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The Hearing Subject*The composer and his own auditory mechanism*

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In the last 40 years the physical image of sound has changed. With the help of increasingly sophisticated technologies, we can now analyse sound phenomenology with great accuracy, identifying even the most fluctuating and unstable elements. Through the techniques of recording and visualising acoustic analysis, the passage of time has, in a sense, been mastered: it has been spatialised, split into numeric sequences. We can go through and recover each static instant of a sound and study it and its components with a minute discrimination between the transitory phases of the acoustic imprint. The idea of musical language as a *terminus a quo*, a sort of *ars moriendi*, an ephemeral, perishable art made up of sounds that vanish as reported by Adam of Fulda in 1490 ("*Nam musica est etiam philosophia, meditatio mortis continua*"), has evolved progressively into its opposite: music seems to realise the age-old alchemists' dream of stopping time, and perhaps recomposing it. Our earlier linear vision of sound has now been challenged by a new atomistic vision capable of representing the chaotic states of sound material. Spectral sound imaging makes use of a combination of the level of synchronisation of the attack of the different partials and the level of fluctuation of the spectral envelope, but different images of sound are also produced by parametric, matrix-pencil and formant-based analysis, among others. On the other side of the sound world is the human auditory system, the object of ever more studies and analyses, yet still in many ways mysterious. Extensive research into the physiology of hearing and psychoacoustics has greatly influenced compositional experimentation. How sound-waves travel into our cognitive system, how the auditory system can manage the distribution in time of the series of impulses that strike our two ears, how can be represented the physiological analysis of the components of the heard sound, are questions concerning researchers and composers.*Beethoven's ear*The composer's auditory system should be the most rewarding to analyse, to learn how many physiological relay stations must be passed before an acoustic signal is actually received as a cognitive acquisition. It is also the case that no ears are as famous as Beethoven's, because of the tragedy of his deafness and what he managed to do despite it.Beethoven's outer and middle ears gradually lost their acrobatic mechanical elasticity because of massive formations of calcium, as we learn from the original medical report, and yet he could, in a sense, "hear" music. Recent studies by Robert Zatorre, of the Montreal International Laboratory for Brain, Music and Sound Research, seem to demonstrate the special abilities musicians, especially composers, possess to evoke music, even when it is not physically present, by making use of the same area of the brain that is used in actual hearing. In musicians, the auditory cortex is activated at the same points in the absence of sound as in its presence, as if for self-induced sound images. This also demonstrates that our neural hardware, at once the instrument and the decoder of the instrument, allows us to reconstruct and manipulate internal musical representations after the arrival of a series of external impulses.When his Ninth Symphony

premiered at Vienna's Kärntnertor Theater on May 7, 1824, Beethoven was in attendance. Because of his deafness he could not himself conduct the symphony orchestra and chorus, but he did stand next to the conductor during the performance to indicate each tempo, giving instructions and following the score internally, evoking the musical result. But at the end, when the audience erupted in wild applause, Beethoven had no idea. He stood with his back to them, still facing the orchestra, until the contralto, Fräulein Unger, turned him around.Dr. Johann Wagner, assistant at the Viennese Pathological Museum, and his student, the subsequently celebrated professor of medicine Carl von Rokitansky, who was attending his first autopsy on the 27th of March 1827, were both bent over Beethoven's ear. According to them, the outer ear was very large and irregular in shape: "*Cartilago auris, magna et irregulariter formata*". The scapha and the concha were one and a half times bigger, the angle and curves much more marked, than normal. The membranous portion of the lamina was unusually red. Their meticulous account, in their imperial Latin, reveals a boundless curiosity: but they were, of course, seeking to explain the enigma of the transmission of musical language. Researchers today are still trying, with the aid of both hearing and sound analysis, to solve these puzzles. Dr. Wagner and von Rokitansky then set about analysing Beethoven's brain: they found that the cerebral convolutions were much deeper and wider, as well as much more numerous, than was normal. These formed a dense and intricate web suggestive of a visual image of the labyrinthine counterpoint of some of the last of Beethoven's quartet pages, the Grosse Fuge, opus 133, as if he had been able to project onto the score an analysis of his own hearing mechanism.*Internal musical representations of sound* Although hearing might be considered a passive physiological process, it becomes an active information-seeking and -processing system in response to our conscious decision. Hearing occurs in the temporal continuum and must bridge the interval between beginning and end, forming a two-way connection. Sound perception must be anticipatory, 'hearing forward', as well as retrospective, 'hearing backward'. It's a temporal mosaic we are continually called upon to recompose, but at the same time, hearing is also the most passive of the senses, being under constant siege. We can't choose to stop hearing: at most we can try to limit our attention.The temporal nature of hearing is related to the temporal nature of life, and both are a progression. Time could theoretically also go backwards, but not for the hearing apparatus: listening is not a reversible act, except in our retrospective imaging. The listener must use the temporal relationships among the components of a sound, the partial modulation, the variation in amplitude and frequency, to parse the sound-wave into discrete components. The auditory system does not have perfect temporal resolution, but varies from person to person. Differentiation between the duration of transitions, steady states and silences is related to our personal reconstruction of overall duration. Synchronic differentiation is important for the contrast we need to create between partials as well as for the delayed perception and differentiation of formants. The issue of time has always been of great importance to composers. Listening itself tells us that our experience comprises temporality and directionality, but their physical basis is still completely mysterious and we are unable to postulate any basis

