EINSTEIN, MODERNISM, AND MUSICAL LIFE IN AMERICA, 1921–1945

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ABSTRACT

ALLISON KERBE PORTNOW: Einstein, Modernism, and Musical Life in America, 1921–1945
(Under the direction of Annegret Fauser)

This dissertation explores the relationship between Einstein's theories of relativity and the concepts and products of musical modernism in the United States from 1921 to 1945. The interactions of the musical world with this particular area of scientific thought are traced from the time that Einstein became famous in America until the end of World War II, when the scientist's public persona expanded to include his political activism. During this period, modernist composers working in America took part in the cultural phenomena of Einstein and relativity's celebrity, invoking scientific rhetoric related to relativity in their writings about music and participating in the larger cultural discourse surrounding science, modernism, and life in early-twentieth century America.

My research is divided into three large chapters, each tracing one facet of Einstein's reception and incorporation into modernist musical life. Following an introductory outline of the relationship between music-making and science in general in "Chapter 1: Introduction," "Chapter 2: Einstein" explores the reception of Einstein the man. I look at the elements of Einstein's public persona, including his representation as a rebel or revolutionary, as a hero or savior, as a genius, as an understandable intellectual, and finally as a musician. I explore the perceived and carefully constructed parallels between the figure of the modernist composer and Einstein. In "Chapter 3: Relativity" I

examine the use of Einstein's relativity theories as models for modernist theories of music, both in terms of methodology and as a source of inspiration for new ideas in music theory. I look especially at how Einsteinian ideas of space and time inspired new theories about the relationships between pitch and rhythm in modernist musical aesthetics. In "Chapter 4: Space-Time" I delve further into how changing notions of musical space and time, inspired by Einstein and his new theories, shaped musical compositions of this period. I conclude my dissertation in "Chapter 5: Conclusions" with an overview of the relationship between music and science after Einstein, which offers an avenue for further investigations. It also serves as a point of contextualization for the vibrant interactions between Einstein and modern music discussed in my dissertation.

For all scientist-musicians and musician-scientists,

especially my father Stephen Portnow (1940–2006).

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INTRODUCTION

The reason in reviewing certain scientific and historical aspects of music is not to bring out new facts, but to present these facts in a new light...
- Henry Cowell, *New Musical Resources*, 1930[1]

When people ask me about this project—about Albert Einstein, modernism, and musical life in America—our discussion of my work generally goes in one of two ways. The first stance is curious skepticism: While they consider my dissertation's title plausible and the topic interesting, they wonder about the connection between music, modernism, and Einstein and ask for more information—in a nutshell. The second stance is a more indignant one: these scholars (and they are usually scholars) question whether there is really some connection between Einstein and modernist music. After all, if this were so, it should be known by now. I understand both initial responses and I think that there is something truly valuable in exploring the rationale behind each.

As I respond to the first reaction, I must address not only Einstein, relativity, and space-time in a nutshell, but also what any of those might have to do with music, and abstract modernist music at that. In asking for the elevator-pitch version of my dissertation, this group of enquirers has hit on something that I contend with in the historical material that I research. Just like my kind skeptics, who want me to sate their

[1] Henry Cowell, *New Musical Resources* (Draft 1, Folder 11, NYPL), 2.

curiosity with a few sentences about scientific revolutions and modernist artistic upheavals, the musicians, composers, music-writers, and critics who take center stage in my dissertation often had usually only a cursory understanding of Einstein and relativity theory. Yet these musicians' surface-level understanding sparked something in their imagination that led them to discover, uncover, and create connections between the scientific world and their musical one. Modernists' fascination with and curiosity about Einstein and his theories led them into a broader cultural dialogue about modernist art, modern life, and the scientific and technological concerns that formed both. Modernist musicians and music-writers both shaped, and were shaped by, this larger discourse. They did not see themselves as separate from the scientific world or other cultural spheres; rather, they were part of a cultural project that explored all realms of modernity. This type of deeper cultural awareness is what I hope to provide for my colleagues, acquaintances, and now readers in the first category. Whether these readers are musicians, scientists, historians, or regular folks (and I have encountered this reaction by all of the above), I hope that by exploring how musicians' basic curiosity in scientific culture shaped musical life as much as it did, they begin to make interdisciplinary connections in their own scholarly and non-scholarly lives.

With the second reaction to my topic, people wonder whether there is any validity in my topic at all, having seen no evidence themselves. I understand this indignant reaction well; with so much insightful research being conducted on modernist musical life in America, it seems unlikely that the infiltration of complex scientific ideas into musical discourse could have been missed. In this case, I defer to the wise words of Henry Cowell quoted in the epigraph at the beginning of this chapter. They are worth repeating here: "The reason in reviewing certain scientific and historical aspects of music is not to bring out new facts, but to present these facts in a new light." I feel that I am undertaking a similar project: rather than uncovering new musical artifacts or historical events, I am reexamining well-known documents of modernist music in America—scores, books, articles—and, in doing so, unveiling previously overlooked connections. These documents contain references to Einstein, relativity, and space-time that have gone unnoticed or unremarked upon by previous scholars. This has happened for a number of reasons. For one, musicology as a discipline has had very little contact with the history of science whence the type of interdisciplinary scholarship necessary for uncovering this aspect of American modernist life has barely been explored.[2] Another reason lies in the fact that few scholars of American modernisms have been *looking* for these details; with their sights aimed on other aspects of musical life in the early part of the twentieth century, musicologists have simply passed over certain pieces of textual evidence.

Most importantly, however, many of the instances of the intermingling scientific with musical thought in texts of this period appear at first to be insignificant. In certain cases, only a few references to Einstein or relativity can be found in a given prose or musical text, as significant as these details might be upon careful inspection. In other cases, the references may seem like surface-level statements that simply come with the historical territory, textual objects that popped into the text and seen to us now like quaint reminders of contemporary culture. By examining more closely both of these incidences—which do in fact constitute the majority of the references to Einstein and relativity that I have encountered—my dissertation makes significant scholarly headway. Even if references to Einstein and relativity occur few and far between in a given text, in

[2] There are a few exceptions to this, which will be discussed at the end of this chapter.

the broader context of American modernist cultural debates, I am able to show that what appear to be insignificant elements on their own actually form portions of a much larger network of ideas about modernism, science, and the arts. With the necessary musicological and science-historical tools, I build up a new picture of musical life, documenting a significant cultural movement that created and then was defined by the parallel revolutions of Einsteinian physics and modernist musical aesthetics.

I. Music in the Machine Age

It is a truism that life in the early twentieth century was affected by the technological developments of the times. Modes of communication, travel, education, and commerce were all influenced by inventions like city-wide electricity, the phonograph, telephone, personal camera, and new forms of individual and mass transportation. And although we can imagine the extent to which these inventions and technological developments shaped musical life in, as André Coeuroy called it, "an era of velocity," it is worth reviewing this idea here.[3] Composers and critics frequently spoke of the impact of technology on music.[4] Furthermore, many of the composers and critics who play a key role in this dissertation perceived technology and science as intimately connected. Ezra Pound, for example, saw George Antheil's upbringing in an industrial setting as a formative aspect of the composer's later scientifically-oriented compositions.

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[3]André Coeuroy, "The Aesthetics of Contemporary Music," trans. Theodore Baker, *Musical Quarterly* 15/2 (April 1929), 252.

[4] See, for example, Alfred Einstein, "Art and Technology," *Modern Music* 12/2 (January 1935), 55-61, and Boris de Schloezer, "Man, Music, and the Machine," *Modern Music* 8/3 (March 1931), 3-9.

Critics of Modern Music and Technology

Aaron Copland, whose music criticism figures more centrally in my dissertation than his compositions do, wrote about connection between modern music and life. In the introductory pages of *Our New Music* (1941), Copland gives an overview of modern music's break with its romantic (and specifically German, nineteenth-century) roots. He argues that the aesthetic differences present in new music result from the specific conditions of the modern era:

> The twentieth-century composer seeks a more universal ideal. He tends to be more objective and impersonal in his music. . . . The tempo of modern times calls for a music that is more matter-of-fact, more concise—and, especially, less patently emotional.[5]

Copland sees the aesthetic focus on objectivity as linked to the nature of the modern era.[6] It is an artistic imperative, it seems, for modern music to engage with the fast pace of modern life in the city. Composers answer this call intuitively:

> Modern music, in a word, is principally the expression in terms of an enriched musical language of a new spirit of objectivity, attuned to our own times. It is the music of the composer of today—in other words—*our* music.[7]

Composers of new music, then, are directly engaged with their environment, composing music to match the "tempo" of life in the early twentieth century.

Another important critic of modernist musical life in America, Paul Rosenfeld, documented the ways in which certain avant-garde composers' works were connected

[5] Aaron Copland, *Our New Music; Leading Composers in Europe and America* (New York: McGraw-Hill Book Company, 1941), 4.

[6] Copland is expressing a view held by many at this time, both in America and abroad.

[7] Aaron Copland, *Our New Music*, 5.

with the technological developments that surrounded them.[8] For Rosenfeld, who adopts the voice of a collective audience in his criticism, the connection between modern composers and modern technology occurred at the level of interpretation. Rosenfeld is careful not to argue that a composer of new music attempted imitate the sounds of life in the modern city, although he admits that certain environmental factors shaped the modern composer's aesthetic stance. Instead, he offers an analytic view from the perspective of the listener. The idea that both the composer and the listener have a relationship with the technological developments in their everyday lives separates Rosenfeld's commentary from other, more socially-removed critics (including Copland).

In discussing the music of Edgard Varèse in *An Hour with American Music* (1929), Rosenfeld offers critical commentary on a number of the émigré composer's works and an overview of his distinctly modern attitudes to composition *as heard by* audiences. One particularly poetic passage compares the music of Varèse to the sounds of the "monster town," a dystopian sounding metaphor for the modern city—though Rosenfeld seems more enthralled with the monster town, than terrified by it.[9] He describes Varèse's relationship with the distinctly American-sounding megacity as similar to Picasso's one with Paris. And, even though he suggests a type of influence garnered from the cityscapes surrounding each artist, the experience of the sensations of modern life come from the audience's perspective. He describes listening to Varèse's works as performed in a concert hall:

[8] Rosenfeld was an important critic for *The Dial* and actually grew to be friends with Copland, introducing the composer to a number of other artistic figures. See Elizabeth Bergman Crist, *Music for the Common Man: Aaron Copland During the Depression and War* (Oxford: Oxford University Press, 2005), 16.

[9] Paul Rosenfeld, *An Hour with American Music* (Philadelphia: J. B. Lippincott Company, 1929), 161–162.

> For the concert-hall just quit, overtones and timbres and rhythms corresponding to the blasts and calls of the monster town had formed part of a clear, hard musical composition; a strange symphony of new sounds, new stridencies, new abrupt accents, new acrid opulencies of harmony. Varèse has done with the auditory sensations of giant cities and the industrial phantasmagoria, their distillation of strange tones and timbres much what Picasso has done with the corresponding visual ones. He has formed his style of them. Or, rather, they have transformed musical style in him by their effect on his ears and his imagination; much as Picasso's city walls, billboards, newspapers, and chimney-pots have helped the Parisian magician to his original and intensely personal idiom.[10]

In analyzing what he and other audience members heard in Varèse's music, Rosenfeld describes the shared experience of modern life, an experience that affects both composers and their listeners.

As Rosenfeld begins to discuss specific works of Varèse's in *An Hour with American Music*, he focuses on works composed while the Paris native was living in the United States in the 1920s. What was only suggested in the description of the general character of Varèse's modernist works—that their relationship with the "monster town" was a uniquely American modernist perspective—is reiterated with certainty in Rosenfeld's analyses of Varèse's works composed on American soil. His testimony about the first performance of Varèse's *Intégrales* (in 1925 in New York) conveys the experience of listening to the sound of modern, urban, *American* life:

> The memorable evening of its baptism, *Intégrales* resembled nothing so strongly as shining tubes of freshest, brightest brass and steel set in abrupt pulsing motion. And for one impressionable instant, they were strangely symbolic. They were not merely sounds like metals. They were sounds strangely related to the massive feeling of American life, with its crowds, city piles, colossal organization, mass production, forces and interests intricately welded; sounds that for a moment revealed them throbbing, moving, swinging, glowing with clean, daring, audacious life. A new power exulted in them. Majestic skyscraper chords, grandly resisting and

[10] Paul Rosenfeld, *An Hour with American Music*, 161–162.

> progressing volumes, ruddy sonorities and mastered ferocious outbursts, sung it forth.[11]

The piece and its performance take on a machine-like quality and, for Rosenfeld, the unique sounds were not merely metal instruments making metallic sounds. Rather than imitating city life, the "strangely symbolic" music acted as a musical metaphor for America. Rosenfeld makes it clear that the modernist compositions of the émigré Varèse are a part of a uniquely American—that is, non-European—brand of modernism. Elsewhere in the Varèse chapter he states:

> [Varèse's] music significantly orientates us to a kind of world to which America is closer than Europe is, a new world not only of the new scientific and mathematical perspectives but of the latent, the immanent, free of prejudice and habit and dogma: the whole glittering region of the unrealized.[12]

The scientific world brought to life in the music of Varèse is modern, objective, and distinctly American. As we will see in discussing the writings and music of other immigrants, the break with the romantic and romanticized European past was an important rhetorical gesture for presenting oneself as imbued with an American, scientific, and modernist aesthetic.

There were, apart from Varèse, a number of composers working in America—born both in and out of the United States—that espoused an urbanized if not mechanistic aesthetic in their works. The New Jersey native George Antheil played a key role in this techno-centric movement. For Ezra Pound, Antheil's first significant champion and biographer, the composer's focus on the machine aesthetic was the only valid artistic choice in a modern world dominated by technology.

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[11] Paul Rosenfeld, *An Hour with American Music*, 174.

[12] Paul Rosenfeld, *An Hour with American Music*, 167.

> I take it that music is the art most fit to express the fine quality of machines. Machines are now a part of life, it is proper that men should feel something about them; there would be something weak about art if it couldn't deal with this new content.[13]

Pound insists that machines must be a part of artistic life for art form to remain relevant. As a poet, Pound even appeared jealous of the ease with which musical composition could replicate machine sounds. "Machines are not literary or poetic," he said, "… Machines are musical."[14] Pound made these comments in his book on Antheil written in 1924—at the height of Antheil's "mechanical period" and shortly after the poet had met the enfant terrible in Paris. Pound praised Antheil's music not only because it was able to replicate a mechanistic sound, but also because of the composer's inclusion of various mechanical instruments and his appropriation of noise-making machines in works such as the *Ballet Mécanique* (1924-5).

The Music of the Machine Age

Apart from *Ballet Mécanique,* a number of other works written in the 1920s and 30s reflected on life in the big city in the United States as a uniquely American experience.[15] The prevalence of such works speaks to the poignancy of experiencing the increasingly industrialized cities in the U.S. One such work is John Alden Carpenter's ballet

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[13] Ezra Pound, *Antheil and the Treatise On Harmony* (Chicago: Pascal Covici, 1927), 53.

[14] Ezra Pound, *Antheil and the Treatise On Harmony,* 51.

[15] While there are a number of works that reflected city life in American, there was at this time a global fascination with the representation of machines in music. Alexander Mosolov's ballet *Steel* and his famous work *Iron Foundry* (which had its origins in the ballet) show just for far-reaching this phenomenon was. In order to contextualize the reception of composers' works in America, I am focusing on the representation of technology in music on American soil.

"Skyscrapers" (1923–1924) written originally for Diaghilev,[16] but premiered instead at the Metropolitan Opera in February 1926.[17] The ballet "presents a view of American life as a mechanical alternation of work and play"—in other words, it depicts the rhythm and pace of American life as mechanical.[18] Renowned music critic Olin Downes praised the ballet and its reflection of life in urban New York City: "There is the vibration, as it seems, in this music of exhaustion, of nervous and harried merriment, of heavy dreams, all caught up in a current of electricity and noise and quest."[19] Downes' use of a technological metaphor ("a current of electricity") in describing this stage work that depicts modern life reveals the porousness of the boundaries between art and life at this time. Carpenter's ballet portrayed the technological developments at the time, displayed the rhythm of modern life in comparable musical rhythms, and prompted existential reflections on the nature of modern life.

Aaron Copland's score for *The City* (1937) had a similar aesthetic in its musical depictions of urban life as mechanistic and harried. In this film, directed by Ralph Steiner, Copland is able to juxtapose the aesthetics of country and city life as the film moves from the pastoral setting of the opening into a portion called, in Copland's film

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[16] This work was intended for Diaghilev in the same season in which the Ballet Suédois produced a double bill of Darius Milhaud's *Création du Monde* and Cole Porter's relatively unsuccessful ballet about New York City, *Within the Quota* (premiered Paris, 25 Oct. 1923).

[17] The exact date was February 19, 1926. It was produced in 1928 in Munich as well. Felix Borowski, "John Alden Carpenter," *Musical Quarterly* 16/4 (Oct. 1930), 453. See also Howard Pollack, *Skyscraper Lullaby: The Life and Music of John Alden Carpenter* (Washington: Smithsonian Institution Press, 1995).

[18] Fred Hauptman, "Review of John Alden Carpenter. Skyscrapers, etc. London Symphony Orchestra; Kenneth Klein, conductor. 1987. Angel DS 49263," *American Music* 7/2 (Summer 1989), 229.

[19] Olin Downes, "J. A. Carpenter, American Craftsman," *Musical Quarterly* 16/4 (Oct. 1930), 446.

cue, "Sunday Traffic."[20] Like Carpenter's ballet, Steiner and Copland are able to depict both visually and musically the idea that even in leisure, American life is hectic. Accompanying visions of pedestrian-packed city streets and interminable highway bottlenecks, Copland's brass-driven score rhythmically pounds out the pace of an American life where humans and machines work mechanistically in unison (in an aesthetic moment highly reminiscent of the factory scene in Fritz Lang's 1927 expressionist film *Metropolis*). Even though the on-screen motion is not (intentionally) matched to the rhythmic pulse of the score, the viewer/listener cannot help but join the two cognitively while watching the film. The result is a score that seems to imitate the sound of technology, creating a machine aesthetic.[21] Copland's score came on the heels of Colin McPhee's for another Steiner film, *Mechanical Principles* (1931) that in Bauer's words "was an extraordinary realization of the spirit of the mechanical age imprisoned in an art expression."[22]

Both Carpenter's and Copland's compositions accompany larger works that contain both visual and narrative elements, but there were also instrumental concert works that addressed themes of the city and machine life. In her comprehensive survey of

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[20] In his PhD dissertation, Neil Lerner discusses another of Copland's documentary film scores in depth: that composed for *The Cummington Story* (produced in 1945 for the Office of War Information). This short propagandistic film does not address much of city life and instead contains more of Copland's pastoral sound. Neil Lerner, "The Classical Documentary Score in American Films of Persuasion: Contexts and Case Studies, 1936–1945," PhD Dissertation, Duke University, 1997. See also Neil Lerner, "Aaron Copland, Norman Rockwell, and the 'Four Freedoms'," in *Aaron Copland and His World*, Eds. Carol J. Oja and Judith Tick (Princeton: Princeton University Press, 2005), 351–77.

[21] Interestingly, Howard Pollack notes that, "The Sunday outing music is a close if more sardonic cousin to the finale of *From Sorcery to Science*, a 1939 puppet show that Copland produced incidental music for." Howard Pollack, *Aaron Copland: The Life and Work of an Uncommon Man* (New York: Henry Holt and Company, 2000), 341.

[22] In fact, this film was screened in 1931 at a Copland-Sessions concert. Marion Bauer, *Twentieth Century Music: How it Developed, How to Listen to It* (New York: G. P. Putnam's Sons: 1947), 408.

early twentieth-century compositions, Claire Reis mentions a few lesser-known works along these lines.[23] Carl Eppert composed *A Symphony of the City*, a "grand symphonic cycle in four parts," in 1934. Arthur Cohn wrote a piece for two pianos called "Machine Music" (Op. 20, No. 2) in 1937. Perhaps the ephemeral nature of these pieces' renown speaks to the trendiness of this topic in the 1930s. But some works that echoed the sounds of the city did survive the test of time including, of course, George Gershwin's *An American in Paris* (1928) and "Rhapsody in Blue" (1924).

Scientific and Technological Influence

For some, the influence of machines on music and the proliferation of machine-themed music was nothing but a trend; even in 1932, composer, critic, and music publisher Arthur Farwell called this development in music history a "passing phase which worships the machine."[24] Marion Bauer discussed this time saying "we speak of this as the Mechanical Age" and described the significance that machines and the world of technology had on art:

> Not only the power of the machine grows, but man's worship of its power and his respect for the mechanical principle increase. He finds beauty in the perfection of its mechanism, and in the rhythm of its movement. He personifies the Machine in literature, painting, drama, dance, and music. It has changed the face of the physical world and has created "a new mental attitude toward the world of the spirit," Thomas Craven says in *Men of Art*. "America is the land of machines. . ."[25]

[23] Claire Reis, *Composers in America: Biographical Sketches of Contemporary Composers with a Record of Their Works* (New York: MacMillan, 1947).

[24] Farwell uses this phrase to contrast the innovative and long-lasting work of Roy Harris in an article about the composer. Arthur Farwell, "Roy Harris," *Musical Quarterly* 18/1 (Jan. 1932), 19.

[25] Marion Bauer, *Twentieth Century Music*, 397.

After this passage, Bauer discusses the particular musical elements that reveal this American, machine-dominated aesthetic and ideological stance. She sums up by saying, "The science of composition seems of greater import than the art of composing."[26]

This sudden flourishing of machine-music is evidence of the prominence of technology in composers' thoughts. Interestingly, it was not just the work of composers and other artists that was shaped by the machine age. Science historians have acknowledged the debt that Einstein's theories owe to his personal relationship with a techno-centric environment. In his ground-breaking work on Einstein, Peter Galison has offered a view of the physicist beyond the disembodied brain in a jar that Roland Barthes described in *Mythologies*.[27] Galison breaks down the portrayal of Einstein as a genius scientist-philosopher working apart from society in solitude and, instead, explores the ways in which Einstein's techno-centric environment allowed the scientist to theorize in the way he did.[28] While working in a Swiss patent office processing new electronic technologies, Einstein developed a fascination with the idea of the synchronization of clocks. Among his duties as a patent officer was the assessment of new technological developments that could aid in the synchronization of clocks, including devices that communicated by sending signals at the speed of light.[29] Einstein often worked out thought experiments related to moving trains and clocks that he used both in his published scientific papers and in later explanations of his theories before lay

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[26] Marion Bauer, *Twentieth Century Music*, 397.

[27] Roland Barthes, "The Brain of Einstein," in *Mythologies*, trans. Annette Lavers (New York: Hill and Wang, 1972), 68–70.

[28] Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W. W. Norton & Company, 2003).

[29] Walter Isaacson, *Einstein: His Life and Universe* (New York: Simon and Schuster Paperbacks, 2007), 78.

audiences.[30] For Einstein, who had been thinking about some of the larger inconsistencies he saw in existing ideas about physics, his theorizing about synchronizing clocks and the perception of simultaneity was the push he needed to get his theory of relativity off the ground in 1905, his so-called *annus mirabilis*. Galison writes:

> For Einstein clock coordination was the turn of the key that would at last set in motion the theory machine that he had struggled for a decade to assemble. There was no ether; there were actual fields and particles, and there were but real times given by clocks.[31]

The machines around him—clocks, trains, and the many devices used to power them that he encountered in the patent office—shaped Einstein's thinking in a radical way. Galison's historiographic contributions to our understanding of Einstein are significant; his work counteracts a portrayal of the physicist as a god-like figure embraced by multiple Einstein biographers in the decades after his death in 1955. But during Einstein's own time, the techno-centric metaphors and frequently-cited thought experiments dealing with train travel, clocks, and the problems of simultaneity might have made it apparent to even a lay audience that, especially in Einstein's case, technology had a crucial role in shaping scientific thought.

Just as Einstein was influenced by his exposure to new technologies, composers, critics, and audience members espoused and encountered new technologies that helped create and inform their ideological and aesthetic concerns about modernist music. Their machine-based aesthetic was part of a larger interest in considering the place of science in a musical discourse. For modernists, science and technology were bound together. On the

[30] In one, he pondered what would happen if lightning struck simultaneously at two different points along the embankment of a set of train tracks. From the ground, the two events would appear simultaneous. But what would an observer on a fast-moving train rushing towards one of the two points observe? Summarized from Walter Isaacson, *Einstein: His Life and Universe*, 123–124.

[31] Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time*, 47.

one hand, technological developments were seen as the practical application of scientific ideas, and, on the other, technologies could be cast as shaping scientific (in addition to artistic) progress. This attitude is reflected in the similarly bidirectional relationship many modernists saw in burgeoning field of electronic music at this time, which they considered both a scientific and technological development.[32] New scientific research on music and musical acoustics prompted modernists to build and commission new instruments that would be able to express their scientific ideas about music.[33] This is what encouraged Cowell to commission the production of the Rhythmicon. On the other side, certain new technological innovations, like the Theremin, prompted composers like Varèse and Schillinger to compose new, scientifically-oriented pieces that could use this instrument. Thus even in the most literal responses to music in the machine age, the give and take of science and technology and their interrelation played a part in modernist musical thought.

II. The Composer as Scientist

Modernist composers were often discussed in scientific terms by their contemporaries—from fellow composers and critics to regular folks. On the surface, the link between those who were musically experimental and those that experimented by trade seems obvious.

[32] This trend began with musicians' and composers' interest in the writings of Herman von Helmholtz, whose massive treatise *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (published originally in German in 1877 and subsequently translated) piqued the interest of a number of composers. Benjamin Steege's dissertation speaks to the inherently modernist elements of Helmholtz's scientific and musical treatise. Benjamin Steege, "Material Ears: Hermann von Helmholtz, Attention, and Modern Aurality," (PhD Dissertation, Harvard University, 2007).

[33] Among the many authors who discuss electronic instruments listed in this dissertation (including Henry Cowell and John Redfield), the work of Carlos Chavez also displays the influence of turn-of-the-century scientific research on musical acoustics. See Carlos Chavez, *Toward a New Music: Music and Electricity* (New York: W. W. Norton and Co., Inc., 1937). The use of existing technological instruments also served some composers' more scientific aims, as we can see in Stravinsky and Colin McPhee's fascination with the player piano as a means of accomplishing their compositional and aesthetic goals.

But, further than that, modernist composers possessed, or were perceived as being possessed of, a number of traits similar to those associated with scientists. Composers used strict methods in which the elements of music were subjected to an outside process. Schoenberg's twelve-tone compositional method or Cowell's dissonant counterpoint and its regulations made easy examples for this methodical approach to composition. These calculated, rather than intuitive processes differentiated their creators in the popular imagination from their romantic, neo-romantic, and even neo-classical compositional peers. Indeed, modernist composers were seen as treating composition as an experimental process.

On the other side of the comparative coin, composers shared the negative connotations of scientism in the early twentieth century. Scientists were often portrayed as socially-removed individuals who nevertheless had a tremendous impact upon society through their role in the creation of new technologies. The same caricatures of the scientists of the day—their cold, calculating ways—were applied to contemporary composers, most often by those who disliked their music or the artistic, anti-establishment sentiments. In these negatively-oriented scientific associations between composer and scientist, the false dichotomy of what C. P. Snow called "the two cultures"—that is, the arts and the sciences—was often invoked.[34] When scientific language was employed to criticize a composer's work negatively, it was often related as a predominance of scientific objectivism at the expensive of (seemingly more desirable)

[34] The phrase was first used by C.P. Snow, a British novelist, as the title for a 1956 essay in *The New Statesman*. Roger Kimball summarizes the meaning of its phrase and its lasting impact by saying, "The phrase has lived on as a vague popular shorthand for the rift—a matter of incomprehension tinged with hostility—that has grown up between scientists and literary intellectuals in the modern world." Roger Kimball, "'The Two Cultures' Today," *New Criterion* (Feb. 1994).

artistic subjectivity. Yet while this negative use of science in describing a composer was present at times, more often than not, the scientific associations bestowed upon a composer—especially by the composer's peers—were overwhelmingly positive.

The associations between scientists and composers were made by critics, fellow composers, and by composers speaking of themselves. Certain scientific themes recur frequently in articles describing new composers on the American music scene: experimentation, invention, innovation, and theorization. The scientific composer or scientific musician was a figure necessary for modern music, according to Marion Bauer, because of the breakdown of the established rules of the tonal system, an idea central to almost all brands of modernist music aesthetics. She writes:

> A new tonal system must be subjected to a period of experimentation before it can become established; it must be established before the theorists can study it scientifically, and it takes a long time before the new idea, established by the composer and explained by the scientist, reaches the classroom or the public.[35]

She asserts that the theoretical study of music done by musical scientists is necessary for understanding new music. She even allows for the possibility that, in some cases, the two figures are combined: "Occasionally composer and theorist is one person, as is the case with Schoenberg."[36] In fact, Arnold Schoenberg was often singled out as a composer-scientist, both in his capacity as analyst and as a scientifically-minded composer.

American music critics characterized Schoenberg as a scientific composer both before and after he emigrated to the United States. In Paul Rosenfeld's *Musical Portraits: Interpretations of Twenty Modern Composers* (1920), the author links the Viennese

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[35] Marion Bauer, *Twentieth Century Music*, 114.

[36] Marion Bauer, *Twentieth Century Music*, 114.

composer with experimentation and intellectualism in music. In this case, Rosenfeld makes the parallel between scientist and composer with more than a hint of negativity. About Schoenberg's compositions, he says:

> Indeed, it is only as experiments, as the incorporation in tone of an abstract and intellectualized conception of forms, that one can at all comprehend them. And it is only in regarding him as primarily an experimenter that the later Schoenberg loses his incomprehensibility and comes somewhat nearer to us.[37]

Rosenfeld seems to be arguing that Schoenberg's compositions only have value inasmuch as they represent scientific experimentation in the art of music. It is also worth noting that Schoenberg and his music are bound up as one in the same entity—when Rosenfeld states that it is only when "regarding him as primarily an experimenter" that we can comprehend "the later Schoenberg," the author slips effortlessly from composer to his music, turning the music's scientific air into a personality trait of its creator.

