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Automata *in extremis*: Mauro Lanza's sublime sound machines[1]

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Abstract

Mauro Lanza and composer-technologist Andrea Valle's cycle *Systema Naturae* (2013-17) combines acoustic instruments with computer-controlled mechanical sound objects. The first work of the cycle, *Regnum animale,* surrounds a string trio with a circle of computer-driven, electro-mechanical devices, whimsical creations that offer a second life to discarded consumer electronics such as hair dryers and electric knives. Every performance of *Regnum animale* will be different, as the jerry-rigged mechanical objects necessarily break down or malfunction, as part of an instrumentarium in a state of constant becoming. *Regnum animale* thus represents a paradoxical combination of ideals. The composers demand extreme rigor from themselves and their performers. Yet both composer and performer blend their efforts with the the contingent sounds and rhythmic qualities of found and discarded consumer objects. Lanza recomposed five of the *Regnum animale* for orchestra as the basis for *Anatra digeritrice (Piccola Wunderkammer di automi oziosi*) (2014), inspired by the Eighteenth-century inventor Jacques de Vaucanson's duck automaton Le Canard Digérateur (1739). Although the recomposition imparts a certain a sense of depth and grandeur to its source, *Anatra* remains, in Lanza's words, «a little collection […] of precision-made mechanisms that move about pointlessly». Lanza's *The Kempelen Machine* from 2015 celebrates Wolfgang von Kempelen's speaking machine developed at the end of the 18th century by orchestrating the results of a human-mechanical voice hybrid.

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[1] I would like to thank Mauro Lanza for making available to me his working materials for *Regnum animale*, and for scores and recordings of all the works discussed in this article.

These “characters” – the mechanical sound objects, defecating duck, and talking machine – represent automatons in the most general terms: contradictions in the delicate balance between nature and artifice that flaunt their own “insoluble paradox”, in the words of Minsoo Kang. The figures of Vaucanson and Kempelen marked the beginning and end of the Enlightenment’s fascination with automatons, and their respective “failures” only heightened the fascination of their creations for contemporary and later audiences. In a similar way the clash between precision and chance in *Regnum, Anatra* and *Kempelen* highlights the allure of technology’s flawed analogues of the real. As *Regnum* brought the flawed sound of discarded objects to a chamber music stage, *Anatra digeritrice* transforms actual automata into that most deceptive machine, the modern orchestra. *The Kempelen Machine* recreates the acoustic grandeur of its namesake’s failure, a ventriloquist’s dummy speaking not for its master, but for what its master desired.

Keywords

Mauro Lanza · automaton · spectral music · Systema Naturae · electoacoustic music · algorithmic composition

The Italian composer Mauro Lanza’s works negotiate a nuanced and historically-informed dialogue between contemporary digital artifice and live performance. As early as 1998 in *Barocco*, Lanza derived a “musical logic” from toy instruments and everyday objects, in opposition to Boulez’s criticism that such objects are too singular to participate in a unified musical structure (Gorelli – Valle – Lanza 2015). Recent works draw inspiration not just from specific technologies of the past, but from famous avatars of those technologies, creations whose fascination for their contemporary audiences encapsulated an entire era’s unique relation to the technological advances of its age. Over four years, Mauro Lanza and composer-technologist Andrea Valle composed the cycle *Systema Naturae* (2013/2017), which combines acoustic instruments with computer-controlled mechanical sound objects. Lanza re-wrote five movements of the first piece in this cycle – *Regnum animale* (2013) – as the basis for *Anatra digeritrice (Piccola Wunderkammer di automi oziosi*) for orchestra (2014), inspired by Jacques de Vaucanson’s duck automaton Le Canard Digérateur (1739). *The Kempelen Machine*

celebrates the infamous Wolfgang von Kempelen's speaking machine, developed at the end of the 18th century.

All these "characters" – the mechanical sound objects, defecating duck, and talking machine – represent automatons in the most general terms: contradictions in the delicate balance between nature and artifice that flaunt their own «insoluble paradox», in the words of Minsoo Kang (Kang 2011, 36). The figures of Vaucanson and Kempelen marked the beginning and end of the Enlightenment's fascination with automatons. Yet all these figures embody in some sense the failure of technology: discarded household objects form the basis for the *Systema Naturae* cycle, the defecating duck did not really process its feed, the talking machine could not actually communicate. The paradox that unites all these inspirations is not their role as automata per se, but the role each played in three different eras as defining figures in our ongoing fascination with technology. Hence Lanza describes *Anatra digeritrice* as «a little collection of musical automatons, of precision-made mechanisms that move about pointlessly», while he stresses that the instrumental ensemble in *Kempelen Machine* orchestrates the results of the human-mechanical voice hybrid, in an imperfect but fascinating approximation (Lanza 2015). Paradoxically, the beautiful failure of these models crystallized their fascination for not only contemporary audiences, but those of later generations. Lanza's recreation of such historical examples in sound reveals this connection across eras, and at the same time transforming it, using both ancient devices and computer sound-processing techniques to capture the nuance and allure of technology's flawed analogues of the real.

I will analyze portions of these three works from this viewpoint, with special attention to the role their mechanized avatars play in mediating between notions of the artificial and the natural.

***Regnum animale*, part I of *Systema Naturae* (2013-17)**

I begin with five movements of *Regnum animale* that establish Lanza's aesthetic approach, and the pointed clash between precision and chance that operates in the subsequent works under discussion. Lanza and Valle

composed the larger cycle following a clear manifesto: «the main ratio at the basis of the composition of *Systema Naturae* is thus to create and explore a middle ground where mechanized objects can be controlled in a standard – even if basic – musical way (by creating events, exploring their spectra, organizing their dynamics) while music instruments are treated in an "object-like" fashion by means of a wide usage of extended techniques» (Lanza – Valle 2017, 392).

The four works that comprise *Systema Naturae* are inspired by Medieval catalogues – bestiary, herbaria and lapidaria – and the later systematic description of the natural world found in Carl Linnaeus' original *Systema Naturae* (Linnaeus 1735-1793). The small pieces that comprise each cycle receive fanciful, quasi-Latin titles in binomial nomenclature, the better to characterise their dependence on specific acoustic-electric hybrid combinations and patterns, within a universe of like objects and similar, short life-spans. They represent seven families (six and a «special» group) that seem to represent an homage to the original six of Linneaus (*Mammalia*, *Abes*, *Amphibia*, *Pisces*, *Insecta* and *Vermes*). The first work, *Regnum animale*, was premiered in 2013 by RepertorioZero, and features 28 short pieces (the longest is 48 seconds), that unite a string trio with various combinations of 25 electronic assemblages (described below). *Regnum vegetabile* for sextet and 30 hacked hair dryers was first heard in Darmstadt in 2015, while *Regnum Lapideum* for septet and 25 objects premiered in 2016 in Paris.

The composers' homage to 18th century scientific taxonomies does not end with the name of each piece, which follow a nonsensical binomial classification. They pursue this analogy to its extreme, classifying each object according to an augmented Hornbostel and Sachs classification system that accounts for mechanical features, control behaviour, pitched vs. unpitched, time responsivity (discrete vs. continuous), and control technology (sound card vs. microcontroller). The composition of *Systema Naturae* further subverts historical norms in that it involves two individuals who share duties that include instrumental construction, algorithmic composition, architectural and formal protocols, trial-and-error experimentation and long-distance collaboration (catalogued in Lanza – Valle 2017, 395).

Audio files generated by the sound bodies and instruments (performing extended techniques) serve as basic compositional materials: they are analysed for spectral data, and feed other algorithms. Algorithmic compositional environments generate sound body scores as ASCII files that control events, and which are themselves fed back into the larger algorithmic composition environment – processed further in the real-time application for further recording and analysis. Sound samples representing both these sound bodies and acoustic instruments are synchronised to preface the final work through its «complete and accurate» simulation (Lanza – Valle 2017, 396). The algorithmic composition environment subsequently generates music notation for musicians, while a post-script generator gives a visual snapshot of sound body «scores». A main computer correlates click tracks for musicians and sound body performance; performers remain separate from the sound bodies.

Regnum animale surrounds a string trio with a circle of computer-driven, electro-mechanical devices – whimsical creations that offer a second life to discarded consumer electronics such as electric knives, radio clocks, hair dryers and turntables. Those objects that perform in *Regnum animale* belong to three families: idiophones (subdivided into struck percussion, and objects animated by friction or shaking), aerophones (free reeds and flutes with ducts), and electrophones (radios and turntables)[2].

Giacomo Albert has written of the merging of two trends that meet in the *Systema Naturae* works: sound sculpture and algorithmic composition, which reflect earlier cultural moments, such as the machines of Athanasius Kircher (Albert 2016, 110-111). Although the sequence of the 28 pieces in *Regnum animale* (pointedly identified as separate works, not movements of a larger piece, Albert 2016, 123) may appear random, a serial permutation determines animal placements among pieces, and

[2] The composers note that Galpin's addition of electrophones to the origin Hornbostel and Sachs taxonomy is problematic; all of Valle and Lanza's electromechanical instruments are driven by electricity but operate autonomously, and may be considered a variety of idiophone Lanza – Valle 2017, 395.

the entire work divides intro two parts related by the golden mean (Albert 2016, 113, fn18, 122). The work represents a paradoxical combination of ideals. The composers demand extreme rigor from themselves (the tedious process required to produce mechanical tracks which can be coordinated with live performers) and their performers. Yet both composer and performer blend their efforts with the contingent sounds and rhythmic qualities of not only found but pointedly discarded consumer objects.

The *Regnum animale* score is very explicit about performance practice, and includes detailed instructions for patafixed strings, and specific tempo indications. It also provides click-tracks at varying augmentations of the notated tempo to aid practice and performance. The composers exert algorithmic control over their mechanical "animals", and include charts of their performance in the printed score. Lanza and Valle analyze the spectra of objects and instruments, from which they derive acoustic information for composition. The combination of objects and instruments is tested via an audio simulation to provide a more accurate model of acoustic behavior. The rigor of this process can be gleaned from Lanza's discussion of his basic compositional procedures in a lecture delivered at IRCAM in 2013 on his *Ludus de Morte Regis* for 28 singers and electronics (Lanza 2013). Lanza typically begins with a harmonic skeleton, using procedures such as ring modulation. His harmonic language is constructed from a «logic of chordal proximity», based on an artisanal function that weights the relation between any two chords. His algorithm calculates the proximity of partials sounded by any two clusters, determining their relation based on a comparison of their respective spectra.

