Shared Compositional Techniques between György Ligeti's *Pièce électronique N° 3* and *Atmosphères*

by Jennifer Iverson

It is well known that Ligeti originally used the title *Atmosphères* for his third and unfinished electronic piece[1]:

> Es hieß ursprünglich *Atmosphères*, doch dann habe ich diesen Titel revoziert, weil später ein Orchesterstück von mir den Titel *Atmosphères* erhalten hat, und dieses dritte elektronische Stück – eigentlich das zweite – nannte ich *Pièce électronique N° 3*.[2]

Ligeti's account is borne out in his hand-drawn manuscript score of *Pièce électronique N° 3* (1957) held at the Paul Sacher Foundation, as the back of one of the score pages bears the inscription *Atmosphères*. The shared title is more than a superficial connection between the two works. Ligeti has admitted that his electronic works influenced his famous orchestral works, *Apparitions* (1958–59) and *Atmosphères* (1961), in important ways.[3] He has written how, after the respective premières of these works in Cologne and Donaueschingen, many commentators remarked that these were actually electronic pieces set for the orchestra. For Ligeti, this seemingly preposterous idea was nevertheless perceptive:

> Sicher ist diese Behauptung merkwürdig – wie könnte etwas elektronisch sein, was rein instrumental ist –, dennoch enthält sie einen Kern von Wahrheit, das heißt ohne die Erfahrung im elektronischen Studio wären die Orchesterstücke nicht so komponiert, wie sie eben komponiert worden sind.[4]

If the associative relationships between Ligeti's electronic and orchestral works are commonly acknowledged, the tangible connections between them are perhaps less well understood.[5] A manuscript study of the sketches and scores for *Pièce électronique N° 3* and *Atmosphères* bears out Ligeti's rather vague suggestion that the electronic studio experience was in some way essential for his ability to compose his subsequent orchestral works and reveals important shared compositional techniques between the two works.

Pièce électronique N° 3 is constructed largely from the technique of "additive synthesis," a process of building sounds from their constituent elements. A single sound can, of course, be analyzed and described as a fundamental plus a number of overtones, and the composers working at the

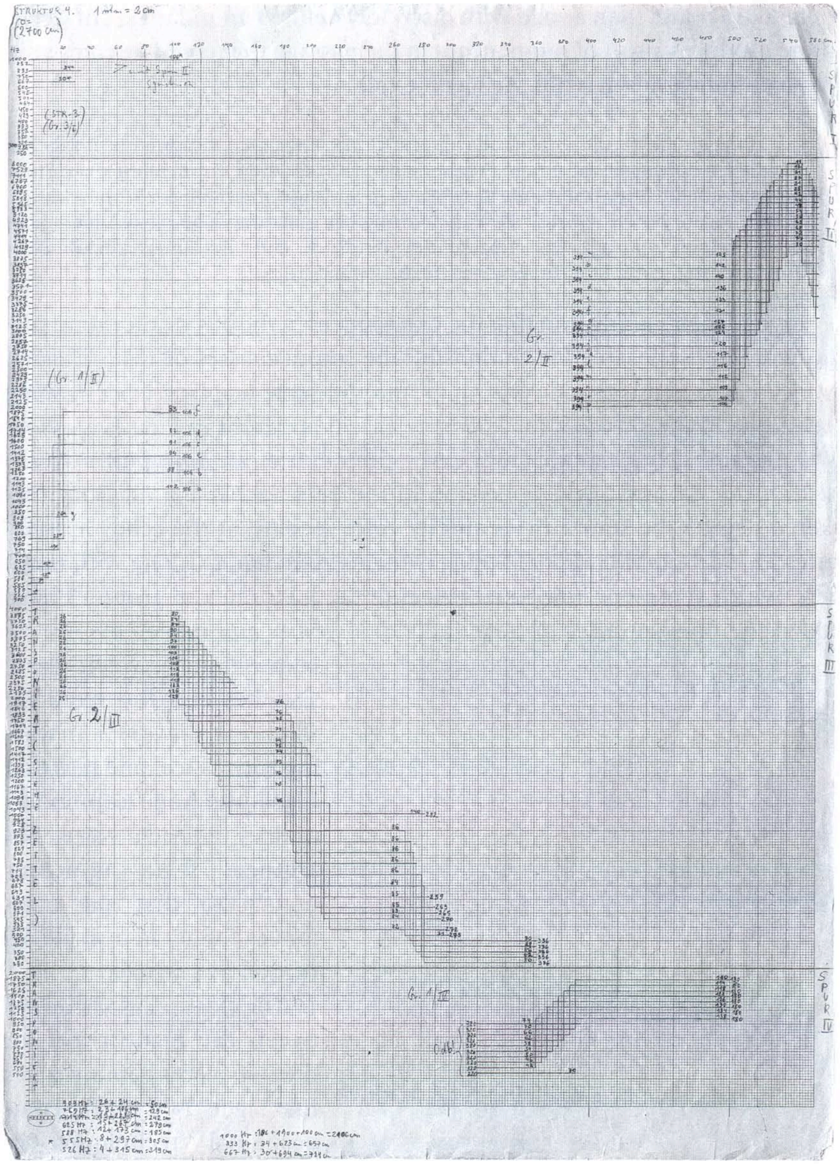
Cologne studio in the 1950s often synthesized electronic sounds by applying this process in reverse. Using an oscillator to generate a number of sine waves at particular frequencies – often frequencies that corresponded to overtones above a fundamental – and then recording these individual sine waves together, composers could produce sounds with specific, defined timbres. By layering together sine tones that correspond to an inharmonic spectrum, on the other hand, one could produce sounds with more texture: noise, roughness, and beats between competing partials characterize the sound rather than the blending typical of partials of the harmonic spectrum.[6]