Later in the same chapter on Schoenberg, Rosenfeld concretized the link between the composer's scientific music and his scientific persona. He says:

> But, for the present, Schoenberg, the composer, is almost completely obscured by Schoenberg, the experimenter. For the present, he is the great theoretician combating other theoreticians, the Doctor of Music annihilating doctor-made laws. As such his usefulness is by no means small. He speaks with an authority no less than that of his adversaries, the other and less radical professors. He, too, has invented a system and a method; his "Harmonielehre," for instance, is as irrefragable as theirs; he can quote the scripture with the devil.[38]

This charge of ivory-tower elitism might come as no surprise, but the clear link established between Schoenberg and the scientific intelligentsia is unique to this period of

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[37] Paul Rosenfeld, *Musical Portraits; Interpretations of Twenty Modern Composers* (New York: Harcourt, Brace, and Howe, 1920), 234.

[38] Paul Rosenfeld, *Musical Portraits; Interpretations of Twenty Modern Composers*, 242.

modernist musical criticism. Schoenberg, like other moderns, is recognized for his intellectual kinship with the scientific world. And although in this case the link is meant to reiterate a negative aspect of the composer's artistic personality and agenda, the connection made by Rosenfeld reveals the pervasive attitude that grouped scientists and modernists together.

The young Henry Cowell was also described by his peers in scientific terms. Aaron Copland positioned the upstart using distinctly ambivalent scientific language in an article about "America's Young Men of Promise" in a 1926 issue of *Modern Music*. Copland notes that Cowell was "an inventor, not a composer" and links the young composer's personality explicitly with Schoenberg's.

> Like Schoenberg, Cowell is a self-taught musician, with the auto-didact's keen mind and all-inclusive knowledge.
>
> But Cowell is essentially an inventor, not a composer. He has discovered "tone clusters," playing piano with the fore-arm, and the string piano. Yet from a purely musical standpoint his melodies are banal, his dissonances do not "sound," his rhythms are uninteresting. Cowell must steel himself for the fate of the pioneer, opposition and ridicule on the one hand, exploitation and ingratitude on the other. His most interesting experiments have been those utilizing the strings of the piano.[39]

While Copland praises Cowell as inventive, he nevertheless dismisses Cowell's experiments as mostly boring and unmusical. The exceptions to that aesthetic judgment are actually Cowell's most avant-garde works, "those utilizing the strings of the piano"—these purely experimental pieces strike Copland, it seems, as worthwhile intellectual pursuits. While Copland put a negative spin on Cowell's scientific persona, Marion Bauer keeps her assessment of the young composer value-neutral, while echoing many of

[39] Aaron Copland, "America's Young Men of Promise," *Modern Music* 3/3 (March-April 1926), 16.

Copland's sentiments: "Henry Cowell is first and foremost an experimenter whose keen mind keeps him on the jump from one problem to the next."[40]

In examining the reception of Schoenberg and Cowell as scientific composers, it is clear that in adopting this metaphor fellow composers and critics employed both the positive and negative connotations of the scientific persona. In either case, the scientific associations both responded to and shaped responses of the composers' works. Schoenberg's scientific persona was perceived as being formed by his calculated twelve-tone compositions, for example, and added to his portrayal as an icy, academic composer.[41] Conversely, Cowell's more inherently scientific persona was seen as molding his pieces, which were considered "mere" experiments in sound design by some. With this duality of composer-as-scientist in mind, we can see why the ambivalent position was easiest to adopt. For both composers, the negative associations with their scientific persona justified their sometimes ascetic works. Yet for those critics and listeners who aligned themselves with the modernist musical agenda of progress, these apparently cold and difficult works could be praised for their experimentalism alone. Even if Cowell's or Schoenberg's works were not the most ear-pleasing compositions in concert halls, they were intellectually stimulating and culturally relevant.

III. Composition in the Musical Laboratories

Modernist composers developed hypotheses about new music, based on their concerns with older methods of composition and the place of those methods in modern art and

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[40] Marion Bauer, *Twentieth Century Music*, 335.

[41] As we will see in Chapter 4: Space-Time, Webern and Berg's twelve-tone techniques also get grouped into the category of relativistic music, but neither composer is as strongly associated with Einstein as Schoenberg was.

society. And composers, like scientists, tested these hypotheses by working in a type of laboratory. The metaphor of the musical laboratory, as the place in which aesthetic hypotheses about new music were put to experiments, became an important one for composers and critics of modernist music. Writing in 1929 in *Musical Quarterly,* André Coeuroy described the musical laboratory as the primary site for new developments in modern music:

> Our young musicians—I mean those who have something to say—our young musicians, immured in their laboratories, are trying to discover a music wholly free from extra-musical appeal; just as our painters envisage a painting that shall obey the laws of line and color only. This is the real objective of their experiments, and, even when they fail, they never weary of beginning over again.[42]

Although earlier in the article he criticizes "modern esthetes" for their "would-be scientific language," Coeuroy nevertheless adopts this language and, in using it, offers in this passage a summation of the entire relationship between science and modernism in music: These young musicians conduct experiments in their laboratories to try to find, prove, and compose using objective laws of music.[43]

As with the idea of the composer-as-scientist, the notion that musical composition took place in a laboratory setting was used with both positive and negative cultural associations, and often with ambivalence. Marion Bauer, who sees experimentation in music in a generally positive light, reveals the driving sentiment behind the ambivalence towards composition in the musical laboratory:

[42] André Coeuroy, "The Aesthetics of Contemporary Music," 247.

[43] Andre Coeuroy, "The Aesthetics of Contemporary Music," 246. Although Coeuroy seems to be deriding modern musicians for their use of scientific language, it may be a criticism of the unintelligent slinging of scientific jargon.

> Under the cloak of experimentation, composers have occasionally tried to palm off glitter for gold, and many crimes have been perpetrated against the listening public in the name of "modernism." We do not need to worry about the effect of these experiments on the future of music because posterity will retain what it needs and desires, and the rest will be lost through "innocuous desuetude."[44]

Bauer thus met the idea of experimentation and invention in a musical laboratory with mixed, yet realistic feelings. However, in an earlier article in 1928, Bauer argued for the importance of a musical laboratory in her article, "The Case for a Music Laboratory," in *Modern Music*.[45] Perhaps the later view expressed by Bauer in her book, then, was a tempering of an earlier optimism about musical laboratories—one that was shared by many.

John Redfield's *Music: A Science and an Art* was one of the most influential books on music-making and the scientific method. Redfield was a professor of physics at Columbia University, focusing his research and course offerings on the physics of music (a rather new field in the 1920s).[46] Redfield was described by his contemporaries as a "keen scientist," an "uncommonly good musician," and a "champion of music."[47] Redfield convened, along with fellow "organizing members" Henry Cowell, Otto Kinkeldey, Lazare Saminsky, Joseph Schillinger, Charles Seeger, and Joseph Yasser, the first meeting of "The Group Interested in the Rapprochement of Science and Music" on

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[44] Marion Bauer, *Twentieth Century Music*, 374.

[45] Marion Bauer, "The Case for a Music Laboratory," *Modern Music* 5/4 (May 1928), 36-38.

[46] Redfield's position is mentioned in a review of his book featured in the *Music Supervisors' Journal* in 1928. See Will Earhart, "Review of *Music: A Science and An Art*," *Music Supervisors' Journal* 15/1 (Oct. 1928), 89.

[47] Will Earhart, "Review of *Music: A Science and An Art*," *Music Supervisors' Journal* 15/1 (Oct. 1928), 91.

29 January 1930.[48] After a sustained naming-debate, in which the alternate titles "Society for Musico-Scientific Research," the "Musico-Scientific Society," and the "Society for Experimental and Speculative Musicology" were ruled out, the group was finally dubbed the "New York Musicological Society."[49] The society (which would later evolve into the American Musicological Society)[50] was one of the first of its kind, and it was linked with and forged from the musical salons held by Charles Seeger and Ruth Crawford (attendees of which included Cowell, Carl Ruggles, Richard Buhlig, Dane Rudhyar, and more occasionally Edgard Varèse and Carlos Salzedo).[51] The physicist also presented numerous papers before the "New York Musicological Society" in the early 1930s.[52] In other words, Redfield, a physicist, was well-connected with the musical world. He knew personally many of the main figures in this modernist circle (and this dissertation) and worked closely with them to integrate musical and scientific study.

Redfield's monograph was first published in 1928 and drew the direct attention of numerous modernist composers, including Henry Cowell and Edgard Varèse, who cited

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[48] See footnote 10 of Nancy Yunhwa Rao, "Partnership in Modern Music: Charles Seeger and Ruth Crawford, 1929-31," *American Music* 15/3 (Autumn 1997), 376.

[49] For more on the young society, its members, and the papers given under its auspices see Nancy Yunhwa Rao, "American Compositional Theory in the 1930s: Scale and Exoticism in 'The Nature of Melody' by Henry Cowell," *Musical Quarterly* 85/4 (2001), 596–600.

[50] Richard Crawford, "American Musicology Comes of Age: The Founding of the AMS," in *The American Musicological Society, 1934–1984: An Anniversary Essay by Richard Crawford* (Philadelphia: The American Musicological Society, 1984), 8.

[51] Nancy Yunhwa Rao, "Partnership in Modern Music," 354. For more on this circle, especially Ruth Crawford's involvement, see Judith Tick, *Ruth Crawford Seeger: A Composer's Search for American Music* (New York: Oxford University Press, 1997), 105–28. See also Suzanne G. Cusick, "Gender, Musicology, and Feminism," in *Rethinking Music*, ed. Nicholas Cook and Mark Everist (Oxford: Oxford University Press, 1999), 471–98.

[52] See footnote 36 of Nancy Yunhwa Rao, "Partnership in Modern Music," 378.

the book and its main themes in their own writings and lectures.[53] As Will Earhart, one reviewer of Redfield's text, notes, the author's unique position as scientist and musician (and his vivid writing style), endeared the book to fellow musicians rather than angered them, a potential pitfall given the book's focus on the musical world's scientific ignorance.[54] Earhart wrote:

> Were it scorn for music and musicians because of our lack of scientific knowledge that motivated his criticisms, we should become indignant; but he writes rather as one of us who flays the world because it has permitted scientific thought to neglect music, leaving it to creep and muddle along with only sentiment, tradition and senseless convention for its guides, and at the same time lavish treasures of thought and experimentation upon far less worthy and beautiful things.[55]

Earhart's assessment makes clear the reasons why musicians like Cowell were not offended by Redfield's call-to-arms. It also brings out one of the primary reasons why Cowell and his contemporaries *did* pick up the book: Redfield offered the first step in the intellectual revolution that would remove the "sentiment, tradition and senseless convention" that music had been seen as wallowing in without the intellectual rigor of scientific study.

In *Music: A Science and an Art*, Redfield expressed one of the paramount concerns of modernists in America: music and science must work in tandem for an artistic and intellectual revolution to take place in musical culture. The main premise of

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[53] Cowell points out the remarkable singularity of this book in his introduction to *New Musical Resources*. Henry Cowell, *New Musical Resources* (New York: Cambridge University Press, 1996). Varèse quotes from Redfield's book in his lectures given in Santa Fe in 1936 and bases some of his own ideas about science and music on Redfield's notion of the musical laboratory. See John D. Anderson, "Varèse and the Lyricism of the New Physics," *Musical Quarterly* 75/1 (Spring 1991), 39.

[54] Earhart was an early leader in American music education and its main organizations. He was a long-time member of the Music Educators National Conference and served as its president in 1915. See Michael L. Mark, *A History of American Music Education* (Lanham, MD: Rowman & Littlefield Education, 2007).

[55] Will Earhart, "Review of *Music: A Science and An Art*," *Music Supervisors' Journal* 15/1 (Oct. 1928), 91.

the book is that the science of music, having undergone very limited previous study, must be integrated into any current discussion of music. Redfield sums this up eloquently:

> That there is an art of music will be readily conceded. That there is a science of music as well is not quite so obvious; yet such is undoubtedly the case. And that music as an art can not attain the full growth of which it is capable unless fostered and nurtured by science, is equally true.[56]

Redfield acknowledges the commonly held belief that there exists a separation between art and science, and yet, he argues that for music to grow *as an art*, it must be examined and conceived of scientifically.

For Redfield, the work of blending music and science was primarily achieved in the examination of musical acoustics in tandem with a study of aesthetics. But apart from offering insight into the nature of sound and musical beauty in lay terms, Redfield's book is prescriptive. The author is not content to have his book sit on the shelf as the sole example of the blending of music and science; rather, he offers specific suggestions for the further study of music as a science. Naturally, this study takes place in a "musical laboratory." He states:

> The central feature of a school of music should be the musical laboratory. There is no other means or instrumentality by which music can be so quickly, so effectively, or so economically advanced, and so surely placed upon a solid and enduring foundation. Sound is the raw material out of which the musician fashions the finished product called music, and his efforts would be much more effective if he thoroughly understood the material with which he works.[57]

The study of music in a musical laboratory, a place in which sound itself is analyzed and explored, is the most effective way to get to the heart of music. For Redfield, therefore, the objective, calculated study of sound production does not contradict the artful

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[56] John Redfield, *Music: A Science and An Art* (New York: Tudor Publishing Co., 1928, 1949), 1.

[57] John Redfield, *Music: A Science and An Art* (1928, 1949), 104.

composition of music. Instead, it is only through the careful examination of the nature of tone and rhythm that the musician (and thus the audience) gains access to the beauty of music at all. His book concludes with a hopeful note:

> …the persons who will hereafter most improve the music of the world will be those who give their lives to the scientific study of it, and those who make that scientific study possible through the establishment of a musical laboratory in which such studies may be pursued.[58]

For Redfield, the scientific study of music is *the* most important task for the future of music. Redfield's idea of a musical laboratory—both metaphorical and actual—was shared by a number of composers and critics, some of whom directly borrowed the concept from the physicist.

Metaphorical Musical Laboratories

Edgard Varèse had a particular fascination with laboratories, and he spoke more than once about the creation of a musical version of the scientific locale. He was most certainly influenced by Redfield's book, as he referred to it in a number of his lectures given in 1936 in New Mexico. In 1939, in a lecture given at the University of Southern California, Varèse even paraphrased the title of his talk from Redfield: Redfield's *Music: A Science and an Art* became Varèse's "Music as an Art Science."[59] John D. Anderson noted that Varèse also directly quoted from Redfield's book in one of his 1936 Santa Fe lectures. The topic of the chosen passage was the creation of musical laboratories.

> There should be at least one laboratory in the world where the fundamental facts of music could be investigated under conditions reasonably conducive to success. The interest in music is so widespread

[58] John Redfield, *Music: A Science and An Art*, 306–307.

[59] John D. Anderson, "Varèse and the Lyricism of the New Physics," *Musical Quarterly* 75/1 (Spring 1991), 39.

> and intense, its appeal so intimate and poignant, and its significance for mankind so potent and profound, that it becomes unwise not to devote some portion of the enormous outlay for music to research its fundamental questions.[60]

Varèse was so fascinated by the concept of a musical laboratory that, in 1932, he contacted the acoustician at Western Electric (what would become Bell Telephone Laboratories) and asked to collaborate on sound experiments at their laboratories. He actually met with the acoustician, Henry Fletcher, several times in 1933.[61] Louise Varèse recalled that "it may be imagined how Varèse, with his hunger for more and more knowledge of acoustics and his passionate interest in the voyaging of sounds in space, lived for those visits to the laboratory as though he were going to a Socratic banquet."[62] For Varèse, the relationship between his own music and the musical laboratory was primarily a metaphorical one, but he was equally fascinated with the real application of scientific and technological developments.

Schoenberg was also tied to the concept of the musical laboratory. In his case, it was the purely metaphorical space in which he, the scientist-composer, carried out his experiments. Unlike Varèse, however, Schoenberg did not describe himself in this metaphorical musical laboratory—that was left up to his critics (many of whom discussed the composer in scientific terms). Rosenfeld, in a portion of his criticism of Schoenberg "the experimenter," extends the metaphor of Schoenberg-as-scientist to describe the

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[60] This borrowing is noted in Anderson's dissertation, and the author cites the Redfield properly, but he does not give the source for the Varèse. We can assume that this quotation became part of one of the 1936 New Mexico lectures. See John D. Anderson, "The Influence of Scientific Concepts on the Music and Thought of Edgard Varèse" (Dissertation, University of North Colorado: 1984), 100.

[61] Olivia Mattis, "Varèse's Multimedia Conception of 'Deserts'," *Musical Quarterly* 76/4 (Winter 1992), 566.

[62] Quoted in Olivia Mattis, "Varèse's Multimedia Conception of 'Deserts'," 566.

creation of the composer's works within a musical laboratory, complete with a discussion of scientific methods of composition. The first mention of the musical "laboratory" is couched within a passage that criticizes—not surprisingly—the lack of artistic merit the author finds in Schoenberg's works.

> Unfortunately, the magnificent passages are interspersed with unmusical ones. It is not only that the work does not quite "conceal art," that it smells overmuch of the laboratory. It is that portions of it are scarcely "felt" at all, are only too obviously carpentered. The work is full of music that addresses itself primarily to professors of theory. It is full of writing dictated by arbitrary and intellectual conception of form. ... It is Schoenberg the intellectualist, Schoenberg the Doctor of Music, not Schoenberg the artist, who obtains here.[63]

The unmusical, for Rosenfeld, reeks of the laboratory and of over-intellectualism. He continues with a description of the working methods of Schoenberg's musical lab, which includes a "process of consideration" before arriving at a conclusion.

> These latter have all the airlessness, the want of poetry, the frigidity of things constructed after a formula, daring and brilliant though that formula is. They make it seem as though Schoenberg had, through a process of consideration and thought and study, arrived at the conclusion that the music of the future would, in the logic of things, take such and such a turn, that tonality as it is understood was doomed to disappear, that part-writing would attain a new independence, that new conceptions of harmony would result, that rhythm would attain a new freedom through the influence of the new mechanical body of man, and had proceeded to incorporate his theories in tone. One finds the experimental and methodical at every turn throughout these compositions.[64]

The allegory of Schoenberg's music being concocted in a laboratory setting was so wide spread that we can find it in sources not dealing explicitly with music. For example, in a 1920 article about modernist poetry, there is mention of "Schoenberg's interminable

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[63] Paul Rosenfeld, *Musical Portraits; Interpretations of Twenty Modern Composers*, 238–9

[64] Paul Rosenfeld, *Musical Portraits; Interpretations of Twenty Modern Composers*, 239.

laboratory expositions."[65] These uses are overwhelmingly negative, but not all references carried this connotation.

In reviewing Alfredo Casella's book on the future of music, *The Evolution of Music Through the History of the Perfect Cadence* (1924), Olin Downes brings Casella's thoughts about Schoenberg to the American public's attention. Casella, whom Downes describes as "a modern, out for blood," makes the argument that current technological developments in the science of sound make Schoenberg's earliest aesthetic experiments a reality.

> If one considers the countless possibilities of invention and improvement of which modern instrument-making is physically and mechanically capable, it is difficult to deny that the science of tone color—a science so closely resembling chemistry—is at present the most powerful and progressive mainspring in music. . . . The melodies of tone color predicted by Schoenberg in his "Harmonielehre" no longer strike us as the vision of a laboratory.[66]

Casella is able to rehabilitate the negative associations of Schoenberg's compositions in a musical laboratory and turn them into prescient scientific experiments. Because of Casella's own modernist (and sometimes techno-centric) leanings, this reconciliation of Schoenberg's lab with the ideas of experimentation and modernist aesthetics is not surprising.

At Work in the American Musical Laboratory

Above all, the musical laboratory was seen as an American compositional and educational environment. Three years before Redfield published *Music: A Science and*

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[65] Amy Lowell, "Some Musical Analogies in Modern Poetry," *Musical Quarterly* 6/1 (January 1920), 134.

[66] Alfredo Casella, *Evolution of Music*, quoted and reviewed in Olin Downes, "Alfredo Casella Surveys the Past and Forecasts the Tonal Future," *New York Times* (5 October 1924), X6.

An Art, Eugene A. Noble, the secretary of the Juilliard Foundation, argued in the *New York Times* that what America needed to compete as a "musical nation" with Europe's compositional and performative prowess was a "musical laboratory."[67] For Noble, the laboratory, in which young performers and conductors would learn musical techniques in a scientific manner and with scientific guidance, was a matter of national musical pride.

Often the idea of a musical laboratory was connected, as it was for Noble, with a specific educational setting. Answering the Juilliard secretary's nationalist plea, musical laboratories were founded across the country. Howard Hanson, as the director of the Eastman School of Music, provided and sustained "a composer's experimental laboratory" in which young composers could learn about composition, write new works, and hear them performed. In *Capturing Sound: How Technology Changed Music*, Mark Katz argues that the phonograph served as technological vehicle for transporting culture, specifically "good music" to the U.S. One of the destinations for this "good music" was the American classroom. Katz notes that the inherent objectivity of the phonograph made it ideal for classroom at this time:

> With [the phonograph], the type of music and level of performance heard in the classroom were not limited by the talents of the teachers, students, or available musicians. Nor did a school's ability to bring classical music to its students depend on its wealth or location. "A talking machine and a few records," suggested *Musician* magazine in 1919, could turn any classroom into a "world-laboratory and Musical History Museum at small cost, no matter how remote . . . from the acknowledged centers of music."[68]

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[67] Eugene A. Noble, "American Ideal Seen as Big Need in Making Us a Musical Nation," *New York Times* (11 March 1923), X13.

[68] Mark Katz, *Capturing Sound: How Technology Has Changed Music* (Berkeley: University of California Press, 2004), 62.

This technological apparatus, then, could create a portable musical laboratory that would bring "good music" to the United States. Moreover it was its technological capability for repetition that helped construct an objective space of musical study—in other words, the phonograph was a scientific instrument used in the American musical laboratory.

When national musical projects were developed in an effort to lift the country out of the Great Depression, the idea of the laboratory was linked with American musical work. The Composers' Forum was an organization established using the funds of the Federal Music Project, a subset of the Works Progress Administration. The organization, which was better known at the time as the "Composers' Forum Laboratory," produced concerts of new music by up-and-coming composers as well as lectures and moderated discussions. The concerts associated with the organization took place in New York City from 1935 to 1940 before being moved to San Francisco when the WPA's work was ceased.[69] Aaron Copland and Edgard Varèse were among those who formed the advisory committee to begin the project; Marion Bauer, Charles Seeger, Roy Harris, and George Antheil were enthusiastic and early supporters.[70]

The purpose of the project was stated in the *New York Times* in a September 1935 article written about the proposed organization.

> The purpose of the projected composers' forum-laboratory is "to provide an opportunity for serious composers, residing in America, both known and unknown, to hear their own compositions, to test to reactions of auditors, as well as to present their own particular viewpoint, if any, and benefit by a public discussion of their works."[71]

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[69] B. C. Vermeersch, "Composers' Forum," *Oxford Music Online* [accessed 10 October 2010].

[70] Melissa de Graaf, "Documenting Music in the New Deal: The New York Composers' Forum Concerts, 1935-1940," PhD Dissertation (Brandeis University: 2006), 16.

[71] "Composers' Forum-Laboratory," *New York Times* (29 September 1935), X7.

Following the first concert, held on 30 October 1935 at the Midtown Community Music Center (with works by Roy Harris), there was more talk in the press of the forum-laboratory and its endeavors.[72] Each concert received an announcement in the *New York Times*, although full reviews were infrequent. In addition to this public press, the workings of the Composers' Forum Laboratory were extensively documented by the organization. Letters, programs notes, and transcripts of the discussion sessions were among the documents carefully kept by the organization. This documentary impulse was, according to Melissa de Graaf, sustained in an effort to "record the American experience," but the methodological tie to the laboratory sciences is obvious.[73] Each element of this musical project was dutifully recorded for posterity, just as the scientist records his or her every step so that a laboratory experiment has the crucial feature of reproducibility.

Ashley Pettis, the founder of the Composers' Forum-Laboratory spoke of the success of the project as if completing the final sections of a lab report:

> As to the actual effect of this enormous activity, which is nationwide, one may offer much interesting evidence in the nature of the specific case histories; but it must be admitted that the sum total of the practical results—such as the composer's opportunity of hearing his works rehearsed, performed publicly, and discussed (not to mention the training of the nucleus of a public in the open-minded hearing and free discussion of unfamiliar music)—cannot be computed. In these latter respects the imponderable elements are of the utmost importance.[74]

[72] For reference to the concert see "Activities of Musicians," *New York Times* (27 Oct. 1935), X7. For more on the first series of concerts see "Composers' Laboratory," *New York Times* (24 November 1935), X8.

[73] Melissa de Graaf, "Documenting Music in the New Deal: The New York Composers' Forum Concerts, 1935-1940," 5.

[74] Ashley Pettis, "The WPA and the American Composer," *Musical Quarterly* 26/1 (Jan. 1940), 106.

Pettis employed scientific jargon—words like evidence, case histories, results, nucleus—to stress the experimental *and functional* nature of the musical laboratory that he had helped to build. Not only did this laboratory make forays into new intellectual territory by allowing young composers to express previously unrealized artistic ideas, it also had an extremely practical purpose in offering a place for experimentation, trial and error, and "peer review." Like the scientific laboratory, it supported its occupants both intellectually and functionally.

In January 1937, in a review of the concert series, Olin Downes assessed the work of the organization in an article entitled "Laboratory for Native Composers." He explained the general purpose and usefulness of the project and—finally!—addressed the issue of its name. As to the purpose, he explained that the Composers' Forum-Laboratory was, as he saw it, the long-awaited answer to a call for an institution that supported new works.

> It has long been recognized that a great need of the American composer was a practical laboratory for the experimental scoring and for hearing his works. . . . This institution affords real laboratory work for American composers, in an eminently useful and practical way. [75]

This is very much in line with Pettis's description that extends the scientific terminology. Downes description of the name, "The Composers' Forum-Laboratory," and specifically the "laboratory" part is quite insightful.

> Some people have questioned the use of the word "laboratory" in connection with this series. It was even stated that our better-known composers would object to the term—that it would deter them from entering this arena. No arguments are necessary to disprove this contention. The facts speak for themselves.[76]

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[75] Olin Downes, "Laboratory For Native Composers," *New York Times* (10 January 1937), 159.

[76] Olin Downes, "Laboratory For Native Composers," 159.

Thus Downes assures readers that, despite the questioning of the connection with the laboratory because of its sometimes-negative connotations, this has not caused any big shots to withdraw—Cowell, Antheil, Varèse, and other 1930s big-name composers were eager to participate.

IV. The Case for Einstein, Modernism, and Music

Until this dissertation, no large-scale study of the influence of scientific ideas on modernist musical life has been undertaken. As we have seen, the scientific world fascinated modernists and those who talked about them. There were clearly areas of ideological overlap and common aims amongst scientists, composers, and musicologists/critics. The recognition of the extent to which modernists had an interest in general science in the early part of the twentieth century is an important starting point for understanding my study of Einstein, modernism, and musical life in America. Musical modernists participated in a larger discourse about change in the face of an increasingly fast-paced and technologically oriented world. They took part in this discourse not just with other artistic moderns, like modernist poets and painters, but also with scientists. Thus the new ideas—and ideas about newness—expressed by modernist musicians cannot be described using an influence-only theory. Composers were not necessarily trying to translate Einstein's ideas directly into music. Instead, they were taking part in a shared enterprise of reexamining and trying to understand the changing world. The use of scientific language and ideas is evidence of this.

My dissertation will examine the cultural confluence of music and science during a time when these two entities developed within a broader ideological spectrum of attitudes about the new century and all of the changes that came with it. It is critical to keep sight of the larger view when studying the interaction of science and modern music because neither science nor music should be regarded as a fixed entity. In other words, I cannot examine the direct influence of science on modernism, or more specifically of Einstein on modernist music, for two reasons. First, scientific advances like Einstein's theory of relativity and modernist musical developments (for example, Schoenberg's twelve-tone method) were both the products of their time. Secondly, there is no one version of Einstein's theory of relativity *as understood by others* and there is no one understanding of "modernist music." Both were constructed by contemporaneous minds and have been deconstructed by a number of important scholars in the history and philosophy of science and in musicology in recent years. In the following few sections, I will examine the contributions of these scholars in order to present the intellectual roots of my project on Einstein, modernism, and musical life in America. While this study is one of the first major research projects to delve this deeply into shared histories of music and science in the early twentieth century, there is a good deal of preliminary work that has been done on science and modernism in general, on science and music more specifically, and on Einstein and the arts. The most important contributions have been the cultural-theoretical models offered by the scholars in the three categories listed above.

Existing Research on Science and Modernism

There have been a number of valuable studies on the relationship between modernism and science. Mark Morrison's review-essay "Why Modernist Studies and Science Studies Need Each Other" makes note of a number of these studies, including those that highlight the importance of exploring science and modernist studies together.[77] He places the most value on those essays and books that have helped to "illustrate the need in modernist studies to avoid seeing science as a given, a backdrop against which the real objects of interest—poems, paintings, and novels—can be explored." This approach (and the books that illustrate it) is critical to my dissertation project as well. In considering Einstein's scientific ideas that might have played into modernist musicians' conceptions of their own art form, I have tried to remain conscious of the constructed nature of "Einstein," "relativity," and "space-time." Each of these main areas of thought, around which my dissertation is organized, must be considered as diffuse networks of ideas, built by a number of minds with differing agendas and read and understood by other minds with other perspectives. As I explore the newspaper articles that attempted to translate ideas about Einstein the man, relativity as a theory, and space-time as a concept, I want to remain conscious of the authors' and readers' perspectives and goals. There is not one Einstein, one relativity theory (or even two), or one space-time. At the same time, like Morrison, I want to eschew a theory of direct influence, as ideas about the importance of Einstein's theories were shifting as rapidly as modernist musical ideas were.