Such a harmonic process, as Lanza avers, «can be riddled with "creative" errors» (Lanza 2015) Similarly, despite this detailed preparation, every performance of *Regnum animale* will be different. As Valle notes, part of the aesthetics with the use of Rumentarium or «residual orchestras» entails the hazard that jerry-rigged mechanical objects will occasionally break down or malfunction, requiring substitutions or alterations. These «re-fabrications» are part of a larger attempt at sustainable design, and the creation of an instrumentarium in a state of constant becoming and

change (discussed in Valle 2015). *Regnum animale* thus represents a paradoxical combination of ideals. The composers demand extreme rigor from themselves and their performers. Yet both composer and performer blend their efforts with the contingent sounds and rhythmic qualities of found and discarded consumer objects.

Ioris Casachocii

I argue that this ambivalence is engineered into the work on a structural level, as shown by close readings of *Ioris Casachocii* (number XI*)* and *Zampychis flalutengla* (number IV*)* from *Regnum animale*. *Ioris* belongs to a subset of pieces that resemble clumsy, drunken dances, promising a periodicity at the outset which never materializes. This periodicity is thwarted in different ways. But there is no evidence of periodicity, only the hint of a lumbering dance rhythm articulated by an inaudible "tune" in cello, articulated with *écrasé* on a fourth string tuned a minor sixth lower, composed of three notes (F-sharp3, B3, D-sharp4). The striking entrance of a low E1 played pizzicato in cello, followed by harmonies in viola and violin, anchors the dance with a bassline, yet also doubles for the low hum of an electric circuit, as if all the players were members of one fitful machine.

The harmonic unfolding of *Ioris Casachocii* juxtaposes a sequence of chords in violin, viola, cello and one *armonica* (a harmonica attached to a hair dryer) with an écrasé melody on cello (my analysis expands upon that in Albert 2016, 120). The melody establishes a phrase that quickly telescopes in length: four sequences, as well as the four chords, are each time of shorter duration (respectively 16, 10, 6, 5 and 4 quarters and 3, 2, 1.5 and 1.125 quarters). The string chords expand in density as the phrases shorten: the alteration of the violin's first notated pitch – Fsharp4 – produces a spectral chord, whose elements are identified in a chart that prefaces the score as E4–C-sharp5–F-8th-tone higher4. Four bars later the violin interjects a double stop on one open (I) and one patafixed string (II), harmonizing the E1 in cello. New repetitions of the cycle add a stop to the harmony played by violin and viola: the initial dyad is followed by a trichord, tetrachord and finally a pentachord.

Each note sounded by violin and viola plays a role in the E1 spectrum, as listed in Table 1[3]. The cello's four articulations of low E1 anchor the harmonic structure of the piece as its intervening melody adds notes. Yet harmonic content seems to relate to the rich spectrum played by *armonica 2*, tuned to G-sharp4, E5, B5, E6. The most prominent partials performed by the animals appear in Table 2 (those notes not part of a spectrum on E1 are shaded in gray).

Table 1, pitches performed by violin and viola in Ioris Casachocii.

instrument	Partial no.	Frequency (Hz)	Note name	¢ dev. from 12TET
vc	1	41.203	E1	0
vn, va	8	329.628	E4	0
vn	10	412.034	G#4	-14
va	12	494.441	B4	2
va	13	535.645	C5	41
va	14	576.848	D5	-31
vn, va	16	659.255	E5	0
vn	17	700.459	F5	5
va	18	741.662	F#5	4
vn	20	824.069	G#5	-14
vn	-23	947.679	Bb5	28
vn	24	988.883	B5	2
vn	26	1071.290	C6	41
va	27	1112.493	C#6	6
vn	-33	1359.714	F6	-47
vn	34	1400.917	F6	5
vn	39	1606.934	G6	42
vn	65	2678.224	E7	27
vn	84	3461.089	A7	-29

[3] I compared peak frequency spectral analyses performed with Pierre Couprie's EAnalysis, and Sonic Visualizer by Queen Mary University, London, utilizing Matthias Mauch's Chordino and NNLS Chroma Vamp plugins <http://www.isophonics.net/nnls-chroma> (accessed 10-4-2021).

Table 2, pitches performed by animals in Ioris Casachocii.

molatore1		molatore2	molatore3		armonica2		armonica3	
radio3	segopiatto3	segopiatto4			spremoagrume			
B6		B6						
A#6					A#6			
A6	A6				A6			
	G6		G6		G6			
F#6	F#6	F#6	(F#6)			F#6		
	F6					F6		
	E6							
						C#6		
							C6	
			B5					
							A#5	
							A5	
		G#5		G#5				
			G5	G5			G5	
			(F#5)	F#5	F#5	F#5	F#5	
F5				F5			F5	
E5		E5		E5			E5	
D#5								
D5			(D5)	D5				
						C#5		
			B4					
	Bb4+28c							
G#4	Ab4+19c							G#4
							F#4	
D#4								
C4+49c								
							B3	
	A3							
		E3						
D3	D3+45c		(D3)					

Figure 1 compares a sonogram of a draft of the animals track of *Ioris*, created with digital samples (below), with a live recording of the piece that includes strings (above). Red lines indicate those points where the cello's E1 attack is supported by a rich spectrum on E supported by armonica 2,

segopiatto 4 (an electric knife set to excite a cymbal or metal plate), and lampadini. The two sonograms also hint at the harmonicity and pseudo-regularly of the mechanical instruments, a framework muted in the recording of the live performance by the sustained noise elements of the écrasé melody in cello. (The lampadina is simply a switch that turns a light on and off, an animal that plays a larger structural role in the *Regnum animale*, appearing in pieces VI, XI, XVI, XIX, XX, XXII, XIV and XVI.) Yet this simple metallic attack generates an E major spectrum with a hint of the major 7th, adding a subtle glow to the conjoined attacks in armonica 2 and segopiatto 4 that mark the ends of the first four "phrases" of *Ioris Casachocii*.

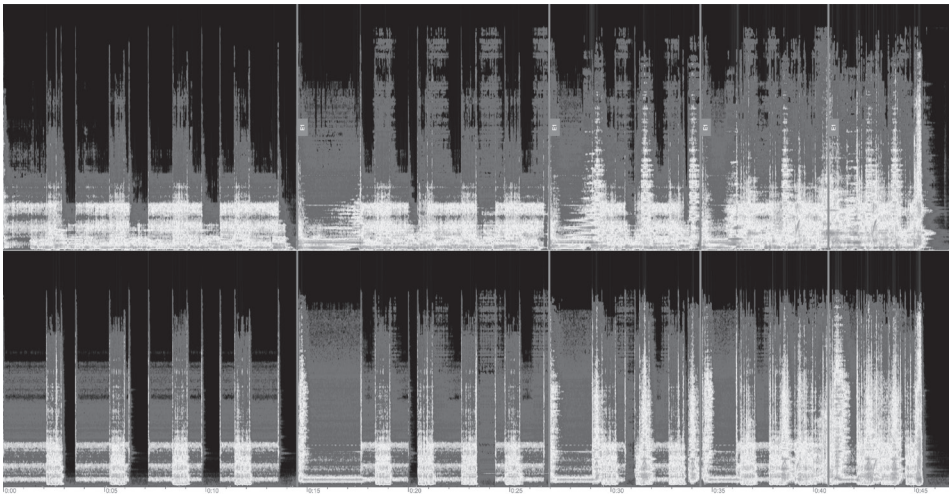


Figure 1: sonogram of animals track in Ioris Casachocii (below), and live recording that includes strings (above).

A diagrammatic time notation chart indicating the micro-controlled animals accompanies each piece in *Regnum animale*. The chart for *Ioris* reveals regular repetition of the same attack point durations distributed among the twelve animals. Something of this irregular periodicity is captured by the chart of instrumental and animal attacks in Figure 2. As the period condenses and more animals fill in the gaps between the strings "cantus", the dance becomes more agitated up to the point the rasoio (an electric shaver in a metal box partially filled with buttons), enters to indicate the final cadence.

Figure 2: chart of instrumental and animal attacks in Ioris Casachocii.

Zampychis flalutengla

The harmonic structure of *Zampychis flalutengla* is more complex than that of *Ioris*. It could conceivably express the partial structure of either G or D, and fits into an audible progression of diatonic clusters that include prominent upper partials on E-flat, F, G G-sharp, B, and C; *Zampychis* ends on a D5/G-sharp5 dyad fading to D5. All sustained tones are briefer than a dotted eighth, with pitch functioning as an articulation of a sharply-etched rhythmic structure composed of five different durations, as shown in the chart of string rhythms in Figure 3. Violin alternates an E5 pizzicato with two spectral harmonies (that is, notes performed on patafixed strings), viola alternates two different spectral harmonies, and cello alternates écrasé sixteenth-notes and 32nd note triplets that hover around C4 and C5. Violin and viola alternate broken sixteenth-note triplets and pizzicati with the spectral harmonies.

Similar to the string patterns, the diagrammatic time notation chart of animals shows regular repetition of the same attack point durations distributed among the eight animals (the attack pattern of molatore 3 is unique in following a subset of the attack pattern for zampogno 2). Altogether 25 different durations are distributed among the animals. Much more significant in the profile of *Zampychis* is the rhythm created by the six different durations that occur between events; over 50 percent of these gaps last .27 of a second. Hence our perception of the piece us is that of an underlying metric pulse constantly stretched or telescoped by animals that seem to come in either too late (most often by .54 of a second) or too early (most often by .18 of a second), by the same, regularly recurring amounts, as indicated by Table 3.

Table 3: Animal patterns in ***Zampychis flalutengla***, with definitions.

