017.

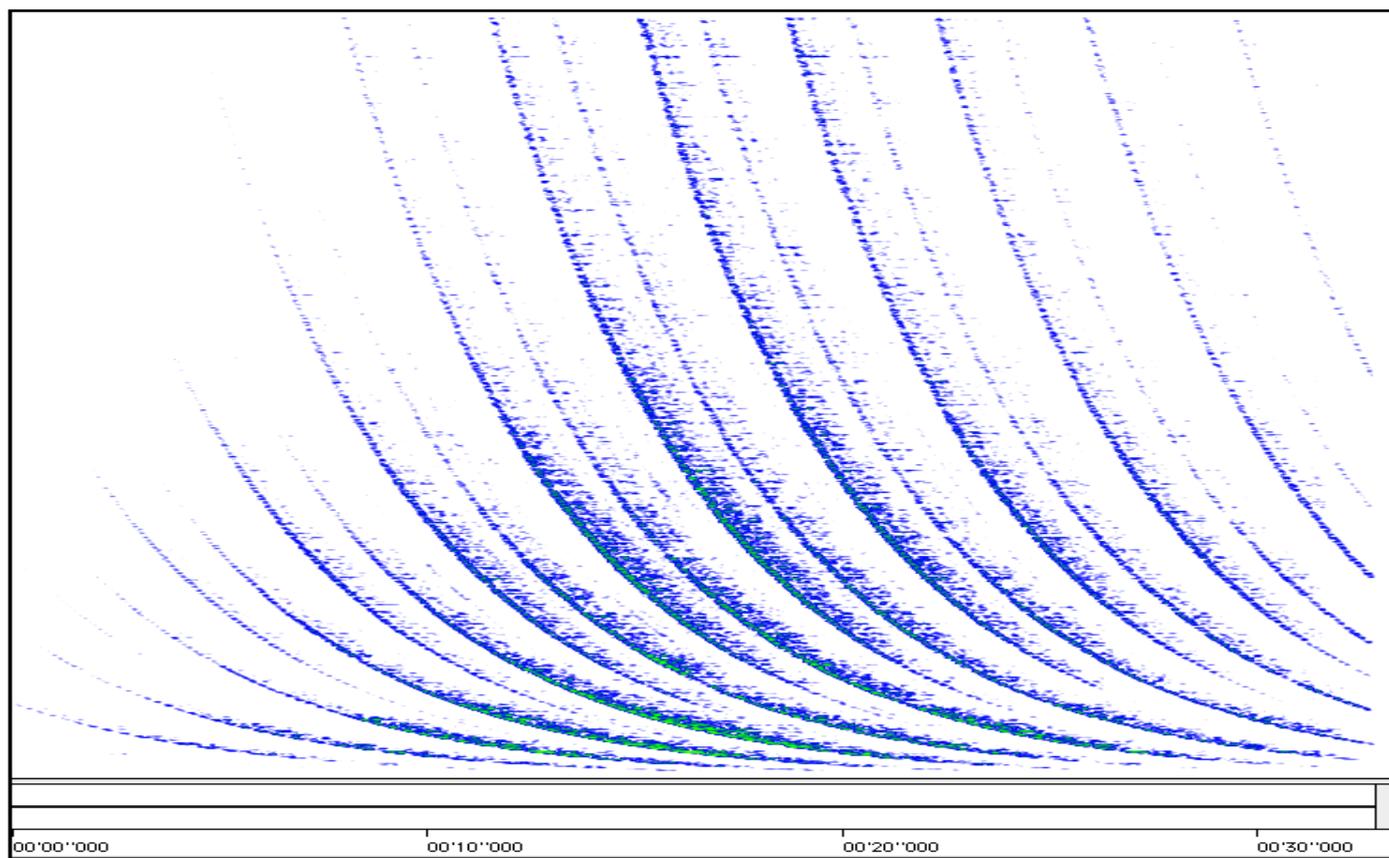


Fig. 7: The track No. 2 closes with a downward Risset-glissando - apart from the slamming shut of a large hatch at the end (which is not included in the spectrogram, though). There is also a slight return of another endless series in the very end of the track (see **Fig. 5**). © Manfred Bartmann 2017.



Conclusion

So-called endless series can be useful when trying to achieve drone effects. "According to Brandl", one of my ethnomusicology teachers, "a drone may occur not only as a harmonic, externalised continuous bass, which often marks the fundamental" (or tonal centre) "of a whole soundscape, or a chord, but also as a so-called 'Binnenbordon' (= inner drone)" (Brandl 1995) "that may function as a reference system musicians rely on when intoning other than western scales, as well as gliding tone steps and expressive ornamentations (Bartmann 2013: 67). Endless series also serve to invite use of the so-called continuity illusion (Dreier 2011, URL Dreier 2011). At the same time they may also work as an injection of energy, the very meaning of 'to give the tune a lift'.

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See DLR Bartmann 1999; Bartmann 2005; CD Bartmann 2011; Bartmann 2013; CDs Bradshaw 2010 (1992); Brandl 1995; Braus 1995; TG4 Brennan, Moya 2011 (Television production); Burns 1981; CD Darling 2004; Deutsch/Dooley/Henthorn 2008; Dreier 2011; URL Dreier 2011; Glatt 1997; Hai 1983; Hoerburger 1966; Hofstadter 1979; LP Hsu Tsang Houei 1981; Kurosawa 1973; URL Larkin 2012; APP Larkin 2014; Patterson 1990; Piller/ Broug/ Shatanawi/ Zoeter 2013; Platz/Wharton 1995; Risset 1985, 1989, Schattschneider 2010; Shepard 1964; O'Toole 2006, CDs Zemp 1996, CD III, No. 6 Taiwan (Bunun).

Some search keywords for Wikipedia: *A Day in the Life*, *Ascending and Descending*, *Bothy Band*, *Bunun people*, *DADGAD*, *Dónal Lunny*, *Drone (music)*, *Formant*, *Lux Aeterna (Ligeti)*, *M. C. Escher*, *Paul Brady*, *Penrose stairs*, *Planxty*, *Psychoacoustics*, *Sgt. Pepper's Lonely Hearts Club Band*, *Shepard-Risset glissando*, *uilleann pipes*.

Some search keywords for YouTube: *Beatles A Day in the Life*, *Bothy Band*, *Michael Coleman (fiddle)*, *Escher Alhambra*, *Ligeti Lux Aeterna*, *Dónal Lunny*, *MC Escher*, *Penrose*, *Planxty*, *Posibutbut*, *Jean-Claude Risset Computer Suite from Little Boy*, *Taiwan Bunun*, *The Sailor's Bonnet*.



Fig 8: Manfred Bartmann with his 5-string electric guitar. © photo courtesy of B. Rothauer 2015.

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