An important contribution to the study of modernism and science, one mentioned by Morrison in his review essay, is *From Energy to Information: Representation in Science and Technology, Art, and Literature*.[78] This collection of essays examines the interaction of science with the modernist arts, broadly speaking, by focusing on the idea

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[77] Mark Morrison, "Why Modernist Studies and Science Studies Need Each Other," *Modernism/Modernity* 9/4 (2002), 675–82.

[78] Bruce Clarke and Linda Dalrymple Henderson, editors, *From Energy to Information: Representation in Science and Technology, Art, and Literature* (Stanford, CA: Stanford University Press, 2002).

of energy. It looks at the ways in which the arts and the sciences grew together out of certain technological imperatives that shaped the imagination of both fields. Through the various essays, the book makes clear the inherent intellectual overlaps in the two fields that enabled mutual growth. For example, within the introduction, Bruce Clarke and Linda Dalrymple Henderson are careful to point out the scientific world's tendency to produce and reproduce scientific concepts graphically and to think in allegorical and metaphorical terms about science.[79] These factors offer the scientific world an easy kinship with the artistic one. In the same way, the co-editors point out the specifically modernist attitudes held by artists that provided a breeding ground for scientifically-oriented ideas about their art. "In marked contrast to the lassitude of art nouveau or the vagaries of symbolism, to be a poet or artist in the early twentieth century seemed to many to require modes of art forceful enough to rival the new scientific energies and technologies."[80] This book provides an excellent example of the nuance and care with which a study that hopes to shed new light on both the history of science and the culture of modernism—an obvious goal for my dissertation—must strive to attain.

Existing Research on Science and Music

The complex interrelationships of science and music have, in general, been understudied by musicologists. There are, however, a number of important books that provide a foundation for my own research, though they deal primarily w/ other historical periods. In the musicological literature, many of these studies have focused on the direct

[79] Clarke talks more specifically about the idea of allegory both in an essay contained within *From Energy to Information* entitled "Dark Star Crashes: Classical Thermodynamics and the Allegory of Cosmic Catastrophe" and in another of his books *Energy Forms: Allegory and Science in the Era of Classical Thermodynamics* (Ann Arbor: University of Michigan Press, 2001).

[80] Bruce Clarke and Linda Dalrymple Henderson, editors, *From Energy to Information*, 3.

connection that Renaissance musicians and scientists saw between music and science. Music was one of the four branches of the Quadrivium, and this important place of music as one of the four pillars of scientific studies has been explored by music scholars like Claude V. Palisca, James Haar, Linda Austern, and Penelope Gouk.[81] These studies focus on a period of history in which music and science were viewed as one discipline (as opposed to parallel and mutually-shaping disciplines). As such these studies are methodologically distant from my own, but their subject matter provides a good historical foil for examining the very different way that music and science interacted during the early twentieth century.

Musicological texts about the interaction of music and science in later periods of history tend to be methodologically grounded in a "theory of influence" model (either scientific influence on music or vice versa). This differs greatly from the texts produced on music *as* science in the Renaissance; without a contemporaneously-perceived subsuming of music into the category of science, authors assessing the historical interaction of the fields in other periods describe the more nuanced links between the two. One example is Jamie C. Kassler's examination of the interactions of music and

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[81] Claude V. Palisca, "Moving the Affections through Music: Pre-Cartesian Psycho-Physiological Theories" and "Was Galileo's Father an Experimental Scientist?" in *Number to Sound: The Musical Way to the Scientific Revolution*, Paolo Gozza, ed. (Boston: Kluwer Academic Publishers, 2000); "Scientific Empiricism in Musical Thought," originally published in *Seventeenth-Century Science and the Arts*, Hedley Howell Rhys, ed. (Ann Arbor, MI: University Microfilms International, 1980); "The Science of Sound and Musical Practice" in *Science and the Arts in the Renaissance* (John W. Shirley and F. David Hoeniger, eds. Washington, DC: Folger Shakespeare Library, 1985). James Haar, *The Science and Art of Renaissance Music* (Princeton, NJ: Princeton University Press, 1998). Linda Austern, "'Tis Nature's Voice': Music, Natural Philosophy, and the Hidden World in Seventeenth-Century Science," in *Music Theory and Natural Order from the Renaissance to the Early-Twentieth Century* (Cambridge: Cambridge University Press, 2001). Penelope Gouk, *Music, Science, and Natural Magic in Seventeenth-Century England* (New Haven, CT: Yale University Press, 1999); *Representing Emotions: New Connections in the Histories of Art, Music, and Medicine* (Burlington, VT: Ashgate, 2005). See also D. P. Walker, *Studies in Musical Science in the Late Renaissance* (London: Warburg Institute, University of London, 1978) and Charles S. Singleton, ed., *Art, Science, and History in the Renaissance* (Baltimore: Johns Hopkins Press, 1967), for a general perspective.

scientific culture in the eighteenth century in her essay collection *Music, Science, Philosophy*.[82] Her discussion of the eighteenth and early nineteenth centuries (and the centuries that lead up to them) focuses mainly on music theory, rather than specific works of music. However, the collection as a whole offers a valuable methodological framework: she uses a concept of mobile models of thought in which groups of metaphorical terms are used to represent musical ideas.[83] In his book *Harmonious Triads: Physicists, Musicians, and Instrument Makers in Nineteenth Century Germany*, Myles W. Jackson, a historian of science, more concretely explores the specific interaction of music and science in Germany in the nineteenth century, examining music theorists, musical-instrument makers, and scientists, as well as their mutual influence on one another.[84] Musicologist Bennett Zon has examined nineteenth-century British "musicology" (which he defines broadly as any considered study of music including the tasks of both historians and theorists) and its reliance on metaphors of biology and evolution to describe music.[85] The idea of metaphor put forth by Zon is a useful tool, for unlike Kassler's notion of model theory, the examination of specific metaphors allows one to perform discourse analysis on the object of study (whether it is a theoretical text, a popular book, or a piece

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[82] Jamie C. Kassler, *Music, Science, Philosophy: Models in the Universe of Thought* (Burlington, VT: Ashgate, 2001).

[83] She writes: "It seemed to me that most considered discourse is not about reality but about representations of selected aspects of a particular domain of knowledge. Hence, models were a natural focus for my investigations because they present facts belonging to one category in idioms of another—for example, representing music *as if* it were matter in motion." Kassler, *Music, Science, Philosophy*, viii.

[84] Myles W. Jackson, *Harmonious Triads: Physicists, Musicians, and Instrument Makers in Nineteenth-Century Germany* (Cambridge, MA: MIT Press, 2006).

[85] Bennett Zon, *Music and Metaphor in Nineteenth-Century British Musicology* (Burlington, VT: Ashgate, 2000).

of music). This type of discourse analysis will be important especially for the examination of the three key concepts discussed in Chapters 2, 3, and 4.

A few recent studies have begun to examine the interaction of science and music at the end of the nineteenth century and into the first few decades of the twentieth touching on the beginnings of modernist thought. Some, like those by Mark Katz and Annegret Fauser, have explored the music-cultural importance of technological developments like the phonograph, the telephone, and electrical power.[86] These works, while not specifically about modernism, have helped to initiate musicological dialogues about science and technology in the modernist period. Other early twentieth-century studies have focused on modernism and science more specifically, such as Benjamin Steege's dissertation "Material Ears: Hermann von Helmholtz, Attention, and Modern Aurality."[87] Steege explores the scientific and musical contexts of Helmholtz's work and the impact that this famous acoustician had on modernist music history and musicology. Steege applies his research on Helmholtz to a specific modernist composer, Edgard Varèse, in an article in *Current Musicology* entitled "Varèse in Vitro: On Attention, Aurality, and the Laboratory." In both the dissertation and the article, Steege offers an excellent model of scholarship on science and modernism, one that blends historical criticism, close textual analysis, and the application of critical theory related to the history of science.[88]

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[86] Mark Katz, *Capturing Sound: How Technology Has Changed Music* (Berkeley, CA: University of California Press, 2004). Annegret Fauser, *Musical Encounters at the 1889 World's Fair* (Rochester, NY: Rochester University Press, 2005).

[87] Benjamin Steege, "Material Ears: Hermann von Helmholtz, Attention, and Modern Aurality" (Ann Arbor, MI: UMI Press, 2007).

[88] Benjamin Steege, "Varèse in Vitro: On Attention, Aurality, and the Laboratory," *Current Musicology* 76 (Fall 2003), 25–51.

Existing Research on Einstein, Modernism, and Music

There are a handful of brief references to Einstein and music within in the existing literature on modernism. While these references are few, they have served as life rafts to grab ahold of in the sea of my preliminary dissertation research. References are made in musicological, science history, and general scholarly literature, as well as in books intended for a general audience.

In the field of musicology, Glenn Watkins's *Pyramids at the Louvre: Music, Culture, and Collage from Stravinsky to the Post-Modernists* has served as an important jumping-off point for my research on modernist music and science. Although the book focuses on life in Paris in the early part of the twentieth century, it brings out important trends that have shaped my research. Watkins's book explores music in its broadest possible cultural context without making the subject unwieldy. This means discussing musical ideas in tandem with artistic and literary ones, as well as within their political, historical, and scientific contexts. Einstein is brought into the book in his discussion of the Parisian avant-garde in the 1920s. He notes that many participants in this aesthetically-minded circle—including painters Sonia and Robert Delaunay, as well as Stravinsky and his crowd—were interested in new ideas of time. He mentions both the philosophical interest, centered around Henri Bergson, and the more strictly scientifically view, focused on Einstein's theory of relativity.[89] Although he does not outline specific instances in which artists invoked Einstein or relativity theory, he suggests that relativity theory was in the minds of artists as part of a larger cultural discussion about simultaneity

[89] Glenn Watkins, *Pyramids at the Louvre: Music, Culture, and Collage from Stravinsky to the Post-Modernists* (Cambridge, MA: Belknap Press of Harvard University Press, 1994), 220.

and theories of time. His approach is useful because it offers an example of how to integrate musical analysis with cultural criticism.

Leon Botstein mentions modernist music very briefly in his essay "Einstein and Music" in *Einstein for the 21st Century: His Legacy in Science, Art, and Modern Culture*.[90] Although Botstein's essay focuses mainly on Einstein's personal relationship with music-making and his musical taste, the author does point out of a few of the ways that musical contemporaries of Einstein's like Dane Rudhyar may have been adapting some of the physicist's ideas in their writings about music.

Writers on modernism outside of the musicological field have also provided helpful starting points for my research. Two comprehensive books, Stephen Kern's *The Culture of Time and Space, 1880-1918* and Leonard Shlain's *Art and Physics: Parallel Visions in Space, Time, and Light*—are both examples of successful approaches to studying the multifaceted nature of modernism, and both include references to musical life in this context. Kern, a cultural theorist and historian, discusses Bergson's and Einstein's impact on early twentieth-century culture in *The Culture of Time and Space, 1880–1918*, and briefly examines the overall culture's (the *Zeitgeist*'s) influence on musicians in this time period.[91] Art historian Leonard Shlain mentions composers, especially Stravinsky, albeit briefly, when discussing modernist art and the impact Einstein and modern science had on that field.[92]

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[90] Leon Botstein, "Einstein and Music," *Einstein for the 21st Century: His Legacy in Science, Art, and Modern Culture* (Princeton: Princeton University Press, 2008), 161–175.

[91] Stephen Kern, *The Culture of Time and Space, 1880–1918* (Cambridge, MA: Harvard University Press, 1983).

[92] Leonard Shlain, *Art and Physics: Parallel Visions in Space, Time, and Light* (New York: Harper Perennial, 1991). See also Arthur I. Miller, *Einstein, Picasso: Space, Time, and the Beauty That Causes Havoc* (New York: Basic Books, 2001), although this book does not cover musical culture in any way.

These brief mentions of Einstein, modernism, and music together have done two things: provided useful starting points for my research and pointed out the gaps in our collective knowledge about this important time period. On of the aims of my dissertation is to fill in some of these gaps. Not only will I "present the facts in a new light," as Cowell did, I will also offer a tangible method for conducting interdisciplinary research within two traditionally separate subjects—musicology and the history of science—by focusing on this fascinating confluence of artistic and scientific culture.

In a way, the research in my project, which extends the typical bounds of musicological study, is perfectly in line with one final interaction of music and science that has not been touched open: the birth of musicology. While many of the composers discussed so far were working in the musical laboratory, some even working (as we will see) on theories of musical relativity and Einsteinian pieces of music, many of the music-writers were working to shape the emerging discipline of musicology, a field termed at that time "the scientific study of music." These early musicologists, like Charles Seeger, whom I will discuss later, saw their project as both scientific and musical. So, as I review the facts of this period marked by the confluence of modernism, science, and music, I am building on the work of the earliest musicologists and, in doing so, "presenting these facts in a new light."

Einstein, Modernism, and Music in a Nutshell

The body of my dissertation is organized into three chapters, each tackling one type of response to Einstein and his theories. The first deals with the reception of Einstein the man, the second with relativity as a theory, and the third with new conceptions of space and time, the contents of relativity. This division allows me to explore different aspects of the relationship between Einstein and modern music. Because both were cultural constructions, it is important to dissect them into their varying components to properly view the interactions. As a cultural concept, "Einstein" meant a number of things: it was a man, it was his theories as such, and it was the content of his theories. Similarly, for "modern music," the composers' personalities, their theories about what modern music should be, and the musical ideas themselves (the notes on and off the page, so to speak) made up the public's conception of what modern music was. By dividing my research into these three chapters, I am able to analyze the parallels between each of the aspects of the construction of both "Einstein" and "modern music." This helps to show how both scientific and musical cultures influenced each other, since these "constructions" were being formed in real time by real people, both inside and outside the respective fields of science and music.

In the first main chapter, "Chapter 2: Einstein," I explore the construction of Einstein's public persona and the ways in which composers of modern music built or intended to build their own personas as reflections of Einstein's. This chapter extends the work I began in this introduction—the examination of the composer as scientist. We saw earlier in the introduction that a number of composers were compared to scientists, assuming both the positive and negative associations of the scientist in American society. In Chapter 2, we will see that the more specific comparison of individual composers and composer archetypes to Einstein followed a similar path. Composers who were linked with Einstein were thought to have a connection with certain key personality traits that characterized Einstein's public persona. And while a scientist *in general* was seen as both hero and villain, Einstein was so overwhelmingly popular with the American public that most of the composer associations with him were intended to be complimentary (though in some cases, this was wishful thinking by composers themselves).

I start with an introduction to Einstein's burgeoning fame in Europe and America in late 1919, when Arthur Eddington announced that he had proven that Einstein's relatively-unknown general theory of relativity was correct. From this point on, Einstein's personal fame skyrocketed. In Europe and America, he became one of the most famous living scientists; he was compared with Isaac Newton and, in fact, was seen as Newton's challenger through his new theories. I discuss the specific characteristics of Einstein's public persona that defined Einstein the man. He was Einstein the Revolutionary, Einstein the Hero and Savior, Einstein the Genius, and Einstein the Understandable Intellectual. Most importantly, for this study, was a final aspect of his persona: Einstein the Musician. I focus in more depth on this final feature of Einstein's public persona by looking into the ways in which he was portrayed as a musician—as a violinist, a music lover, an artistic personality—and what these elements meant to the general public and to the music world. Einstein's status as a musician helped to humanize him and temper his genius persona for the masses. For musicians, Einstein's artistic personality symbolized the bridging of the gap between that which is intuitive or artistic and that which is rigorous and intellectual. Einstein's musical life drew composers to him, and from there, they were inspired to use Einstein—and his personality traits—to construct the ideal modernist composer. The remainder of that chapter explores the construction of an Einsteinian modernist composer by musicians and critics. I look at particular instances in newspaper articles, biographies, and books about music in which music writers see themselves as Einsteinian geniuses, heroes, revolutionaries, and understandable intellectuals. By focusing on composers' responses to Einstein's musical side, I emphasize what I see as the primary argument of this chapter, and perhaps this dissertation: modernist composers looked to Einstein as a model because they wanted their music to receive the same popularity amongst the general public that Einstein and his theories had.

In the following chapter, "Chapter 3: Relativity," I extend this argument to the theories themselves—that is, Einstein's theories as well as certain composers' theories of modern music. In this chapter I discuss how relativity was described to the American public in the newspapers, in books, and even in films. As part of this survey, I take note of the key tropes employed in the popularization of the theory amongst a non-scientific audience. Because these tropes were used not only by musicians, but also by artists in other fields including the visual arts, literature, and poetry, I examine these reactions to relativity. This also provides examples of scholarly approaches, a useful tool since a textual analysis of scientific thought in writings about music is so rare. These scholarly approaches also show parallels in some of the relativity-themed content I encounter in the theories of music.

Composers' reactions to relativity occurred in varying kinds and degrees. Some composers latched on to the symbolic importance of relativity, as a model for intellectual change—Dane Rudhyar's writings fall squarely into this category. As early as 1922, he advocated a musical revolution comparable to that offered in the science world by Einstein's newly popularized theories. Other composers attempted to mimic the rigorousness of Einstein's relativity theories while borrowing some of the physicist's terminology. Composer-teacher Joseph Schillinger attempts this in his theory of musical composition, published posthumously in 1946. His work straddles the more form-based responses with the more-content based ones. Charles Seeger's articles from the late 30s and early 40s also show a desire to capitalize on the cultural weight that Einstein's theories had, in a fashion similar to Rudhyar. Both Henry Cowell and Ezra Pound, the latter writing about George Antheil, used Einstein's theories as models for their theories of music. In addition to integrating the symbolic significance of Einstein's theories, both writers imported ideas from relativity in their treatises about modern music. The depth of these authors' intellectual relationship with relativity theory shows just how significant this scientific trend was to modernist musical life.

The fourth chapter, "Chapter 4: Space-Time," explores this final piece of the love story between American modernist music and Einstein's theories. Having already examined how composers thought of themselves as Einsteins of music and believed their theories to be comparable to and reflective of relativity theory, I turn to the music itself. The inclusion of musical pieces in this chapter helps to show the diversity of responses to Einstein's persona and theories within musical life. It also reveals the breadth of musical production that Einstein's ideas reached, for in this chapter we encounter both conscious and unconscious incorporations of new ideas about space and time in music.

Before discussing the details of how Einsteinian ideas of space-time infiltrated modern music, I explore both the older conceptions of space and time (dating back to the classical era) and the newly reconfigured notions of time and space according to Einstein. With respect to the earlier views of space and time, I examine briefly how these ideas shaped musical notions of space and time in their day. This sets up an important parallel between the older conceptions of space and time and their effects on music in contrast to the newer space-time theories and their effects on modern musical life. This works well because of the fact that many of the tonal and rhythmic conceptions that modernists eschewed had close ties with earlier notions of space and time. Because I have, in the previous chapter, surveyed many of the key newspaper articles and other print materials that would have informed the general public's—and the composing public's—opinion of space-time, this chapter moves into the ways in which music was seen to embody Einstein's concepts.

I first explore the music of composers whose works were considered Einsteinian by the general and musical publics. For many of these composers and their works, there was often an overarching stylistic trait that marked the works as Einsteinian. This designation was given by recent scholars, contemporaneous critics, or sometimes both. I begin examining two composers whom recent scholars have deemed Einsteinian in their approaches to space and time in composition—Charles Ives and Henry Cowell. I explore how simultaneity in Ives' music paralleled Einstein's ideas about this concept, just as similarly *avant-la-lettre* Einsteinian aesthetics were observed in late-nineteenth-century painters. For Cowell, I examine his development of tone clusters as a marker for the collapsing of space and time in an Einsteinian universe. Later in this section, I explore the ways in which Stravinsky and Schoenberg were both considered Einsteinian composers by the American public, not so much because their personas reflected that of Einstein, but because something in their compositional style resonated with Einstein's theories and their cultural significance. I explore the reception of these two figures, neither of whom identified with Einstein on a personal or ideological level, to show how the public's perception of both Einstein's theories and these composers' musical contributions were linked.

In the final portion of this chapter, I explore the compositions of two composers who attempted to compose using theories of space and time—or pitch and rhythm—that could only have existed in a post-Relativity world. I look first at Edgard Varèse's uniquely four-dimensional notion of musical space. After discussing Varese's interest in physics, I point out the ways in which his ideas about musical space and time were specifically Einsteinian, employing new notions about space-time borrowed from popular distillations of relativity theory. I analyze his unfinished stage work *Espace* in this light, uncovering the ways in which various ideas about space-time infiltrated this composition. Following my discussion of Varèse, I focus on George Antheil's theory of "time-space," a theory of musical composition that Antheil developed while living in Paris. I explore Antheil's construction of this theory in his writings and in the writing of Ezra Pound, the composer's first true supporter. After establishing the nature of Antheil's conception of time-space, I explore the ways in which it tied into Einstein's notions of space-time (as popularized in books and newspapers). Finally, I analyze Antheil's most well-known work—and one which he himself saw as the apex of musical composition in time-space—his *Ballet Mécanique*.

Rather than summing up the details discussed in the previous chapters, I conclude my dissertation in "Chapter 5: Conclusions" by looking forward to the future interactions between Einstein, music, physics, and modernist thought. In doing so, I am able to explore, for reasons that I will discuss in the conclusion, many of the most famous overlaps between Einstein and music including, for example, Philip Glass's *Einstein on* *the Beach*. I also offer insight into the ways in which studies of music and science might progress, on the one hand, by pursuing other post-Einsteinian connections between music and science that I point out in the conclusion, and, on the other, by following in my methodological footsteps.

I believe my dissertation marks an important step in both musicological scholarship and work in the history of science precisely because it combines the two. I look forward to the many discussions that I hope will come out of this dissertation and its construction. I now welcome even more curious and skeptical reactions, indignant responses, as well as the personally and professionally enriching discussions that will come out of this exploration of Einstein, modernism, and musical life in America.

CHAPTER 2

EINSTEIN

On 31 December 1999, *Time* magazine named their "Person of the Century." Beating out Franklin Delano Roosevelt and Mohandas Gandhi was Albert Einstein, physicist, pacifist, sometimes philosopher, and lifetime musician. This honor marked the culmination of eighty years of American (and international) fame for Einstein. In the time between the proclamation that Einstein's General Theory of Relativity had been proven correct in November 1919 and *Time* magazine's "Person of the Century" announcement, Americans had come to know many aspects of the physicist's personality, life, and work. Some of these elements are captured in photographs: Einstein with his tongue out, Einstein with a violin, or Einstein on his sailboat. Some are preserved in writing: Einstein's own explanations of relativity, his essays on religion and human rights, and his letters to and from children. Others are present in our idiomatic use of Einstein's name as a synonym for genius: phrases like "He's no Einstein!" or products like the "Baby Einstein" series of educational cartoons for infants.

In his article "Why Einstein Became Famous in America," Marshall Missner argues that Einstein's fame in America was the result of the unique portrayal of the scientist and his theories in the American press between 1919 and 1921.[1] In November 1919, the press announced the confirmation of Einstein's theory of relativity. Because it

[1] Marshall Missner, "Why Einstein Became Famous in America," *Social Studies of Science* 15/2 (May 1985), 267–291.

was immediately hailed as a groundbreaking theory, ending ideas about the universe held since the time of Newton and even Copernicus, it was discussed often and enthusiastically in the press. Thus when Einstein made his way to America in 1921, his personal fame was immediate. Roger Rosenblatt argues further, in an article that appeared in *Time* magazine in the issue announcing the "Person of the Century," that Einstein's fame was the result of his portrayal as a distinctly American hero. He states:

> For Einstein to become a modern icon, especially in America, required a total revision of the definition of a hero. Anti-intellectualism has been as integral a part of American culture as the drive for universal education, and the fact that both have existed concurrently may account for the low status of teachers. *In America it is not enough to be smart; one must compensate for one's intelligence by also showing the canniness and real-world power of the cowboy and the pioneer. Einstein did this.* He was the first modern intellectual superstar, and he won his stardom in the only way that Americans could accept—by dint of intuitive, not scholarly, intelligence and by having his thought applied to practical things, such as rockets and atom bombs.[2]

Like Missner, Rosenblatt sees Einstein's fame as centered on his humanization, a process that came to a head in 1921. The shift from Einstein, creator of a revolutionary theory, to Einstein the celebrity is reflected in the press between November 1919 and summer of 1921, when Einstein toured America. What both Missner and Rosenblatt missed in the equation that explains Einstein's rise to fame, however, is the role of music. Arguably, the single most important element in the shift from Einstein the distant intellectual to Einstein as a household celebrity was the press's use of Einstein's musicianship.

In this chapter I explore Einstein's reception in the United States beginning with the critical period around 1921. Four key tropes were used in the American press to characterize Einstein the man: Einstein the Revolutionary, the Hero/Savior, the Genius,

[2] Roger Rosenblatt, "The Age Of Einstein: He became, almost despite himself, the emblem of all that was new, original and unsettling in the modern age," *Time* 154/27 (31 December 1999), 90. Emphasis mine.

and the Understandable Intellectual. To these four tropes, a fifth can be added—one that came to the fore with Einstein's first visit to the U.S.: Einstein the Musician. This final trait aided in the important shift towards celebrity that could only have occurred once Einstein was seen as an accessible, regular human being. I highlight some of the ways in which Einstein was portrayed as a musician: a lover of music, a charity performer, and, most importantly, as a violinist. These are the elements of Einstein's American reception that would have drawn in a musically-oriented readership both because of their familiarity and their role in making Einstein the American hero for a general audience.

For the musically-minded readers—the composers and music-writers that I will discuss in this chapter—these fives tropes constituted nodes of identification; they could see in Einstein the ideal role model for their modernist agendas. Like the physicist, modernist composers saw themselves as breaking away from the past, relieving their shoulders of the weight of a century and a half of musical expectations. Indeed, the choice of Einstein as an icon for American musical modernism says a great deal about modern music's aesthetic ideologies and provides a window into the discourses of modernism in the United States. Perhaps because of the abstract nature of some of the compositions by American modernists, even to the twenty-first century ear, scholars often wrongly assume that this musical migration away from the tonal and pleasing sounds of the nineteenth century was an aggressive aesthetic goal, purposefully distanced from what musical audiences wanted. Whatever audiences may have heard in the 20s, 30s, and 40s, my study makes clear that modernist composers believed their aesthetic theories and compositions to be relevant to their audience. In choosing Einstein as a role model, an immensely popular figure in spite of the intellectually challenging theories he was associated with, composers were hoping to appeal to the public, to make their theories culturally relevant. This radical reappraisal assesses outdated histories of American musical modernism and builds on recent historiographical trends seen in the work of scholars like Carol Oja and Ellie Hisama. Through the lens of Einstein and music we can re-envision both a particular aspect of music history in America and take a new look at the place of musical modernism in American culture as a whole.

I. The World Meets Einstein

As one of the most famous expatriates to settle on American soil, Albert Einstein represents a quintessential part of what it is—or was, especially in the first few decades of the twentieth century—to be "American." His American-ness was transnational, bridging European and U. S. cultures. Before we explore why and how musicians and composers, many of whom were European emigrants, were drawn to Einstein in America, it is necessary to understand who Einstein was in Europe and how he was received there.

Though Einstein's *annus mirabilis*—the year he published four of his most important papers on physics—took place in 1905, he achieved world renown much later, beginning in 1919 and reaching its culmination in 1922. Einstein, who was born in Germany, but became a Swiss citizen as a young adult, lived largely in public and even professional anonymity after he finished his schooling at the Swiss Federal Institute of Technology in Zurich. While he was publishing some of his (later) well-known work, Einstein was working as a patent officer at the Federal Office for Intellectual Property in Bern. The physicist went largely unknown in the world of science between 1905 and

1911, despite his four papers and his appointments at the universities in Bern and Zurich. During this time, he continued to work on his ideas in theoretical physics, including his General Theory of Relativity, but this remained under the public radar. In 1911, Einstein published a paper on the effects of gravity on light, one which—if proved—would confirm his as yet unpublished General Theory of Relativity. In the 1911 paper, Einstein issued a challenge to astronomers to measure the bending of light around large celestial bodies, but it went unanswered in spite of the urging of Einstein's colleague Edwin Findlay-Freundlich. Einstein finally published the General Theory in 1915, after wavering on certain ideas, affirming his contention that gravity was a distortion of space-time by matter and that the bending of light at a certain angle would prove this. Einstein's indecision and the resulting delay in publication did not postpone any potential progress made towards answering Einstein's 1911 challenge—but the First World War did. It was not until 1917 that any astronomers took up Freundlich's call to prove his physicist-colleague's theoretical ideas.[3]

To prove—or disprove—Einstein's newly published General Theory of Relativity, astronomers would have to observe the degree to which light was distorted when it passed through a strong gravitational field. This would demonstrate Einstein's prediction that what we perceived as gravitation was really a curvature of space itself around a massive body. Since Newton's time, astronomers had known that the light from a distant star would appear shifted slightly from its true coordinates because, it was thought, the gravity of large astronomical bodies pulled the light toward the body and

[3] A total eclipse of the sun did occur before 1917, in August of 1914, and it would have been visible from Crimea. Much to Einstein's dismay (and Freundlich's—as he had been dispatched to Eastern Europe by Einstein to observe it), war broke out in the region and the eclipse could not be observed.

bent it. But if as Einstein predicted, the shift (a phenomenon known as gravitational redshift) was greater than that acknowledged by Newton, Einstein's theory would be given experimental confirmation. This redshift can be observed during a total solar eclipse using specific astronomical instruments, thus narrowing the window of opportunity for astronomers. In 1917, the first of two American efforts took place in the United States. Astronomers at the Mount Wilson Observatory, located outside of Los Angeles, performed experiments that actually disproved Einstein's claims. Undeterred, the Lick Observatory, also in California, attempted to measure for gravitational redshift one year later in 1918 and again found that nothing unusual could be detected. On a hunch, the astronomers at the Lick Observatory held off on the publication of these findings, believing (irrespective of their data) that Einstein was correct.