Periodic Animals	cycle	spectrum
segopiatto 1	9 attacks; strikes first 1.34 seconds in, after that ca. every 4.82 seconds	Lacks audible fundamentals, diatonic 6-note cluster over B4
radio 1	14 attacks; strikes first .27 seconds in, after that ca. 3.21 seconds.	Very dense spectrum, expresses a sharp G

radio 2	13 attacks; strikes first 2.41 seconds in, after that ca. 3.21 seconds.	Dense spectrum, expresses G#
zampogno 3	after 2nd attack at .80, 4 ca. every 6.56	Tuned to sharp F5, E6 and B5 +1/4
zampogno 4	after 2nd attack at 1.88, 4 ca. every 6.96	Tuned to flat G#5, sharp E6 and G6
Non-Periodic Animals		
zampogno 1 and 2 (molatore 3 plays 16x with z1)	Constantly varying intervals, speech-like, to express a kind of hocket melody	

Zampogno: a set of three recorders connected to a modified hair dryer (the array may include both soprano and sopranino flutes).
Molatore (grinder): scavenged components from tape decks that generate soft, noisy continuous sounds by exciting various metallic surfaces.
Radio: a hacked small radio—tuned to white noise—in which the loudspeaker is interrupted by the associated relay to cause an audible clicking sound.

My choice of which *Regnum animale* to review was motivated by those five chosen by Lanza to be recomposed and orchestrated to produce the orchestral *Anatra digeritrice*. In addition to *Ioris* and *Zampychis* those include *Omysomyomys cacaca* (number IX), *Adius geradii* (number XIV) and *Urophoturonta glistrispus* (number XXV). *Omysomyomys cacaca* is shorter and considerably more regular than *Ioris* or *Zampychis*. Strings are accompanied by the soft grinding of two molatore and the hocket-like interlocking of armonica 2, zampogno 1 and the meshugghello (doorbell powered with alternating current). The rhythmic chart in Figure 4 shows the different periodicities aligned as if out of phase. Although strings alternate only two durations (a triplet eighth-note and quarter-note), the resulting pattern fluctuates, as indicated by the brackets between tutti quarter-note punctuations; numbers below each bracket indicate the length of each period as a sum of triplet-eighths (the lowest common denominator). This fuzzy periodicity contrasts sharply with strict periodicity in each animal, although none of those patterns support each other.

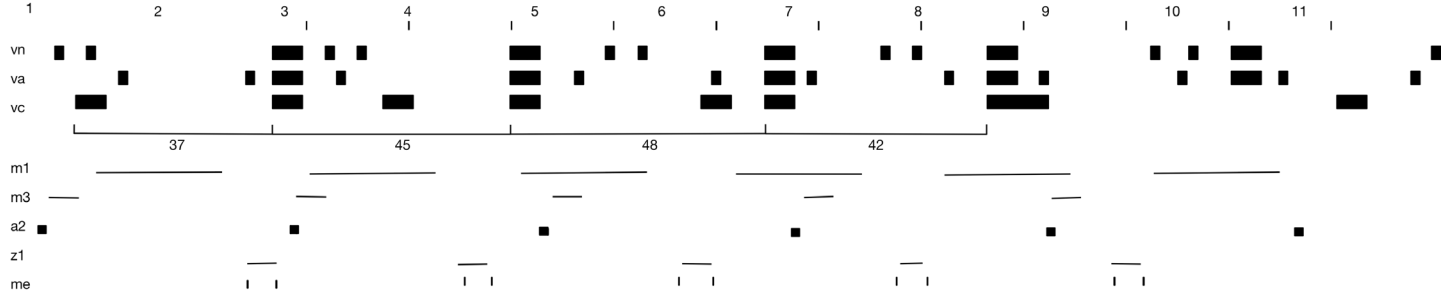


Figure 3: chart of rhythmic attacks in Omysomyomys cacaca.

Adius geradii is a charming dance of percussive sounds dominated by individual fortissimo écrasé tones in strings (marked abrasive, similar to the radio) and sforzando pizzicati. The instruments are accompanied by a huge battery of objects: molatore 2, armonica 1 and 3, segiopiatto 1 and 4, spremoagrume (a juicer featuring a low-pitched rumble), and all three radios, cadenced by the ring of the meshugghello. A rhythmic chart in Figure 5 demonstrates the growing density and frequency of attacks as the piece draws to a noisy close. Glissandi strings dominate *Urophoturonta glistrispus*, punctuated regularly by three molatore, three zampogni, and three girodisco, a low quality, self-amplified turntable set to produce a gliding sound as it speeds up and slows down a 33rpm disc (featuring string repertoire) at 45rpm. The chords of the zampogni penetrate the dense spectrum that results: zampogno 1 plays the third and major seventh over a raised C5, zampogno 2 the sharp fifth and eleventh over a raised C#5, and zampogno 4 plays G#5, raised E6 and raised G6.

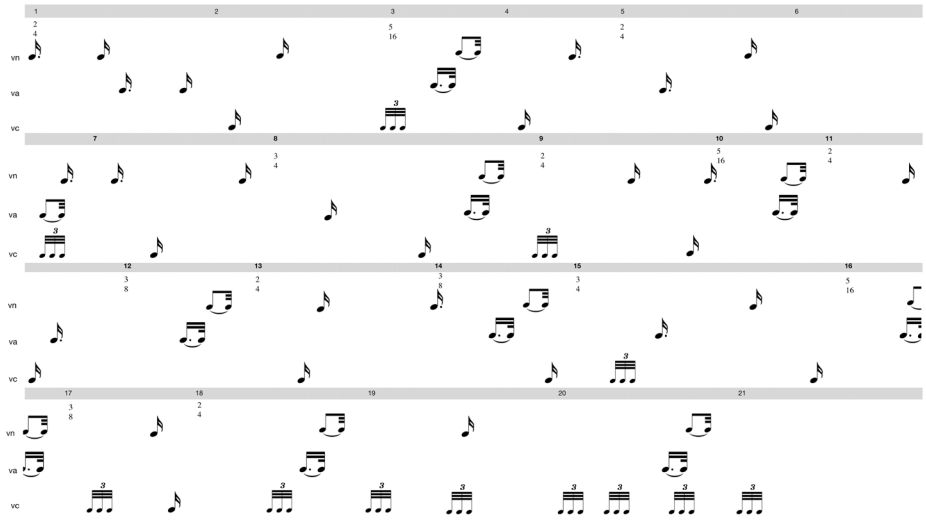


Figure 4: chart of rhythmic attacks and string articulation in Adius geradii.

There are two obvious questions raised by these works: first, what is the relationship between the robotic objects and traditional instruments? Secondly, how do Valle and Lanza's methods critique the traditional division of labor – the composer as autarchic and heroic, in Valle's words – by relying on a constant feedback loop? *Regnum animale* could be seen as a critique of recent actor-network and object-oriented philosophies, in which humans and non-humans are viewed symmetrically, as coexisting together in a "flat ontology" in which neither holds hierarchical sway over the other. Human intentions are mediated by the programming of the animals, within a structure both limited and directed by the sounds the objects produce. But instruments mediate the performance of the animals, to produce a hybrid work that hearkens back to the early modern era *Regnum animale* playfully cites. Lorraine Daston and Katherine Park note how during the enlightenment the wonders of art and nature each embodied a form of symbolic power, one augmented in the naturalist's collection of marvels and the *Wunderkammer* (Daston – Park 1998, 91, 158). Within this «economy of astonishment», the violation of the boundary between art and nature represented by such wonders illustrated an aesthetic of virtuosity: nature bending to the will of the artist and craftsman. If nature fitted form to function, such collections «gloried in superfluity, careless of function and extravagant in expenditure of labor and materials. […] The *lusus naturae*, like the luxury object, multiplied form without function. [… And] Nature approached art when her workmanship approached playfulness; wonder once again ensued from the convergence of opposites» (Daston – Park 1998, 276-277).

The lovingly-assembled animals of the *Regnum* evoke such superfluous items, but they also reference those classes of objects that overcame this simple convergence – those early hybrids of art and nature that defied that formal division, while highlighting their artifice (and hence that of nature itself) (Daston – Park 1998, 280). The artisan who fashioned automata strove to imitate nature, while those aspects of nature that resembled painting or sculpture were singled out, much as the natural strings become one with

their mechanical adversaries. These are but a couple of the layers one could excavate; there is an essay to be written on the glorification and critique of both consumer waste and the fetishism of instrumental sounds, which always gesture toward a set of relations that lie beyond the instrument itself. If Pierre Gervasoni could call Lanza the "Paganini" of the hair dryer, does he not imply that Lanza rescues the *sound of the dryer* from its limited identity as a discarded commodity? (Gervasoni 2016).

Anatra digeritrice (Piccola Wunderkammer di automi oziosi)

Each of the five sections of *Anatra digeritrice* is based on one of the above works, but unlike their progenitors, each section of the Digesting Duck refers to a specific pitch inventory and further "spectralises" its source material. This collection of (mostly) semi-and quarter-tone pitches occurs throughout, but specific harmonies and sections present as higher overtones of central pitches, as in *Regnum animale*. The pitch structure of the primary harmonies in the work resembles an inverted spectrum. Lanza deals with a limited inventory of quarter-tones (with one lowered B-flat3), a collection that forms an almost symmetrical arrangement around a central F-sharp/G-sharp4. An indication of how this works is shown by a pitch inventory of *Anatra*'s first section in Figure 5 (mm. 1-35). The single stave in Figure 5 shows an inventory of pitch-classes in this section with the interval between adjacent pitch-classes indicated in cents. The grand staff in Figure 6 indicates the actual pitches used in this section (pitches in parentheses do not appear in the score, but are provided for reference). The pitch-class C is the only one to appear in four octaves; all other pitch-classes are carefully distributed with regard to register. The same primary harmonies repeat throughout in the same rhythmic and instrumental combinations, to reflect at various levels of precision the original works on which they are based.

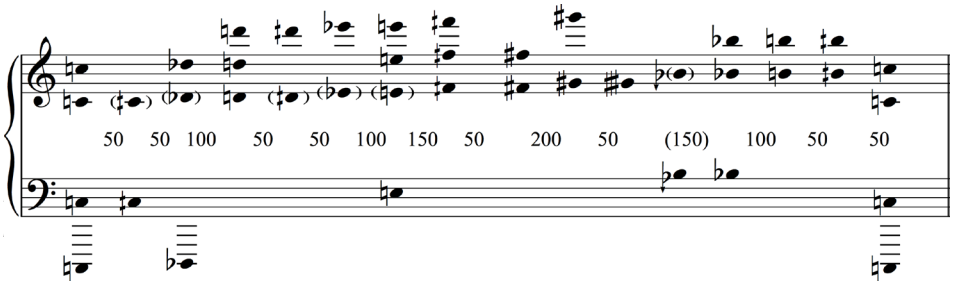


Figure 6: inventory of pitches in the first section of Anatra digeritrice.

