WIRELESS IMAGINATION
SOUND, RADIO, AND THE AVANT-GARDE

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Marcel Duchamp produced very few works of music in the same sense that he produced very few works of sculpture: his two or three musical compositions have had a great deal of influence on subsequent developments in music, just as his two or three dozen readymades have had a great deal of influence on subsequent developments in sculpture. The key to Duchamp's seemingly disproportionate success lies in the fact that he was largely responsible for proving that art can be whatever the artist decides it is. In sculpture, it can be the unnoticed objects of the world—the ordinary things like bicycle wheels and bottle racks—that lie undisclosed in the oblivion of disregard. In music, it can be the noise that lies hidden in the intervals between the notes or the gaps left empty between the sounds.

Music is often posited as a corollary of the visual arts, particularly in regard to the development of formalist criticism during the late nineteenth and the early twentieth centuries. Walter Pater's well-known remark typifies this approach: "All art constantly aspires towards the condition of music." Pater means to imply that much of the strength in a work of art is carried by its formal elements, by such things as its color "tones" and "harmonies." Duchamp's approach is very different; he opposes formal approaches and adamantly expresses his antipathy for "retinal" painting: he wants to place art once again "at the service of the mind." Perhaps the most important way in which he tries to add intellectual content to the art process is by choosing readymades. As George Heard Hamilton put
it, "Duchamp had annihilated all that haughty aesthetic talk about empathy, pure painting, significant form, etc. Art is what one decides it shall be. We do not so much find it, or make it, as determine it. Consequently it has no value whatsoever except in so far as it exists in the context of a mental event." With his seemingly uncomplicated mental gestures, Duchamp brings a new set of ideas not only to ordinary objects but also to the entire enterprise of making a work of art. He places his chosen objects within a new arena for observation. He does the same thing for music. Duchamp’s avant-garde gestures, although certainly revolutionary, are not necessarily nihilistic. Just as his readymades were not exclusively anti-art objects, neither were his works of music. "I'm not anti-music," he explained to Otto Hahn. "But I don't get on with the 'cat-gut' side of it. You see, music is gut against gut; the intestines respond to the cat gut of the violin. There's a sort of intense sensory lament, or sadness and joy, which corresponds to retinal painting, which I can't stand. For me music isn't a superior expression of the individual. I prefer poetry. And even painting, although that's not very interesting either."

By isolating the interstices between rhythmic notes and by creating a kind of visual or conceptual music not really intended to be listened to—that operates in the gaps between the sounds—Duchamp opens up the ordinary world of nonmusical noise to the artistic considerations of intentionality. In order to achieve his philosophical purposes, Duchamp often crosses over from one sensory system to another: he looks at hearing and listens to vision. In one of his notes from the Box of 1914, he suggests an apparently impossible task: "Make a painting of frequency." Frequency is something we normally associate with sound, as in the "Frequency Modulation" that gives FM radio its name. Of course, "frequency" can also be used to describe the entire electromagnetic spectrum. In that context, it refers to the number of oscillations that occur each second in an electromagnetic wave. In such terms, frequency is a matter of wavelength, and the radio waves that are translated into sound by a radio are essentially the same as the light waves that are translated into colors by the human visual system. Radio telescopes "see" objects in the universe that are radio bright just as optical telescopes see objects in the visible range of the spectrum.

Duchamp does not specifically discuss, so far as I know, the fundamental equivalence of visible light and other kinds of electromagnetic noise, but many of his notes involve hypothetical ways of connecting (or conflating) aural and visual phenomena. He often puts the ordinarily distinct realms of sound and sight together and mixes up hearing and seeing. In one of his most interesting posthumously published notes, he proposes making a sculpture out of sound. He argues that if the right kind of aural environment were constructed, the listener would be able to hear sculptures in space, although such a system would require considerable training and, apparently, the inheritance of acquired characteristics:

Like... luminous electric lights which light up successively, a line of identical sounds could turn around the listener in amblesques (on the right, left, etc. around).

Develop: one could, after training the listener's ear, succeed in drawing a resembling and recognizable profile. With more training, one could make large sculptures in which the listener would be at the center. For example, an immense Venus de Milo made of sounds around the listener. This probably presupposes an aural training from childhood and for several generations. After the Venus de Milo, there would be an infinity of other transformations more...
Duchamp's first readymade, the Bicycle Wheel, was chosen in 1913 at just the moment when he was producing his first musical work, *Études Musicales*. This latter "musical readymade," as it is often called, describes a way of choosing a musical composition much as one might randomly select a manufactured object. Both categories were involved with chance operations. In a discussion of the Bicycle Wheel, Duchamp points out that "at first it wasn't even called a Ready-made":

It still had little to do with the idea of the Ready-made. Rather, it had more to do with the idea of chance. In a way, it was simply letting go by themselves and having a sort of casual atmosphere in a studio, an apartment where you live. Probably, to help your ideas come out of your head. To see that wheel turning was very soothing, very comforting, a sort of opening of avenues on other things than material life of every day.

*Erratum Musical* is generated by drawing notes cut from a scale out of a hat at random. When played, the "composition" generates a very provisional kind of music that is not too far from noise. The Bicycle Wheel, when spun—and it must be spun in order to fully satisfy its design parameters—produces a faintly musical sound, a soft whispering noise. It can also be played. We could play the turning spokes by dragging our fingers or a stick across them as they turned. The frequency of sound could be varied by moving whatever plectrum we were using back and forth from near the spinning rim to the hub.

A rotating bicycle wheel can thus be thought of as a sculpture of frequency, if not a painting of frequency, and it may have been intended to suggest the equivalence of the visible and the invisible parts of the electromagnetic spectrum in the sense suggested previously. At least it could have been meant to deal with blending from the visible to the invisible. Lawrence Steevel in an early discussion of the Bicycle Wheel makes several interesting observations about its visibility:

If spun slowly, the object becomes blurred at the outer extension of the spokes, but still retains its object-identity. Pushed harder, the spokes blur into what Moholy-Nagy calls a "virtual volume," transforming the object-identity into a luminous illusion of transparency and dematerialized "spatial motion." The rim, which remains a constant enclosing circle, will also glimmer more radiantly, so that the passage of the distinctly delineated forms into an indistinct shimmer (which is half mirror, half window) integrates and fuses the parts of the object into a new unity and also into what seems to be a new physical condition.