In 1919 Arthur Eddington of Great Britain set off on an astronomical expedition to photograph a total eclipse of the sun from two vantage points, Principe, off the western coast of Africa, and Sobral, Brazil, on 29 May 1919.[4] Eddington's team of astronomers had photographed Eddington himself worked at the location in Africa and was disappointed with the partially cloudy skies; in Brazil his team had trouble with some of the equipment meant to produce photographs of the eclipse—those that would photograph, more importantly, the tiny specks of starlight seen next to the darkened sun. Eddington's teams returned to England and began processing their findings, calculating the shift of the stars with respect to their normal locations. In his General Theory of

[4] Though it seems surprising that a British team would be dispatched to help prove a German's scientific theory in the midst of war, it was actually part of Eddington's remedy for his pacifist leanings. Rather than be jailed for his conscientious objection to the First World War, Eddington served as part of this expedition that would bring international prestige to Britain through scientific achievement. This being said, the expedition actually departed in March of 1919, shortly after the war ended.

Relativity, Einstein had asserted that light would be deflected as it passed next to the sun by a number double to Newton's assumption of .85 arc-seconds (a unit of angular measurement). Einstein stated that the gravitational redshift observed during an eclipse "stars ought to appear to be displaced outwards from the sun by 1.7 seconds of arc, as compared with their apparent position in the sky when the sun is situated at another part of the heavens."[5] The African cloudy-sky slides revealed a redshift of about 1.6 arc-seconds; on the slides from Brazil Eddington saw conflicting accounts: one had a deflection of 1.98 arc-seconds and the other—blurred because of the heat—showed only a 0.86 deflection. Despite the mixed messages Eddington made an announcement to the scientific community: Einstein was right; the world according to Newton needed to be radically reconsidered. After Eddington presented his research to the British Royal Society on the 6 November 1919, the *London Times* produced an article with the headline "Revolution in Science – New Theory of the Universe – Newtonian Ideas Overthrown."[6]

Word of this new theory of the universe spread quickly to the general public in Europe and it soon made its way to America as well. Einstein himself learned of the data collected from the Eddington expedition at least a month before the Royal Society's meeting, as did scientific professionals in Germany, France, and of course Britain. But when the *London Times* announced a "revolution in science"—and newspapers around the globe echoed this statement—the general public was introduced to the theories of relativity and to Einstein.

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[5] Albert Einstein, *Relativity: The Special and the General Theory* (1916), Chapter 22. Available online at www.Bartleby.com/173. [accessed 1 March 2009]

[6] "Revolution in Science – New Theory of the Universe – Newtonian Ideas Overthrown," *London Times* (7 November 1919), 12.

British Reception

Because Eddington's British expeditions to South America and Africa were first to publicly prove Einstein's General Theory of Relativity correct, it was the British press that had the greatest impact on how the news was received. The British press was quick to report on Eddington's (and by extension Britain's) success. The British reception of Einstein established a number of trends used to describe the man and his theories. The three I would like to discuss were connected to themes of British national pride, but they also shaped the way that the American public understood Einstein the man. The first trend was the idea that Einstein was a popular figure, the second was that he was a revolutionary, and, finally, that he was—at least as far as relativity was concerned—a philosopher in addition to a physicist.

One day after Eddington announced his findings at the meeting of the Royal Society (6 November 1919), the *Times* published an article that brought the news to the public. It documented the general agreement that Einstein's discovery was "the most remarkable scientific event since the discovery of the planet Neptune"[7] and president of the Royal Society Sir Joseph Thomson's observation that it was "one of the most momentous, if not the most momentous, pronouncements of human thought."[8] These statements established the idea that Einstein was a revolutionary by virtue of his theory. The title of this story focuses on the idea of scientific revolution (Figure 2.1):

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[7] Neptune was discovered by mathematical calculation, based on an anomaly in Uranus' orbit, in September 1846.

[8] "Revolution in Science – New Theory of the Universe – Newtonian Ideas Overthrown," *The London Times* (7 November 1919), 12.

REVOLUTION IN SCIENCE.

NEW THEORY OF THE UNIVERSE.

NEWTONIAN IDEAS OVERTHROWN.

Figure 2.1 - London Times (7 November 1919)

The following day's article of 8 November reiterated this idea of a "Revolution in Science," but extends the revolution to the physicist. It specifically pitted Einstein against Isaac Newton—not their ideas (as in 7 November's title), but the men themselves (Figure 2.2).

THE REVOLUTION IN SCIENCE.

EINSTEIN v. NEWTON.

Figure 2.2 - London Times (8 November 1919)

As one learns within the latter article, Einstein won. But for England, the idea of revolution was not simply a combative one. It was also interested in a revolution as newly reworked worldview (as in the "Scientific Revolution" or the "Industrial Revolution") based on Einstein's ideas—and pride in Eddington's achievements at proving them. We can see these two meanings in the two similar titles. These two notions of revolution needed to be brought together, however, as British citizens wanted to claim Eddington's expedition and Einstein's discoveries, in turn, but without disavowing their national scientific hero, Newton. Eddington's victory in the race to prove Einstein's theories seems to have mediated the fact that Einstein, a German Jew, had toppled Newton's principles. We can see this concern in the careful portrayal of Einstein in the first article, which helped to diminish the foreign (or more specifically German) aspects of his biography and allowed for an easier adoption of the physicist by British citizens. He was billed as a Swiss Jew, a professor at the University of Prague, and an anti-German revolutionary of sorts:

> During the war, as a man of liberal tendencies, he was one of the signatories of the protest against the German manifesto of the men of science who declared themselves in favor of Germany's part in the war, and at the time of the Armistice he signed an appeal in favor of the German revolution.[9]

Despite Einstein's having grown up in Munich and his current residence in Berlin, the article plainly assigns him a non-German identity. This fact must have helped resolve any potential tension related to Einstein's "triumph" over Newton.

As the reception of Einstein in Britain unfolded in the press each day, a second trend became clear: Einstein was popular. The 8 November *Times* article begins:

> Wide interest in popular as well as in scientific circles has been created by the discussion which took place at the rooms of the Royal Society on Thursday afternoon on the results of the British expedition to Brazil to observe the eclipse of the sun on May 29.[10]

This *Times* author is already able to note the "wide interest" among a diverse audience—from the general public to the members of the Royal Astronomical Society—just two days after Eddington's announcement had been made. This unlikely, near instant fame is the result not of some superior scientific knowledge on the part of the British public, rather it was developed from what we would call "hype." In his 2002 article "Constructing a 'Revolution in Science': The Campaign to Promote a Favorable Reception for the 1919 Solar Eclipse Experiments," science historian Alistair Sponsel

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[9] "The Revolution in Science – Einstein v. Newton – Views of Eminent Physicists" *The Times* (8 November 1919), 12.

[10] "The Revolution in Science – Einstein v. Newton – Views of Eminent Physicists" *The Times* (8 November 1919), 12.

points out that by the time the results of Eddington's experiments were announced, any *Times* reader would have already been familiar with the experiments and their implications.[11] The coming eclipse was announced in the *Times* as early as January 1919, and, in a later article, its author restated (expedition member) A. C. D. Crommelin's assertion from *Nature* that

> There are three possibilities: no shift, the half shift [the amount predicted by Newton's theories], or the full Einstein shift. The definite establishment of any one of the three as the truth would be an important addition to our knowledge of physics.[12]

This "false trichotomy" (as Sponsel puts it), familiar early-on to readers of the *Times* and *Nature*, allowed both lay and professional audiences to process Eddington's November announcement immediately and positively. In the 8 November article, the author's remark about "wide interest" documents this background reception, but it also undoubtedly had the effect of generating a great deal of further interest in the theories of relativity and in Einstein. This tactic—overstating the public interest to increase the popular intrigue, or hype—would also be used in the American press.

One of the ways that this trend was picked up was through the *Times*' publication of editorials. Prominent scholars' opinions of relativity were expressed, often focusing on the ways in which it has been discussed in print—and in the pubs. In the British press, popular interest was effectively maintained by "reporting" on popular interest. The editorials contained phrases like "the great interest that has been aroused by the recent

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[11] Sponsel's assertion is based on an exhaustive survey of the British press. See Alistair Sponsel, "Constructing a 'Revolution in Science': The Campaign to Promote a Favourable Reception for the 1919 Solar Eclipse Experiments," *The British Journal for the History of Science* 35 (December 2002), 439–467.

[12] Sponsel, "Constructing a 'Revolution in Science'," 444. Bracketed insertion mine.

verification of Einstein's prediction"[13] and "he [Einstein] is famous just now."[14] Strangely, Einstein's immediate personal fame in Britain had only a subtle impact on the way that Americans received him. Although the American press immediately picked up on the news of Eddington and relativity in November 1919, Einstein himself did not become truly "famous" in America until 1921. This delayed celebrity was most likely due to Einstein's status as foreigner, changed only with the physicist's first steps on American soil. Yet when that time came, with the preparation of his theories' fame (to be discussed further below) and his celebrity status in Britain, Einstein was able to achieve notoriety in the United States of America almost immediately.

Beyond Einstein's portrayal as a revolutionary and popular figure, he was also often dubbed a philosopher, by virtue of the fact that many believed relativity had more metaphysical ramifications for the average person than physical or scientific ones. On 7 November 1919, when the Royal Society's meeting was first discussed in the *Times*, the newspaper also published an editorial titled "The Fabric of the Universe," in which the author discusses how Einstein's theory might necessitate a reappraisal of the way humans think about the world around them. This statement set the stage for many more discussions of Einstein's theory with respect to philosophy.

> ...it is confidently believed by the greatest experts that enough has been done to overthrow the certainty of ages and to require a new philosophy of the universe, a philosophy that will sweep away nearly all that has hitherto been accepted as the axiomatic basis of physical thought.[15]

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[13] "Newton and Einstein – Historical Theories of Space – To the Editor of the Times," *The Times* (25 November 1919), 8.

[14] "Dr. Einstein's Theory," *The Times* (28 November 1919), 13.

[15] "The Fabric of the Universe," *The Times* (7 November 1919), 13.

In an editorial published on 25 November 1919, H. Wildon Carr (a professor at King's College London and author of books on Einstein and relativity) hypothesized about the curious surprise of scientific specialists at the philosophical interest in Einstein and his theories, bringing back the familiar figure of Newton to do so.[16]

> ...general surprise has been expressed at the discovery that the real interest of the problem is not mathematical, but philosophical. It is difficult to imagine, however, that any interest would be shown in the matter at all, outside the narrowest specialist circles, were the interest not philosophical. But the reason it calls forth surprise on all sides, including the mathematicians and physicists and even philosophers themselves, is really that so few people now are able to think of Newton as his contemporaries thought of him, that is, as the founder of a new philosophy.[17]

Thus both Einstein and Newton were presented not as abstract scientists but as thinkers who engaged with the nature of the universe. Both were presented as foundational philosophers. Although Einstein did not engage in a debate with a modern philosophical opponent in England (as with Bergson in France), the idea that his thoughts (in addition to his scientific theories) carried philosophical weight took root here, and would continue to shape how Einstein was perceived for many decades both in England and abroad.

German Reception

Einstein learned from colleagues that Eddington's expedition to Brazil and Africa had been a successful one—as far as he was concerned—by late September 1919. The German-speaking public was also made aware of the news well before the British announcement triggered by the November meeting of the Royal Society. In early

[16] H[erbert] Wildon Carr was the author of *The General Principle of Relativity in its Philosophical and Historical Aspect* (London: Macmillan and Co, Limited, 1920) and *A Theory of Monads; Outlines of the Philosophy of the Principle of Relativity* (London: Macmillan and Co, Limited, 1922). In addition to this, he translated many of Bergson's books into English and published a monograph entitled *Henri Bergson: The Philosophy of Change* (London: T. C. and E. C. Jack, 1911).

[17] H. Wildon Carr, "Newton and Einstein – Historical Theories of Space – To the Editor of the Times," *The Times* (25 November 1919), 8.

October, the news of the validity of Einstein's General Theory of Relativity hit the presses in two key documents: first, an article explaining the Eddington expedition and its impact on the veracity of Einstein's prediction; second, a brief letter from Einstein himself, reaffirming the success of the expedition's findings.[18] Alexander Moszkowski, who later published a popular book on Einstein, wrote in an 8 October 1919 article published in the *Berliner Tageblatt* that:

> The apparent distance between the measured stars corresponds, within experimental error, to the magnitude predicted by Einstein. Which is only possible if Einstein's fundamental scaffold, the general theory of relativity, can be taken to be the true constitution [the word is used in its political sense] of the universe.[19]

This announcement prompted Einstein to direct a letter to *Naturwissenschaften* (which was republished and further explained in *Vossische Zeitung*). This is the first news Germans received that hinted at the success of Eddington's observations, but they were familiar with the eclipse as early as April 1919, one month before it took place. Thus they were already primed to receive the information once it resurfaced in the fall; this preparatory journalism parallels the technique used in Britain of the "false trichotomy," although it does not push the argument as far.

Einstein's true fame in Germany began slightly later than the first news of Eddington's experiments, although how much later is still under debate by historians. Ronald W. Clark characterized this fame as an overnight phenomenon, stating that "Einstein awoke in Berlin on the morning of November 7, 1919, to find himself

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[18] Lewis Elton, "Einstein, General Relativity, and the German Press, 1919–1920," *Isis* 77, No. 1 (March 1986), 95–103.

[19] *Berliner Tageblatt* 476 (8 October 1919). Cited in Elton, "Einstein, General Relativity, and the German Press," 97.

famous."[20] Lewis Elton doubts the immediacy of Einstein's fame as assessed by Clark, pointing out the rather dry article appearing on 18 November in the *Vossische Zeitung* detailing the Royal Society's meeting and an essay in the same newspaper twelve days later by Edwin Freundlich (the early champion of Einstein) that states: "A scientific event of extraordinary significance has not yet received the acclamation in Germany that according to its significance it deserves."[21] However, by late November and certainly by December, the German press picked up on the more sensational tone used in the British and American presses and Einstein and his theories appeared on the front pages of the *Frankfurter Zeitung* and the *Berliner Illustrirte Zeitung*. After articles like these appeared, the German public began to recognize the importance of Einstein's theories—and started recognizing the man himself in the streets of Berlin.

Einstein's fame in Germany, as pointed out by Elton, was more along the lines of a respectful reverence for the internationally-known scientist among them. This interest in Einstein differed greatly from the "personality cult" created in Britain thanks to the *Times* (we will see this again in the United States with the *New York Times*). According to Elton:

> . . . the German treatment in equivalent newspapers was restrained and informed: it did not present the issues in terms of antagonists; and it stressed the potential comprehensibility of the theory and not its intrinsic incomprehensibility.[22]

Einstein was not metaphorically battling Newton in the German press, nor was his work (as we will hear in the American press) a "theory for twelve men." Rather, he was an

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[20] Ronald W. Clark, *Einstein: The Life and Times* (New York: Harper, 1973), 231 (cited in Elton, 98).

[21] *Vossische Zeitung* (18 November 1919, evening) and Edwin Freundlich, "Albert Einstein: On the Victory of His Theory of Relativity," *Vossische Zeitung* (30 November 1919, morning). Both quoted in Elton, 98.

[22] Elton, "Einstein, General Relativity, and the German Press, 1919–1920," 101.

intellectual associated with a well-known and very thought-provoking theory. This "respectful" German reaction to Einstein nevertheless induced a fair amount of anxiety in the physicist. In letters to friends and colleagues dating December 1919 and later, Einstein starts to complain of the burden of notoriety in his homeland, feeling "much pestered by the excessive adulation."[23] Thus when Einstein traveled outside his native land, into France and across the ocean in the U.S., the more overt personal fame, which had been transmitted from the British printed-word reaction to the scientist, must have seemed simply outrageous.

French Reception

French popular interest in Einstein and his theories really only began in 1922, not with the 1919 eclipse. 1922 marked the year that Einstein traveled to Paris, an invited guest of French physicist Paul Langevin. An important trend characterized French reception of Einstein: the philosophical import of the theories remained at the center of the press related to Einstein—possibly because of Henri Bergson's public debate with the physicist on the nature of time.[24] In this way, Einstein the person was seen as a philosophical figure, in addition to his status as physicist. This made him much more interesting and accessible to the general public.

In April 1922, Einstein visited Paris and was welcomed (mostly warmly) by scholars and intellectuals in many fields including, of course, physics. Before Einstein's official visit and lecture at the Collège de France, his theories had received much

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[23] Einstein in a letter to Michele Besso, 26 July 1920. Cited in Elton, "Einstein, General Relativity, and the German Press, 1919–1920," 98.

[24] Philosopher Henri Bergson published *Durée et simultanéité: À propos de la théorie d'Einstein* (*Duration and Simultaneity: A Response to Einstein's Theory*) in 1922. The two also debated at a meeting of the Société Parisien de Philosophie.

attention in the form of a series of public lectures given by Paul Langevin, professor of physics at the Collège. Between 1919 and 1922, all of Langevin's public lectures revolved around the theme of "Relativity and Gravitation."[25] Then (as now), the Collège de France was a free university located in the heart of Paris, near the Sorbonne. The lectures, given by some of the most distinguished scholars from France and abroad, have tackled topics of broad interest while adhering to rigorous academic standards set in place by the Collège at the time of its founding in 1530. Because they were open to the public (and later published) Langevin's lectures served to educate an audience outside of the professional and academic world of physics. Similarly, when Langevin arranged for Einstein to visit Paris in April of 1922, the main event of Einstein's tour was a lecture scheduled at the Société Française de Philosophie (the French Philosophical Society).[26] Einstein's visit to Paris made headlines in multiple Parisian periodicals including *Le Temps*, *Le Figaro*, *L'Humanité*, *Excelsior*, *La Croix*, *L'Écho de Paris*, *Le Gaulois*, *L'Œuvre*, *L'Action française*, *Paris-Midi*, *Bonsoir*, *L'Éclair*, *L'Ève nouvelle*, *Le Matin*, *Le Petit Parisien*, *Le Peuple*, *La Presse*, and *Le Journal*. Many of them included photographs of Einstein and discussed the public's interest in Einstein.[27] On 6 April 1922 (just over a week after Einstein arrived in Paris), a journalist in *L'Éclair* asked the question:

> Why does the general public seem to be interested in Einstein's theories, in as much as they can understand them? Without a doubt it is because the

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[25] B. Bensaude-Vincent, "When a Physicist Turns on Philosophy: Paul Langevin (1911–39)," *Journal of the History of Ideas* 49 (April-June 1988), 320.

[26] B. Bensaude-Vincent, "When a Physicist Turns on Philosophy," 321.

[27] Michel Biezunski, *Einstein à Paris: Le temps n'est plus...* (Saint-Denis, France: Presses Universitaires de Vincennes, 1991), 19 (fn 17)

> general public instinctively sees in the theories the old theme 'everything is relative.'[28]

This remark displays the near-immediate popularity of the scientist and the interest in the theories—even if the Parisians understood them from a loosely philosophical perspective rather than from any scientific position.

This philosophical perspective on Einstein's theories carried over to the French view of Einstein the person. Einstein was often linked rhetorically with Henri Bergson whose arguments on the nature of time and duration, put forth in *Durée et simultanéité* (*Duration and Simultaneity*)(1922), were distinctly leveled at Einstein. This pairing even made its way into an early French biography of Einstein entitled: *L'incroyable Einstein: ses théories scientifiques et leurs conséquences; de Leibnitz à Bergson; une métaphysique nouvelle* (The Incredible Einstein: His Theories and Their Impact; from Leibnitz to Bergson; a New Metaphysics).[29] Other works picked up on Einstein's newly-decided status as philosopher following the 1922 Einstein-Bergson debate that accompanied the publication of the philosopher's book. *La révolution philosophique et la science: Bergson, Einstein, Le Dantec, J.-H. Rosny* (1924) also explored Einstein's philosophical impact by relating his theories not only to those of Bergson, but also to the ideas of the biologist and philosopher of science, Félix le Dantec, and the science-fiction

[28] "Pourquoi le grand public semble-t-il s'être intéressé aux théories d'Einstein, tout au moins en ce qu'elles aient pu atteindre son entendement ? Sans doute parce qu'étant des théories de la relativité, instinctivement les gens d'une certaine culture générale les ont rattachées au vieux thème du tout est relative." [translation mine] Quoted in Michel Biezunski, *Einstein à Paris*, 38.

[29] F Jean-Desthieux, *L'incroyable Einstein: ses theories scientifiques et leur consequences; de Leibnitz à Bergson; une métaphysique nouvelle* (Paris: Carnet critique, 1922).

writer, Joseph Henri Honoré Boex, who published—sometimes together with his brother—under the pseudonym J.-H. Rosny.[30]

American Reception, November 1919 to April 1921

The British, German, and French receptions of Albert Einstein established a number of important trends that related to or even influenced the American reception of the scientist. In the German and French portrayals of Einstein, we see how two different cultural groups responded to a figure that had been in their midst. German newspapers reflected the reverential reaction the public had toward Einstein, although Einstein's letters tell a different story about the everyday reality of fame, however respectful. The French public's reaction came out of a similarly venerating position, likely having to do with the academic circumstances under which Einstein first visited Paris. Einstein was viewed as a respected scientist and philosopher—unsurprising given the nature of the events choreographed by Paul Langevin in 1922. The coverage of these events in the press, like the German reportage, reinforced this perception for the general public. The German and French reactions to Einstein made their way into American print news, contributing to the U.S. public's view of Einstein as a genius well worthy of respect and admiration.

The German and French receptions of Einstein are important not only because of their influence on Americans' opinions through their adoption by the U.S. press; they also need to be considered because they may well have shaped the perceptions of musicians who grew up in Germany and France and then migrated across the Atlantic in the 1920s and '30s or those Americans who spent many of their creative years in Europe. Dane Rudhyar, George Antheil, and Edgar Varèse all spent lengthy periods of time in

[30] J. Sageret, *La révolution philosophique et la science: Bergson, Einstein, Le Dantec, J.-H. Rosny* (Paris: Alcan, 1924).

Paris, absorbing French popular culture.[31] Arnold Schoenberg and Ernst Krenek both resided in Vienna and Berlin before moving to the United States in the 1930s. These transnational currents in Einstein reception are important to note, then, because many of the composers and critics who play a crucial role in this dissertation were literally moving between nations.

In contrast to the more mediated influence in the United States of the continental European response to Einstein, many of the sensational trends found in the British reception of Einstein had a direct impact on how Einstein was received by the American public.[32] The technique of hype, as explored in some detail in the British reception of Einstein will also been seen in the American press, and even gained momentum with news of Einstein's visit to America in 1921. Even some of the idiomatic linguistic markers used in the *Times* made it into the *New York Times*.[33]

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[31] Dane Rudhyar was born in Paris, but moved to the United States in 1916 to pursue his musical career and for various health reasons. He remained in America for the rest of his life, living at different times on both coasts. New Jersey native George Antheil spent his youth in NJ and New York City, but moved to Europe as a young adult, spending 1922 in Berlin and then moving to Paris 1923. After some more time in Berlin, Antheil returned to the United States, calling California home. American music critic (and poet) Ezra Pound moved to London in 1908 and spent a number of years there before heading to Paris in 1920. From Paris, he moved to Italy in 1924 where he spent most of his adult life as an expatriate; he did not return to the U.S. until well after WWII when he was forced to stand trial for treason committed while living in fascist Italy. In the U.S. he saw only the inside of St. Elizabeth's Hospital, having been found mentally unfit to stand trial. He returned to Italy when he was released and remained there until his death. Varèse was born in France and lived for the majority of his young adult life in Paris. He left for the United States in 1915, but returned again to Paris in 1928. He moved back to the U.S. in the mid-1930s. Arnold Schoenberg resided in Vienna until his move to America in 1934. Ernst Krenek was born in Austria, lived and studied in Berlin, and moved to the United States in 1938.

[32] The American press's early adoption of British trends like this one is likely the result of practicality: many of the presses borrowed news and even entire articles from one another—conveniently, for American newspapers, British articles were in English. Stories could be quickly and easily wired across the Atlantic and made available for the American public's digestion within days or hours.

[33] For example, the outrageous "battle" between Einstein and Newton crossed the Atlantic almost immediately.

Two days after the *Times* announced Eddington's results (7 November), the *New York Times* ran an article summarizing the events of the Royal Society Meeting and attempting to explain to significance of Eddington's findings.[34] The bulk of the *New York Times* article dryly reported the details of the meeting (similar to the *Times*' contribution), yet the title reveals the importance of the Royal Society Meeting's events (Figure 2.3):

ECLIPSE SHOWED GRAVITY VARIATION

Diversion of Light Rays Accepted as Affecting Newton's Principles.

HAILED AS EPOCHMAKING

British Scientist Calls the Discovery One of the Greatest of Human Achievements.

Figure 2.3 - *New York Times* (9 November 1919)

Einstein's new theories are pitted against Newton's principles throughout the article, echoing Britain's emphasis on the earlier scientist.[35] The following day, the *New York Times* issued another, even more sensationalist, statement on the eclipse and Einstein's theory, evidently responding to the demand for more information on this topic.[36] The headlines of the 10 November article reveal a popular interest in the subject—though it may have been based on fear (Figure 2.4):

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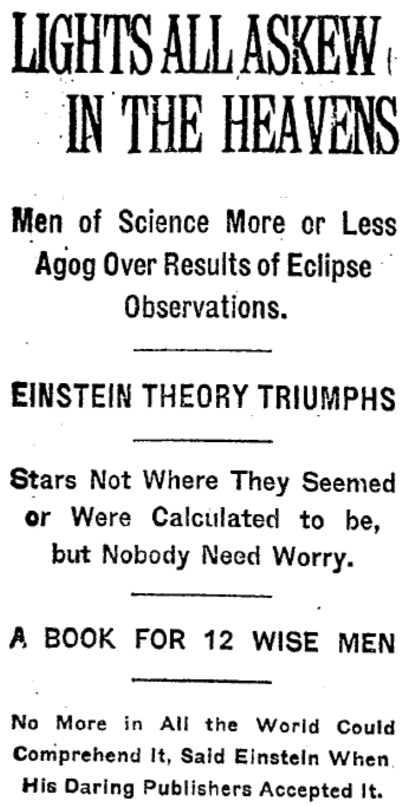
[34] "Eclipse Showed Gravitation Variation," *New York Times* (9 November 1919), 6.

[35] Unlike the British article on which it is based, the *New York Times* one features the theme of "revolution" solely relating to the Einstein/Newton dyad—Eddington, and his world-changing expedition, is not mentioned once.

[36] "Lights All Askew In the Heavens," *New York Times* (10 November 1919), 17.


LIGHTS ALL ASKEW IN THE HEAVENS

Men of Science More or Less Agog Over Results of Eclipse Observations.

EINSTEIN THEORY TRIUMPHS

Stars Not Where They Seemed or Were Calculated to be, but Nobody Need Worry.

A BOOK FOR 12 WISE MEN

No More in All the World Could Comprehend It, Said Einstein When His Daring Publishers Accepted It.

Figure 2.4 - *New York Times* (10 November 1919)

The reassurance that "nobody need worry" about the fact that Einstein's theories called for a reappraisal of the known universe implies that, in fact, many had been concerned about the implications of Einstein's theories. Unlike in the previous article, Einstein's name now appeared in the title lines, but even this mention ("Einstein Theory Triumphs") deals more with the theory than the person himself. This differs greatly from Britain's treatment of Einstein as his theory personified; Einstein was pitted directly against Newton there, not Einsteinian ideas against Newtonian ones.

As if to counter some of the accusations of the previous day's news that only a few people can understand Einstein, the *New York Times* ran a column quoting five prominent scholars in the United States, one from Brown University, two from Vassar, one from Dartmouth, and a final, unidentified scholar.[37] All but the latter praised Einstein for accomplishing "one of the greatest scientific achievements of modern times" (although the final scholar's anonymity suggests a bit of wavering in his or her *un*certainty with the theory). If the *New York Times* could find five scholars who not only understood the significance of, but also comprehended the General Theory of Relativity, surely more than twelve scholars worldwide would be able to as well. In addition to keeping Einstein's publicity flame alive in the press, this article countered the trope of incomprehensibility and turned Einstein into a figure who could be understood by the general public.[38] An editorial in the *New York Times* also appearing on 11 November expresses cynical disgust with the lack of real information appearing in the early articles on the eclipse and its relevance. The author remarks:

> It is a pity that the Wise Ones told us anything at all about this new scandal in scientific circles, if they cannot tell us more, for, somehow, what they do say hints less at the impossibility of making us understand the Einstein discovery than at an inclination to keep a particularly interesting thing to themselves.[39]

This author is plainly offended by the assumption that "amateurs" cannot understand the theory. His or her desire for more information would be granted sooner rather than later. Even so, the myth was restated frequently by the press and it allowed those who came to a passable understanding of the theory a chance to pat themselves on the back. Thus even as more information was doled out, a careful balance was struck between the description of the theory's difficulty and its ability to be grasped.

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[37] "Accepts Einstein Gravitation Theory," *The New York Times* (11 November 1919), 17.

[38] It might be worth noting that the two professors from Vassar quoted in this article, "Miss" Caroline Ellen Furness, Ph. D and Professor Edna Carter, are female. Perhaps this gendered aspect, at this time, would have helped the cause of showing Einstein's understandability.

[39] "Topics of the Times: Amateurs Will Be Resentful," *New York Times* (11 November 1919), 12.