This first section of *Anatra digeritrice* is based on *Zampychis flatulengla* from *Regnum animale*. Figure 7 represents a reduction of the three chords that comprise its first phrase. The most audible tonal components of this progression are a gentle rocking back and forth from what sounds like an E major-minor7 harmonica chord, to G major and B minor, closing the phrase with a pronounced D major harmony. The chords express partials of E-flat minor, with hints of D major and, to a lesser extent C major.

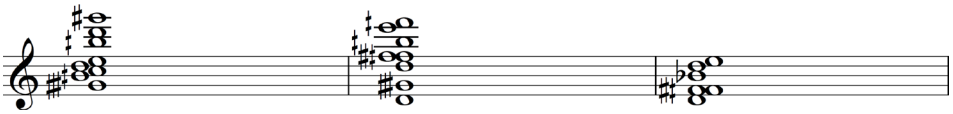


Figure 7: harmonic reduction of the three chords that comprise the first phrase of Anatra digeritrice.

The second section (mm. 36-58), based on *Ioris casachochii*, employs a similar harmonic inventory quite differently[4]. The unambiguous fundamental E here appears in five octaves, often linked to specific registral positions, while prominent notes of the E spectrum – F-sharp, G-sharp and B – appear in four octaves. Most other pitches are also linked to a given registral position. This section shows a marked transformation from its generating piece; the prominent E in the bass serves as both a humorous homage to Gérard Grisey's *Les espace*

[4] The grand staff shows an inventory of pitch-classes in this section with the interval between adjacent pitch-classes indicated in cents.

acoustiques and a link back to *Ioris*. The melodic thrust of *Ioris* performed with écrasé generated more noise elements than pitch. In *Anatra* this melody becomes a heterophonic chord progression orchestrated by flutes, clarinet, bassoon, horn and strings. The slow tempo, quiet dynamics, muted and *tasto* strings – performing a small number of tones in rotation – produce a dreamy submerged sound much like certain movements of Ligeti's 1960s works (specifically the first movements of the *Chamber* or Cello Concertos). The melody in flute more clearly expresses E, buoyed by harmonies that suggest a D and F spectrum, with an ominous C-sharp in the bass. The phrases become shorter, from approximately 38 eighth-note beats to 25 beats, to 16 beats, to 12, before fading off into a fuzzy cloud over F-sharp dominated by overtones on C-sharp and G-sharp.

Omysomyomys cacaca forms the basis of the third section of *Anatra* (mm. 59-90). Here a quiet theme in strings and winds that features E, F-sharp and G-sharp – alongside C quarter-sharp in several octaves – alternates with Tuba zigranato corraguphone (a whirled tube), whose high whistling creates a hushed cluster from C6-E6. This whispering melody is punctuated by fortissimo iterations of an 11-note chord in flute, oboe, clarinet, horn, trumpet, pianoforte and violin, with the same function as the blurred punctuation achieved by the string *tutti*, armonica, zampongo and meshugghello in *Omysomyomys*. An abstraction of this process is shown in Figure 8. The first two harmonies in flute, oboe and contrabass are succeeded by six iterations of the 11-note chord which evince the fuzzy periodicity seen in the original work, here represented by intervals calculated as sums of sixteenth-notes.

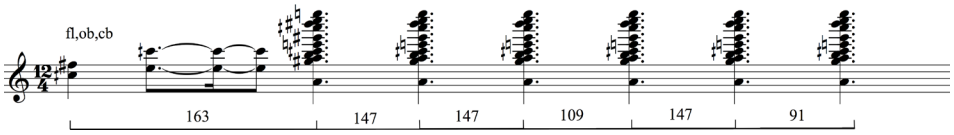


Figure 8: the first two harmonies in flute, oboe and contrabass succeeded by six iterations of the 11-note chord in the third section of Anatra digeritrice (intervals between chords equal sums of sixteenth-notes).

As *Anatra* continues it appropriates more and more of the sound world provided by the animals of *Regnum animale*. The first section represented a rousing dance for full orchestra punctuated by humorous asides in wah-wah trumpet and a battery of tuned and non-tuned percussion. In the muted second section écrasé effects in pitched percussion, harmonica and a desk bell replicate some of the animals' sound world. The third section begins with the Tubo zigrinato paired with small metal maracas, filling the space between attacks of the 11-note chord, which itself is accompanied by a spring coil. But the fourth section of *Anatra* (mm. 91-126) enters fully into the spirit of the mechanical. The first attack – a ten-note chord that includes tasto strings, flautando flute and wah-wah trumpet – summons the écrasé strings and multiple animals of *Adius geradii*. This section features 16 variations on this two-chord progression, one that – despite its dense appearance – rocks back and forth on audible D and F fundamentals. Repetitions of this progression draw out and elaborate it to create breath-like phrases ornamented with noise elements, stuttered rhythmic patterns and articulations, and upper partials, as shown by a comparison of the initial two-chord progression at measures 91-2 with its 15th iteration at measures 120-121.

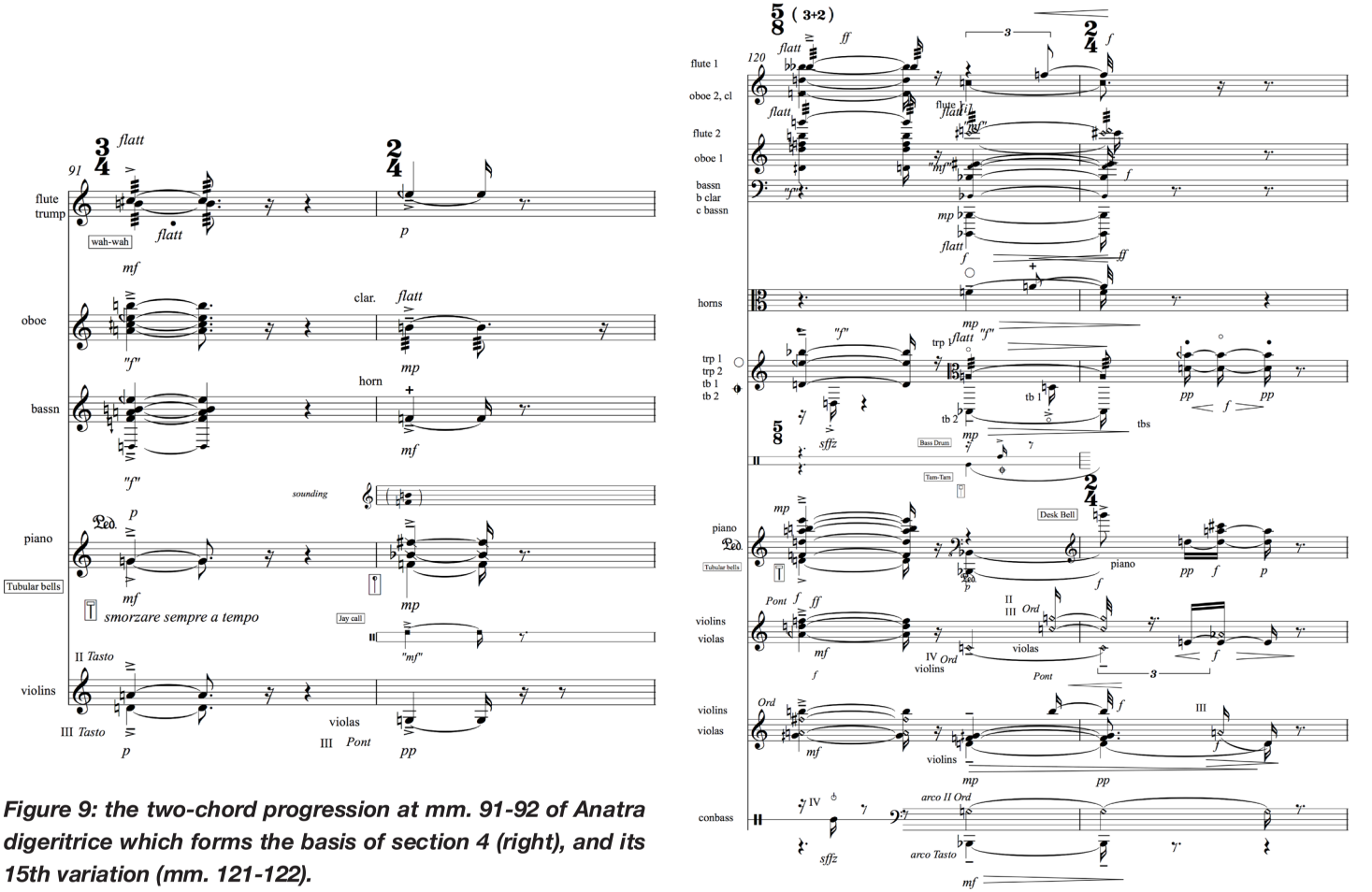


Figure 9: the two-chord progression at mm. 91-92 of Anatra digeritrice which forms the basis of section 4 (right), and its 15th variation (mm. 121-122).

The fifth and final section (mm. 127-166) of *Anatra* composes out the string glissandi and multiple motors, scratching and gliding record players, whistles and bells of *Urophoturonta glistrispus*. The entire percussion battery is employed – tuned cowbells, siren and slide whistles, glissandi on the marimba's resonators – along with multiple articulations in winds, brass and strings. Once again there is a clear, periodic phrase anchored by two chords in winds, here answered by strings in a kind of call-and-response, as indicated by the first phrase in Figure 10 (a reduction of mm. 127-130). And again, the complex harmonies express fundamentals related by a third, G and B. But as this phrase picks up more gliding and stuttering elements – the latter in winds, piano and strings – it breaks down precipitously on its way to the coda, ending in a flurry of entropic energy as the digesting duck winds down without fanfare.