By integrating the visual and aural components of the Bicycle Wheel, Duchamp could augment its geometrical overtones. Thus, his purposes in choosing the readymade were probably not simply a matter of producing a work of antiart, as Steevel also suggests:

As a conceptual symbol and as a visual phenomenon, Bicycle Wheel is not so much a "vicious circle" as a "four-dimensional" object. As a Ready-made, Bicycle Wheel does not contradict, but supports the contention that Duchamp's preoccupation with mechanical forms and the beauty of indifference which mechanization allows is not necessarily restrictive or cynical.

Duchamp's readymades are open ended, and they can stand for many things; they operate at multiple levels throughout his oeuvre. I have argued in another context that the Bicycle Wheel can be read as a reference to a four-dimensionally expanded point of view with the moving spokes taken as metaphors for the multiply contingent lines of sight that such a point of view entails; it is also possible that the moving Bicycle Wheel is intended to stand for a four-dimensionally expanded "point of hearing." The turning wheel, when it is conceptualized as a sculptural portrait of an (n + 1)-dimensional vision, can be related to the Oculist Witnesses in the *Large Glass*. These last designs, drawn with mirror coating on the surface of the glass, can, in their turn, be related to *To Be Looked (from the Other Side of the Glass)* with One Eye, Close to, for Almost an Hour. This latter work clearly involves shifting from binocular to monocular vision, and as I have argued, it too is likely to have been intended as a metaphorical analy-
sis of how one might "see" the fourth dimension. In a note that is directly concerned with *To Be Looked at...*, Duchamp connects hearing with his geometrical speculations: "One could base a whole series of things to be looked at with a single eye (left or right). One could find a whole series of things to be heard (or listened to) with a single ear."

Duchamp may have felt that shifting from hearing with two ears to hearing with one ear could produce the kinds of dimensional transformations that, he argues, occur in shifting from seeing with two eyes to seeing with one eye. Although actually more complex than Duchamp indicates in his statements (the world does not flatten out completely when you close one eye), vision with a single eye is relatively "two-dimensional" when compared with the fully three-dimensional perception provided by binocular disparity. Perhaps the visual changes that occur when the Bicycle Wheel is spun, its becoming transparent, have some aural analogue that takes place when the listener puts one ear up beside it in order to hear the faint noise it makes while turning.

In a related work contemporaneous with the Bicycle Wheel, Duchamp depicts a bicyclist riding across a sheet of music paper. In *To Have the Apprentice in the Sun*, as the drawing is titled, the bicycle (a machine equipped with two bicycle wheels) rolls up an incline. Its implied movement was presumably intended as a musical reference. Gavin Bryars, in his article about Duchamp's music, suggests that the line the wheels follow should be read as a drawing of a continuous tone, or a continuously rising tone, and that the drawing can consequently be related to Duchamp's interests in producing sound by means of "precision musical instruments" designed to avoid artistic skill, or "virtuosity," as he calls it. In a 1913 note included in *A Little Hasn't*, Duchamp describes such a project:

Construct one and several musical precision instruments which produce mechanically the continuous passage of one tone to another in order to be able to record without hearing these sculptured sound forms fugue..."

Duchamp makes comparisons between a continuum of sound waves and a continuum of light waves. Punctuating these continua with notes or with specific colors, he seems to imply, runs the risk of making a work of art and falling into virtuosity.

What these discussions have to do with "having an apprentice in the sun" is unclear, but perhaps the various components of Duchamp's interrelated system—his references to readymades, his desire to produce continuous tones, his disdain for color theories, and his nonsensical titles—are unified in their purpose of flattening out the meaning in a work of art. The drawing was included with fifteen other short notes, which are also difficult to understand, in the Box of 1914. The title, *To Have the Apprentice in the Sun*, probably fits within a group of works that Duchamp was producing at this time, all of which were concerned with denying meaning. He explained to Robert Lebel that the drawing was produced at a moment when he was mixing together "bits of different arts (e.g., writing and drawing) with no connection to each other (or at least as little as possible)." During this same period, 1913 to 1916, he was also beginning to add meaningless titles to his readymades, something that added a "literary" dimension to them, as he explains: "One important characteristic was the short sentence which I occasionally inscribed on the 'readymade.' That sentence instead of describing the object like a title was meant to carry the mind of the spectator towards other regions more verbal." These more verbal regions were not concerned with conveying rational meaning but rather with suppressing it.

In October 1915, Duchamp composed his first work in English, a kind of readymade text entitled "The." Each time the definite article appears in this work, it is replaced by an asterisk, a "glue gap. The point of the exercise was to produce something that was not a story," as Duchamp explains:
The meaning in these sentences was a thing I had to avoid. . . . The construction was very painful in a way, because the minute I did think of a verb to add to the subject, I would very often see a meaning and as soon as I saw a meaning I would cross out the verb and change it, until, working it out for quite a number of hours, the text finally read without any echo of the physical world.

The resulting text, which includes such statements as “however, even it should be suitable to shut the hair which the water writes always in the plural, they have avoided the frequency meaning, mother in law,” has, of course, led to a number of interpretations, as has a similar text in French entitled “Rendez-vous du Dimanche 6 Février 1916 . . .” written a few months after “The.” Despite our ability to hear suggestive echoes in these texts, they are uninterpretable, at least in the sense of reading meaning out of them; they produce noise rather than meaning, and all the interpreter can do is read meaning into them because the words themselves are empty or hollow.