for our sense of physical time. Scientifically we know that all sensory stimuli — acoustic, visual, tactile — are transmitted to the brain in the form of temporally organised electric impulses, and the more intense the stimulus, the faster or denser the series of impulses travelling towards the brain.One of the evolutionary consequences of having removed the brain from the periphery of the body, leaving that periphery to work as an interface with the habitat through the sensory system, is that everything we experience must be translated into electric signals, transmitted and then read in a time sequence. Following Hilary Putnam's suggestive image, our brain is a prisoner in a dark room, isolated from the sensory environment but receiving transmissions from a temporal series of electric impulses. A receptional kind of inner music for decoding and listening to the “external” music.But the listener does not receive only a sound. The temporal subdivision of the sound that reaches him — direct sound, first reflections, second reflections — is incredibly complex, but can nevertheless be verified by considering the geometry of the hall and the distribution of the absorbent material. The listener himself to some extent controls such reflections by moving his head and shifting his binaural balance, introducing new delays and attenuation, as intra- and extra-corporeal modulations of the incoming signal. The asymmetries that the listener introduces into hearing by moving his head or his eyes increase both the complexity of the incoming signal and his pleasure in decoding it.Similar observations lead many composers to realise compositional investigations of extreme temporal and receptive experiences. One of the most interesting recent results was provided by Georges Aperghis and Gérard Grisey. They tried to realize the dream, to develop a compositional method peculiarly connected to his individual hearing experience.*On the edge of the auditory system*The *Musikfässli*, consisting of the first pencil drawings made by Adolf Wölfli in the Waldau psychiatric hospital in 1904, represent "little kegs full of music": clear-cut and reiterative frames that enclose surprisingly bare staves, with a gentle curve on either side and two straight lines to mark top and bottom. A bare staff, exhibited as if it were full of notes — potential density and metonymical absence, the theatricality of the negative: a sound happening that could not, as it happened, be transcribed.In 2004-2005 Georges Aperghis took up the challenge and created an hour-long musical monument for six solo voices and chorus, the *Wölfli Cantata*, which attempts to commit to a score what is inexpressible, uncountable and unperformable, by challenging temporal performance praxis and perceptual rules in the name and with the poetics of Aldolf Wölfli.The composer analyses the poetic alphabet and the spatial topography of a pictorial language that knows neither interruption nor respite, but is nonetheless kaleidoscopically orderly within its apparent chaos of symbolic ornamentation, and he dwells upon Wölfli's only forms of stasis: his closely packed enumerations of cities, rivers, animals, numbers, castles, bridges, secret cellars and subterranean hideaways. Aperghis, in his score, has realised a contrapuntal grid of monochromatic lines that intersect endlessly, based on an extremely fast *tactus*, thus suggesting a surreal correspondence between acoustic effect and semiotic system. Temporal units are subdivided to the outer limit of vocal capability, with infinitesimal figures that the voice can only just articulate, thus providing the listener with the acoustic image of a

page that is almost entirely black, thanks to the density of its converging signs. The six solo voices of *Petrrohl*, one of the sections of the cantata, sketch monochromatic melodies that move sinuously around the same main frequencies, fragmented like a succession of short vocal explosions that produce, as a whole, a sequence of brief throbbing sound clusters that throb just like the feverishly dense network of Wölfli's written signs. *Manipulating internal musical representations*Inverse acoustics (concerned with potentiating the reconstruction of a physical event that has generated a specific sound) and ecological acoustics (considering the relation between the physical characteristics of a vibrating object and its perception), are the fields comprised in the musical quest conducted by Gérald Grisey.While Aperghis wages war against listening itself, pushing beyond the possibilities of performer and listener alike, Grisey wants to set up a dialogue between the listener and himself.In his music, sound events are analysed by identification of the formant range, and by studying the inharmonicity of the spectrum, the dynamic evolution, the roughness of the acoustical beats and the pathway of the secondary combination sounds. The composer has constructed a form by following the evolution of the sound, its drift, its orientation and temporal flux.Grisey's dream is to create an expansion of the temporal flux, to reach a sort of rhythmic silence in which the listener, navigating within his own hearing experience, might notice the tiniest alteration of the sound structure. His scores are a sort of sonographic pitcure, a bi-dimensional projection of the acoustic space of his sound composition. Starting from an analysed sound, the composer assigns each partial that appears in the spectral sound imaging — the point of departure of his compositional process — to a different instrument: thus he, in a sense, 'orchestrates' the results of the analysis and recreates the sound in the orchestra — but very much slowed down, as if he were navigating in slow motion within the sound itself. The unfamiliar stretching of time he organises allows one to enter and *read* the sound, to become *conscious* of the hearing process.The study of human aural perception tells the composer that the listener can distinguish only a limited amount of information within the temporal frame of a sound event, so it is important that the structure, the internal organisation of the message, be limited and altogether perceptible. The listener performs a sort of selection of certain partials of the sound, as a result of an unconscious internal process governed by predictability or 'preaudibility', based on the consistency of the message. In other words, the listener, on the basis of what he has heard so far, anticipates what will follow, and periodicity reinforces the process. The listener's understanding of the complexity of the message can be supported by repetition, which alters his perspective and sense of expectation. Hence Grisey seeks a *périodicité floue*, an irregular periodicity, since nothing in nature oscillates in an exact periodic rhythm, and subtle differences in oscillation can then provide aesthetic values. This quasi-periodicity allows the musical message to be comprehensible. Since the inner ear acts like a band of filters tuned to a reduced set of superimposed frequencies, the ear itself selects and filters the frequencies. Grisey suggests an *a priori* particularisation of the nature of the signals through filtering; hence he himself executes purposeful filtering, in order to propose a configuration which he has already extracted

from other sounds, so that the listener can understand that sound may be surrounded by noise; he assists in the listening process by offering the listener the formal model that the latter was meant to process by himself. The composer aims to compete with the listener's auditory system and cognitive reception, by conducting an auditory self-analysis and transforming listening into a compositional experience.