How do we situate *Anatra digeritrice* in relation to its foundation in *Regnum animale*? *Anatra* "digests" the first work to produce something both new and gloriously old at once. Our reference point shifts from medieval and early modern taxonomies to the automatons of the Enlightenment. The earlier works are refashioned as movements of a Baroque dance suite, in which the wide variety of articulations and constantly shifting orchestration impart a sense of depth and splendor to the sound. Lanza stated his affection for the «the golden age of the automata […] where the hoax and the genuine invention, the circus-like trick and the systematic investigation seem to coexist without apparent contradiction» (Lanza 2015). *Anatra digeritrice* similarly performs a trick by transforming actual automata into that most deceptive machine, the modern orchestra. As *Regnum* brought the flawed sound of discarded objects to a chamber music stage, *Anatra* elevates those sounds as models for its own glorified «precision-made mechanisms», the flawed analogue of a life all the more thrilling for its clumsy grace.

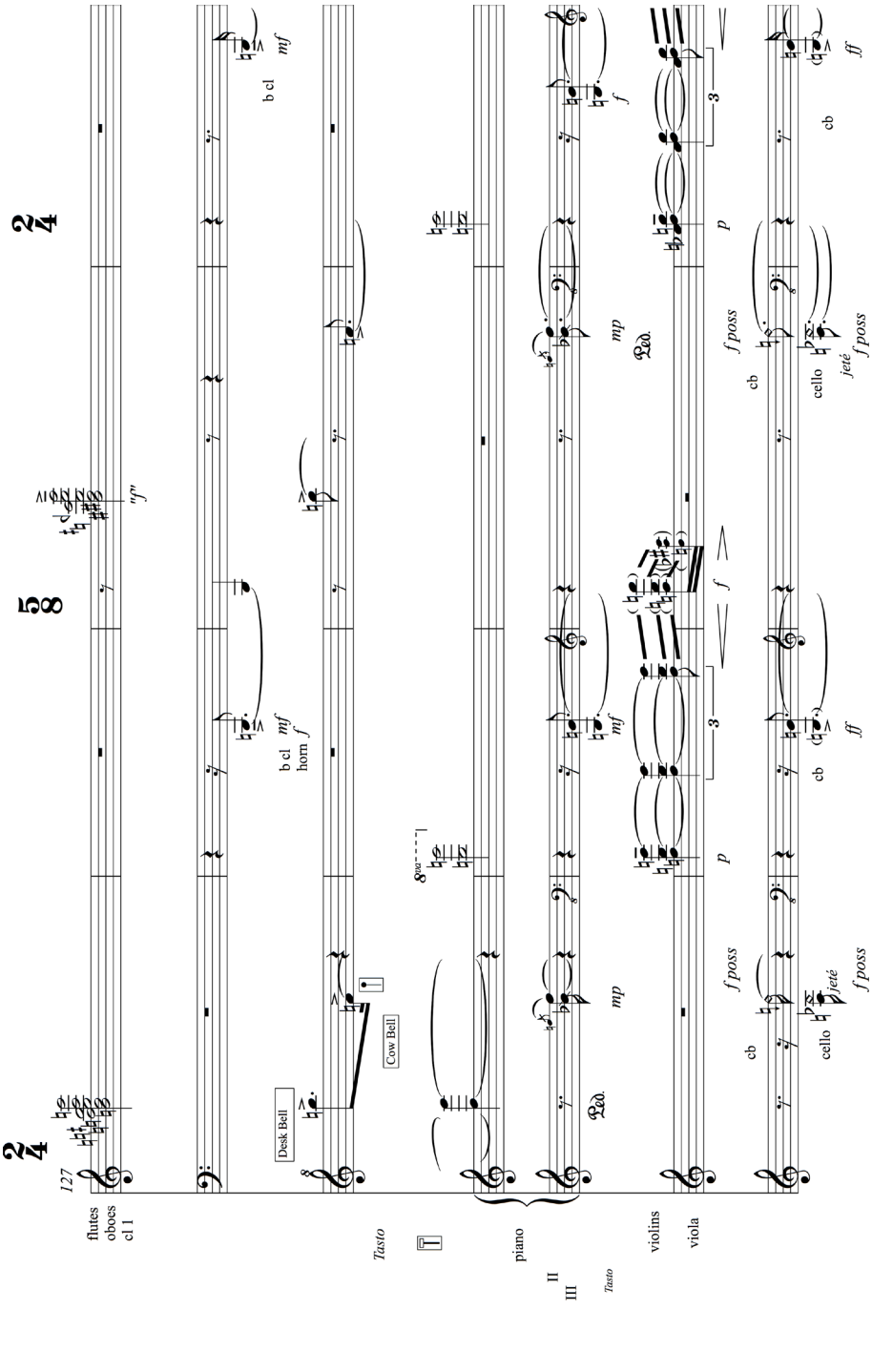


Figure 10: the two-chord progression that shapes the first phrase of section 5 of Anatra digeritrice (mm. 127-130).

The Kempelen Machine

Lanza's *The Kempelen Machine* for "prepared" voice and eight instruments premiered at the 2015 Huddersfield Festival, with soprano Donatienne Michel-Dansac and the ensemble United Instruments of Lucilin conducted by David Reiland, but is still under development (composer communication). *The Kempelen Machine* was inspired by the famous "talking machine" invented by Wolfgang von Kempelen in the latter 18th century (most famous for the mechanical Turk illusion). The earlier *Ludus de Morte Regis* for 28 singers and electronics (2013) relied on inexpensive and ubiquitous wind harmonicas and recorders. Two simultaneous audio signals played by the same musician – voice and instrumental -underwent «subtle amplitude modulation […] resulting in a very predictable and stable spectrum» (Lanza 2015). *The Kempelen Machine* takes this combination to a new level: a system of tubes with accordion reeds mounted on microphone stands which the singer slowly navigates, «modulating her voice with the frequencies of the reeds» (Lanza 2015). Constantly new sounds are produced by the contact between the differing size and resonance cavity of tubes and the singer's proximity, to produce effects that efface the source identity as either human or mechanical. Meanwhile an instrumental ensemble orchestrates the output of this hybrid sound, with intermittent attempts to "synthesize" the sound of a human voice and its accompanying speech.

Wolfgang von Kempelen worked on his speaking machine from 1769 to 1804 (described in Kempelen 1791). It attempted to model the human vocal tract – lens, glottis, nose and mouth – using a box, wind chest, ivory reed and bellows manipulated by the user's hands. Kempelen's machine remains the most well-known and influential non-electronic approach to the creation of artificial speech, in part because he invited readers of his *Mechanismus der menschlichen Sprache* to reconstruct and improve his machine, although it took over 40 years for the next attempt (Brackhane – Gósyvan 2017; van den Broeke 1983, 9). Kempelen's machine came along at the right historical moment; along with perpetual

motion, spoken language was considered the holy grail of automata builders (Riskin 2003a, 317). These inventors saw speaking as an organic process, composed of soft, supple parts that could only take place in living bodies (Riskin 2003b, 23), Kempelen's long journey towards his speaking machine was hampered as he first tried to atomize sound, producing each sound independently of context (Kempelen 1791, 401). It was only when he realized that the sounds of speech were dependent on their links within language did he succeed at all.

Various twenty-first century reconstructions have replicated the "childlike" sounds and specific phonemes noted in contemporary accounts of the machine in action. The machine's relatively high fundamental frequency suggested the voice of a child, but that voice was also a strategic feature of the machine, intended to conceal its lack of fricatives, final plosives, and the clumsiness of transitions between phonemes, as well as its limited vocabulary. The speaking machine – contrary to von Kempelen's more famous Chess-playing Turk – offered no intentional deceit, but was always intended as a work-in-progress, one whose limitations demanded that the listener meet it halfway, and imagine a more fully-formed speech within the halting voice that emerged. It was less a speaking-machine than the proof that such a possibility existed. As such, Marcel van den Broeke notes, von Kempelen's audience was more sympathetic towards his speech synthesizer than we could ever be, accustomed as we are to perfect reproductions of the human voice (van den Broeke 1983, 18).

Lanza's tribute requires similar largesse from his audience, but the comparisons do not end there. Kempelen experimented with oboes, clarinets and vox humana organ pipes on the road to the speaking machine. If the separate sounds emitted by musical instruments remained too atomized to produce genuine speech, the experiment was crucial in establishing the importance of context and connection in speech comprehension. In the Kempelen machine, a soprano becomes the machine, filtered through various tubes, membranes and filters (such as a small bottle of water). She is surrounded as well by string harmonics

produced by the prepared strings used earlier in *Regnum animale*, wind multiphonics, as well as by a prepared piano. The delicate sounds that result move forward and backward in space, suggesting a muted agency struggling to free itself: cries and whispers from a giant resonating cavity, a mouth alternately singing, humming, whispering, stuttering and struggling to communicate in a private language with vast timbral, dynamic and rhythmic resources.

A very specific ensemble aids *The Kempelen Machine* in its quasi-representational task: the soprano singing has access to ten tubes that allow for 14 different sustained pitches – variously fashioned with reeds and a kazoo membrane – as well as a corrugated conduit (enabling glissando effects), and a bottle half-filled with water (producing the pitch A4). Bass flute, B-flat and bass clarinet, and alto sax support the vocalist in winds; these perform specific multiphonics, designed so that the full spectrum expands or contracts gradually over a *crescendo* or *descrescendo dal niente*. A pianist who also performs on midi keyboard and two harmonicas, various percussion instruments associated with bells and tubs (boom whackers, wa-wah tube, bottle), and a string trio performing with select strings prepared by patafix produce a rich, inharmonic spectrum. The piano is also prepared with small coins and augmented with patafix to produce two different effects. Four strings – D4, E-flat5, F-sharp5 and C6 – are prepared to produce slightly lower pitches, while an additional eight strings are merely damped with patafix, but not altered in pitch.

Section 1: Respiration – Exhalation

Three large sections and a coda shape the overall form of *The Kempelen Machine*. The first section (mm. 1-200) comprises ten phrases of various lengths divided into two sections I term “breaths” and “exhalations”. I read this section of *The Kempelen Machine* as somewhat of an homage to Gérard Grisey’s *Prologue* (1976), the first movement of the larger cycle *Les espaces acoustiques* (1974/1985). Grisey’s deceptively simple work for solo viola was constructed on a single gesture, out of minimal

pitch materials derived from the reduced harmonic spectrum of a single note E1 at 41.2 Hz. Its melodic curve replicates a moment of respiration alternated with a heartbeat, embodying simple processes on several levels as it moves from consonance to increased inharmonicity, in a kind of dialectic, as Grisey puts it, between «form and frenzy» (Grisey 1976).