Duchamp’s music is also empty or hollow. It is gap music, “musique en creux” as he called it, and it does not tell a story. Neither does it sing a song or play a melody. It is not to be listened to or performed. Duchamp’s music is readymade, and just as the readymade were his most powerful means of analyzing the workings of art, his musical errata were his most effective means of revealing the conventional nature of music. In a discussion of his archetypal readymade, the Bicycle Wheel, Duchamp explained that “the wheel serves no purpose, unless it is to rid itself of the conventional appearance of a work of art.” His forays into music operated in equivalent terms. He chooses a system, a score, and a libretto, and then allows chance operations to determine their final outcome, much as he places an ordinary object, such as a bicycle wheel, a comb, or a urinal, in a new context and waits to see what happens. The art exists not only because of the artist’s choice, but also because of the viewer’s choice, and it was this reciprocal nature of the interchange between art and its audience that so fundamentally interested Duchamp.

Erratum Musical was included in the Green Box and is therefore intended to be associated with the Large Glass. In addition to choosing the notes by drawing them out of a hat one at a time, Duchamp determined the words for the song “by chance.” They consist of a standard dictionary definition of how to make a print: “To make an imprint mark with lines a figure on a surface impress a seal on wax.” As happens with so many aspects of Duchamp’s work, this ready-made definition pulled from a French dictionary in 1913 sounds exotic and poetic now, some seventy-five years after it was chosen. It functions like the text of “The” or “Rendez-vous du Dimanche 6 Février 1916 . . .” The words of the song do not quite make sense. The title of Erratum Musical is itself poetic. The Latin term, erratum, can be translated as “error” or“mistake” or “misprint.” It is the past participle of the verb errare, which means to wander off or to stray, and that is pretty much what the music and the meaning of the text do. They move about and refuse to remain stationary.

Duchamp also produced a more elaborate version of Erratum Musical, and it was apparently meant to be even more closely associated with the Large Glass than the version included in the Green Box, given its heading: La Mariè mise à un par ses célibataires, même: Erratum musical. This work also uses chance operations to generate a musical score. Duchamp’s instructions read as follows:

Each number indicates a note; an ordinary piano contains about 89 notes; each note is the number in order starting from the left.

Unfusshable; for a designated musical instrument (player piano, mechanical organs or other new instruments for which the virtuoso intermediary is suppressed); the order of succession is (in taste) interchangeable; the time which separates each Roman number will probably be constant (?) but it may vary from one performance to another; a very useless performance in any case.
An apparatus automatically recording fragmented musical periods, i.e., containing the 89 notes (or more: 1/4 tone)....
more philosophical punch into his attacks on "retinal" painting. By entailing his readymades and his musical notes with the notion of a continuum, he focuses on their status as copies, as examples, along a potentially infinite continuum of identical readymades and sounds. A musical note (say b flat) can be replicated ad infinitum, ad nauseam. Duchamp apparently thought that replication could be used as a means of examining the meaning structures that operate in the art process. Part of his project involved devaluing the "cult of the original," as he called it. He wanted "to wipe out the idea of the original, which exists neither in music nor in poetry; plenty of manuscripts are sold, but they are unimportant. Even in sculpture the artist only contributes the final millimeter; the casts and the rest of the work are done by his assistants. In painting we still have the cult of the original."[8]

Duchamp's musical compositions are analogous to his more complex readymades such as the 3 Standard Stoppages (a work that he once called a readymade but "not quite").[9] Both the music and the Stoppages are examples of "canned chance." They also involve isolating discrete moments in moving continua. Many of Duchamp's readymades (and proposed readymades) have iterated elements: the prongs of the Bathos, the teeth of the Comb, the spokes of the Bicycle Wheel, the floors of the Woolworth Building (proposed as a readymade), etc.[10] In terms of music, the most important such component is the basic temporal interval. The beat of the music (our choice since Duchamp does not provide a time signature) is a rhythmic equivalent of the repeated elements of the readymades. In the most general terms, the teeth of the Comb, the prongs of the Bathos, and the spokes of the Bicycle Wheel can be considered analogs to the repeated elements of a sound wave, and the readymades themselves become sculptures of frequency, as suggested earlier. (I think we can also all remember playing music on the teeth of a comb.) Even at the abstract level of repeated basic elements, these readymades function as concrete representations of the wave oscillations of sound (and also of light).

The readymades can be thought of as portraits of sound, visualizations of pulses prescinded from noise, and, as such, they can be conceptualized as conventionalizations of music. At least this much is true: Duchamp's music is involved with the basic notion of the interval, and it is this mathematical in a way that parallels the iterative nature of the readymades. In an interview with Arturo Schwarz, Duchamp said that the Comb was a "remark about the infinitesimal," and there is no way that he could have used such a term without meaning to index its mathematical content. He intends to associate the readymade with his ideas about the continuum. In addition to mathematics, he also emphasized the commonplace nature of the Comb and the spaces between its teeth. "The teeth of the comb are not really a very important item in life. Nobody ever cared to consider the comb from such an angle.... I was struck by this unimportance and so I made it important to me."[11] Schwarz then asked Duchamp about a statement that he found difficult to understand. What was the association in one of the Green Box notes between a Comb and a rattle? "Well," Duchamp explained, "the rattle is a toy for children that makes noise when you turn it, and the comb becomes a generator of space, space generated by the teeth."[12] Schwarz's initial confusion is explained in part by the somewhat misleading English translation of crécelle as "rattle."[13] A crécelle is a noisemaker that works by rotating a device equipped with a clapper around a ratchet wheel. The tongue of the clapper strikes the teeth of the ratchet wheel and produces a punctuated interval of sound, a sharp clattering noise. In Duchamp's conception, the regularly spaced teeth of the ratchet wheel in the crécelle are analogous to the regularly spaced teeth of the comb.