Several articles appeared throughout the duration of November and December, each explaining the theory in different ways. On 16 November, a lengthy article appeared in the *Sunday Times* contextualizing Einstein's "theory of light" within past theories, including Isaac Newton's "defeated" one.[40] The following Sunday, an article appeared in the *New York Times* by Sir Oliver Lodge, reiterating some of his comments to the *London Times* in the previous weeks.[41] Arthur Eddington then explained Einstein's theories to *New York Times* readers in early December, quickly becoming more well-known as an author of general-audience books on the physicist than the leader of the expedition to prove Einstein right—he even attempts humor in expounding upon the implications of the theories.[42] Next, R. D. Carmichael penned an article for the *New York Times* with the following authority-lending incipit: "The writer of this article is the author of the first book on the theory of relativity published in the English language. It was issued by Wiley & Son of New York in 1918."[43] Carmichael described the recent experiments in the context of Einstein's special and general theories of relativity, using an unpretentious tone to encourage understanding by a lay readership. One more expert weighed in in December, Dutch physicist H. A. Lorentz.[44] His "simple examples" explaining Einstein's theories included a discussion of special relativity using the metaphor of "the earth as a

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[40] "Don't Worry Over New Light Theory," *New York Times* (16 November 1919), E1.

[41] "A New Physics Based On Einstein," *New York Times* (25 November 1919), 17.

[42] "How Tall Are You, Einstein Measure?" *New York Times* (4 December 1919), 19.

[43] R. D. Carmichael, "Given the Speed, Time is Naught," *New York Times* (7 December 1919), 18. In addition to the book on relativity mentioned above (that was also re-released in 1920), Carmichael was the author of *A Debate on the Theory of Relativity* (Chicago: Open Court Publishing Co., 1927).

[44] H. A. Lorentz, "Dutch Colleague Explains Einstein," *New York Times* (21 December 1919), 20.

moving car," and a description of the Eddington experiments and their place in proving general relativity correct.

It is clear that the articles appearing in the *New York Times* were heavily influenced by those written in the *London Times*. Immediately following the announcement at the Royal Society, the New York newspaper mimicked the excitement of the "battle" for a new view of the universe. It also employed techniques of "hyping" Einstein's newly proven theory, suggesting a level of popularity before the numbers were in, so to speak. At the same time, many of the articles in the *New York Times* reflected tendencies more closely associated with the German and French presses: a well-deserved respect for the scientist and a sense of Einstein's philosophical importance, as well as a potential for a general understanding of his ideas (in spite of their—and Einstein's—own pronouncements of limited comprehensibility).

By late November and into December, the *New York Times* was not the only voice contributing to the discourse about Einstein and his theories. The *Washington Post* and the *Atlanta Constitution* published a few articles on Eddington's announcement to the Royal Society and Einstein's theories.[45] Outside of the daily presses, *The Independent* stands out for its contribution to the discussion on Einstein. Within its pages, Edwin E. Slosson contributed a number of fascinating articles, specifically designed for the lay reader on the nature of Einstein's theories and on their importance. As the first editor of the newly minted Science Service, a news service dedicated to the popularization of science in the U.S., Slosson took very seriously the task of explaining Einstein in a

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[45] Charles Davidson, "Science Weighs Light," *Washington Post* (7 December 1919), E5; "New Theory of Space," *Washington Post* (14 December 1919), E5. Clair Price, "Fourth Dimension Proved to Exist Beyond a Doubt," *Atlanta Constitution* (14 December 1919), D7; "Einstein Theory Means Acceptance of Queer Things," *Atlanta Constitution* (22 December 1919), 2.

welcoming, yet rigorous way.[46] His first article in *The Independent*, appearing on 29 November and entitled "The Most Sensational Discovery of Science," emphasized the scientific import of Einstein's theories. In spite of the flashy title and the sometimes grandiose language—after all he describes 1919 as "the year of the overthrow of Newton's theory of gravitation"—Slosson was careful to keep the focus on the scientific side of things.[47] The same blending of trends witnessed in the *New York Times*, then, can be seen in the articles of Slosson for *The Independent*.[48]

What all of these articles have in common, apart from this balance of the sensational with the serious, is their lack of focus on Einstein himself. Brief mentions of Einstein's life—either personal or professional—begin to arise slowly throughout 1920. As news of Einstein with respect to Eddington's expedition dies away, the physicist is kept in the press with smaller stories about Einstein's personal life and updates on the acceptance of his theories. Slowly, pieces of his biography work their way into the press. In May 1920, *Current Opinion* published a piece on the "Unpromising Career of Einstein," chronicling his boyhood struggles with school, a phenomenon likened in the article to the well-known case of Verdi's rejection as a pupil to the Conservatory of Milan, the first of many parallels with composers.[49] Einstein is portrayed as a frequently

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[46] David J. Rhees, "A New Voice for Science: Science Service under Edwin E. Slosson, 1921–1929" (Thesis, University of North Carolina at Chapel Hill, 1979).

[47] Edwin E. Slosson, "The Most Sensational Discovery of Science: The Weight of Light," *The Independent* (29 November 1919), 136.

[48] Slosson's other articles for *The Independent* include: "Can You Tell the Difference Between Rest and Motion? Does the Earth Move Round the Sun or the Sun Move Round the Earth? Do Two Parallel Lines Ever Meet? Do We Need a Fourth Dimension?" *The Independent* (13 December 1919), 174; "Things You Can't Be Sure Of," *The Independent* (20 December 1919), 236; "That Elusive Fourth Dimension," *The Independent* (27 December 1919), 274.

[49] "The Unpromising Career of Einstein," *Current Opinion* Vol. LXVIII No. 5 (May 1920), 651.

misunderstood savant, but the full weight of the seemingly tongue-in-cheek title is not really applied. The result was more a strange litany of Einstein's career failures than a cheeky way of pointing out Einstein's true genius. The following month, Frances Newman closed an article about the curious popularity of Einstein's theories (despite the complete misunderstanding by all who claim to know them) with a section on Einstein's personal life. Newman explains the scientist's place in the intellectual world:

> Unlike Kant and Leonardo and most of the other great original thinkers, Professor Einstein has married a wife and even a second wife, and moreover he plays the violin, both of which seem very properly human in the man who has taken the law of gravitation and light rays and the ether out of a vacuum, so to speak, and placed them in the world, or the universe, of reality.[50]

This is one of the earliest mentions of Einstein's life outside of physics and yet, the comments are immersed within a theme related to his larger-than-life scientific persona: one of the most distinctive traits of Einstein is his humanity in spite of his genius. Here we have one of the first instances of Einstein's humanization, the beginning of the creation of an American national hero, violin playing included. Another rare early glimpse into Einstein the human being comes in the form of a drawing, published alongside an article defending Einstein's complicated, technical language.[51] The caption below the sketch by Herman Struck, borrowed from the *Vossische [Zeitung]*, describes the "Hero of the New Physics": "The simplicity of Einstein, his freedom from the ponderous traits ordinarily associated with the German Professor and his human sympathies are all said to be indicated in this swift sketch" (Figure 2.5).

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[50] Frances Newman, "Carnegie Library Notes: Einstein Without Tears," *The Atlanta Constitution* (6 June 1920), 4K.

[51] "Why Einstein's Theory Is So Hard to Explain," *Current Opinion* Vol. LXIX No. 1 (July 1920), 77.

From the *Vossische* (Berlin)

THE HERO OF THE NEW PHYSICS

Professor Albert Einstein is here seen in the impression he made upon the artist Herman Struck. The simplicity of Einstein, his freedom from any of the ponderous traits ordinarily associated with the German Professor and his human sympathies are all said to be in 'icated in this swift sketch.

Figure 2.5 - *Current Opinion* (May 1920)

Here is Einstein: a careful balance between sensational hero and serious professor, a balance achieved through his humanity, said to be seen in the simplicity of his face.

The German and French reactions, in addition to the British reception, can be viewed as nascent trends that fed into the pre-visit American reception and eventually became the five "tropes" I will discuss in more detail. Rather than receiving the scientist in exactly the same manner as its European cousins or completely without knowledge of their reactions, the American press mediated some of the trends of European reception and crafted a uniquely American reaction to Einstein. In the period between November 1919 and April 1921 many of the trends from Europe circulated in American newspapers and magazines. During this time we can observe the ways in which the public became familiar with Einstein mostly through his theories. This encouraged a reception of the scientist that carefully balanced his reputation as a respected genius with that of the awe-inspiring man who reshaped the way we thought about the universe. Later, when Americans would finally meet the man, and could humanize him through various other journalistic strategies to be explored later, Einstein would become an unconquerable figure of American popular culture, seemingly the perfect image of what it was to be American at that time.

II. Einstein in America

Einstein arrived in New York on 2 April 1921 with Chaim Weizmann and other delegates of the World Zionist Organization. They were met by thousands of Jews who had waited for hours at the Battery to greet the delegation. Consisting of prominent Jewish figures from many European countries, the organization came to New York on a fundraising mission, which hoped to garner support for rebuilding Palestine and starting a university in Israel. But the crowd's attention (both at the Battery and in the coming days) focused keenly on Einstein, creator of relativity theory. Although the throngs of New Yorkers gathered to meet the delegation, the press latched onto the idea that Einstein's was a hero's welcome and publicized it in this way.

Einstein's imminent arrival was chronicled in a number of newspapers, including, but not limited to the *New York Times*. Short announcements preceded his trip: 22 February 1921: "Einstein is Coming Here"; 9 March 1921: "Einstein Sails for America

March 23"; 2 April 1921: "Einstein Due Today; Leaders Await Him".[52] Finally, on 3 April 1921: "Prof. Einstein Here, Explains Relativity."[53]

Explains Relativity? When Einstein arrived, the original purpose of his visit faded from the public's mind. The opening paragraph of the 3 April article describing his arrival reveals how at least one reporter saw him, as he disembarked from the ship that brought him to America:

> A man in a faded gray raincoat and a flopping black felt hat that nearly concealed the gray hair that straggled over his ears stood on the boat deck of the steamship Rotterdam yesterday, timidly facing a battery of cameramen. In one hand he clutched a shiny briar pipe and with the other clung to a precious violin. He looked like an artist—a musician. He was.
>
> But underneath his shaggy locks was a scientific mind whose deductions have staggered the ablest intellects of Europe. One of his traveling companions described him as an "intuitive physicist" whose speculative imagination is so vast that it senses great natural laws long before the reasoning faculty grasps and defines them.
>
> The man was Dr. Albert Einstein, propounder [sic] of the much-debated theory of relativity that has given the world a new conception of space, and time and the size of the universe.[54]

Only in the fourth paragraph of the article does the author mention the Zionist World Organization, the group with which Einstein traveled to the States. The opening paragraph, in particular, reveals not only American perceptions of what an artist should be—a shaggy-looking figure who shuns conventional attire—but also that Einstein was immediately seen as such. Additionally, Einstein himself contributed to his reception as a musician by disembarking with a violin in his hand. Thus the first impression of Einstein

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[52] "Einstein is Coming Here.," *New York Times* (22 February 1921), 11; "Einstein Sails for America March 23," *New York Times* (9 March 1921); "Einstein Due Today; Leaders Await Him," *New York Times* (2 April 1921). See also "Einstein to Visit America," *The Washington Post* (22 February 1921).

[53] Full citation in footnote below. See also: "Thousands Greet Einstein at Pier," *The Washington Post* (3 April 1921), 5.

[54] "Prof. Einstein Here; Explains Relativity," *New York Times* (3 April 1921), 1.

built by American journalism was that of a struggling musician marked by his looks and demeanor. With this article, and with Einstein's face in newspaper photographs like the one seen in Figure 2.6, a new era in American Einstein reception began. Einstein was much more than a mere instigator of a well-known theory (not to mention more than a member of the Zionist organization). From this point on, the public became fascinated

Prof. Albert Einstein, whose "Relativitatsprinzip" has thrown a monkey wrench into scientific machinery generally, receiving the freedom of the City of New York. This photograph, taken in front of the City Hall, shows, from left to right, Dr. Chaim Weizman, the Zionist leader; Mayor Hylan, and Prof. Einstein. From Wide World Photos

Figure 2.6 - *Washington Post* (17 April 1921)[55]

with Einstein the person. This interest was centered on five key tropes: 1) Einstein the rebel/revolutionary, 2) the hero/savior, 3) the genius, 4) the understandable intellectual, and 5) the musician.

These tropes developed out of the early reception of relativity and Einstein as its creator, which was (as previously discussed) heavily influenced by European reception of the scientist. Both fanaticism and reverence play a part in the use of these tropes. The

[55] "News Caught as It Happens," *The Washington Post* (17 April 1921), 67.

idea of Einstein as a musician, obviously key to this dissertation, will be discussed in the most detail in the last two sections of this chapter. For now, I will explore the first four tropes, for although a musically-minded readership might have been most intrigued by the idea of Einstein as a musician, the first four tropes also had critical roles in allowing Einstein to serve as a symbol of modernism for many of the musicians and writers to be discussed in this dissertation.

Einstein the Rebel/Revolutionary

The idea of Einstein as a revolutionary has an obvious connection to the initial portrayal of the physicist by British authors and the trend's early adoption by American newspapers. From 1919 to 1921, Einstein was often seen as a major contender in the battle over the nature of the universe by virtue of his development of a revolutionary theory in physics. In the June 1921 issue of *Current Opinion*, the author explores Einstein's impact on the philosophical world asking the question (in the title) "Has Einstein Turned Physics into Metaphysics?"[56] While most of the article discusses relativity's relationship with philosophy, the scientist himself is represented primarily through the accompanying photograph, which takes up nearly as much space as the text of the article. Its caption describes the subject of the photograph: "The World's Champion of the Astrophysical Prize Ring" (see Fig. 2.7). The description continues, underneath this grand title:

> Here, with a pipe in his mouth and the suggestion of an easy smile not only on his lips but in his eyes, is that Professor Einstein who, having knocked out Euclid and driven Newton into a corner for the time being, stands proudly among the world's physicists as the John L. Sullivan of science.

[56] "Has Einstein Turned Physics into Metaphysics?" *Current Opinion* Vol. LXX No. 6 (June 1921), 803.

Ironic in light of his later pacifism, this interesting comparison keeps the theme of Einstein as a revolutionary, in the combative sense, alive in the public mind. Just like the heavy-weight champion John L. Sullivan (a.k.a. the Boston Strong Boy), Einstein beats

Photograph by Brown Brothers.

THE WORLD'S CHAMPION OF THE ASTROPHYSICAL PRIZE RING

Here, with a pipe in his mouth and the suggestion of an easy smile not only on his lips but in his eyes, is that Professor Einstein who, having knocked out Euclid and driven Newton into a corner for the time being, stands proudly among the world's physicists as the John L. Sullivan of science.

Figure 2.7 - *Current Opinion* (June 1921)

out any competition for the title of science champion. From the upward angle of the image, which turns the scientist into a superhuman figure, to the language of the caption, this presentation offers a masculinizing counterpoint to the other narratives that focus on the scientist’s shy musical demeanor. Einstein’s life-long rebelliousness became part of the biographical tales told about the physicist: anecdotes about his precociousness as a child, his defiance as a schoolboy, and his resistance toward the status quo became frequent topic.

Because Einstein was so closely linked with his theory when he arrived—the public had very little else to go on at this point—the idea that his theory had "destroyed time and space" was tied to Einstein's early persona. What Americans actually found, either in person or in descriptions in the news, was a rather timid, slightly disheveled, often smiling man. Despite this, the close association with his theoretical ideas allowed the idea of Einstein as a revolutionary figure who had overturned the way we look at the world persisted.

When Einstein arrived in New York City and was given the key to the city by the mayor, one public figure's misstep became big news. New York City Alderman Bruce M. Falconer "accidently" refused to acknowledge the honorary key, but later explained his confusion:

> Alderman Falconer wants everybody to understand that when he said he had never heard of Professor ALBERT EINSTEIN he didn't know it was the famous EINSTEIN, the destroyer of time and space.[57]

This view of Einstein as the destroyer of space and time set him apart as an active revolutionary. Here is an Einstein who carved out his place in history. As we can see in articles like the one above, this revolutionary side made him "famous" just five days after arriving in a new country.

Einstein the Hero/Savior

The idea that Einstein was a hero, or even a savior was the other side of the coin. It developed out of the first portrayals of Einstein's arrival in the U.S. in the press. The *way*

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[57] "Relativity and the City Hall," *New York Times* (7 April 1921), 14.

in which his arrival was covered rather than *what* was being said about him, helped to form a picture of Einstein as a hero/savior. Here, the technique of "hype" was in full swing. Einstein's visit was, as we have seen, discussed in the weeks before his arrival and then covered in the many articles that described Einstein's stay in New York. These articles described the masses that came out to greet him on the pier, the ones witnessed his being granted the keys to the city, and those that ventured up to Columbia University to hear the professor speak. Even news of his apparent shyness (to put it nicely) in front of the numerous newspaper reporters and photographers had the effect of magnifying the excessive interest in this newly-minted cosmopolitan and national hero.

An interesting record of the public reaction to Einstein's arrival in New York occurs in the form of a poem, published in *Contact* magazine shortly after Einstein set foot in New York. American modernist poet William Carlos Williams penned "Saint Francis Einstein of the Daffodils" not only to celebrate Einstein's visit, but also to experiment with new poetic methods that he saw as coming out of Einstein's theories (as he understood them)[58]:

> When Einstein promulgated the theory of relativity he could not have foreseen its moral and intellectual implications. He could not have foreseen for a certainty its influence on the writing of poetry. . . . [We need] some sort of measure, some sort of discipline *to free* from the vagaries of mere chance and to teach us to rule ourselves again.[59]

Within the poem, Williams makes use of and intensifies the language from the popular press. He calls Einstein a "Savior of the daffodils," having set up the metaphor of

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[58] William Carlos Williams was a personal friend of fellow American modernist poet Ezra Pound, author of the first book on composer George Antheil. This web of relationships will be discussed in more detail when Antheil's name resurfaces later in the chapter/dissertation.

[59] William Carlos Williams quoted in Stephen Tapscott, *American Beauty: William Carlos Williams and the Modernist Whitman* (New York: Columbia University Press, 1984), 115.

daffodils to represent the American masses. The relationship between this “saint” Einstein and his daffodils is captured well in a passage in the second stanza:

> Sweet Land of Liberty,
> at last, in the end of time,
> Einstein has come by force of
> complicated mathematics
> among the tormented fruit trees
> to buy freedom
> for the daffodils[60]

Einstein is characterized here as a savior who, through his well-known theories, has the power to set people free from their old ways, just as Williams sees himself freed by Einstein to compose poetry outside of the traditional bounds of the art form. The specific nature of this new-found human freedom is suggested later in the poem:

> April Einstein
> through the blossomy waters
> rebellious, laughing
> under liberty’s dead arm
> has come among the daffodils
> shouting
> that flowers and men
> were created
> relatively equal.
> Oldfashioned knowledge is
> dead under the blossoming peachtrees.[61]

Williams’ poem is both a testament to the treatment of Einstein as a hero/savior and a tool in developing this portrayal further.

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[60] William Carlos Williams, “St. Francis Einstein of the Daffodils,” *The Collected Poems of William Carlos Williams*, Vol. 1: 1909–1939, A Walton Litz and Christopher MacGowan, Eds (New York: New Directions Publishing, 1986), 130–33.

[61] William Carlos Williams, “St. Francis Einstein of the Daffodils,” *The Collected Poems of William Carlos Williams*, Vol. 1: 1909–1939, A Walton Litz and Christopher MacGowan, Eds (New York: New Directions Publishing, 1986), 130–33.

Einstein the Genius

The trope of Einstein as a genius hinged on two factors: first, on Einstein's status as a shining star even among the most respected scientists of the time and, second, on Einstein's projected intuitive and simple nature. This can been seen in a description of Einstein by Chaim Weizmann in the *New York Times*. Einstein was "an 'intuitive physicist' whose speculative imagination is so vast that it senses great natural laws long before the reasoning faculty grasps and defines them."[62] This statement seems to infer not only that Einstein was a remarkable scientist, but that he also was somehow in tune with other concerns about the nature of human existence. This idea may have stemmed out of earlier ideas that Einstein was both physicist and philosopher because his theories had philosophical implications. It was likely also connected to the fact that Einstein's General Theory of Relativity was sometimes called a "Universal Theory of Relativity." This gave some members of the general public the impression that Einstein's observations on relativity extended beyond the physical world and into the more metaphysical realm (even though the press repeatedly stated that for all practical purposes, relativity had *no* effect on the everyday physical world). This Einstein, the intuitive genius, had an impact far beyond his profession's bounds.

Einstein the Understandable Intellectual

Although Einstein was seen as a great intellect, possibly one of the "greatest minds of all time," his friendly public demeanor helped cast him as an understandable intellectual, very unlike any other scientists Americans had come into contact with before. The *New*

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[62] "Prof. Einstein Here, Explains Relativity," *New York Times* (3 April 1921), 1.

York Times described him this way, within an article about one of his first public lectures in April 1921:

> Professor Einstein is so far from being the usual conception, to use one of his own words, of the average man of science that he has made an unusual impression of geniality, kindliness and interest in the little things of life on those who have come in contact with him.[63]

Einstein was seen as shy, yet friendly and exceedingly unpretentious (this extended right down to his plain shoes worn without socks). Additionally, some of Einstein's words and actions shaped the idea that he was an understandable intellectual. In the very first articles published at the time of his visit he was quoted as saying "No man of culture or knowledge has any animosity toward my theories. Even the physicists opposed to the theory are animated by political motives."[64] This type of statement would probably have won over any self-respecting *New York Times* reader—even if Einstein had not intended to make a statement about the type of person who might understand his theories. In other articles, Einstein was also quoted on the "simplicity" of his theories, and even admitted to the possible philosophical or metaphysical resonance they might have for the non-scientist.[65]

Einstein himself explained his theories to the public in a number of ways, an act that must have been seen as a confirmation that he and his theories were intellectually accessible. Not only did Einstein try to clarify his theories in short sentences quoted within newspaper articles, he also gave lectures at local universities during his first visit, including Columbia University and the City College of New York. Although these

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[63] "Einstein Sees End of Space and Time," *New York Times* (4 April 1921), 5.

[64] "Prof. Einstein Here, Explains Relativity," *New York Times* (3 April 1921), 1. This statement is repeated in the Philadelphia newspaper *The Public Ledger*'s "Einstein Explains Relativity Theory" (3 April 1921), 2.

[65] "Einstein Sees End of Space and Time," *New York Times* (4 April 1921), 5.

lectures were intended for faculty members, curious bystanders often tried to push their way in, according to reports in the campus newspaper of the City College.[66]

In addition to Einstein's own role in this process of mediation, a great effort was made by many American authors to translate Einstein's theories for any- and everyone who would read them. Books like *Easy Lessons in Einstein: A Discussion of the More Intelligible Features of the Theory of Relativity* (1920) by Edwin E. Slosson and *The A B C of Relativity* (1925) by Bertrand Russell responded to and generated interest in Einstein and his theories.[67] This sparked the publication of a number of biographical sketches of the man, aimed at readers as young as elementary-school children. Catherine Owens Peare's *Albert Einstein: A Biography for Young People* (1949) grabbed the younger audience, while *Albert Einstein: A Biographical Portrait* (1930) by Anton Reiser, *Albert Einstein: Maker of Universes* (1939) by H. Gordon Garbedian, and *Einstein: An Intimate Study of a Great Man* (1944) by Dimitri Marianoff with Palma Wayne would have appealed to more mature readers.[68]

Einstein was seen, despite his revolutionary, heroic, and genius status, as a fundamentally relatable figure. And while much of this is derived from the positive portrayal, for every type of reader, of the man and his theories, one key element of his

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[66] Quoted in Jozsef Illy, *Albert Meets America: How Journalists Treated Genius during Einstein's 1921 Travels* (Baltimore: Johns Hopkins University Press, 2006), 112.

[67] Edwin E. Slosson *Easy Lessons in Einstein: A Discussion of the More Intelligible Features of the Theory of Relativity* (New York: Harcourt, Brace, and Howe, 1920). Bertrand Russell, *The A B C of Relativity* (New York: Harper and Brothers, 1925).

[68]Catherine Owens Peare, *Albert Einstein: A Biography for Young People* (New York: Henry Holt, 1949). *Anton* Reiser, *Albert Einstein: A Biographical Portrait* (New York: Albert and Charles Boni, 1930). H. Gordon Garbedian, *Albert Einstein: Maker of Universes* (New York: Funk and Wagnalls Company, 1939). Dimitri Marianoff with Palma Wayne, *Einstein: An Intimate Study of a Great Man* (New York: Doubleday, Doran, and Co.,1944).

success as an unpretentious, understandable intellectual and as an American icon is yet to be explored: Einstein's status as a musician.

III. Einstein the Musician

Einstein's association with music became apparent as soon as he stepped off the Rotterdam at the pier in New York holding only a briar pipe and his violin case.[69] This image of the physicist not as an affable, artistic man caught the attention of the press and the general public. Numerous references to Einstein's musicianship in the press accompanied his first visit to the United States and continued into the next decades. The press's inclusion of details about Einstein's musicianship had the effect of humanizing the theoretical physicist and making him more accessible to the general public. Einstein's musicianship was critical in fashioning Einstein as an American icon; it fully rounded out his public persona. Additionally, it is the fact that he was a musician—and an awareness of the notoriety his musicianship won him—that drew American modernists to the figure of Einstein.

Einstein the Violinist

As part of the process of creating a more accessible Einstein for the general public, authors frequently invoked the scientist's violin playing. Other hobbies of Einstein's were sometimes included within descriptions of the man in the press and monographs—his interest in sailing, for example—but the focus on Einstein's violin playing is unparalleled in comparison with the coverage of his other passions. Einstein began playing the violin as a child, but was at first an unenthusiastic musician, just as he was a reluctant student.

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[69] This fact is stated in "Prof. Einstein Here, Explains Relativity," *New York Times* (3 April 1921), 1.

Eventually, however, Einstein came to love the instrument, and more and more the violin and his music-making became an escape from his daily work life. Einstein played often as an adult, collaborating with colleagues in benefit concerts and playing alone in his apartment in Berlin. After 1921 and throughout the 1920s, every time Einstein and music were mentioned together in the newspapers, his violin was a part of the equation—and that was nearly every time Einstein was written about. Because Einstein and relativity remained in the news throughout the decade, references to Einstein's violin became a part of the cultural currency surrounding Einstein.

When Einstein announced that he had completed a draft of his Unified Field Theory in 1929, the public was curious about the new theory apparently to the point that Einstein wanted to retreat from their view. This curiosity was accompanied by a continued interest in his personal life as is evident in a *New York Times* article from 4 February 1929: "Einstein Distracted By Public Curiosity; Seeks a Hiding Place." Within the article, musicianship takes center stage; in the subsection simply titled "Plays a Violin." the author describes Einstein the musician.

> His passion aside from work and his boat is his violin, which he plays beautifully, but seldom for any one but intimate friends. Occasionally with a cellist and pianist he had played at concerts for Jewish old age funds. This news having crossed the Atlantic, a photographer once received instructions to get pictures of Einstein playing.
>
> 'Wouldn't you prefer a picture of me standing on my head?' was the suggestion in reply to the photographer's request.[70]

Einstein's cheeky response indicates the extent to which he was portrayed as a violinist first and scientist second. This constant public admiration for the physicist would no doubt continue because, as with earlier articles supposedly related to his theories, this one

[70] Wythe Williams, "Einstein Distracted By Public Curiosity," *New York Times*, 4 February 1929, 1, 3.

delves into the personal—and more popularly appealing—aspects of Einstein's own life, including his violin playing.

In a 1934 article entitled "In Einstein Music and Mathematics Blend: The Same Rhythmic Force That Governs His Scientific Work Is Active Within the Professor When He Plays on His Violin," Alfonz Goldschmidt reported that the "great physicist" carries his violin with him wherever he goes.[71] He recalls the many charity concerts that Einstein has taken part in and takes the time to note that "[Einstein's] circle of friends includes not only scientists but many musicians." The photograph that accompanies the article, a now-famous image of the physicist, shows Einstein playing the violin. It is striking because of the unsubtle caption included underneath it—simply: "Virtuoso."

Times Wide World.
Virtuoso.

Figure 2.8 - *New York Times* (April 1934)

In other words, despite what Einstein said about his talents as a violinist, for Goldschmidt, the genius physicist could be no less than a virtuoso violinist.

[71] Alfonz Goldschmidt "In Einstein Music and Mathematics Blend: The Same Rhythmic Force That Governs His Scientific Work Is Active Within the Professor When He Plays on His Violin," *The New York Times* (1 April 1934), SM18.

Einstein was by no means a virtuoso violinist, but he was quite proficient on the instrument. This is demonstrated by the fact that in 1943 Bohoslav Martinů, a recent war-time émigré, composed a piece dedicated to—and intended to be played by—Albert Einstein. Martinů's *Five Madrigal Stanzas*, composed shortly after the composer settled in Danbury, Connecticut, was a piece written specifically for amateur violinist with piano accompanist. Einstein was, by this time, himself a newly-minted citizen of the United States, living and working in Princeton, New Jersey. According to Martinů's biographer Harry Halbreich, Einstein did in fact premier the work, accompanied by the composer on the piano.[72] This remarkable event can be seen from today's vantage point as an instance in which the performance-shy Einstein actively participated in a public display of affection for his classification as a violinist.

Einstein's Taste in Music

In the 3 April 1921 *New York Times* article that described the physicist's first visit, a section entitled succinctly "Mozart and Brahms His Favorites" begins:

> On the ship, when a concert was held Dr. Einstein played selections from Mozart, of whose work he is particularly fond, on the violin. Brahms is another of his favorites.[73]

Einstein's taste in music was frequently a subject of interest for readers perhaps because his musicianship in general was often tied to his scientific genius. Readers were curious about the composers that were said to inspire the scientist. Einstein was quick to discuss his admiration for Mozart's music, especially inasmuch as he enjoyed playing it himself

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72 Harry Halbreich, *Bohuslav Martinů: Werkverzeichnis, Dokumentation und Biographie* (Zurich: Atlantis-Verlag, 1968), 139.