Prologue serves in many ways as an archetypical example of the gradual, idealized transition from periodic sounds to white noise expressed in Grisey's writings (see Grisey 1987). At the outset, each melodic breath dips to E3, arpeggiating harmonics 3-7 con sordino, without vibrato except for the peak of the phrase. The open B by contrast serves as iambic "heartbeat" played ordinario at the same tempo. As in the overtone series, higher notes appear closer together. The performer is directed to play without vibrato except for the peak of each gesture, which lengthens with repetition, and – as if mimicking the onset of a single tone writ large – adds ever higher notes in the spectrum, but eventually those outside as well. The first sound outside this spectrum occurs seven notes after the mute comes off, which initiates the gradual corrosion of the homogenous series as an element of the formal process, and intimates the eventual retuning of the fourth string from to D in the work's prolonged coda. Jeffrey Hennessy defined form in Prologue as the fusion of the respiratory melody as color (overtones and amplitude envelope) against the kinetic heartbeat (Hennessy 2009)[5]. This improbably simple gesture is repeated with irregular, odd number expansions and contractions in a process that Jérôme Baillet compares to Messiaen's three-part rhythmic characters, which embrace contrasting phases of expansion, contraction and constancy (Baillet 2000, 59). But Grisey's «reinvention of monody», to paraphrase Peter Niklas Wilson, pushes this model to its limit, by

[5] It should be noted that *Prologue* exists in three versions, two of which incorporate exterior resonators.

simulating an entropic process in three dimensions: registral, spectral and performative, as the performer determines aspects of form, tempo and duration (Wilson 1992).

Although a chamber work, the first section of *The Kempelen Machine* articulates a similar pattern of "heartbeats" (labeled pulses in Figure 11) alternating with a chaotic exhalation outward, dominated by the sound of descending harmonic glissandos in violin and viola. The pulses begin as soft, breath-like periodic articulations in cello, marimba and bass flute (woodwinds play multiphonics throughout, which expand and contract in range with dynamics). The length of the basic pulse changes in each subsequent phrase, as does the number of pulses in the breath section, as shown in the annotated graph of section I in Figure 11. The voice, producing a glissando of harmonics through a corrugated tube (tube a in the score) is added in the middle of the first breath, and will reappear with bass flute, marimba and cello in the following two sections, which move from 10 pulses, or "breaths" of 19 eighth-notes in duration, to 9 pulses of 14 and 7 pulses of 11. Subsequent breath sections shorten each breath, accelerate its pace, and add additional wind instruments – first harmonica, then bass clarinet and alto sax – as though the machine were growing more excitable in its effort to speak. The periodicity of breath sections is halted by the noisy, chaotic exhalations during which the voice hums. As the pace becomes more frenzied midway through the section, the voice alternates between the corrugated tube and a pitched tube equipped with a single reed (tube b in the score, pitched roughly at C-sharp5.

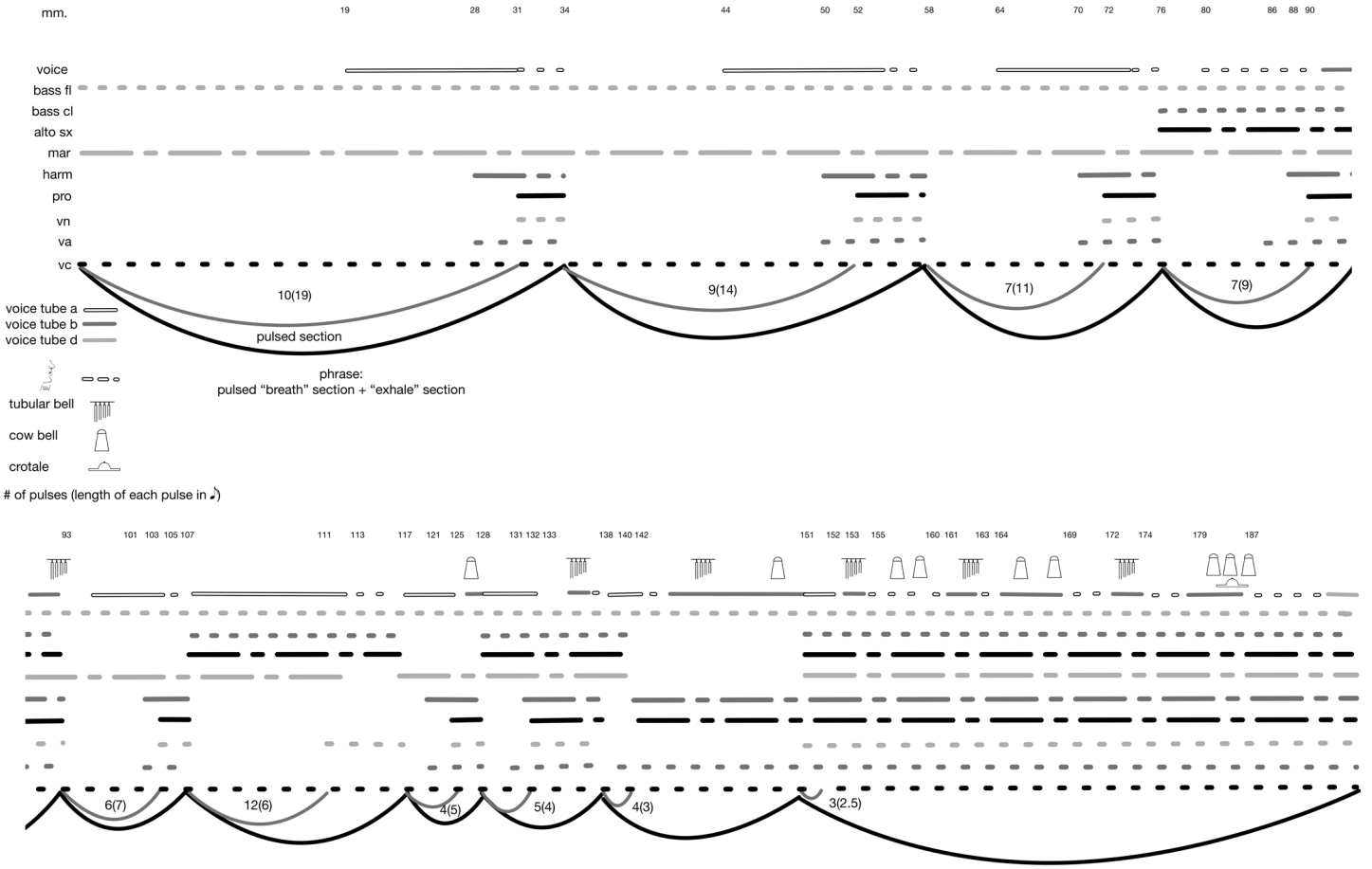


Figure 11: chart of multi-leveled phrase structure in the first section of The Kempelen Machine, mm. 1-20.

Figure 12 displays a reduction of the soprano's progress through section 1. Short downward humming glissandos are interrupted by the noise produced by the corrugated tube (mm. 31-117). In measure 125 the soprano switches to a tube that accompanies her descents – this time over /a/ – with a C-sharp5 drone. Although the vocal line returns to alternate humming and noise, the descent over /a/ is complicated in measure 146. The corrugated tube is dropped shortly after that as the voice ascends for the second time to B-quarter-sharp4. The progress of the voice over this section is revealed as a protracted, circular, lament-shaped line, as indicated by a registral graph (Figure 13) that further condenses each continuous descent, with over half of the descents occurring during the final phrase.

As in *Regnum animale* and *Anatra digitrice*, strings perform both sustained and disjunct pitches on patafixed strings. But the piercing glissandos are their most salient trope, and contribute to the sense of a large, slow cycle throughout the first section. Figure 14 shows the most important single pitches and string glissandos in section 1, set against their counterparts in soprano. Beginning on C7 and B-flat6, the strings describe a constant descent from the 7th octave which mimics that of the voice octaves below. More so than the voice, these glissandos appear to loop around in the manner of Shepard tones, falling to F6 and beginning again at F7 to come back to C7 at the outset of the second section. By the time *The Kempelen Machine* reaches measure 151 the periodic breaths last but a few beats before launching into a tutti section, during which spectral melodies in voice, strings and piano compete with the descending glissandos.

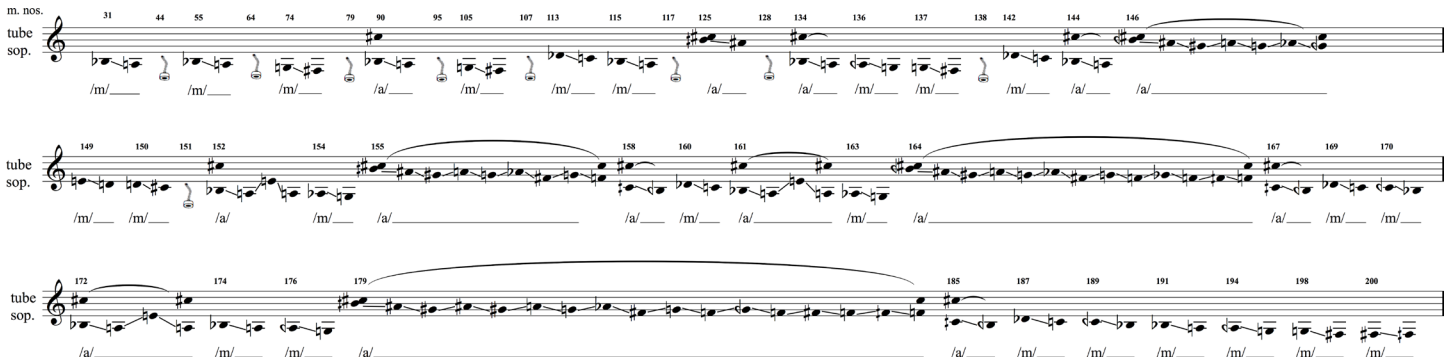


Figure 12: a reduction of the soprano's progress through the first section of The Kempelen Machine.