Again, Duchamp's concerns about the geometrical properties of a noisemaker, its ability to "generate space," are relevant to the notion of interval and repetition that seems so important to his overall conception of the readymades. He uses his concept of "elementary parallelism" to get an n-dimensional configuration to gen-
erate an \((n + 1)\)-dimensional configuration. In other words, he conceptualizes the teeth of a comb or a child's noisemaker as whimsical devices for generating not only noise (music) but also space. In one of his posthumously published notes, Duchamp explains what he is after: he points out that a "noisemaker with elementary sectioning capacity" can function in terms of the "application of the principle of elementary parallelism." The sketch that accompanies the note shows a group of parallel lines attached at one end to an axis of rotation. In three-dimensional space, "these lines parallel to each other at a unit distance cut the volume, the plane, or the line, each into its constituent elements." The multiple clicks of the teeth generate space, just as the discrete pulses of sound combine into a continuum of tone. Both are analogous "demultiplications." The sound pulses in the musical sense would parallel the light pulses captured in a chronophotograph, as is pointed out by Duchamp's primary source for his ideas about "elementary parallelism," Étienne-Jules Marey. In Le Mouvement, Marey points out, as does Duchamp in his remarks to Schwarz, that lines can generate planes and planes can generate solids: "Such objects are said to be 'engendered' by straight lines or curves, which undergo various displacements. Thus a regular cylindrical surface is engendered by a straight line which moves parallel to another straight line, and yet remains at the same distance from it. The straight line which moves is the 'generator' of the cylinder; that which remains fixed is its axis." Marey goes on to explain that this kind of abstract discussion of geometrical figures can be given concrete visual expression by taking multiple-exposure photographs. When a one-dimensional straight line is rotated around a central axis, it generates the two-dimensional surface of a cylinder. When a half circle is rotated around an axis, it generates a sphere, as shown in Marey's illustrations.

Many of Duchamp's discussions are similar in tone, but they are more speculative. He ends the note quoted previously by suggesting that a "four-dimensional noisemaker might be found." By entailing a hypothetical geometry with sound, Duchamp seems to indicate that translation from one invisible realm to another is possible within a highly speculative metaphysics. In the physical world of three dimensions, a four-dimensional rotation is difficult even to visualize, despite its being a fairly trivial mathematical operation. It requires that an object move around a stationary plane while every element perpendicular to that plane remains perpendicular throughout the entire rotation. Carrying out such an operation in ordinary space is, of course, impossible, something that makes the rotation of a four-dimensional "creste" highly complex.

Duchamp did produce one noisemaker that is closer to what one thinks of as a "rattle," his "assisted readymade" With Hidden Noise, produced in 1916. This work is related to a note included in the Green Box that deals with saving or conserving something. Because of Duchamp's fascination with the multivalenced nature of language, the note contains some potential puns. It is headed by a reference to a "tirelire (on conserve)," a "money box" or a "piggybank." The term tirelire in French is also related to a verb, tirelire, which means "to sing like a lark"—something that may give the readymade a "sound" pun. In English, it can be read as a reference to the bicycle wheel: a "tire lyre." The note's instructions read as follows: "Make a readymade with a box containing something unrecognizable by its sound and solder the box." Sealing an unknown object inside a box would produce a noisemaker whose sound, in some ironic sense, could not be seen. This was also the essential purpose of With Hidden Noise. The readymade was constructed by placing a ball of twine between two metal plates held together by long screws. Duchamp's friend and patron, Walter Conrad Arensberg, then placed a small object inside the ball of twine which produced a rattling sound when the readymade was shaken. Duchamp himself never knew what the object was, so that the work involved a sound that could not be "seen," at least in the sense of being fully comprehended. The noise the object produced was hidden from view.

Duchamp's purposes in constructing such open-ended systems are of course in many ways hidden from us, and it is
not wholly clear what a "hidden noise" could possibly be. However we take the term's meaning, I believe that such crossovers in Duchamp's oeuvre have important purposes. His works, especially those aspects that are contained in his notes, are filled with impossible projects. Much of his fascination with the fourth dimension was entailed with its fundamental invisibility. Such geometry was irretrievably hidden from view; it was not really even imaginable, and thus it was also hidden from the mind's eye. Nevertheless, Duchamp's discussions of the fourth dimension and other n-dimensional spaces are couched in terms of trying to find physical analogies for them.

With Hidden Noise is an analogical readymade; it stands for what cannot really be seen. Looked at from within the fourth dimension, any three-dimensional object is grasped by an expanded point of view; looked at from within the third dimension, a four-dimensional object reverberates outward along the "extra" axes of the fourth dimension. Complicating matters further, from within four-space, the normal height, breadth, and depth of three-space seem to be compressed into a "couche infiniment mince" as suggested in the passage from Jouffret cited earlier. In terms of a four-dimensional space, the dimensional effect can be thought of as resembling the reflections of sound waves in an echo. In one of his notes from A l'infinitif, Duchamp includes a sketch of a cube containing a sphere that looks very much like With Hidden Noise. The sketch is labeled "Echo. Virtual sound." These words indicate a possible way of interpreting his apparent conflation of a readymade with the geometrical category of a continuum. An echo is a repetition. It is, in a sense, a reproduction or a "mass-production" of a natural phenomenon. The hidden source for the noise inside the ball of twine suggests a "virtual sound," in the sense that it cannot be seen or identified. It is an echo of an object. The hidden source for the sound can be taken as a "point source" and thus can stand for an aspect of what "virtuality" means in terms of images: a virtual image involves a point source being reflected in a mirror. Duchamp wants to talk about a "virtual sound," and he can do so only by analogy. Such a source for noise would be analogous to the image in a mirror, but with differences. The "point source" in With Hidden Noise is actually there, but it cannot be seen; the point source of a light reflected in a mirror can be seen, but it is not actually there. This kind of noncom-
In other words, a hidden echo or a virtual sound in normal space could possibly suggest what a four-dimensional vision would be like just as the image of a three-dimensional object in a mirror—its virtual image—could stand for the virtuality of the fourth dimension, its "thereness" that cannot be specified.

With Hidden Noise and Duchamps other ready-mades are metaphorical objects that stand for aspects of a geometry that is invisible but that nonetheless has a speculative kind of presence. The ready-mades represent what is missing. Inscribed on the upper and lower brass plates of With Hidden Noise is a nonsensical message written in French and English. The text has small gaps in it:

P.G.--.E.C.I.D.E.S—DÉBARRASSÈ.
--A.S—H.O.W.V.R—C.O.R.E.S.P.O.N.D.S

Ir.—C.A.R.—E.—L.O.N.G.S.E.A

Duchamp explained that reading this work was "an exercise in comparative orthography (English-French), The periods must be replaced (with one exception: débarrassé[e]) by one of the two letters of the other two lines, but in the same vertical as the period—French and English are mixed and make no sense." The three arrows indicate the continuity of the line from the lower plate to the other [upper] still without meaning. Duchamp’s pun on "orthography" suggests not only "correct spelling" but also writing at right angles in the sense of "orthographic projection." Turning With Hidden Noise over and over, following its implied spiral while taking periodic ninety-degree turns, puts the viewer (the reader) in a position of looking at hearing, but the object making the noise remains hidden from view, just as the cryptic message of the nonsensical words engraved on the brass plates makes no "sense" and the virtual fourth dimension remains located ninety degrees from everything else.