73 "Prof. Einstein Here, Explains Relativity," *New York Times* (3 April 1921), 13.

on the violin. He also was particularly fond of the music of Johann Sebastian Bach. Einstein had a noted dislike for Wagner, and seemed to base this on musical as well as personal judgments (i.e. the composer's noted anti-Semitism, of which Einstein was keenly aware). He expressed some interest in Beethoven and other nineteenth century composers including Brahms (as above) and Schubert.

Anton Reiser (a pseudonym for Rudoplf Kayser, Einstein's son-in-law) published *Albert Einstein: A Biographical Portrait* in 1930 in which he explains the physicist's relationship with music in terms of his musical tastes.

> But Einstein's greatest love is music, especially classical music. Here profundity and significance of experience is joined with beautiful form, and such a union, to Einstein, means the greatest human blessing. The human will live as it is experienced hourly in great and small things has been raised by means of music to an absolute force, which in turn absorbs every experience and dissolves it into a transcendent, beautiful reality. The school of German music from Bach to Beethoven and Mozart best manifests for Einstein the essence of music. It does not follow that he is dogmatic and despises other musical personalities and tendencies. He loves old Italian music, he also loves the German romanticists, but the peak of musical achievement is, in his opinion, this triple constellation. On one occasion when he had to answer a questionnaire about Bach he said briefly: "In reference to Bach's life and work: listen, play, love, revere, and—keep your mouth shut!"[74]

For Reiser, the real meaning of music in Einstein's life can be explained by his devotion to certain composers and styles of music. While the author's philosophical musings might seem heavy-handed, especially given Einstein's usual privacy regarding his thoughts on the philosophical or spiritual world, it is worth noting that Einstein himself wrote the preface to this book, giving his seal of approval to "the author . . . who knows me rather

[74] Anton Reiser, *Albert Einstein: A Biographical Portrait* (New York: Albert and Charles Boni, 1930), 201–202.

intimately in my endeavors, thoughts, beliefs—in my bedroom slippers."[75] For Reiser, and maybe for Einstein then, the scientist's taste for the music of Mozart might actually represent a deeper affinity for the elegance of idea that Einstein perceived in the classical composer's music. This relationship was not observed by Reiser alone.

Alfonz Goldschmidt, who we have heard from regarding Einstein's violin playing, also gives his take on Einstein's preferences in music. Goldschmidt fits the scientist's propensity for a Mozart melody into his theory of mutual scientific and artistic influence. He argues that because Einstein is an intuitive genius in his field, and because his theoretical work seems to constantly seek a simplified, more elegant view of the universe, Einstein prefers the music of Mozart to the "richness and variability of melodies" found in more recent composers' music. For Goldschmidt, all of Einstein's musical choices, including his

The Look of an Artist

Einstein's physical description was often linked with musicianship as well. After stepping off the ship, he was said to look "like an artist—a musician. He was." of the scientist set the tone that he was to be received with.[76] The rest of this portrait in prose was the first "image" that New Yorkers had of Einstein. This portrayal was strengthened by further reports on Einstein's appearance. *The Campus,* the student newspaper at the City College of New York, described Einstein's looks for the readers who were not in attendance at the four lectures that Einstein gave on their campus.

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[75] Albert Einstein in the preface to Anton Reiser, *Albert Einstein: A Biographical Portrait* (New York: Albert and Charles Boni, 1930).

[76] "Prof. Einstein Here, Explains Relativity," *New York Times* (3 April 1921), 1.

> At first sight Dr. Einstein seems to be a great musician, rather than a great scientist. His long black hair, combed in the fashion of a Liszt, his high forehead, his dreamy eyes and dark complexion all belie the man of learning, the deep and penetrating thinker, the man of boundless power and resource.[77]

This easy comparison with the nineteenth century's genius improviser makes it clear that Einstein's visual kinship with the great composers extended to elements other than his hair cut. The *New York Call* also mentioned Einstein's musician-like appearance in their 3 April article noting: "The distinguished physicist is a broadly built man who looks more the artist than the scientist."[78]

The idea that Einstein looked like a musician was kept alive in later biographical portraits of the scientist. A 1929 piece in the *New York Times* entitled "Ludwig on the Greatness of Einstein," begins much like the first written description of Einstein from April 1921.

> The head is that of a musician, but not one of the type of Mahler or Toscanini. In his features the relationship between music and mathematics shows itself—no sharp lines, but the soft, almost dreamy face of a Schumann, a Busoni or a Chopin. Out of this tender face, two big, wide-open eyes seldom look at the visitor; nor do they appear to notice the things about us; the lifted eyebrows seem astonished at the world; a gray halo of long hair surrounds this face and two full, sensuous lips are waiting quietly for the right moment to move. All these, but most of all the floating look, which seems to question in a childlike way, belong to an artist; but there rises the faultlessly shaped dome of the forehead, of ivory, apparently, in contradiction to the sensuous fullness of the other features.

Unlike the previous prose descriptions of Einstein as the musician look-alike, however this one was also accompanied by a portrait. Einstein's face appears as if excerpted from a children's book of the greatest composers of history (Figure 2.9).

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[77] "Professor Einstein Given Ovation," *The Campus* (26 April 1921), 2.

[78] "Einstein Here with Weizmann to Aid Zionism," *The New York Call* (3 April 1921), 1.

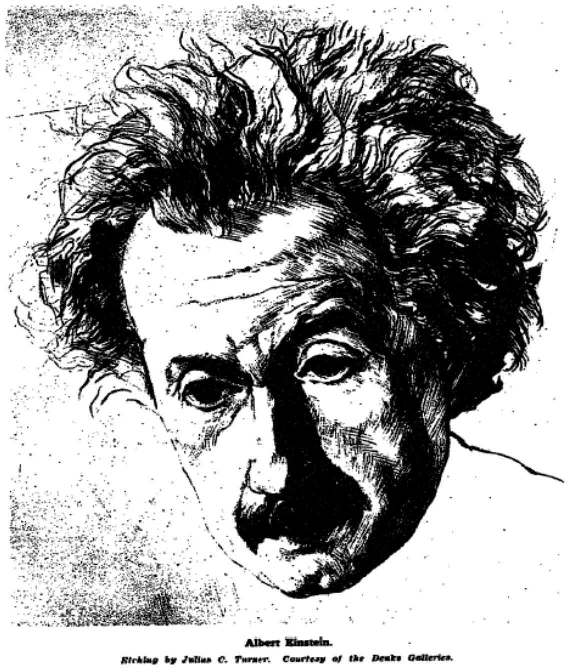

Figure 2.9 - *New York Times* (10 March 1929)

In fact, the artist responsible for the etching, Julius C. Turner, is better known for his drawing “Beethoven on the Mountain,” which explains the striking resemblance of Einstein in the *Times* portrait to the classical composer (Figure 2.10). It seems likely that

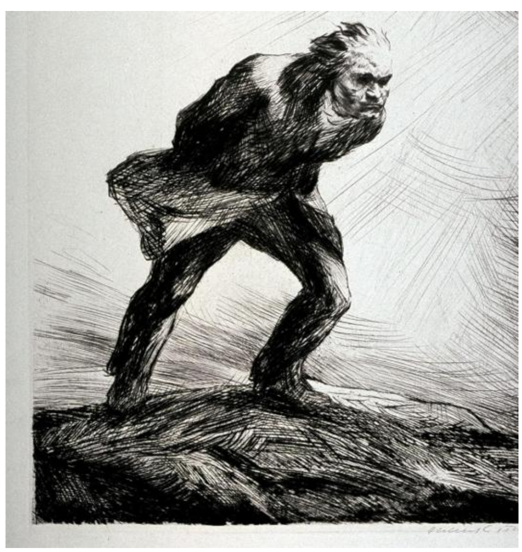

Figure 2.10 - Julius C. Turner, "Beethoven on the Mountain" (undated)

Turner had his etching of Beethoven in mind when he undertook the portrait of Einstein. It also seems possible that another etching of Beethoven might have influenced this picture of Einstein, either in its conception or its reception by the public. American artist Arthur Heintzelman's portrait of the classical composer bears a striking resemblance to physicist as well.His etching entitled "Beethoven: Vieux Lion Fatigué'" appeared in 1929 like Turner's sketch of Einstein did. The bust-only portrait style solidifies the link (see Figure 2.11):

Figure 2.11 - Arthur Heintzelman, "Beethoven: 'Vieux Lion Fatigué'" (1929)

Of course, both of the Beethoven and Einstein portraits seem influenced by the iconic representations of the German musician from the early nineteenth century, in particular the widely disseminated portrait by Joseph Karl Stieler from 1820.

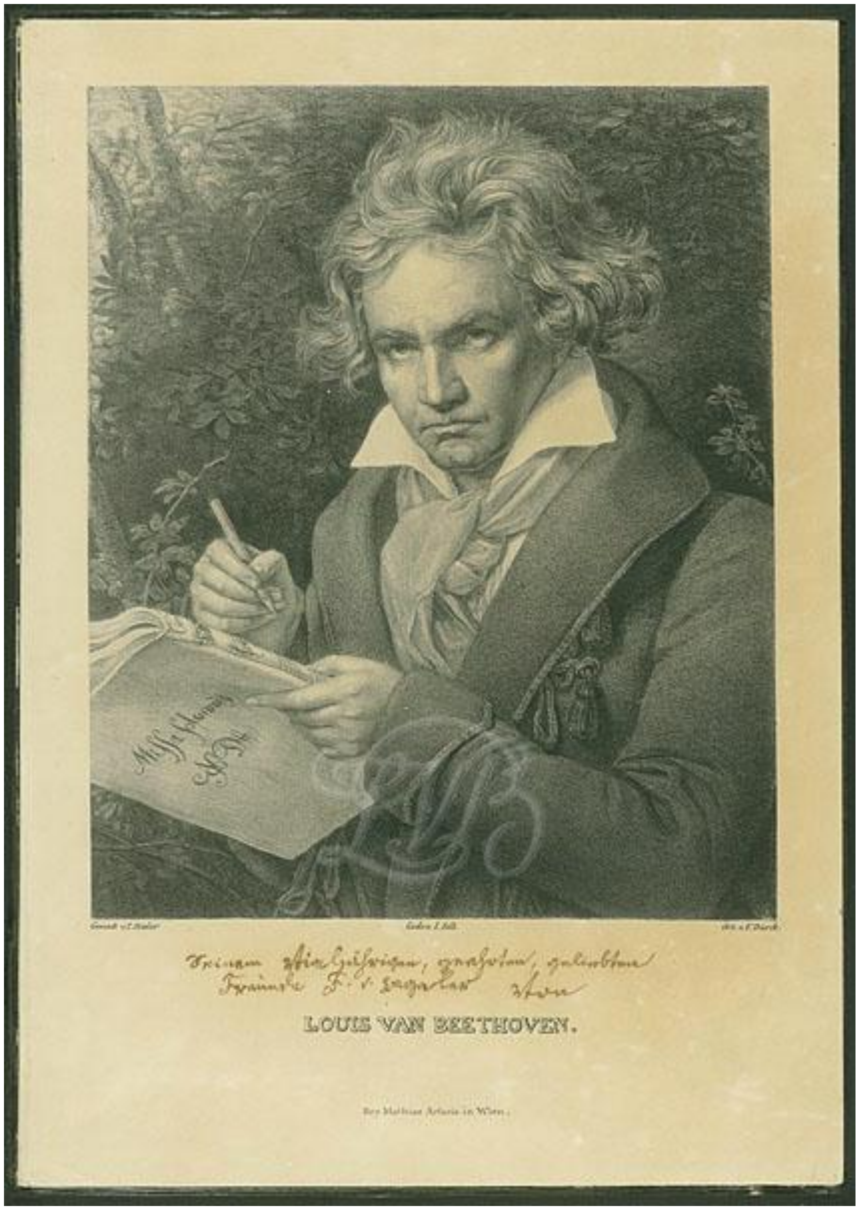

Figure 2.12 - Joseph Karl Stieler, *Louis van Beethoven* (1820)[79]

[79] Joseph Karl Stieler, Louis van Beethoven (1820). Accessed on 2 March 2009. [http://www.beethoven-haus-bonn.de/sixcms/detail.php?id=15357&template=dokseite_digitales_archiv_en&_mid=Pictures%20and%20objects&_ug=Beethoven%20composing&_dokid=i978&_eid=&_seite=1]

Later in the *New York Times* article, which surveys Einstein's public fame to date and argues for the scientist's place in a canon of geniuses, the author explains the apparent relationship between Einstein's appearance and his actual musical persuasion:

> Einstein's nature, as it is revealed in his features of a musician, impels him toward music. He is an exceptional violinist and, when nobody listens, a pianist who needs fantasies on the piano to relieve the strain. His nature tends more towards Bach and Mozart than toward the dramatists. A decided adversary of Wagner, he prefers Beethoven in his lighter symphonies, looking everywhere for the brighter expression, thus showing how right Poincaré was when he wrote of Einstein at 31: 'What we admire most in him is the ease with which he takes up new conceptions to find advancement.'[80]

Thus the link between Beethoven and Einstein, implicit in the choice of Turner's etching, is made explicit in the reporter's prose. Ludwig twists Poincaré's proclamation so that the reader can easily substitute the "he" for Einstein or Beethoven.[81] Both great men have an air of easy genius about them.

In the final portion of an article appearing in the *Washington Post* in December of 1930, David Rankin Barbee discusses Einstein's artistic disposition and appearance. [82] He begins by imagining Einstein as a student walking the narrow streets of Paris's Latin Quarter.

> This Einstein one could easily grow fond of. The Eistein [sic] of another mood, artist, sitting at the piano and improvising chords and music that vary with the intellectual nuances of the moment; or with a fiddle in hand, drawing a bow that in other times and on a different stage might stamp him as a genius along with Ole Bull, Paganini, Kreisler, and Jehudi Mehunum [sic]—this artist or genius one could love.

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[80] Emil Ludwig, "Ludwig on the Greatness of Einstein," *New York Times*, 10 March 1929, 81.

[81] American readers would have been familiar with Poincaré's assessment of the young Einstein. The sentence quoted by Ludwig appeared with the rest of Poincaré's statement in an article from May 1920 appearing in *Current Opinion* entitled "The Unpromising Career of Einstein" (VOL. LXVIII, No. 5), 651.

[82] David Rankin Barbee, "Mathematician's Human Side Shows His Tastes Are Simple," *Washington Post* (14 December 1930), M22.

> It is small wonder, then, that George Bernard Shaw, himself no slouch with an Irish penny whistle, sent him this word: "Tell Einstein that, if appearances go for anything, he is really a musician masquerading as a scientist."
>
> While Einstein laughs at this witticism—which he regularly did, we are told, for it is impolite not to laugh at everything Bernard Shaw says—let us look at the man's form and figure through the loving eyes of a disciple:[83]
>
> "A noble head of black hair, sprinkled with gray, standing up and away from the scalp in all directions; alert, gleaming eyes, alternating between a merry twinkle and detached absorbed contemplation; full, sensuous and singularly red lips; a beautiful marble white forehead, seamed with a perpetual wrinkle which imparted to the face a strange expression of mingled wonderment and naivette [sic]."

This description of Einstein as an artistic man, both in his musical talents and his appearance, is reminiscent of the account of him given by Ludwig in the *New York Times*. It also plays on tropes of artistic genius as an explanation for the physicist's achievements in science by interweaving both pursuits into an interdependent quest of inspiration.

Music and Science Intertwined for Einstein

Einstein's musicianship was seen as inherently intertwined with his scientific thought. Music was often portrayed as an indispensable part of Einstein's creative life, extending well beyond his violin performances and into the creation of his scientific theories. The importance of music for Einstein is elaborated on in the first article about Einstein's visit

[83] This "disciple" is most likely Dr. Archibald Henderson, who is quoted extensively throughout this article. Henderson, a physicist and professor at the University of North Carolina at Chapel Hill, wrote one of the first books explaining Einstein's theories. He traveled to Berlin to meet with the scientist in 1924. This encounter, including George Bernard Shaw's remark that Henderson passed along to Einstein during his visit, is recorded in a "conversation" printed in *Forum* in October 1924 (Vol. LXXII, no. 4) entitled "Ulysses and Einstein: A Dialogue Between George Bernard Shaw and Archibald Henderson." Henderson tells the story slightly differently the first time: "He laughed heartily when I told him you had remarked to me that he looked much more like a musician than a mathematician. He is very fond of music, being a finished violinist himself; and assured me that the creative mathematician was always an artist, with a highly developed sense of form." (453)

using the words of Chaim Weizmann, head of the Zionist delegation, and Elsa Einstein, Albert's second wife. Weizmann states:

> "When he was called 'a poet in science' the definition was a good one. He seems more an intuitive physicist, however. He is not an experimental physicist, and although he is able to detect fallacies in the conceptions of physical science, he must turn his general outlines of theory over to some one else to work out. That would be readily understandable to a man of science. He first became interested in mathematics when he was 14 years old, and his work is his life. He spends most of his time reading and thinking when he is not playing his violin."[84]

Weizmann seems to position Einstein in this case primarily as an intelligent and thoughtful man; whether he is thinking or playing music, he is somehow engaged in an intellectual activity related to his philosophically-relevant theories.

Elsa Einstein was interviewed for the same article and asked to explain his hesitation at being bombarded by members of film crews upon his arrival in New York City. She declared that he "would rather work and play his violin and walk in the woods." She continues later, elaborating on his work ethic and how he managed to stay focused:

> When he was engaged on some problem, "there was no day and no night," but in his periods of relaxation he went for weeks without doing anything in particular but dream and play on his violin. Whenever he became weary in the midst of his work he went to the piano or picked up his violin and rested his mind with music.
>
> "He improvises," she explained. "He is really an excellent musician."[85]

The author paraphrases Mrs. Einstein's words about the physicist's reliance on the violin for a type of restorative power, ostensibly without which his scientific theories would not exist. This idea appears again in the *New York American*, which also summarizes Einstein's first visit. Mrs. Einstein articulates her husband's reliance on music: "When a

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[84] "Prof. Einstein Here," 13.

[85] "Prof. Einstein Here," 13.

problem is put up to him in the work he loves he works days and nights without sleep or food. Then to rest his tired body he will turn to the violin or the piano."[86]

In his biography of Einstein, Anton Reiser discusses many of the ways that music has affected the physicist's life. About music during Einstein's childhood, he makes the following remark:

> His love for music grew with his love for mathematics and his religious devotion to the wonders of nature. During the years of his physical and spiritual adolescence, the classical music of Germany opened for him a world which, descending from metaphysical heights, sounded the profoundest mysteries of the human soul. He played the sonatas of Beethoven and Mozart. He studied the music of John [sic] Sebastian Bach, which at that time was little known. These things made up the boy's world and with them he maintained himself against the slavery of school and the great stone city.[87]

As with the newspaper articles in the 1920s and 30s, Reiser, like other authors of full-length biographies, related Einstein's musical abilities to his scientifically-oriented mind—even with Einstein the child.

Alfonz Goldschmidt argued in 1934 for the undeniable link between Einstein's theoretical physics and his musicianship, asserting that a knowledge of "Einstein the musician" is integral to an understanding of Einstein the physicist and stating that "just as his mathematical thought-processes are an instrument of his personality, so is his violin."[88] Whereas in previous articles, authors made indirect assertions about the role of music in the creative scientific process, Goldschmidt makes it clear that for Einstein music and mathematics are inseparable elements of the scientist's genius for "he gets

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[86] "Einstein's Music Excels Science in Wife's Opinion," *New York American* (3 April 1921), 3.

[87] Anton Reiser, *Albert Einstein: A Biographical Portrait* (New York: Albert and Charles Boni, 1930), 37–8.

[88] Alfonz Goldschmidt, "In Einstein Music and Mathematics Blend: The Same Rhythmic Force That Governs His Scientific Work Is Active Within the Professor When He Plays on His Violin," *New York Times* (1 April 1934), SM18.

from music new force for his scientific investigations." This seemed no stretch given that, in Goldschmidt's opinion, "the professor seeks in his music, as in his other activities, the ground formula of life." Additionally, despite the fact that he understands Einstein's own insistence that he is merely an amateur violinist, Goldschmidt compares the physicist's work to that of the genius composer.

> The creative scientific process in Einstein is, in fact, similar to the creative process of the greatest composer. It is really intuitive. He does not reject the constant experimenting that the empiric method prescribes, but his creations in physics come about in a deductive way.

Einstein's musicianship and scientific thought, then, are mutually shaping. His musically-oriented mind helps place the physicist in a creative mode of thinking, allowing the famous theories to come into being. In the same way, the mathematical and scientific aspects of Einstein's personality affect his musical tastes and his musicianship.

The idea of a link between Einstein's theories and his musical abilities became a type of popular myth that cemented the public's interest in the physicist and his theories. As the details of the theories of relativity and Einstein's visit became old news, journalists rehashed those elements which held the public's interest most. The American public's continued interest in the link between Einstein's scientific thought and his musically-oriented mind greatly influenced the music world's reception of Einstein. Not only were they interested in his musicianship on a surface level, in the same way the general public was, they were also intrigued and heartened, I believe, by the public's willingness to accept such abstract theories and such a looming presence of genius when it was mediated by *music*.

IV. Einstein for Music

The five tropes used in the portrayal of Einstein shaped how American modernist and ultramodernist musicians reacted to Einstein. Exploited explicitly and implicitly in their writings and compositions, the elements of Einstein's public persona were used as points of identification—both intra- and inter-personally—between a scientist and a composer, as well as among composers. In adopting these tropes, composers were taking part in the much larger, highly diverse public discourse about Einstein and about science in society in the first half of the twentieth century.

A Revolutionary for Music

Using Einstein as a model, American modernists sought a leader (or saw themselves as a leaders) who could break away from the music of the past. This backward-looking vision of the future of music, like Walter Benjamin's angel of history, situated modernist ideologies always with respect to the music of the past. Tonal expectations of the previous few centuries were perceived as a burden, to be broken forcefully away from with the aid of a revolutionary figure—a revolutionary like Einstein. This view of Einstein's theory toppling all that we had known about the nature of the universe since Newton played into this idea. Newton's concepts of the mechanics of the physical world had been accepted as law for centuries, only to be overturned by one rebellious figure. Modernist writers similarly concerned themselves with dispelling the notion that we were bound to the centuries-old tonal "laws." In Ezra Pound's *Antheil and the Treatise of Harmony*, the poet-critic saw modernist composer George Antheil as this type of figure,[89] a portrayal echoed in Antheil's self-proclaimed status as the "Bad Boy" of music in his

[89] Ezra Pound, *Antheil and the Treatise on Harmony* (New York: Da Capo Press, 1924).

1945 autobiography.[90] Cowell also saw himself as pushing against the past, an idea he expresses in his *New Musical Resources*.[91] Neither called explicitly for a revolutionary figure, but it is strongly implied that certain real-life personalities—Antheil for Pound and Cowell for himself—could be seen as this type of figure by the very nature of their writings and compositions.

Other authors made the need for a musical revolution more explicit. In a 1930 article entitled "Musical Modernism: Some Random Reflections" in *Musical Quarterly*, the British-born composer Colin McAlpin expressed his view that what music really needs to start a revolution is an Einstein.[92] The article begins:

> It is obvious that musical "legalism" has, in these last few years, received a very rude shock, if not a veritable deathblow. For what were taken to be inexorable "laws" in music have turned out to be but transient tendencies.[93]

Later in the article, McAlpin explains the cause of this "deathblow."

> Again: even in the matter of growth and expansion, music and science are in singular accord. For the old orthodoxy of science is now entirely discredited. The universe is no longer a bounded prison-house, brick-walled with the ultimate atom of materiality. [...] And harmony, likewise, is now no longer a theoretically confined preserve, from which there is no escape; but rather an esthetic thought-force, elastic and abundant, which contacts an inner world of free creativeness. There is now no cramping finality about harmonial processes, no limit to be set to the possible in the matter of chordal construction. Even the ancient forms and "closed system" of keys show signs of rapidly giving way. And it is interesting to notice that the disintegration of the old harmonial order

[90] George Antheil, *Bad Boy of Music* (Garden City, NY: Doubleday, Doran, and Company, 1945).

[91] Henry Cowell, *New Musical Resources* (New York: Alfred A. Knopf, 1930).

[92] Colin McAlpin was a little-known British composer of such operas as *The Cross and the Crescent* (1903). He was one of a number of European composers that contributed to the on-going American dialogue about modernism and Einstein within the journal *Musical Quarterly*.

[93] Colin McAlpin, "Musical Modernism: Some Random Reflections," *Musical Quarterly* 16/1 (1930), 1.

> synchronises, more or less, with the crumbling of material modes of thought.
>
> If, moreover, an Einstein can give to the Newtonian principle of "mechanical relativity" an immeasurably wider scope, why should not a Strauss unfold the chordal "relativities" inherent in a Beethoven? But there are still some scientists who shut their eyes to anything new, just because it is new; even as there are still some antiquated harmonists who deliberately close their ears to the more delicate effects attendant on the subtler modes of music.[94]

This extended passage exhibits McAlpin's familiarity with Einstein and his theories. Einstein has shattered our older, narrower conception of the universe, i.e. Newton's three-dimensional mechanics. Similarly, an Einstein of music should or perhaps already *has* brought about a revolution in music, a "deathblow" to the music of the past. McAlpin makes it clear that this was not a peaceful changing of the guard from the older "legalistic" style of composition to the new avant-garde styles of the modernists.

> It cannot be denied, however, that contemporary composers have had to face much bigotry and opposition from the enemies of progress. They have suffered much from the tyranny of the "dead hand," the hostility of the traditionalists, and the inertia of the "schoolmen"—all such as feed upon the past and fear to face the future.[95]

Placing this struggle for new music in the context of a battle reflected the war-like sense of Einstein the revolutionary, as originally portrayed in British journalism and later presented to American audiences.

McAlpin's article, published in the premier American music journal *Musical Quarterly*, speaks to an American audience of musicians and educated music lovers that is clearly as familiar with Einstein as he is. Not only must this musical readership have been aware of the basic tenets of Einstein's theories, they must also have been able to

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[94] Colin McAlpin, "Musical Modernism," 4.

[95] Colin McAlpin, "Musical Modernism," 11.

understand Einstein the man in the way in which McAlpin did. This musical readership (which included many of the regularly contributing contemporary composers such as Aaron Copland and Dane Rudhyar) was likely familiar with the portrayal of Einstein as a revolutionary.

McAlpin's destructive revolutionary figure also had a more constructive dimension. His figure, engaged in aesthetic battles, also served as a prophet, heralding and even ushering in a new musical era. In quite messianic language, he describes this so-called prophet and his role:

> So we must be prepared for the voice of the prophet who would usher in an age of new effects and novel harmonies. And though evolution may be a process at once slow-moving and of patient endeavor, present-day science has accustomed us to the idea of an occasional *saltus*—leap or bound—in the upward trend of development.[96]

McAlpin's figure has two sides, just as Einstein was often portrayed in this complex manner. The physicist was seen as both radical revolutionary, making a sharp break with the physics and physicists of the past, as well as peaceful prophet, bringing a new understanding of the universe to the people.

A Hero/Savior for Music

The idea of Einstein as a hero or savior translated well into modernist discourse. As we saw above, often writers identified and utilized the dual nature of Einstein as hero and as rebel. In addition to his combative persona, seen as pushing against ideas of the past, Einstein was viewed as a shining figure whose theories promised a brighter future. Many of the composers who saw themselves as rebelling against the past also considered themselves forward-looking cultural heroes. The ultramodern composer Dane Rudhyar

[96] Colin McAlpin, "Musical Modernism," 11–12.

was among the many writers who appealed to Einstein and his theories of relativity in his aesthetics of new music. For example, in his article "The Relativity of our Musical Conceptions," he optimistically seeks a new heroic figure for the future of music which he describes as choked by the tyrannical hold that the music of the past century has on composers especially of the new world.

> The theory of Relativity is sweeping the intellectual world of to-day. For centuries our thoughts and feelings have been molded over certain definite basic structures which have crystallized along certain lines, and the characteristic fluidity of early times has now been transmuted into a state of utter rigidity, so that they appear to us as mysterious and most sacred idols. ... Yet in these musical axioms which tyrannically rule over European music there lies no more absoluteness, no more certainty than in the axioms of physical science, which have so utterly vanished before a closer and more daring investigation lately.[97]

Rudhyar explains that what modern music needs is a figure like Wagner was for his generation, someone who is able to connect the metaphysical to the aesthetic: "But all are afraid of 'jumping beyond their shadows,' as Nietzsche would say, afraid of clamoring for what Music needs, for what Humanity, Science, Art, Religion need: *a new basis, a new soul, a new faith.*"[98]

A Genius for Music

The isolation of genius, felt keenly by many modernist and ultramodernist composers, was seen as parallel to the internal struggles felt by Einstein. Although he was adored by many, he often rejected his fame, retreating to more secluded spaces, whether these were a private hotel room, his sailboat, or a new city entirely. This self-imposed isolation,

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[97] Dane Rudhyar, "The Relativity of Our Musical Conceptions," *Musical Quarterly* 8/1 (January 1922), 108.

[98] Dane Rudhyar, "The Relativity of Our Musical Conceptions," *Musical Quarterly* 8/1 (January 1922), 109.

reported with curiosity in newspapers and magazines, touched upon something that many avant-garde composers experienced, albeit involuntarily.

The sense that one's work was misunderstood was felt by a number of composers of the time. Reporters discussed this tension with respect to Einstein. The distance between a composer and the audience because of the nature of the composer's genius was conveyed using Einstein's name in a 1930 issue of *The Living Age*. "One critic has described the work as comparable to that of Einstein, in that it is superlatively excellent of its kind, but difficult to understand."[99] Like Einstein and his work, Schoenberg's opera is understood only enough to grasp that it is a work of genius. Indeed, once Schoenberg moved to the United States, as we will see, the musician was regularly identified as "Einstein of Music" in newspapers such as the *Los Angeles Times*.

John Redfield, in his popular text *Music: A Science and an Art*, described musical genius in more abstract terms, comparing such a figure to the genius in general, and to a few well-known geniuses in particular.