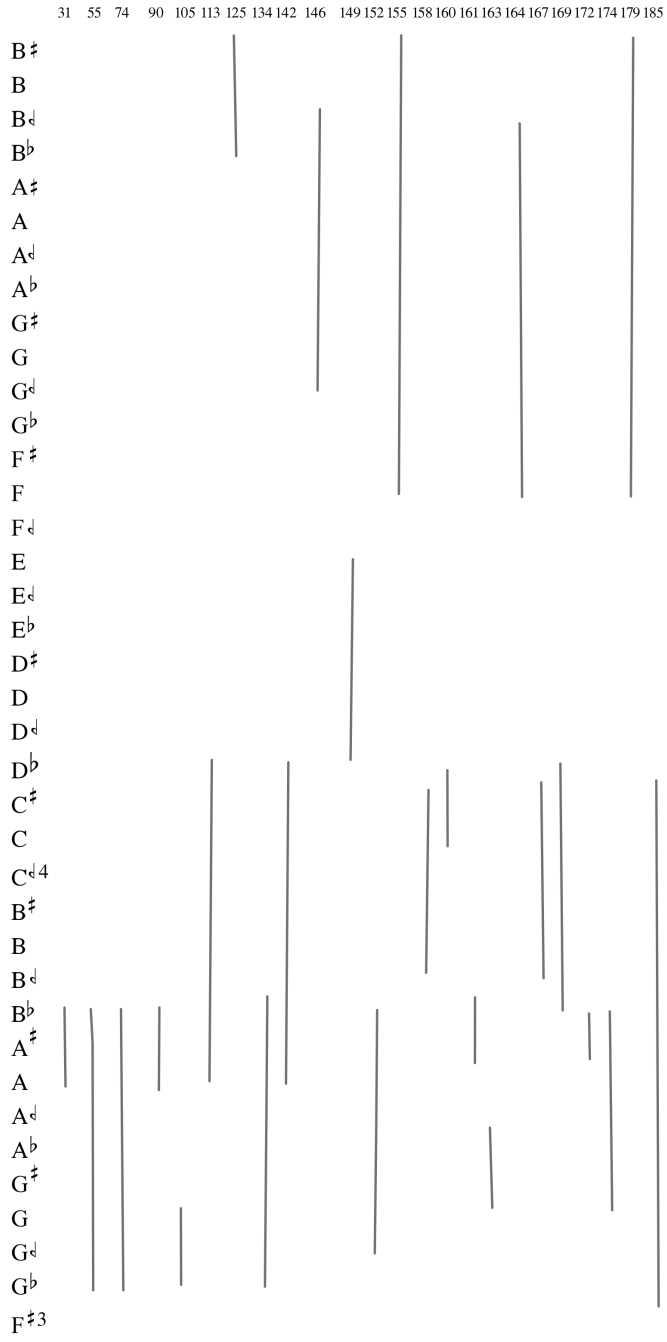


Figure 13: registral graph that condenses Fig. 12 to reveal the soprano's descent over mm. 31-185.

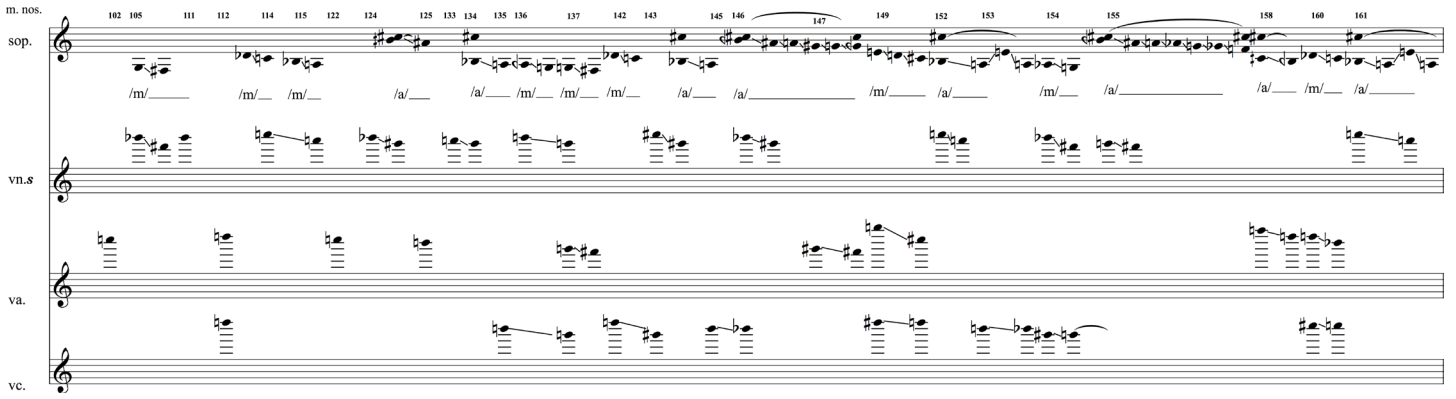
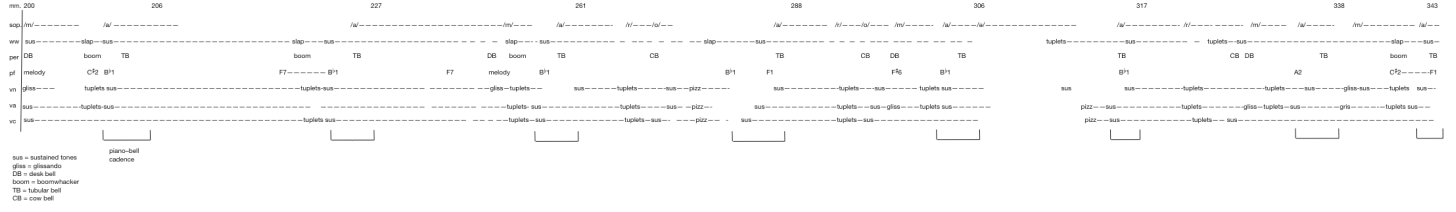


Figure 14: the most important single pitches and string glissandos in section 1, set against their counterparts in soprano.



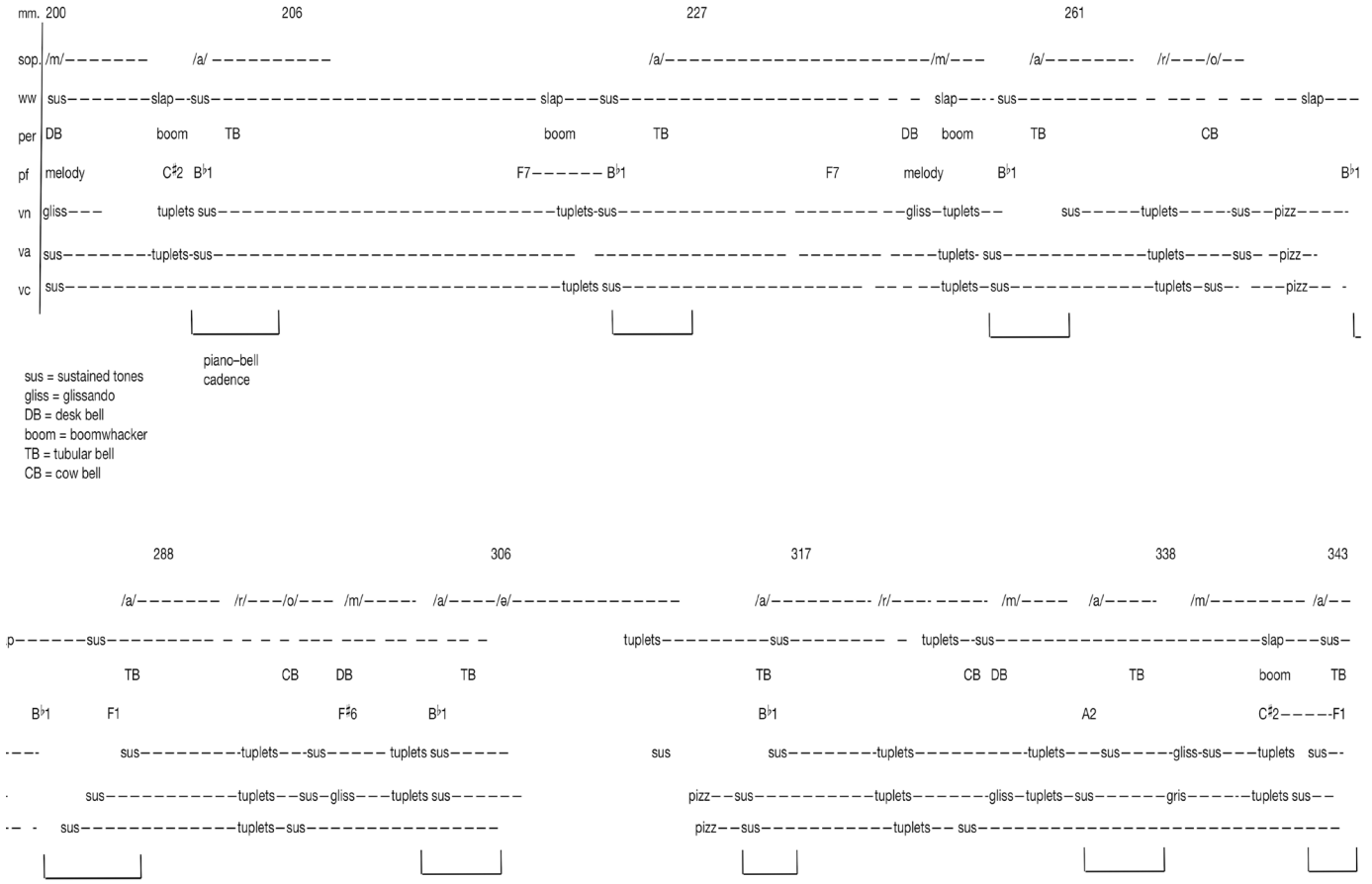


Figure 15: chart of soprano vocables over important cues in percussion and piano in mm. 200-343.

Section 2: "cadential" punctuation and vocal excitation

The second section of the piece is divided similarly into eight phrases of vastly different lengths, as indicated by the formal graph in Figure 15, which depicts soprano vocables, bells and boomwhacker in percussion, significant bass notes in piano, and predominant textures in winds and strings in measures 200-343. Sustained tones in woodwinds and strings form the body of each phrase, followed by no more than two bars of glissandos in violin or viola accompanied by a tune in piano (F-sharp6–F6–C-sharp6–F6–E6–F5–E6– C-sharp5, *ff-mf-pppp,* mm. 200-203), and a bar in which triplets in violin and viola are accompanied by slapped tones in winds. A strong cadence punctuates the end of each phrase: a fortissimo piano chord constructed on B-flat1 followed by a B4 in tubular bell. Although surrounded by a halo of microtones in strings and winds, a spectral analysis of the cadence suggests a tonal cadence over B-flat overloaded with a spectrum on F2 before fading once again into the sustained haze in winds and strings[6].