In order to access the beholder’s share, Duchamp removes his own message. Rather than filling his works with symbolism, he removes any specific meaning, or at least leaves the meaning very vague and builds into it a multivalenced system with all kinds of loops and turns. The texts of "The," "Rendez-vous...," and With Hidden Noise cannot be read. You cannot take the meaning out of the words; you can only put it into them; you can only lay meaning over the top of what Duchamp intentionally removed. In his works, Duchamp focuses attention on what always happens when viewers interact with a work of art; they, as Duchamp says, complete the work and supply what is missing from it. They create a new thought for the art and hear new sounds emanating from it. The artist alone can never supply everything that is contained in the work of art. The artist struggles to make the work of art but can neither be sure that what was intended has been realized nor recognize all that has been realized, as Duchamp explains:

The result of this struggle is a difference between the intention and its realization, a difference which the artist is not aware of.

Consequently, in the chain of reactions accompanying the creative act, a link is missing. This gap, representing the inability of the artist to express fully his intention, this difference between what he intended to realize and did realize, is the personal "art coefficient" contained in the work.

In other words, the personal "art coefficient" is like an arithmetical relation between the unexpressed but intended and the unintentionally expressed.

Turns of language similar to those associated with Duchamp’s ready-mades and ready-made texts also appear in his film Anemic Cinema. The spiraling puns alternating with spiral designs concern themselves with looking at seeing, and also with looking at hearing. They are what Duchamp called, in the four-dimensional jargon of mathematics, "perspectives cavalieres." They produce ninety-degree turns, like the moves of the knight (the "cavalière") on a chessboard, up from the second dimension into the third, and by implication, up from the
They also produce a very singsong aural quality even when seen. In other words, you can hardly watch the film without hearing the onomatopoeic quality of the French puns. It is like listening to the Bicycle Wheel. The spiral of the film turns on and on, engendering a loop of time. The spirals within the film produce meanings that turn back upon themselves. Such effects, implied by the mirror-reversed, palindromic title, are enfolded in a geometrical system that also turns back upon itself. And just as a rotation through the fourth dimension implies a mirror reversal, watching the film inverts meaning.55

Like the twists and turns that produce secret sounds in Willi Hidden Noise, the silent film sings a song that can neither be heard nor understood but only looked at from the corner of the eye. As a subtle reiteration of the point Duchamp makes in Anemic Cinema, when he includes many of the puns from the film Box in a Valise of 1942, the puns are written (calligraphically) on music paper. Again the viewer is asked to look at rather than listen to the singsong sayings of Rrose Selavy. The juxtapositioning of the different media serves to counteract direct interpretation and to block direct access to meaning.

Duchamp's approach often involves not only putting together different media—writing and drawing, painting and music, poetry and sculpture—but also different levels of difficulty. He mixes simple operations and objects with demanding intellectual and epistemological categories. In Duchamp's turning readymades such as the Bicycle Wheel, the child's crotelle, Willi Hidden Noise, and Anemic Cinema, ordinary objects and statements are conflated with complex ideas about four-dimensional rotation and reverberation. His interests in speculative n-dimensional geometries are involved with his overall skepticism, and his meaning echoes along n-dimensional lines. The mathematics provides him with a way of interlarding additional layers of doubt, additional gaps, within his systematic questioning of the art process.

One of Duchamp's most fascinating notes that pulls the various categories of readymade, interval, mathematical continuum, and sound (or music) together discusses "gap music." It deals with both spatial and temporal intervals in terms of taking "cuts" out of a continuum. As a continuum of cuts, the "musical" technique described in the note amounts to a nonphysical analogue for the comb. It is another variation on the basic idea of "elementary parallelism." The verso side of the note reads as follows:

**Parte Mallot, 1913. Leave out.**

Ununiformity of rhythm. An-accentuation. Change. Race between 2 mobile objects A and B. At each cut of time i.e. the uniform interval between 2 "measures"). A and B are drawn spatially, i.e., A is decorated with all the accidents of the road; B also is situated in a different state; there is not in this race, any rivalry between A and B. A follows its own way, B likewise, each one meeting other roads.

Conventionally, one takes a minimum time period which separates two successive spatial states of A and B. (1", 1/2", or less, no importance). To differentiate A from B, for example could be the piano, B, the violin (no importance).

The different notation of the non-A or non-B could be pictured by: magnets + or - of A. In other words: at each moment of the duration A will be drawn or repelled by foreign elements (which will be the notes accompanying the nucleus A at that moment of the duration). A and B are certainly the only kinds of indifference, which as such, are the subject of discord between all these foreign forces.

The note is accompanied by a sketch showing a straight line running from a point labeled "A" on the left to a point labeled "Y" on the right. This line is labeled the "attraction mean of the mobile object A." Above and below the straight line are two jagged lines labeled "the continuum of the magnetization of A or the repulsion of A." The end point of the straight line, "Y," represents the "fall of A into Y." The verso side of the note reads as follows:

**Gap music:** from a (short) group of 32 notes for example on the piano note not emission either, but enumeration through the cold thought of the other 52 missing notes. Add some explanations.56
Again, the abstract nature of Duchamp's approach to music is revealed in this note. He uses an uncanny blend of simplicity and complexity. The note suggests the toylike, gamelike quality of his musical compositions and recalls the long version of *Erratum Musical* in particular. Here, a race between two mobile objects (two bicycle wheels?) going up and down slopes is entailed with magnetism, a force that emanates through space in fairly mysterious ways. Duchamp's continuum approach to music involves its interval nature, its sequential nature, and like the infinite series of cuts that can be taken along a number line, music can be divided into an infinite number of infrathin gaps. As it is the viewers who fill in the gaps in his literary texts, or his works of visual art, it is the listeners who fill in the gaps of his music. As he once expressed it, "What art is in reality is this missing link, not the links which exist. It's not what you see that is art, art is the gap. I like this idea and even if it's not true, I accept it as the truth." 