That Ligeti was using additive synthesis in *Pièce électronique N° 3* is clear from the score. The horizontal x-axis gives information about duration – labeled in centimeters for the length of tape rather than in seconds – while the vertical y-axis contains numbers representing sine-wave frequencies. The first sonic figure of the piece is a simple example of the additive technique: frequencies are layered on top of one another in a static mass, which creates a composite sound. As some of the partials are gradually eliminated, the sound quality changes, becoming smoother and more pure.

This type of static cluster was later made famous in *Atmosphères* – in fact the opening figure of this piece very much resembles the opening figure of *Pièce électronique N° 3*. The complex instrumental cluster at the beginning of *Atmosphères* can be understood as the acoustic equivalent of additive synthesis. Instead of representing the pitches as note-heads on the staff, one could represent them according to their sonic frequency; furthermore, one could write the durations in seconds or lengths of tape (the standard tape speed at the Cologne studio was 76.2 cm/sec) instead of using rhythmic notation, and the transformation would be complete.

It is important to keep in mind that the comparison, while striking, emphasizes transference of compositional technique from *Pièce électronique N° 3* to *Atmosphères* rather than a transfer of sound *per se*. The sine-tones used in *Pièce électronique N° 3* are "pure" tones without partials. If each of the frequencies in the *Atmosphères* cluster is imagined in an analogous way, as a partial contributing to a cluster built through additive synthesis, we must admit that the "partials" of *Atmosphères* are not pure sine-tones but rather fundamentals with numerous partials of their own. Thus the sound of the cluster produced in *Atmosphères* is much richer and more complex than the sound produced by the same additive synthesis technique in *Pièce électronique N° 3* – the resounding of the partials above each of the fundamentals guarantees this result.

Ligeti more often produced moving shapes rather than static ones in *Pièce électronique N° 3*. *Example 1* is characteristic: the technique of additive synthesis is still obvious at the start of the mass, where a number of frequencies (shown on the y-axis) have been added together to create the sound; however, he allows the mass to migrate in register by having voices climb



Example 1: György Ligeti, *Pièce électronique N° 3* (1957), manuscript score of pitches and durations, p. 4 ("Struktur 4") (György Ligeti Collection).

over one another to progressively higher or lower frequencies. For confirmation, one can painstakingly trace each voice individually in the score.

This leapfrog voice-leading technique exhibits remarkable continuity – the constant asynchrony between the voices means that it is nearly impossible to perceive which voice is moving at which time. The perpetual climbing in slightly asynchronous voices means that the sound mass behaves more like a liquid than a solid with discretely defined boundaries. This technique produces a sort of momentum in the passage that could be compared to a ball rolling down a hill. As Ligeti explains,

> [...] erfolgen die Tonhöhenveränderungen in den einzelnen Stimmen in Form von plötzlichen Sprüngen von einem Frequenzwert zum anderen. Da im komplexen Stimmengeflecht die Einsatzabstände der einzelnen Sprünge unterhalb der Verwischungsgrenze liegen, hören wir nur die Veränderung des gesamten Komplexes, nicht aber die einzelnen Sprünge. Es entsteht der Eindruck einer weichen, allmählichen Umwandlung, einer kontinuierlichen Texturveränderung.[7]

Given Ligeti's admission that the experiences in the electronic music studio were indispensable for composing the sound-masses of his orchestral works, perhaps it is not surprising to find the same leapfrog voice-leading technique in the sketches for *Atmosphères* as is apparent in *Pièce électronique N° 3*. *Example 2* is a transcription and annotation of an *Atmosphères* sketch held in the György Ligeti Collection of the Paul Sacher Foundation. This sketch depicts the sound mass and its voice-leading in the cellos in measures 31–33.[8] Ligeti's original sketch contains pitch names along with numbers, which represent individual voices of the instrumental groups. I have added the lines in order to trace individual voices and make obvious the connection between these sketches and the score for *Pièce électronique N° 3*. In tracing each voice, one sees that Ligeti uses large leaps in frequency in each voice, but arranges them asynchronously so that the mass moves fluidly in a single direction as a whole.

Example 2: Transcription and annotation of Ligeti's sketch for *Atmosphères* (1961), mm. 31–33, cellos.