> The genius is an individual who possesses—perhaps I might better say is possessed of—an *extraordinary* interest in the subject which interests him most. ... It is this overwhelming interest in one particular aspect of his life that constitutes him a genius.
>
> Newton and Einstein are examples of persons extraordinarily interested in understanding the physical aspect of existence.[100]

He goes on to explain how these geniuses relate to the musical genius: "The musical genius is a person possessed of an extraordinary interest in music, and who is not below the normal of general intelligence."[101] The musical genius then, an ideal composer,

[99] "Letters and the Arts," *The Living Age* (April 1930), 157.

[100] John Redfield, *Music: A Science and an Art* (New York: Tudor, 1949), 168.

[101] John Redfield, *Music: A Science and an Art* (New York: Tudor, 1949), 170.

mirrors the genius of a figure like Einstein. In his book that enjoins composers of new music to take heed of scientific developments, this reference to Einstein makes clear his plea for the future of music: Music needs a genius like Einstein.

An Understandable Intellectual for Music

Many composers, in spite of their occasional isolation and the frustration it must have caused them, felt that they could be, like Einstein, understandable intellectuals. Although they often spoke of radical concepts and composed challenging pieces, certain modernists and ultramodernists from Copland to Cowell truly believed that their aesthetics theories and practices were part of a larger cultural trend of broader interest; their treatises and compositions were written (often explicitly) for the regular person on the street. The idea that modernist composers of this time pushed against their contemporaries and composed in an exclusionary manner does not match the composers' writings.[102] Composers like Henry Cowell and Carlos Chávez explicitly addressed a lay audience. These books relatively free of musical examples, conveying very little musical jargon, and attempted to contextualize modern music for the general audience.

In addition to composers' writings that were intended to reach a large audience, non-composers writings on modern music also made it apparent that modern music was a genre for all Americans. John Tasker Howard's *This Modern Music: A Guide for the Bewildered Listener* is a book exactly in line with this mode of thought. His candid guide for the average person cuts right to the heart of the matter: "It is not at all strange that people generally do not like modern music, particularly those of us who have arrived at

[102] See the introduction to Carol Oja, *Making Music Modern* (New York: Oxford University Press), 2006.

middle age."[103] But as he dissects some of the most daunting features of modernist and ultramodernist music—from dissonance, through impressionism, and on to polytonality and tone-clusters—in plain terms he brings the real reason for dislike to the surface. A lack of simple explanations has led to misunderstanding of the broad genre, but in his ability to translate complex musical ideas new understanding is gained. Here Howard makes the intellectual understandable.

The aptitude for clarity exhibited by Howard is precisely what Ernst Krenek wishes more modern composers would use in describing their work. Krenek makes his model for elegance of presentation explicit in *Music Here and Now* (1939) by naming Einstein as the perfect translator of complex theories into clear and comprehensible language.

> New music can well envy modern physics its possession of an interpreter who expresses his opinions with such intelligence and calm self-confidence. In this case, the man who originated the theory provided also its interpretation; and the composer who starts out to interpret the new music analytically may derive hope and courage from Einstein's example. There is not much else he can do but explain the music himself, after he has composed it.[104]

Einstein, the understandable intellectual, is the ideal spokesperson for his own ideas. Therefore composers need only imitate Einstein for the perfect role model in the balance of intuitive genius with comprehensible artist.

A Musician for Music

Above all, the idea that Einstein's fame in America derived in large part from his status as a musician intrigued composers, theorists, and critics. Musicians would not only have

[103] John Tasker Howard, *This Modern Music: A Guide for the Bewildered Listener* (New York: Thomas Y. Crowell Company, 1942), 1.

[104] Ernst Krenek, *Music Here and Now* (New York: W. W. Norton and Company, 1939), 214.

been drawn to a person who so obviously shared and revered their passion, but also to the very fact that his musicianship helped to mediate the more inaccessible aspects of his public persona. Einstein the musician—music lover, violinist, artist look-alike, and musician-scientist—was someone who the person on the street could understand and, because they understood the man, they felt reassured in their understanding of his theories and his view of the universe.

The first four tropes that defined Einstein for the American public all set him apart from the average person. While his traits might have been ones that they—the general public and composers—wished to emulate, these aspects of Einstein's public portrayal made him superhuman. We notice this from many of the composers' and writers' uses of Einstein's persona. Most often, when using his name to invoke a particularly desirable trait, they compared him to a hypothetical musician. The few living (or past) composers that were likened with Einstein were seen as imperfect comparisons; when an Einstein for music was desired it was a revolutionary or hero or genius or understandable intellectual that had yet to be seen.

As opposed to the sentiment of inaccessibility surrounding the first four tropes of Einstein's reception in the U.S., the fifth, Einstein's musicianship, was seen to reflect Einstein's total humanity. The different ways in which the scientist was characterized as a musician all served to place the illustrious Einstein on the same level as the people who worshipped him.[105] Like Einstein, even elementary-school children would have been familiar with Bach, Mozart, and Beethoven. His tastes were their (and their newspaper-reading parents') tastes. For professional musicians, the music of these composers would

[105] Ironically, this molding of Einstein into a "regular guy" in spite of his hero's status actually gave his fame longevity in American popular culture.

have been a part of their musical training no matter what their professed current aesthetics were. Similarly, amateur musicianship like that of Einstein's was a common pastime for early-twentieth century Americans. Einstein's insistence upon the level of his abilities being not much more than that of a dabbler certainly must have sounded familiar to members of the general public. In descriptions of Einstein's affable personality, his artist's appearance was always claimed to be one of the indications of his friendliness. Perhaps most humanizing of the facets of Einstein's musicianship was the supposed link between his music making and his scientific thought. The very idea that his musically-oriented mind was responsible for creating universe-shattering theories must have led the music-appreciating public to view the man and his theories more as an extension of something they had in common with the great scientist and less like the products of the ivory tower of physics.

At the same time composers and music writers were observing what was being said about Einstein, they were observing their own and the public's reaction to it. It was clear to composers that Americans were fascinated by Einstein the musician. As Ernst Krenek observed in 1931 (and I included in the epigraph): "Probably the best-known fact about the theory of relativity, the fact that has made the most impact, is that Einstein plays the violin; this after all, is hard news."[106] Krenek's incisive remark reveals the impact of Einstein's musicianship on his broader appeal. If Einstein's complicated theories could be mediated by his musicianship, perhaps modernists' own radical aesthetic theories and avant-garde compositions might have a chance at influencing artistic culture because of the medium.

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[106] Ernst Krenek, "New Humanity and Old Objectivity" (1931), reprinted with permission of Gladys Krenek, in *Modernism and Music*, ed. Daniel Albright, 291.

While it must have been satisfying to see that music helped to weaken intellectual barriers between Einstein and a mass audience, composers and music writers did more than emulate Einstein's status as a musician (it was, after all, within their job description to be musicians). Instead, composers invoked Einstein's name in their writings on music, which worked in two ways. In referring to Einstein, they called to their readers minds all of the associations circulating about Einstein in the popular press, in newspapers, and in magazines. Included among these associations were, of course, his heroism, revolutionary nature, his genius intellect, and his understandability—but also his popularity through musicianship. By engaging with these common tropes in their writings, and positioning themselves as fundamentally similar to the scientist, these aspects of Einstein's persona were transferred onto the composers' personas.

The use of Einstein's name in musical writings also functioned in another way. By invoking Einstein's persona in their writings, composers utilized the same rhetorical device employed by the general press—albeit in a reverse way. While in books, magazines, and articles Einstein's musicianship helped to mediate his scientific character and popularize him as a cultural figure, in articles and books on modernist music, using discourses about Einstein offered composers a way to participate in a wide-reaching dialogue. At a time when books about Einstein and his theories were flying off bookstore shelves, the use of Einstein's name in a book or article about modern music would have shown their authors to be current, up-to-date writers and probably would have made the writings more appealing to the large Einstein-obsessed audience.[107]

[107] In a short piece in *The Journal of Philosophy*, Edwin E. Slosson, noted writer on Einstein and general science, quipped: "In our country we have the amazing spectacle of 'Einstein books,' published hastily to meet the popular demand, stacked up on the quick sales counter of the bookstore to an altitude comparable

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The figure of Einstein worked as a model for composers on both the small scale and the large scale. As a hero, rebel, genius, and understandable intellectual, Einstein reflected some of the traits present in contemporary composers and also those that needed strengthening in order for modernist and ultramodernist music to attain the importance composers believed their art deserved. Einstein also rose to near immediate fame once he and his theories reached America; this situation mirrored the outcome that many composers desired for themselves and their musical ideas.

In electing to invoke Einstein as a figure that could represent the ambitions and struggles of American modernist composers, they were not just choosing a famous American figure (why not a Babe Ruth or a Franklin Delano Roosevelt?), but a charismatic scientific hero. In doing so, they were taking part in the scientific preoccupation of the first half of the century in a powerful way. In “Chapter 1: Introductions” we saw that composers experimented with various scientific identities, associating themselves with scientific methods and language. The specific use of Einstein as a model figure shows modernism’s commitment to an engagement with both scientific and popular culture. Einstein was first and foremost a scientist, and in employing his personality in connection with their artistic agendas, the modernists and ultramodernists were, consciously and unconsciously, participating in a massive cultural shift that attended the techno-centric early twentieth century.

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to that of the latest novel.” Edwin E. Slosson, “Eddington on Einstein,” *The Journal of Philosophy* 18/2 (January 1921), 49.

CHAPTER 3

RELATIVITY

In an article published in *Musical Quarterly* in 1925, musicologist Guido Adler constructed an analogy between his nascent field of musicology and recent developments in the natural sciences:

> The relativity of phenomena in the domain of art is very nearly the same as, or at least analogous to, what we find in nature. And the laws controlling the successions and variations are at one with those of the processes of nature. But the science of music cannot as yet show such advances in knowledge as do the researches of natural science. The irradiations that spread out from an intellectual centre of art suffer manifold alterations and aberrations, quite probably on account of the quality of gravitation immanent to intellectual emanations in their outflowing—parallel with the teachings of the Einstein theory.[1]

According to Adler, contemporary scholarly approaches to music were not quite on par with the developments in the natural sciences. Although Adler invoked Einstein and relativity theory, this reference must be carefully deconstructed. Einstein's theories served not simply as a point of comparison, or an example of the "advances in knowledge" in the natural sciences. Rather, Adler understood the very nature of music to be in accordance with the tenets of Einstein's theory. The complicated nature of the study of music was perceived as stemming from the fact that music suffers "manifold alterations and aberrations" just as light appears to bend as it passes through Einstein's curved space. Adler posited, then, not just that theories of music should be scientific, but

[1] Guido Adler, trans. Theodore Baker, "Internationalism in Music," *Musical Quarterly* 11/ 2 (April 1925), 289.

that music was already defined by the universe as illuminated by Einstein; in effect, music *was* relative. Adler's comment implied that the field of music must find its own revealing theories, just as Einstein's theories revolutionized the way scientists looked at the known universe.

For Adler, and for a number of other musical intellectuals and composers, the newly popularized theory of relativity was a part of their everyday, common knowledge. As such, it worked its way into their writings about music in a variety of ways. In this chapter, I will examine the multifaceted reception of relativity by the modern musical world in a fashion similar to my examination of Einstein as an icon for modern music. Composers responded to Einstein's public persona as a model for their own actions as modernist composers—or their desires for others to follow in his footsteps. When it came to relativity, composers interacted with the scientific theories on their own terms: as theories. The theories of relativity represented a revolution comparable to that desired by musical modernists in America—a revolution comprised of ideas, not necessarily actions, with far-reaching intellectual and philosophical implications. Modernist composers saw themselves as heralds of a new era of artistic freedom and change, and it was their theories of music, as penned in articles and books, that helped push this aesthetic change. In much the same way that composers referred to Einstein directly or obliquely in order to capitalize on his iconic status, they used relativity as a signifier for the extreme importance that a single, and seemingly obscure, intellectual theory could have on an entire culture's worldview.

In distinguishing the reception of relativity "as a theory," I mean to point out the difference between composers' modeling of musical theories on relativity theory and the ways it was disseminated and popularized on the one hand, and their adoption of certain ideas of Einstein's in actual works of music on the other. The latter, which constitutes a few special cases, will be discussed in "Chapter 4: Space-Time." This distinction must be made because, as scholars know too well, what composers *say* and what composers *do* is not always the same. Nevertheless, the fact that composers *said* that they were interested in relativity theory, both as a model for a scientific theory of music and as a parallel with certain ideas they had about music, means a great deal for the study of modernist musical life. Their conscious association with the celebrity physicist of the day (or, really, the century) speaks to modernists' immersion in a broader artistic, intellectual, and *popular* cultural trend.

In the current chapter I will explore how Einstein's notions about space, time, and relativity infiltrated composers' ideas about music, extending the discussion that began in the previous chapter on Einstein and his persona. Just as he was considered a revolutionary model for composers, so too were his theories seen as viable models for revolutionary theories of music. Composers were able to relate to Einstein's theories in a number of ways. Because Einstein's theories were immediately classified as revolutionary, composers were drawn to them as models for cultural change. One method of relating to relativity was a conscious borrowing of the scientific language of relativity theory within an aesthetic treatise on music. Composers and writers like Henry Cowell and Charles Seeger made use of different terms from the popular lexicon of relativity—everything from relativity to space-time to the fourth dimension—in order to invest their prose writings with the cultural capital that Einstein's theories were quickly gaining with the general public.

Composers and theorists also attempted to incorporate some of the ideas of relativity into their own writings about music. This took a number of forms, from the surface-level use of the idea of relativity to the more deeply meaningful adoption of new ideas related to Einstein's. Most approaches in the latter category centered on the use of Einstein's revised notions of space and time in theorizing about musical space and time. For most non-scientists, relativity theory was encapsulated in the idea that Einstein had "destroyed" older conceptions of space and time; space and time were now, in Einstein's system, fundamentally inseparable entities. For composers, this reevaluation offered a refreshing look at the building blocks of music, as space and time had been inextricably bound by metaphor to pitch and rhythm, respectively, for centuries. Reconfiguring the relationship between space and time in the universe opened the door for a number of possible reinterpretations of the art of music, including new relationships between the tonal and rhythmic elements of music.

Composers' own writings on music reveal the impact of relativity on modernist musical life. Modernist and ultramodernist musicians constructed "theories" of music in a number of ways: in articles, compositional handbooks, guides to musical appreciation, and even histories of music. In these documents, there is evidence that composers turned to Einstein's theories of relativity as a model for their music theories. They engaged with Einstein's writings on more than just the surface level: they borrowed a scientific language and embraced popular and scholarly notions of relativity. Although modernists clearly used relativity as symbolic capital, it is also apparent, from the depth with which ideas from relativity are woven into their theories of music, that Einstein's concepts also shaped certain composers' ideas about the nature of music at a more fundamental level.

I. Relativity: A Revolution in Science

Relativity reached the American public in a number of ways. Primarily, Americans were introduced to the theories and their concepts through newspaper articles, but full-length books and even movies played important roles as well. As with the promotion of Einstein as a public figure, certain tropes emerged in early discussions of relativity and then congealed within a short time. The concept of "revolution" as connected with relativity dominated the construction of a collective myth of Einstein's theories, but other notions like the "destruction of space and time" and the "fourth dimension" also infused the popularization of relativity.

It is important to clarify (again) the two relativity theories. The theory that was "proven" in May 1919 by Eddington and his eclipse team and announced in November of that year was the General Theory of Relativity. As discussed in "Chapter 2: Einstein," Einstein had developed both theories by this time, but only the General Theory applied to the apparent bending of light was witnessed during the solar eclipse. Although the Special Theory of Relativity had been discussed in the scholarly community and was known at the time of the fame-making eclipse announcement, it was not considered "proven" in the same way that the General Theory was. Although we are clear today on the peculiar lineage of the related theories and specialists of the day were familiar with the specifics of the two theories, for the general public the two theories were, for all practical purposes, one and the same. Thus, most often we (and contemporaneous audiences) only read about "relativity theory," which was often seen to encompass elements from both Einstein's Special and General theories.

Newspaper articles about relativity circulated in the general press as soon as Eddington's announcement was made in early November 1919. Although relativity was introduced in many of the same media as Einstein the man was, ideas about relativity circulated somewhat differently. Whereas Einstein's persona was crystallized only after his visit to the United States in 1921, popular notions about relativity theory formed immediately and sensationally thanks to the work of the press. Science historian Marshall Missner explains that certain interwar American attitudes—including xenophobia, suspicion of science, and fear of domination, on top of the cultural obsession with advancement and self-improvement—helped boost relativity theory's appeal.[2] Apart from the general cultural interest that brought Einstein's relativity theories to such extreme popularity, the idea of a revolution in our conception of the universe appealed in particular to modernist thinkers and artists. The perceived upheaval of scientific thought allowed for an easy parallel with modernist agendas and the extent to which they broke with the past and attempted to start anew.

Relativity in the News

With the first news of relativity theory hitting American newsstands, the theory/theories were understood to initiate a revolution in scientific thought. The momentous nature of Eddington's theory-confirming announcement was captured in the headlines that led the first article in the *New York Times* on 9 November 1919.

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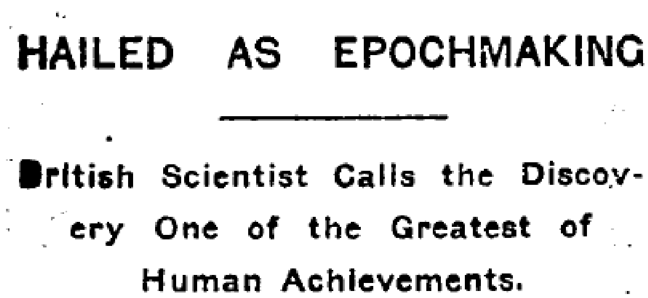
[2] Marshall Missner, "Why Einstein Became Famous in America," *Social Studies of Science* 15/2 (May 1985), 267.



HAILED AS EPOCHMAKING

British Scientist Calls the Discovery One of the Greatest of Human Achievements.

Figure 3.1 - *New York Times* (9 November 1919)[3]

Although it is the scientific community that gives this announcement credibility, it is clear from the nature of the statement "one of the greatest of human achievements" that relativity's import extends far beyond the scientific world. The statement was borrowed from the *London Times*' interview with British Royal Society President, Sir Joseph Thomson, that appeared in the article entitled "Revolution In Science" (7 November 1919) in which Thomson reportedly stated that the Royal Society had just heard "one of the most momentous, if not the most momentous, pronouncements of human thought."[4] Thomson's statement also appeared altered in one of the first articles on relativity that appeared in *The Washington Post*: he supposedly called Eddington's announcement "the most remarkable scientific event since the discovery of the predicted existence of the planet Neptune."[5] This statement is quoted in full in *The Independent* as well:

> "One of the greatest—perhaps the greatest—of achievements in the history of human thought," this is what the President of the British Royal Society calls Einstein's theory of relativity that is explained in the article on "The Weight of Light" in this issue. Next week Dr. Slosson will explain some of the revolutionary consequences of the theory on our ideas of space and time.[6]

[3] "Eclipse Showed Gravity Variation," *New York Times* (9 November 1919), 6.

[4] "Revolution in Science – New Theory of the Universe – Newtonian Ideas Overthrown," *The London Times* (7 November 1919), 12.

[5] "New Theory of Space," *The Washington Post* (14 December 1919), E5.

[6] "Just a Note," *The Independent* (29 November 1919), 115.

This announcement tied Einstein's theories to the concept of revolution in a way that would come to dominate the reception of relativity: the "revolutionary consequences" of the theory would be examined week after week.

Interested in providing a balanced perspective—or perhaps in prolonging the debate for the sake of extending readership—the *New York Times* frequently included articles that pushed against the popular notion that Einstein's theories provoked a fundamental shift in worldview. American scientists from well-known physicist R. A. Millikan to lesser-known local figures like Barnard College's Kenneth W. Lamson, a professor of mathematics, noted the hyperbole with which Einstein's relativity was discussed in the press. "Nothing wrong in space," says the headline accompanying the 2 December 1919 article that quoted Lamson.[7] Despite the (rather correct) opinions expressed by renowned scientists and mathematicians that Einstein's theory had little practical or non-scientific impact, the press continued to publicize the sensational story.

On 3 December 1919 (immediately following the Lamson article), the *New York Times* ran an article entitled "Einstein Expounds His New Theory," a provocative title that sounds as if it were a direct retort by the physicist himself to the previous day's anti-revolutionary spin. The article begins:

> Now that the Royal Society, at its meeting in London on Nov. 6, has put the stamp of its official authority on Dr. Albert Einstein's much-debated new "theory of relativity," man's conception of the universe seems likely to undergo radical changes.[8]

[7] "Einstein's Theory Discussed Here," *New York Times* (2 December 1919), 12.

[8] "Einstein Expounds His New Theory," *New York Times* (3 December 1919), 19.

In describing the conversation between Einstein and an overseas correspondent for the *New York Times*, Einstein's dismissive reaction to the idea of his theories having a "revolutionary effect on the human mind" was counted as mere modesty, rather than a corrective statement.[9] This was characteristic of the reception of relativity as revolutionary. Whether the words issued from a well-known professor's mouth or Einstein's own, the idea that Einstein's theories *did not* have a revolutionary impact was quickly and actively dismissed by the press. For this reason, the notion of relativity as revolutionary stuck with the American public.

In the popular scientific press, there was, of course much discussion of the revolutionary aspects of relativity theory. What is interesting for our purposes is that even journals like *The Scientific Monthly* focused on the ideological, philosophical, and cultural implications of Einstein's theories. In an article entitled "Relativity and Life," the author ("Beta") responds to the implicit criticism that he or she may not discuss relativity because s/he is not a mathematician. Rather, the author insists that "the germ of relativity consists in the idea that there is no one frame of reference from which alone reality can be measured. Does not this idea apply to relativity itself?"[10] But rather than harp on the relative merit with which this non-mathematician can discuss relativity, the author goes on to expound the various ways in which the fundamental idea of relativity applies to the larger world of ideas. In artists, Beta says, we find natural relativists.

> You will never hear artists claim there is only one way of expressing the beauty of life. The painter sees beauty in the statue and in music, in prose and in poetry, in different forms of architecture; he admits that they are all different ways of expressing the beautiful. But before Einstein, if a

[9] "Einstein Expounds His New Theory," *New York Times* (3 December 1919), 19.

[10] Beta, "Relativity and Life," *The Scientific Monthly* 22/2 (February 1926), 170.

> physicist had said that this thing called measured length is not an absolute but will vary according to the way you look at it (which, of course, is just what all artists say of art in general) what would have happened to this pre-Einstein physicist?[11]

Relativity can be comprehended here as a concept uncovered or revealed by Einstein, but understood in principle by artistic minds. In fact, it later becomes apparent that Beta believes this is part of the reason that Einstein himself came across the idea.

> The reason Einstein overthrew absolutism is because he is not a scientist. Einstein is an artist whose medium of expression happens to be mathematical physics instead of line, color, or marble. One has only to look at his picture to recognize the artist.[12]

In returning to the familiar stereotype of Einstein as artist or musician, the author emphasizes the inherently artistic nature of Einstein's new theory. As stated above, the theories and their creator were often used interchangeably to represent one another. In this case, Beta invokes the scientists' artistic persona in order to highlight the cultural importance of the theories themselves. The revolutionary theories of relativity were applicable even outside the scientific realm, touching every aspect of cultural life. Furthermore, for Beta, this far-reaching impact was tied to Einstein's inherently artistic mind—a fact that would not have been lost on artists and musicians who were considering possible links between their aesthetic theories and Einstein's scientific ones.

Relativity in the Bookstores

Within months of the announcement by Eddington at the Royal Society, books about relativity intended for a general audience began to accumulate on bookstore shelves. Some were more specialized than others, containing a few mathematical formulae, but

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[11] Beta, "Relativity and Life," *The Scientific Monthly* 22/2 (February1926), 171.

[12] Beta, "Relativity and Life," *The Scientific Monthly* 22/2 (February 1926), 171.

most were presented in simple, readable prose. Nearly all of the books, even those written by mathematicians and physicists, had some mention of the philosophical importance of relativity theory. What they all had in common was the notion that relativity was revolutionary. Perhaps surprisingly, many of these books contextualized Einstein's thought within longer scientific and philosophical traditions; even within such studies, the idea of relativity as revolutionary still dominated the appraisal of the new theory.

One of the first books to tackle relativity for a general audience was Edwin E. Slosson's *Easy Lessons in Einstein: A Discussion of the More Intelligible Features of the Theory of Relativity* (1920). As discussed in "Chapter 2: Einstein" (and seen earlier in this chapter), Slosson was a prolific science writer, authoring articles about Einstein in newspapers and journals, including *The Independent*, the journal for which he served as Literary Editor. His book on Einstein and relativity built upon the series of articles he wrote for the *Independent*, but had an even more casual tone. The book opens with a "prefatorial dialogue" between the author and "the reader," written as if it were a scene from a play to be acted out (on a street car, Slosson says). In the scene, the reader skims a newspaper article announcing the results of the eclipse observation. In the process, the reader recalls nearly every extravagant phrase spoken about relativity during the initial period of its popularity: "Most sensational discovery in the history of science," "Greatest achievement of the human intellect," "Upsets Galileo, Newton, and Euclid," and "Revolution in philosophy and theology."[13] In restating the many ways in which relativity has been hyped by the press, Slosson's fictional reader is able to both stir the memory of and incite an interest in Einstein's relativity theories. This sets the stage for

[13] Edwin E. Slosson, *Easy Lessons in Einstein: A Discussion of the More Intelligible Features of the Theory of Relativity* (New York: Harcourt, Brace, and Howe, 1920), v–vi.

his straightforward discussion of the scientific ideas and, without having to rely on grandiose statements within the main body of the text, Slosson is still able to bring out the momentousness of Einstein's discovery.

Easy Lessons in Einstein contains two analogies between music and relativity, both of which relate to the ways in which composers might have responded to relativity theory *as a theory*. Slosson notes the difficulties that people have—or say they have—with understanding scientific developments in general and relativity specifically. In doing so, he quite astutely points out that these difficulties are the same ones experienced by musical audiences. "What Mark Twain said about classical music applies also to science; 'It is not so bad as it sounds.'"[14] And, from the other side, Slosson notes that the struggles scientists have in explaining their theories are much the same as those sustained by musicians in explaining their art.

> Mathematics is the proper language of physics as the five-barred staff is the proper language of music. Ask a musician to explain a symphony in plain everyday English and he cannot do it, though he carries the Oxford Dictionary in his head. He can have the music played for us or he can show us the printed score but he could never convey it in ordinary language however long he might be willing to talk or we to listen. But we must not do the musician or the mathematician the injustice to suspect that his notions are hazy or absurd because he cannot explain (*i.e.* translate) them to us.[15]

Within these passages we can see, clearly illustrated, the main reason that composers were drawn to relativity as a parallel to their theories of music *and* the appeal that books like Slosson's would have had for them. The complex scientific theories had the same seemingly distancing nature as theories of modernist music, yet, through books that

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[14] Edwin E. Slosson, *Easy Lessons in Einstein*, 47.

[15] Edwin E. Slosson, *Easy Lessons in Einstein*, 89.

appealed to the general populace like Slosson's, relativity theory became popular, if not understandable.

H. Wildon Carr's *The General Principle of Relativity in Its Philosophical and Historical Aspect* (1922) sought to examine the place of relativity within a large philosophical context (the author was a philosophy professor at the University of London). In doing so, Carr makes an interesting statement about relativity in physics versus relativity in metaphysics:

> To the metaphysician there is nothing subversive or revolutionary in the new principle, it is practically identical with principles which have, time and again, been formulated in philosophy, ancient and modern, but to the man of science it seems like a sudden upheaval of the foundations on which the whole stupendous structure of modern science has been reared.[16]

Carr is distinguishing between relativity theory's association with subjectivity (a common link being made by both casual and professional philosophers at this time) and its importance for physical science. Yet, within the book, Carr is occupied with showing the philosophical importance that this revolution in science has for the world. So although Carr's statement of revolution may seem tempered in this statement—saying that "nothing is subversive or revolutionary" for metaphysics—it is actually a clever device that dismisses unsophisticated assertions of revolution and launches the author's own argument for relativity's revolutionary impact.

Another book that sees relativity theory in its scientific context is George David Birkhoff's *The Origin, Nature, and Influence of Relativity* (1925). The Harvard mathematics professor's monograph situates and evaluates relativity as part of a larger trend in theoretical physics succinctly in the introduction:

[16] H. Wildon Carr, *The General Principle of Relativity in its Philosophical and Historical Aspect*, 2nd Edition (London: Macmillan and Company, 1922), 3–4.

> The trend of the times is toward the deeper unification of scientific thought. In particular it is beginning to be realized that there are a few basic ideas out of which arises the imposing superstructure of the physical sciences. Without doubt the theory of relativity has been the *greatest single influence* in this direction, for it has thrown all physical ideas, including the sacrosanct concepts of space and time, into the fervid crucible of creative speculation. The theory of Einstein constitutes a *revolutionary advance*, comparable with that due to Copernicus, and seems equally likely to affect the direction of mathematical, physical, and philosophical development.[17]

Though one of the author's main goals (as stated in the title, among other places) is to examine how Einstein's conception of the universe evolved out of previous scientific theories, Birkhoff still considers relativity a revolutionary turning point in the history of human thought.

Archibald Henderson, professor of mathematics at the University of North Carolina in Chapel Hill, penned books and articles for academics and average readers alike. His short and more-or-less jargon-free *Relativity: A Romance of Science* (1923) brought the relativity theories to a general audience. In this book he discusses the importance of the theories by asserting, rather directly, that if Einstein's new principles go against our common sense notions of science, we must rework our ideas of common sense. For Henderson, the science of relativity theory necessitated a shift in worldview, not just the analogous philosophical or social counterparts to the theory. Henderson calls relativity theory "epochal" and describes Einstein's hypotheses as bold and revolutionary—"brilliant original investigations."[18] To confirm the scientific brilliance of relativity theory, Henderson quotes from a statement by Max Planck, a physicist nearly as

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[17] George David Birkhoff, *The Origin, Nature, and Influence of Relativity* (New York: The Macmillan Company, 1925), v. Emphasis in original.