Much of Duchamp's art operates in terms of the in-between. It is an empty, hollow, and full of gaps. It is about the in-between, the interstices, the infrathin space between one sheet of paper (not two sheets of paper), or between a sheet of glass. Much of the work is invisible. All Duchamp's art, including his music, is a way of accepting as provisional any given principle, which may explain why so many of his notes are open ended and not really understandable. He rarely develops anything fully, and the familiar refrains of "to be developed" or "add some explanations" echo throughout his notes. All these techniques, it seems to me, are ways of getting at what cannot be gotten at real meaning. He reveals to us that any sense of epistemological surety is illusionary. This point about Duchamp was made a number of years ago by Jean-Paul Sartre in a passage that, because it is less well known than it might be, I will quote here at some length:

"The Surrealists took a hearty dislike to that humble certainty on which the stoic based his ethics. It displeased him both by the limits it assigns us and the responsibilities it places upon us. Any means would go to escaping consciousness of self and consequent sense of our situation in the world. He adopted psychoanalysis because it presumed consciousness as being invaded by parasitical antagonists whose might is elsewhere; he rejected "the homogenizing idea" of work because work implies conjectures, hypotheses, and projects, thus, a prepared response to the subjective. Automaton writing was, above all, destruction of subjectivity. When we try our hand at it, we are spontaneously not through in that which tears us apart; we are ignorant of their origin; we don't know them before they have taken their place in the world of objects and we must perceive them with foreign eyes. Thus, it was not a manner, as has so often been said, of substituting their unconscious subjectivity for consciousness, but rather of showing the object as a fitful glimmering at the heart of an objective universe. But the Surrealist's second step was to destroy objectivity in turn. It was a matter of exploding the world, and as dynamite was not enough, as, on the other hand, a real destruction of the reality of existents was impossible, because it would simply cause this reality to pass from one real state to another real state, one had to do his best rather to disintegrate particular objects, that is, to do away with the very structure of objectivity in these objects-evidences. Evidently this operation cannot be tried out on real existents which are already given with their indefinable essence. Hence, one will produce imaginary objects, so constructed that their objectivity shuts away with itself. We are given a first draft of this procedure in the false pieces of sugar which Duchamp actually cut in marble and which suddenly revealed themselves as having an unexpected weight. The visitor who weighed them in his hand, was supposed to feel, in a blazing and instantaneous illumination, the self-destruction of the objective essence of sugar. It was necessary to let him know the deception of all being, the fake, the self-fulfilling illusion, for example, from trick gadgets, when the spoon abruptly melts in the tea-cup, when the sugar (in inverse hoax to the one Duchamp constructed) rises to the surface and floats. It was hoped that by means of this intuition the whole world would be exposed as a radical contradiction. Surrealist painting and sculpture had no other aim than to multiply these local and imaginary explosions which were like holes through which the entire universe would be drained out. The paranoically critical method of Dali was only a perfection and complication of the procedure. It also professed to be an effort to con-
Duchamp’s gap music, his hollow sound devoid of all musicianship, is akin to Sartre’s Nothingness, as Sartre himself suggests in his discussion of the Surrealists’ and Duchamp’s project:

It is always by creating, that is, by adding paintings to already existing paintings and books to already published books, that it destroys. Whereas, the ambivalence of its works: each of them can pass for the barbaric and magnificent invention of form, of an unknown being, of an extraordinary phrase, and, as such, can become a voluntary contribution to culture; and as such, a project for annihilating all the rest by annihilating itself along with it. Nothingness glitters on its surface, a Nothingness which is only the endless flattening of contradictions.

One source for Duchamp’s particular Nothingness was in the imaginary realm of n-dimensional geometry. The work that Sartre chooses to discuss, Why Not Sneeze, aside from its suggesting a short, explosive noise, is directly related to illustrations for projections of the four-dimensional hypercube. Each little marble cube can be taken as a hypostatized cut, a cellule, in the infinite reverberations of the tesseract. Each cube, each subtle parody of the gaps in classical Cubism, is a reification of what cannot be seen. It represents a dimension not contained within real space, but which echoes along the infinite distances of its virtuality. Duchamp himself explained that, in addition to there being “no connection between the sugar cubes and a sneeze,” there was a “dissociational gap between the idea of sneezing and the idea of... ‘Why not sneeze?’ because, after all, you don’t sneeze at will.” By suggesting the voluntary control of an involuntary action, the title poetically indexes what cannot be done just as the references to an invisible geometrical realm index what cannot be seen. The title carries the reader, the listener, the viewer to other regions more cerebral; its purpose was, as Duchamp says, “to add a verbal color.”

The cage of marble sugar cubes that seemingly contradict gravity is a depiction of what Sartre called the Impossible: “the imaginary point where dream and waking, the real and the fictitious, the objective and the subjective, merge.”

Few passages in the vast literature on Duchamp describe his project better. What we are left with in Duchamp’s art is an abiding sense of doubt, but there is some purposiveness behind it. While his work makes doubt itself palpable, it reveals a mysterious objectivity. As he said about the readymade, it is “une chose que l’on regarde même pas, mais dont on sait qu’il existe, qu’on regarde en tournant la tête.”