The close relationship between the manuscripts for the two pieces demonstrates that Ligeti used similar compositional techniques in both works. Constructing the sound mass from a large number of individually notated voices – a technique Ligeti made famous in *Atmosphères* – is in fact a descendant of the additive synthesis he had first used in *Pièce électronique N° 3*. The leapfrog voice-leading of *Pièce* *électronique Nº 3* strove to create fluid motion that moved the sound masses without sacrificing textural continuity, though due to the technical limitations of the studio in the 1950s, Ligeti realized that this voice-leading would have to be applied in the acoustic realm; he left *Pièce électronique Nº 3* unfinished and transferred his compositional energies to realizing the same kind of voice-leading in *Atmosphères*. Yet *Pièce électronique Nº 3* is anything but an unfinished failure. As this study makes clear, the compositional techniques and modes of thinking he gained in the electronic studio proved nothing short of invaluable for the realization of *Atmosphères*.

[1] Kees Tazelaar, Johann van Kreij, and Paul Berg finally realized *Pièce électronique Nº 3* with digital technology in 1996 at the Institute of Sonology at The Hague in cooperation with Ligeti. It is available on the CD *The Institute of Sonology*, His Masters Noise, vol. 1 (Amsterdam: BVHaast, 2001; BVHAAST CD 06/0701).

[2] György Ligeti, "Auswirkungen der elektronischen Musik auf mein kompositorisches Schaffen," *Gesammelte Schriften*, ed. Monika Lichtenfeld, vol. 2 (Mainz: Schott, 2007), p. 86. See also Ulrich Dibelius, *György Ligeti: Eine Monographie in Essays* (Mainz: Schott, 1994), p. 61; Gottfried Michael Koenig, "Ligeti und die elektronische Musik," *György Ligeti: Personalstil – Avantgardismus – Popularität*, ed. Otto Kolleritsch (Vienna: Universal Edition, 1987), p. 25; György Ligeti, "Musik und Technik: Eigene Erfahrungen und subjektive Betrachtungen," *Gesammelte Schriften*, vol. 1, p. 246; Richard Steinitz, *György Ligeti: Music of the Imagination* (Boston: Northeastern University Press, 2003), p. 90.

[3] See György Ligeti, "Auswirkungen der elektronischen Musik" (see note 2), pp. 86ff; *idem*, "Musik und Technik" (see note 2), pp. 252–61; *György Ligeti in Conversation* (London: Eulenburg, 1983), pp. 38–40, 88; and *Träumen Sie in Farbe? György Ligeti im Gespräch mit Eckhard Roelcke* (Vienna: Zsolnay, 2003), pp. 82–100.

[4] György Ligeti, "Auswirkungen der elektronischen Musik" (see note 2), p. 87.

[5] For discussions of the influence of Ligeti's electronic works on his orchestral works, see Ulrich Dibelius, *György Ligeti* (see note 2), pp. 9–30; Gottfried Michael Koenig, "Ligeti und die elektronische Musik" (see note 2), pp. 11–26; Benjamin Levy, "The Electronic Works of György Ligeti and their Influence on his Later Style" (Ph.D. Diss., University of Maryland, 2006); Marina Lobanova, *György Ligeti: Style, Ideas, Poetics* (Berlin: Ernst Kuhn, 2002), pp. 38–44; Richard Steinitz, *György Ligeti* (see note 2), pp. 77–82, 90; Richard Toop, *György Ligeti* (London: Phaidon, 1999), p. 61.

[6] In the early and mid-1950s, additive synthesis was *de rigueur* for the Cologne composers; in fact, it is this technique that initially established "pure" sound synthesis as the basis of *elektronische Musik* in contrast to the manipulations of sampled sound in *musique concrète*. Even after a piece such as Stockhausen's *Gesang der Jünglinge* (1956) blurred boundaries by using sampled, pre-recorded sounds, additive synthesis remained important because it offered precise control over and, theoretically, the ability to serialize timbre. For Ligeti's discussion of the evolution of this technique at the Westdeutscher Rundfunk (WDR) studio, see "Musik und Technik" (see note 2), pp. 238–40. See also Elena Ungeheuer and Pascal Decroupet in *Elektroakustische Musik*, ed. Elena Ungeheuer (Laaber: Laaber Verlag, 2002), pp. 19–66; David Ernst, *The Evolution of Electronic Music* (New York: Schirmer, 1977), pp. 26–45; Peter Manning, *Electronic and Computer Music* (Oxford: Clarendon Press, 1985), pp. 43–78; *Die Reihe*, vol. 1, *Elektronische Musik*, ed. Herbert Eimert and Karlheinz Stockhausen (Vienna: Universal Edition, 1955).

[7] György Ligeti, "Musik und Technik" (see note 2), p. 248.

[8] Similar sketches are extant in the György Ligeti Collection for the other instrument groups in the same section, including the winds (mm. 32–38), violin I (mm. 31–38), violin II (mm. 30–33), and double bass (mm. 30–31).