The second phrase in this section is over three times as long as the first (mm. 206-227). The pitch envelope shifts, focusing clearly on G, a high F and C-sharp, heading once again towards another cadence. This time there are no glissandos; triplets in piano, pizzicati in violin and cello join the winds and a boom whacker on C-sharp4 to herald a return of the cadence, and the vocalist switches to a second tube, still on /a/. The third phrase brings back the piano tune and the glissandi, augmented by desk bell before the cadence, as the soprano returns to /m/ (mm. 227-261). The fourth, extended phrase models the second, but punctuates the phrase with cowbell, more tuplets in strings, and the buzzing of active reeds in the vocal tube, and lengthens the piano cadence (mm. 261-288). The B-flat1–A-flat3–F4 chord in piano, with simultaneous attacks in strings (E2–B-flat3–D-quarter-sharp5–F-sharp5), precedes the cadence proper: now on F1–A4–B5, followed by a Tubular bell on F5. The fifth and sixth phrases are

[6] The audio example was provided by the composer, but is likely a provisional performance.

shorter (mm. 288–317), retaining all of the preceding elements – cow bell, desk bell, glissandos, free reeds, wind and string punctuation, returning to the piano's B-flat1. But the final two phrases bring back the piano tune immediately before a new cadence which shifts down to A2–C-sharp5–B5–C-sharp6 in piano (m. 330), followed by a cadence on F1–A4–B5 (m. 343), which kicks off the third and final section.

The culmination

The third section of the piece remains divided similarly into 8 phrases of vastly different lengths – befitting the soprano's monologue, which grows more agitated as the work continues – followed by a coda (mm. 518-603). A unique outer-voice counterpoint is created between the acoustic piano, the soprano's sung pitch and that produced simultaneously with the sung pitches by the various tubes and the active reeds (held throughout most of the piece, but allowed to sound at specific points). The pitch reduction in Figure 16 presents those tones produced by soprano, tubes, piano and accompanying percussion in the first part of section III (mm. 343-366). This passage also serves as an effective illustration of one aspect of Lanza's harmonic technique: surrounding central pitches with neighboring quarter- and half-tones to produce a faint dissonant beating among select higher partials.

The strong punctuation of the initial piano-tubular bell F cadence (m. 343) launches a long phrase in which the soprano sounds /a/ on A4 under a slightly sharp F5 sounded by the tube. Patafixed piano strings sound a repeated high G7, climbing to G-sharp7. This is reinforced by the active reeds, until measure 350. Here the soprano rapidly alternates the vowels /a/ and /i/ as the tube's F drops an octave and adds E-flat4, while the piano also drops, to a string prepared with a coin to produce a note not quite an octave above E-flat4. At measure 353 the voice begins a narrow gliding melody on /ə/, beginning on B quarter-sharp3, supported by tube and free reeds. The second cadence at m. 359 sounds C-sharp1 in piano, followed by C-sharp5 in tubular bell. The soprano now takes E-flat in the fifth octave

on /a/, while the tube plays a slightly-sharp A, along with free reeds vibrating on sharp F5 and sharp B3. Soprano sings a rolled /r/ on a sharp G4 which transitions into /o/ on sharp F4, which culminates in F-sharp4, echoed by cow bell at measure 364. A brief melody in piano precedes the soprano's low hum on F-sharp3 to F quarter-sharp3; again, harmonized two octaves higher by the slightly sharp F5 in free reeds. The original piano/tubular bell cadence returns at measure 366, to produce a kind of annotated triad: A sharp A4 sounds in tube between the equal-tempered A, F and C in piano and percussion, augmented by C-sharp4 in voice and D5 in piano.

The subsequent vocal progression follows the profile set out in measures 350 to 366b in Figure 16. The soprano sings /a/, /o/ or alternates /a/ and /i/, punctuated by humming and rolled /r/, all in the middle octave (F3 to B4 in mm. 350-419). In measure 420 the soprano reaches the fifth octave, descending again in measure 472, to close her part on a sharp F4 (m. 525). Over this slowly-shifting background the voice begins humming over the first glissando, and comes to a climax with the triplets in strings and tongue ram and slapped notes in winds. The soprano switches to another tube with the B-flat downbeat in piano, singing D-quarter-sharp5 over the A 3/4 sharp4 sounded by the tube. Her D-quarter-sharp5 is supported by a patafixed-note in the piano; that note forms the spectral peak of the "cadence". As this cadence continues its peak switches to B-flat5, as if to confirm its sense of closure.

This cadence will return 14 times, alternating C-sharp1, F1, A2 and B-flat2 (D2 appears once). The phrases grow more urgent, adding differently-articulated duplets in voice, winds and strings. The cow bell is sounded more frequently, and the Latin cow bell enters in measure 378. The final section adds more bells and boom whacker furiously-articulated duplets in winds and strings. In measure 392, the voice returns to the original cycle of pitched vowels sung in measures 350-364. This sequence of phonemes, pitches and hums will return in full three more times, and in truncated versions until the coda. The last cadence sounds in measure 517; in measures 521-525 the voice retreats as stuttering reeds, winds and piano continue over sustained strings.

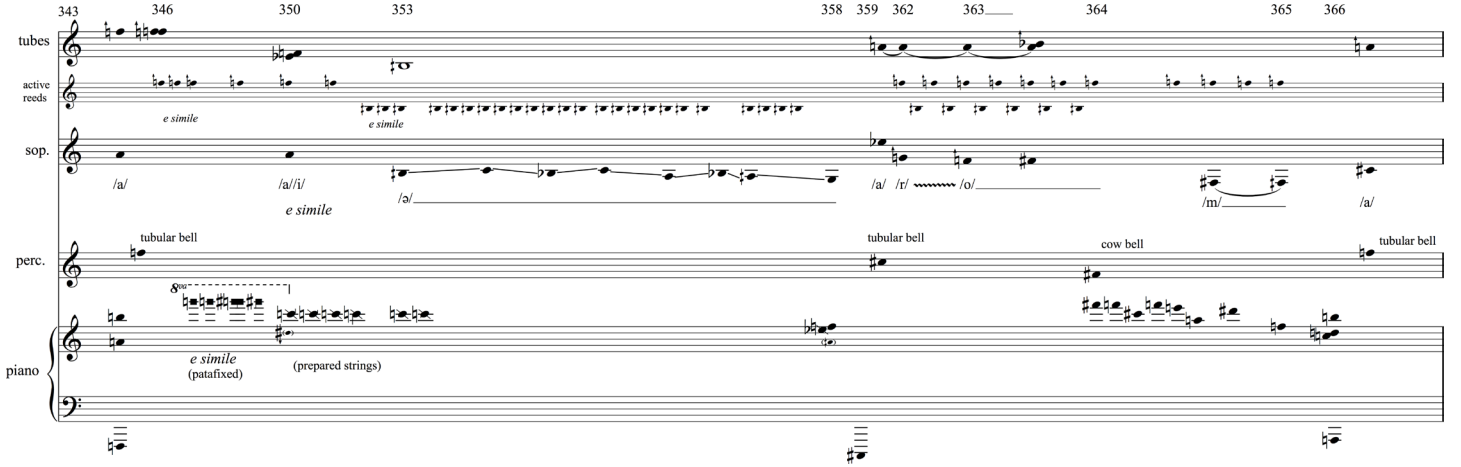


Figure 16: reduction of tube pitches, soprano, piano and percussion punctuation in the first part of section three, mm. 343-366.

Altogether Lanza's *Machine* speaks for almost fifteen minutes. But of what does it speak? Do the exaggerated vowel formants – echoed by harmonics and bells, and surrounded by cushions of expressive noise – suggest an actual dialogue? Running the work through an Italian speech translator produces a fascinating text, divided like the work into three primary sections. The first section is replete with «un», «non», «per», «con» and «il», the alternating back and front vowel sounds and nasal consonants contrasting with the occasional stop duplicating the sounds an Italian infant might make (Zmarich – Bonifacio 2005). As the piece continues larger "words" are generated of four or five syllables, and liquid consonants crowd the text. The vowel /o/ dominates in the third section; altogether the word «non» appears 42 times[7]. Such a translation does not point to a text per se so much as a work that speaks in place of a text, a work that sounds just enough like a machine beginning to speak – expressing its increasing frustration as it continues – that it maps an uncanny valley within the new music landscape.

Other twenty-first century composers work with automata in different contexts: cellular automata that mimic a biological model of evolutionary growth in music, or robotic instruments such as those of the Machine Orchestra project at CalArts (Miranda 2007)[8]. But Lanza and Valle find inspiration specifically in obsolete technologies, signifiers of a comically-flawed past. The failure of the original Kempelen machine to converse was similar to that of Vaucanson's *Le Canard Digérateur*, a defecating duck that did not really process its feed. Yet those failures are what paradoxically crystallized their fascination for both contemporary and later audiences. The lung-bellows, leather vocal tract and tongue, rubber mouth, ivory glottis and pipe nostrils of the original Kempelen Machine made a hybrid creature of sinew and corporeal stuff, a ventriloquist's dummy speaking not for its master, but for what its master desired.

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[7] Translation was through Amazon's commercial machine translation service.

[8] See <https://mtiid.calarts.edu/projects/performances/the-machine-orchestra/> (accessed 10-4-2021).

The Kempelen Machine recreates the acoustic grandeur of that failed attempt; its great efforts, in the form of advanced vocal and instrumental techniques, and a complicated metric scheme replicate at a remove the many years of toil that went into Kempelen's original speaking machine. We might return to the eighteenth-century for a contemporary reflection, from the famous conversation between d'Alembert and Diderot. Diderot compares a musical instrument to a philosopher: both are excited by surrounding nature, and can reflect on those impressions. The instrument-man produces conventional sounds out of need and proximity, but the instrument endowed with the faculty of sensation has discovered that certain sounds produce certain effects, those sounds and actions connected in memory (Diderot 2014, 5-19). Lanza's *Kempelen Machine* functions much as Diderot's allegorical harpsichord: in a moment of delirium it presumed itself the only one of its kind, speaking for the universe.

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