If one thinks about the history of visual art, one realizes that there are almost no representations of sound or music in painting or sculpture. This lack of images of course makes sense because the forms involve mutually exclusive sensory systems: one cannot see hearing, or hear seeing. The exceptions to this general rule seem to be representations of expressions of pain, such as Edvard Munch’s The Scream. Here the silence of the picture stands as a mute and powerful analogue for the inexpressibility of pain, its non-translatability into anything but itself. Duchamp’s approach to the visual representation of sound is much less expressive and emotional, but far more intellectual. Rather than a scream of agony, he depicts a cry in the wilderness, in a silent universe:

The tuner—Have a piano tuned on the stage EEEEEEEEEEEEE EEEEEEEEE or make a noise of the tuner tuning and synchronize the tunings on a piano. Or rather synchronize the tuning of a hidden piano—or have a piano tuned on the stage so the dark. Do it technically and avoid all musicianship.
In his auditory compositions, his gap music, Duchamp strives to express this in-betweenness, this hypothetical space between the real and the fictitious, the objective and the subjective, in order to reveal the conventionality of music and thereby to imply the conventionality of art in general. It is the same with his visual works. In his music, he represents the plastic being of a sound; he makes a composite out of music, visual art, and poetry. That he does so in order to deal with meaning is made explicit (if such a term can be used in the context of Duchamp's writing) in one of his most interesting notes:

This plastic being of the word (by literal nominalism) differs from the plastic being of any form whatever (2 drawn lines) in that the grouping of several words without significance, reduced to literal nominalism, is independent of the interpretation, i.e. that (check, amyl, phaedra) for example has no plastic value in the sense of: these 3 words drawn by X are different from the same 3 words drawn by Y.—These same 3 words have no musical value i.e. do not draw their group significance from their order nor from the sound of their letters.—One can thus speak them or write them in any order; at each reproduction, the reproducer presents (like at each musical audition of the same work) once again, without interpretation, the group of words and finally no longer expresses a work of art (poem, painting, or music).10

Duchamp wanted not to express a work of art in order to reveal the inner workings of the art process. The categories he uses in this enterprise range from virtual spheres to ball-of-twineready-made; from four-dimensional hyperspheres to closed but unbounded non-Euclidean spherical surfaces; from echoes to the infinite visual recesses in mirror surfaces; from infrathin sounds made by velvet trousers to the infinitely subtle folds in space-time between the third and the fourth dimensions; from spinning bicycle wheels to the verbal colors of tumbling marble sugar cubes. Duchamp's project is whimsical and humorous, but seriously intentioned. His poetic writings, his unfinished visual projects, and his chance-generated musical compositions allow us to hear and to see an important aspect of art—much of it takes place in the gaps.

NOTES


3. See Duchamp's statement to James Johnson Sweeney in "A Conversation with Marcel Duchamp," NBC television interview, January 1956, reprinted in Marcel Duchamp, Salt Seller: The Writings of Marcel Duchamp (Montclair, N.J., ed. Michel Sanouillet and Elmer Peterson [New York: Oxford University Press, 1973], pp. 135-136: "I considered painting as a means of expression, not an end in itself. One means of expression among others, and not a complete end for life at all; in the same way I consider that color is only a means of expression in painting and not an end. In other words, painting should not be exclusively retinal or visual; it should have to do with the gray matter, with our urge for understanding." See also his remarks to James Johnson Sweeney in "Eleven Europeans in America," The Bulletin of the Museum of Modern Art 13 (1946), pp. 19-21, also reprinted in Duchamp, Salt Seller, p. 125: "I was interested in ideas—not merely in visual products. I seemed to mix painting once again at the serice of the mind. And my painting was, of course, at once regarded as 'intellectual,' 'literary' painting. It was true I was endeavouring to establish myself as far as possible from 'pleasing' and 'attractive' physical paintings. That extreme was seen as literary."


7. Marcel Duchamp, Notes, ed. and trans.

9. Ibid., p. 442.


13. This note was originally published in A Pinting; see Duchamp, Salt Seller, p. 76.


15. Carol James ("Duchamp's Silent Noise," p. 107) points out in passing that it might be "better to put one's ear to the silently turning Bicycle Wheel than into a tortonism sharpener." I disagree that a turning bicycle wheel is silent, but her point is well taken. She makes her remark after recalling one of Renee Slay's suggestions: "Sharpen hearing (a form of torture)" (Duchamp, Salt Seller, p. 113). The original French pun, "Aignent l'oreille (forme de torture)," turns on the similarity of the words "oreille" (hearing) and "aigle" (eagle), see Duchamp, Salt Seller, p. 122, n6. She also cites Duchamp's statement to Calvin Tomkins that the Bicycle Wheel was "something to have in my room the way you have a fire, or a pencil sharpener, except that there was no usefulness. It was a pleasant gadget, pleasant for the movement it gave" (see Calvin Tomkins, The Bride and the Bachelor [New York: Viking, 1968], p. 26).


17. Duchamp, Salt Seller, p. 75.

18. Adding to the sketch's complexity is a statement included in Duchamp's Notes, no. 128: "On the slopes of snow, pm like a comment illustrating the photo of Having the Appearance in the Sun." With this entry into the Large Glass, the interpreter can proceed in a large number of directions.


20. See Duchamp, Notes, nos. 181, 250, 253, 255.


23. The strategy taken by Duchamp's pseudonymous alter ego Richard Mutt, who signed Fountain, is explained in a statement almost certainly written by Duchamp and published as "The Richard Mutt Case," The Blind Man (May 1917), pp. 5-6: "He CHOSE it. He took an ordinary article of life, placed it in so that its useful significance disappeared under the new title and point of view created by a new thought for that object." For a discussion of Fountain, see William Camfield, Marcel Duchamp/Fountain (Houston: The Menil Collection, Houston Fine Arts Press, 1989).

24. The most famous of these statements is "The Creative Act," Art News 56 (Summer 1957), pp. 28-29; reprinted in Lebel, Marcel Duchamp, pp. 77-78.


33. Gavin Bryars ("Notes on Marcel Duchamp's Music," pp. 279–279, n. 19) agrees with Duchamp's estimation that it would be useless to perform *Érotisme Nucléal*; such a performance would be "as awkward as an enterprise in the vogue, even in the days of graphic notation, for taking exact paintings, especially systematic ones, and treating them as musical scores—the obverse of transcribing Bach fugues into multi-colored grids, or making hazy impressions of Sibelius' 'Swan of Tuonela.'"

34. In one of his notes in *I'lnfinitif*, Duchamp points out that "in the plane, the two-dimensional native is either on one side of an infinite straight line or on the other side. Therefore this line is for him a Dedekind cut (Poincaré) creating two distinct plane fields." This is one of two times Duchamp mentions the mathematician Henri Poincaré by name. In the original French, the German mathematician Richard Dedekind is not named, but the translator, Cleve Gray, was helped by Duchamp, and a "Dedekind cut" is certainly what the word "coupure" in the original French note refers to. (See Duchamp, Salt Seller, p. 94; see also Marcel Duchamp, *Duchamp du Signe*, p. 133.) Duchamp's reference to a "two-dimensional native" recalls a number of turn-of-the-century popularizations of n-dimensional geometry (see, for example, Edwin Abbott Abbott, *Flatland: A Romance of Many Dimensions*, with Illustrations by the Author, A Square [London: Seeley & Co., 1884]).

35. Étienne Pascal Jouffret, *Traité d'analyse descriptive de géométrie à quatre dimensions et introduction à la géométrie de n dimensions* (Paris: Gaumier-Villars, 1903), p. xviii. Poincaré, the other mathematician most likely to have been studied by Duchamp, also talks about crossing "cuts," pointing out that the dimensionality of space can be defined in such terms:

[Space] cannot be divided into several parts either by forbidding the passage through certain points or by forbidding the crossing of certain lines; these obstacles could always be eliminated. It will be necessary to forbid the crossing of certain surfaces; that is, certain two-dimensional cuts. And that is why we say that space has these dimensions.

We may know what a minimum of n dimensions is. A continuum has n - 1 dimensions when it is possible to divide it into many regions by means of one or more cuts which intersect themselves at most n - 1 times. The continuum of n - 1 dimensions is thus defined by the constraint of n - 1-dimensional cuts. This is a definition by recurrence.


37. Duchamp explained his conception of the four-dimensional aspect of the Large Glass in a letter to André Breton published in *Atelium* (1935), p. 33: "In the Bachelor Machine an erotic desire in motion is 'brought back' to its 'projection' of machine appearance and character. Likewise the Bride or the Peninsul femelle is a 'projection' comparable to the projection of an imaginary entity in four dimensions in our world of three dimensions (and also in the case of the flat glass to a re-projection of these three dimensions onto a surface of two dimensions)."

38. Hahn, interview with Duchamp, p. 10.

39. Francis Roberts, interview with Marcel Duchamp, "A Proposal to Saturate the Laws of Physics," *Art News* 67 (December 1968), pp. 62–63. Asked if he thought the readymades were trivial, Duchamp answered by saying, "No, they're not trivial, for me at least. They look trivial, but they're not. On the contrary, they represent a much higher degree of intellectuality. And the one I love most is not quite ... it's a readymade if you wish, but a moving one. By this I mean three means of thread falling down and changing the shape of the unit of length, the 3 Standard Stepspace, I prefer to call them. I was satisfied with the idea of not having been responsible for the form taken by chance."


42. Ibid.

43. For Duchamp's Green Box note about a "crécelle," see Duchamp, Salt Seller, p. 91; Duchamp, *Duchamp du Signe*, pp. 101–1012.

44. For one of Duchamp's own explanations of "elementary parallelism," see interview with Cabanne, *Dialogues with Marcel Duchamp*, pp. 48–49; see also his *A l'lnfinitif* note in Duchamp, *Salt Seller*, p. 92.


47. Jouffret explains the difficulty of carrying out a four-dimensional rotation in
his Traité, p. 38 (my translation): "Two-dimensional geometry knows only a single rotation, that around a point, which is called the center of rotation; in the geometry of three-dimensional space, there is also only a single rotation, that around a straight line, which is called the instantaneous or principal axis of rotation. In the four-dimensional continuum, rotation around a plane is the simplest movement after that of pure translation."

54. Duchamp interviewed in Cahiers d'Art, Dialogue with Marcel Duchamp, pp. 72-73.
56. Duchamp, Notes, no. 181; see also Duchamp, Notes, no. 253: "Exercises of the mind (for the deaf). Given a conventional agreed number of music notes 'hear' only the group of those that are not played. Agree on a fixed group of music notes and 'hear' only the notes of the group that are not played."
59. Jonathan Crary makes a similar point about Duchamp's paintings: "It is the situation of the spectator in the picture that makes a representation meaningful and accurate; the open mouth with no sound reaching anyone in the theater, paintings, or film stills of Grezenthoudt, Saisonette, Dance,以及 it is a human being being immediately assumed in the act of making a sound that cannot be heard, coincides with the way in which pain engulfs the one in pain but remains invisible to anyone else.
62. Jonathan Crary makes a similar point about Duchamp's paintings: "It is the situation of the spectator in the picture that makes a representation meaningful and accurate; the open mouth with no sound reaching anyone in the theater, paintings, or film stills of Grezenthoudt, Saisonette, Dance, as well as Edvard Munch, ""The Scream,"" which pain engulfs the one in pain but remains invisible to anyone else."
63. Duchamp, Notes, no. 199.
Surrealism was acutely aware of its history and prehistory. Even with its first codification in the Manifesto of Surrealism (1924), the Surrealist movement displayed an awareness of and concern for the past which clearly set it apart from such predecessors as Futurism and Dada. Over the long course of their movement, the Surrealists acted as archeologists of the intellect, unearthing and revitalizing theories and ideas that had long since been forgotten or discarded but that still held the potential for significant revolution.

Such was the case with Surrealist sound theory. Sound played an important part in the initial moment of Surrealism, when the word was used almost exclusively within theatrical productions and was still considered the intellectual property of Apollinaire. After the death of Apollinaire, Surrealism moved away from the theatrical and into the theoretical and personal, but sound did not lose any of its importance. Reacting to the excesses of Paris Dada, the Surrealist movement turned to ideas voiced by Giorgio de Chirico and his brother Alberto Savinio shortly before the First World War. These became the basis for most Surrealist music theory, the two best-known pronouncements of which were Paul Nougé's Music Is Dangerous and an excerpt from André Breton's Surrealism and Painting.

On the personal level, sound became the primary focus of the Surrealist movement, for the Surrealists made it their purpose to give concrete form to internal sound—sound, they would argue, that might only be heard in silence.