[18] Archibald Henderson, *Relativity: A Romance of Science* (Chapel Hill, NC: University of North Carolina Press, 1923), 7, 8.

famous as Einstein at this time.[19] Planck's thoughts introduce the section on Special Relativity:

> The Special Relativity Theory surpasses in boldness everything previously suggested in speculative natural philosophy and even in the philosophical theories of knowledge. Non-Euclidian geometry is child's play in comparison. . . . The revolution introduced into the physical conceptions of the world is only to be compared in extent and depth with that brought about by the Copernican system of the universe.[20]

This "review" of the theory by another famous scientist (who was at least better known than Henderson, if not as well known in the U.S. as Einstein), adds weight to Henderson's scientifically-centered argument about the importance of relativity. Not only does Henderson believe relativity to be epochal, the great physicist Max Planck believes it to be revolutionary, too.

Benjamin Harrow approaches the topic of relativity by discussing the similarities and differences between Newton's view of the universe and Einstein's. His popular monograph entitled *From Newton to Einstein: Chancing Conceptions of the Universe* (1920), is incredibly easy to read. It also brings in a number of clear analogies and thought experiments from Einstein and many other leading physicists.[21] Harrow also brings out the significance of Einstein's work:

> Einstein's theories, supported as they are by very convincing experiments, will probably profoundly influence philosophic and perhaps religious thought, but they hardly can be said to be of immediate consequence to the man in the street. . . . Einstein's theories are not going to add one bushel of wheat to worn-turn and devastated Europe, but in their conception of a cosmos decidedly at variance with anything yet conceived by any school

[19] Both were and are well known for their work in physics, of course, but Einstein was becoming at this time a public icon beyond his reputation as a physicist.

[20] Henderson, *Relativity: A Romance of Science*, 22.

[21] Harrow also penned a book called *Eminent Chemists of Our Time*.

> of philosophy, they will attract the universal attention of thinking men in all countries.[22]

While we can see that Harrow has stated plainly that Einstein's theories will not make much of a difference to the average person, we also know that the so-called average person is precisely the audience for this book. We can read between the lines, then, that his "thinking men" might be any "men" who flatter themselves as such while reading this text. This thus encourages readers to place themselves in a more philosophical frame and evaluate the impact that the theories explained within the text might have on their overall worldviews.

American philosopher Bertrand Russell's approach is one of the most successful, as it explains in plain language two very important things: what Einstein's difficult-to-understand relativity theories are all about and why they are so difficult—from a philosophical perspective—to understand. He begins:

> Everybody knows that Einstein has done something astonishing, but very few people know exactly what it is that he has done. It is generally recognized that he has revolutionized our conception of the physical world, but his new conceptions are wrapped up in mathematical technicalities. It is true that there are innumerable popular accounts of the theory of relativity, but they generally cease to be intelligible just at the point where they begin to say something important. The authors are hardly to blame for this. Many of the new ideas can be expressed in non-mathematical language, but they are none the less difficult on that account. What is demanded is a change in our imaginative picture of the world—a picture which has been handed down from remote, perhaps pre-human, ancestors, and has been learned by each one of us in early childhood. A change in our imagination is always difficult, especially when we are no longer young. The same sort of change was demanded by Copernicus, when he taught that the earth is not stationary and the heavens do not revolve about it once a day. To us now there is no difficulty in this idea, because we learned it before our mental habits had become fixed. Einstein's ideas, similarly, will seem easy to a generation which has

[22] Benjamin Harrow, *From Newton to Einstein: Changing Conceptions of the Universe* (New York: D. Van Nostrand Company, 1920), 71–72.

> grown up with them; but for our generation a certain effort of imaginative reconstruction is unavoidable.[23]

This matter-of-fact introduction to his book allows readers to let themselves off the hook a bit as far as understanding Einstein's theories goes. The rest of the book is just as disarming. Russell carefully explains what we know about the physical universe, what we think we know, and what we should know about Einstein's new view of it. As for relativity's philosophical implications—something we would expect the philosopher to comment on—Russell has an intriguing take. He states that "the philosophical consequences of relativity are neither so great nor so startling as is sometimes thought," but believes the true philosophical relevance is one "of which relativity is not the only illustration." He notes that "as reasoning improves, its claims to the power of proving facts grow less and less."[24] Relativity shows that "logic used to be thought to teach us how to draw inferences; now, it teaches us rather how not to draw inferences."[25] Russell artfully concludes his book by implying that his approach in this book—showing what readers think they know about the world and about relativity, and how much of it is actually useful—has been derived from relativity's philosophical directive: "The final conclusion is that we know very little, and yet it is astonishing that we know so much, and still more astonishing that so little knowledge can give us so much power."[26]

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[23] Bertrand Russell, *The A B C of Relativity* (New York: Harper and Brothers, 1925), 1–2.

[24] Bertrand Russell, *The A B C of Relativity*, 219, 224.

[25] Bertrand Russell, *The A B C of Relativity*, 224.

[26] Bertrand Russell, *The A B C of Relativity*, 231.

Relativity in the Movies

In addition to newspaper articles and monographs on the topic of relativity, two films were made for American audiences shortly after Einstein's first visits to the United States. The first was a short film intended for audiences of all ages—and cinematic persuasions. The *New York Times* reviewer discussed the film, which was first shown in December 1922 at the Capitol Theater in New York, and described its universal appeal:

> The advance notice of it says that it is in "a single reel" and combines "novelty, comedy, and entertainment with scientific explanation," which seems to carry assurance that those who are not attracted by "novelty," "comedy" or "scientific explanation," may at least count upon "entertainment."[27]

Professor Delmar Whitson produced this film, but little is known about it and it is not as readily available as the second Einstein film.

The second film, *Einstein Theory of Relativity*, which debuted in late 1922 at the Rivoli and Rialto theaters on Broadway in New York City.[28] This popular short film played in theaters before feature length films and purported to illustrate the main ideas of Einstein's theories using explanatory moving images. *Einstein Theory of Relativity* was a mix of cartoon and live-action scenes, many of which seem to have been borrowed from a German film that premiered there in June 1922.[29] An August 1922 article in *Scientific American* reviews the German film and notes, with some dismay, that the editors of the

[27] "Picture Plays and People," *New York Times* (3 December 1922), 100.

[28] Although the film debuted in New York City, it reached a nationwide audience shortly thereafter. According to the producer of the film, Edwin Miles Fadman, "The Einstein film . . . played four weeks on Broadway at the Riesenfeld theaters [the Rivoli and Rialto], and then played every circuit of prominence through the country. It never failed to get a hand. The people like it in spite of the fact that prior to its premiere some showmen branded it as 'highbrowish' and its producers as lunatics. Needless to say these same showmen were among the first to book it after its successful premiere." Edwin Miles Fadman, "The Art in Pictures," *New York Times* (18 November 1923), X5.

[29] "'Relativity' Film," *New York Times* (18 June 1922), 89.

periodical discouraged an American production of such a film.[30] And, despite the hesitation of the "Einstein Editor" of *Scientific American,* the film received rather favorable reviews, once it opened in the States. An Associated Press review featured in *The Washington Post* applauded the film's ability to clear up "the mysteries of the laws of motion, space, time and light."[31] Additionally, the author found it to be "more popular and far simpler than the rows of intricate figures and formulae with which the lay student of relativity has heretofore been obliged to grapple."[32]

Max Fleischer adapted the film for an American audience and it is clear from some of the still pictures in the *Scientific American* article that the film shown in late 1922 in the United States used a great deal of the content of the original German version. The American version was cut in two forms, a four-reel version and a two-reel version.[33] The longer version was shown daily at the Rivoli Theater for four weeks and the abridged form could be seen before each regular film, as we can see from the advertisements below.[34]

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[30] The Einstein Editor, "Relativity in the Films," *Scientific American* (August 1922), 92.

[31] "Germans Use Films to Explain Einstein's Theory of Relativity," *The Washington Post* (13 May 1923), 37.

[32] "Germans Use Films to Explain Einstein's Theory of Relativity," *The Washington Post* (13 May 1923), 37.

[33] "The Screen," *New York Times* (12 February 1923), 13.

[34] Interestingly, the short film was also used as an opener for the April 1924 New York production of the play *Time is a Dream,* a play in six scenes by French playwright H. R. Lenormand. The play's reviewer described its use as "a somewhat imposing introduction" for the theater work, which took as its main premise the idea, consciously borrowed from Einstein, that "one may travel in time quite as well as in space." "Einstein Inspires Play," *New York Times* (23 April 1924), 24.

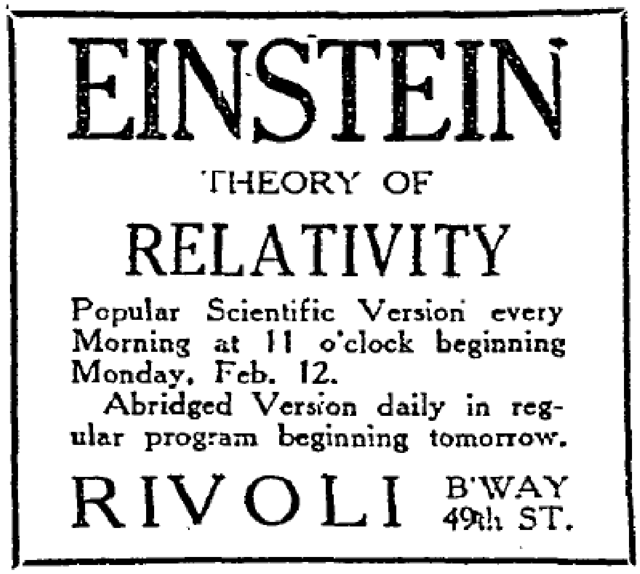

Figure 3.2 - ***New York Times*** **(10 February 1923)**[35]

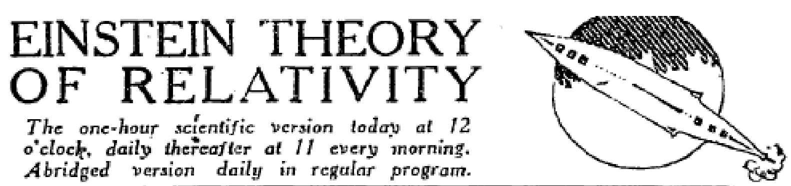

Figure 3.3 - ***New York Times*** **(18 February 1923)**[36]

The longer version was likely intended for educational use, while the shorter one for general audiences. In a review of a screening given for educators and scientists (presumably the longer version), the author is ambivalent about the film. The moving images used in the film to illustrate Einstein's theories seem to serve as a vast "improvement over the scores of volumes which have been written to set forth the figures of speech and analogies which have been considered to assist materially in getting the

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[35] Advertisement for *Einstein Theory of Relativity* at the Rivoli. "Display Ad 11," *New York Times* (10 February 1923), 10.

[36] Advertisement for *Einstein Theory of Relativity* at the Rivoli. "Display Ad 75," *New York Times* (11 February 1923), X3. Also used for Rialto ad: "Display Ad 64," *New York Times* (18 February 1923), X3.

idea of the theory itself."[37] But, while the images are, for the reviewer, an improvement over prose and diagrams, the cheeky article title reveals the author's reveals true feelings about the film: "Relativity, Filmed, Is as Lucid as Ever." In other words, the difficult to understand theories are beautifully illustrated to be just as difficult as ever. Another negative review, summarizing the general public's relationship with the film, put it this way:

> Having seen the pictures, they say, just as have many readers of "popular" articles on the subject, "Why, yes, all that is perfectly comprehensible. Anybody can understand it and most people know it before." Then, if they are persons at all thoughtful, they ask themselves why Dr. Einstein limited so narrowly those competent to judge his discoveries and contentions, and it occurs to them that, as he was not likely to be mistaken, perhaps what they saw in the theater, like what they read in the magazines, had little or nothing to do with Einsteinian relativity.[38]

Although this statement plays on the oft-quoted "twelve men" perception of Einstein's relativity theory, it does make it clear that what the short film offered was a distilled version of Einstein's ideas. But this "highlights" version of relativity theory certainly captured the imagination of those that saw it, and likely added a visual component to that imaginative conception of Einstein's new universe.

One magnanimous commentary on the film, appearing in a quarterly film review, puts it well:

> "The Einstein Theory of Relativity" is also worth attention. Whether it will illuminate the Einstein theory for you is a question—which the present writer answers for himself in the negative—but as a popular science film it's a well-done piece of work.[39]

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[37] "Relativity, Filmed, Is as Lucid as Ever," *New York Times* (4 February 1923), E1.

[38] "Topics of the Times," *New York Times* (6 February 1923), 18.

[39] "Screen the First Quarter," *New York Times* (18 March 1923), X3.

This filmic artifact—and the fact that the film was shown so often—brought many of Einstein's ideas to the general public. It illustrated and reinforced the most popular notions of relativity and confirmed the theory's importance for American culture in the frequency with which it was shown and in its prominence and reach—on Broadway and, following that, all across the nation.

II. Reception of Relativity in the Arts

It is important to look at the reception of relativity theory in the other arts, not only because so many musicians were part of larger artistic circles and their discussions, but also because there has been a great deal more scholarly work on the influence of relativity in other fields, especially in Art History and Literary Studies. This section offers a concise overview over the key debates in artistic communities and relativity's impact on art creation. Furthermore it introduces different scholarly models for the analysis of relativity's cultural influence.

Visual Arts

In the visual arts, relativity's influence has been identified in a number of different artistic schools including, most prominently, cubism and futurism, among other modernist artistic traditions. This wide-spread influence parallels relativity's influence on music for, although I have been speaking broadly about modernism in music, this modernism encompasses a great variety of modernisms including mainstream modernism, ultramodernism, and even the twelve-tone method. In art, as in music, there are more and less conscious and unconscious, direct and indirect responses to Einstein's theories. Some artists had known contact with the scientific world and spoke of attempted connections between their art and the ideas of the new physics; others' relationships with relativity necessitate more careful analysis from the safety of historical distance. The varying artistic encounters and differing scholarly approaches to this variance serve as a fruitful model for the musicological investigations to follow.

One of the most fascinating aspects of modern art's relationship with relativity is that it can be viewed *both* as a philosophical misappropriation of relativity theory (i.e. "everything is relative") and as a highly technical, scientifically-accurate response to Einstein's new conceptions of time and space. For example, the multi-point perspective that dominated cubist and futurist styles of art can be seen as evidence of a type of subjectivism and relativism that is not necessarily dependent on Einstein, but was a common misinterpretation of his theories. However, as Leonard Shlain expertly observes, the idea of distorted time and space was a theoretically observable phenomenon according Einstein's new theories.[40] If, as in the many colloquial descriptions offered by Einstein and others at the time, one could move at a speed nearing the speed of light, actual space would appear to bend.

Cubism's response to relativity provides an interesting take on how the scientific theory affected an artistic style. It has been noted by a number of art historians and scholars that cubism's multi-point perspective—its combination of multiple, subjective, and theoretically mutually-exclusive viewpoints visible in a single object—signify a new conception of space and time that could only have arisen in a universe defined by Einstein's relativity. The shattering of the ideas of absolute time and space, after Einstein,

[40] Shlain mentions this in reference to the "precognition" of turn-of-the-century painters like Manet, Monet, and Cézanne whose distorted perspectives mirror the distortion of space at high velocities predicted by Einstein's theories. See Leonard Shlain, *Art and Physics: Parallel Visions in Space, Time, and Light* (New York: Harper Perennial, 2007), 129.

allowed for a reconceptualization of spatial and temporal order in painting. In cubist painting, we can see multiple observational perspectives simultaneously, and these can be understood as different temporal or spatial perspectives, or possibly both. For example, in the "fractured" image of a Picasso painting we might see a woman's face constructed of various facial features, which appear to the viewer at odd angles in relation to one another; the features are intelligible only as simultaneous representations of the face as viewed from many different vantage points. This can be understood as a visual amalgamation of the perspectives of multiple fictional observers, or of multiple perspectival shifts by one observer (occurring over a period of time). Or, as Leonard Shlain describes it,

> Objects fractured into visual fragments then were rearranged so that the viewer would not have to move through space in an allotted period of time in order to view them in sequence. Visual segments of the front, back, top, bottom, and sides of an object jump out and assault the viewer's eyes *simultaneously*.[41]

This condensation of spatial perspectives parallels an Einsteinian view of space-time, a fundamentally interwoven fabric of the universe in which changes in time affect space and changes in space affect time—neither are immutable.

The relationship between cubism and relativity is a complicated one, though it is readily acknowledged by scholars of the topic. For one thing, Einstein's *annus mirabilis* occurred in 1905 in Bern, while Picasso's development of cubism took place in 1907 in Paris (with *Les Demoiselles d'Avignon*). But, as we know from "Chapter 2: Einstein," Einstein and relativity did not figure into the popular consciousness until 1919. For this reason, the relationship between cubism and relativity simply cannot be viewed as a directly causal one. Of course, two brilliant minds obtaining similar results in the

[41] Leonard Shlain, *Art and Physics*, 189.

differing fields of science and art are not a problem when viewed as part of a larger cultural network of ideas brewing around the turn of the century (as Peter Galison has deftly pointed out in the case of Einstein and Poincaré).[42] However, if a direct link feels necessary, a possible one does occur: both Picasso and Einstein were heavily influenced by the philosophically-oriented science of Henri Poincaré. Picasso was exposed to Poincaré's work through Maurice Princet, a mathematically minded member of *la bande à Picasso* that met at Picasso's Parisian abode, *le Bateau lavoir*. Einstein read Poincaré's influential *La Science et l'hypothèse* in 1904, in a German translation. Arthur I. Miller summarizes the mutual influence saying,

> Just as his suggestive play with higher dimensions was among the factors that spurred Picasso's discovery of geometry as the language of the new art, Poincaré's insights on time and simultaneity were inspirational to Einstein's discovery of relativity.[43]

Thus while the scientific and aesthetic theories of Einstein and Picasso appear to have developed in parallel, Poincaré serves as the philosophical pole where these two parallel lines meet.[44]

More to the point, several scholars see cubism as an influence on Einstein. The philosopher Sheldon Richmond argues that "the Impressionist-Cubist forerunners of

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[42] Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W. W. Norton and Company, 2003).

[43] Arthur I. Miller, *Einstein, Picasso: Space, Time, and the Beauty That Causes Havoc* (New York: Basic Books, 2001), 4.

[44] Nevertheless, as Shlain points out, numerous art historians that have argued against any relationship whatsoever between cubism and relativity theory, even submitting before the scholarly jury a statement from Einstein himself in which the scientist refutes a connection made between cubism and relativity made in an article by art critic Paul Laporte in 1946 stating bluntly: "The new artistic 'language' has nothing in common with the Theory of Relativity." See Leonard Shlain, *Art and Physics*, 201.

twentieth-century painting indirectly stimulated the scientific intuition of Einstein" and summarizes the parallel revolutions of art and relativity as follows:[45]

> The Einsteinian revolution demanded the overturn of Galilean-Newtonian space and time. We move in a finite and expanding spherically symmetrical universe where our motion interacts with the very structure of space and time. The Impressionist-Cubist revolutions demanded recognition of pluralities of visual fields—of different kinds of spatial representation.[46]

This less conventional scholarly approach nevertheless impresses upon us the importance of considering the line of influence traveling in the opposite direction, or, at least, a possibility of mutual influence between Einstein's science and the arts. This statement also relates back to contemporaneous notions, seen mostly in discussions of Einstein's musical tendencies, that Einstein's fundamentally artistic mind was what allowed him to formulate the revolutionary scientific theories at all.

There has been some recent scholarly backlash against the traditional links made by art historians between cubism and relatively. Linda Dalrymple Henderson advocates a scholarly break with the "myth" of this relationship and offers, instead, an insightful look at the ways in which cubists interacted with a less Einsteinian understanding of the "fourth dimension"—a favorite topic in cubist literature—and with other scientific theories and theorists, among them Henri Poincaré.[47] Yet while she carefully disassembles the myth of the cubism-relativity dyad, she notes other instances of Einsteinian modern art. One notable example is Erich Mendelsohn's *Einstein Tower* built

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[45] Sheldon Richmond, "The Interaction of Art and Science," *Leonardo* 17/2 (1984), 84.

[46] Sheldon Richmond, "The Interaction of Art and Science," 81.

[47] Linda Dalrymple Henderson, "Einstein and 20th-Century Art: A Romance in Many Dimensions," in *Einstein for the 21st Century: His Legacy in Science, Art, and Culture*, Peter Galison, Gerald Holton, and Silvan S. Schweber, eds. (Princeton: Princeton University Press, 2008), 101–106.

in 1920–21 in Potsdam near Berlin and intended to be a physical representation of Einstein's theories of relativity using Jugendstil and Expressionist forms.[48] She also discusses another relativity-related style of art: surrealism. Artists like Salvador Dalí explored space and time on the canvas and discussed Einstein's theories on the page.[49] Thus while Dalrymple Henderson asks us to reformulate our view of the relationship between cubism and relativity, she adds insights on the ways in which relativity theory and its new views of space and time stretched even further into the various artistic modernisms.

Futurism in art can be seen to display similarly Einsteinian approaches to space and time. While cubism represents a shift in spatial perception, Italian futurism dealt largely with new (Einsteinian) notions of time. Shlain summarizes the futurists' approach to the representation of time in a visual art form:

> They demanded that artists depict what had not yet happened by incorporating the idea of motion into the stationary canvas. . . . [T]he futurists found they could pull the future into the present by representing sequential frames of individual frozen moments within a single canvas.[50]

Just as cubists imposed multiple spatial perspectives, futurists could, through layering a sequence of minute actions on top of one another, manipulate the viewer's perception of time.

The case of the relationship between futurism and relativity offers two points of identification for a study of musical modernism and Einstein's theories. First, futurists were themselves interested in the ephemeral-ness of musical performance and, as such,

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[48] Linda Dalrymple Henderson, "Einstein and 20th-Century Art: A Romance in Many Dimensions," 107–110. See also Kathleen James, "Expressionism, Relativity, and the Einstein Tower," *The Journal of the Society of Architectural Historians* 53/4 (Dec. 1994), 392–413.

[49] Linda Dalrymple Henderson, "Einstein and 20th-Century Art: A Romance in Many Dimensions," 110.

[50] Leonard Shlain, *Art and Physics*, 205.

music was the subject of a number of important futurist works including Luigi Rossolo's 1911 painting "Music" (Fig. 3.4) and Giacomo Balla's 1912 painting "Rhythm of the Bow" (Fig. 3.5).

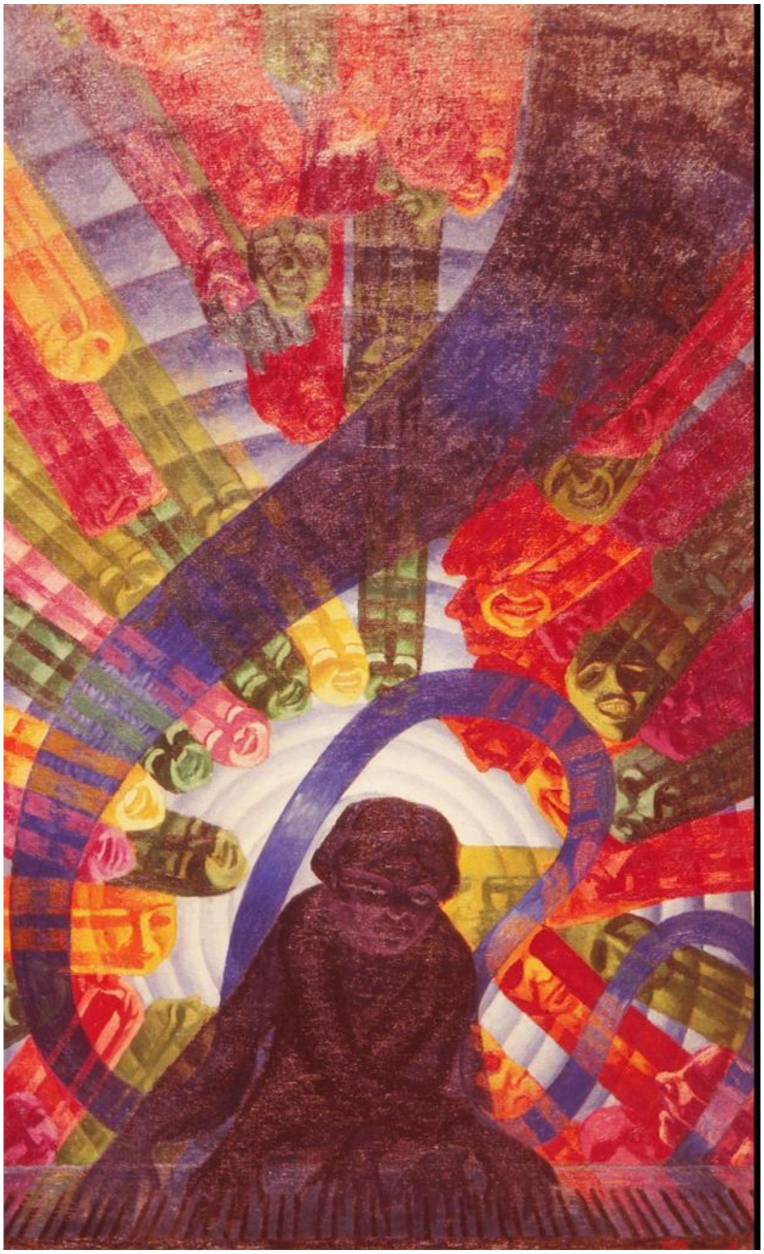

Figure 3.4 - Luigi Russolo, *Music* (1911)[51]

[51] Luigi Russolo, *Music* (1911), from ArtStor (http://library.artstor.org.libproxy.lib.unc.edu/library/secure/ViewImages?id=8CJGczI9NzldLS1WEDhzTnkrX3kteVp8fCE%3D&userId=gDNHeDw%3D&zoomparams) [Accessed on 14 January 2011]

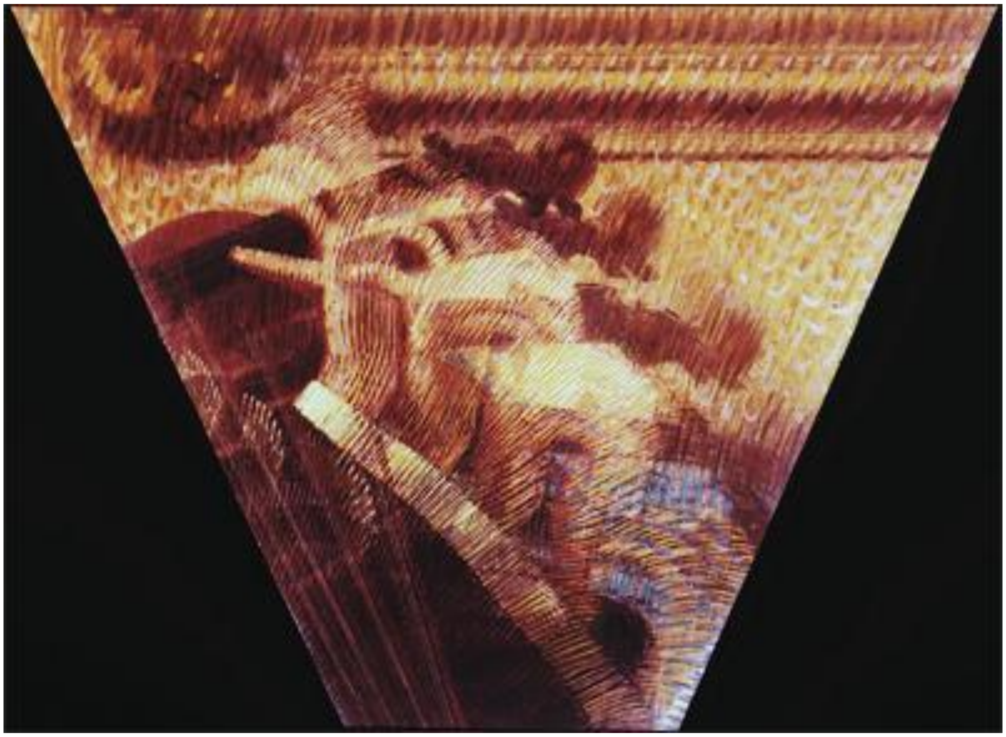

Figure 3.5 - Giacomo Balla, *Rhythm of the Bow* (1912)[52]

Both paintings use the technique of superimposing fractions of movement on top of one another, showing in fixed space, the movement of time. The fact that music is depicted in these well-known futurist works shows that artists—both visual and musical—in this tradition were intermingling and suggests that, although it will not be discussed to a great extent in this dissertation, futurist composers might also have embraced the scientific ideas of Einstein in their work. Futurism's relationship with relativity also provides a good template for beginning to observe music's relationship with science because futurist artists, like nearly all modernist composers, constructed many of their aesthetic ideas in prose (and not just on the canvas). Futurism was (in)famously ignited by Filippo Tommasco Marinetti's Futurist Manifesto, a document which described an aesthetic

[52] Giacomo Balla, *Rhythm of the Bow* (1912), from ArtStor (http://library.artstor.org.libproxy.lib.unc.edu/library/secure/ViewImages?id=8CJGczI9NzldLS1WEDhzTnkrX3kvflp1diE%3D&userId=gDNHeDw%3D&zoomparams) [Accessed on 14 January 2011]

ideology associated with a style of artistic production that was, at the time of its publication, not yet associated with any actual works of art (the "perfect embodiment of futurism!" as Shlain puts it).[53] These types of artistic creeds were important for musical modernists as well. As we will see from the aesthetic treatises of Henry Cowell and Joseph Schillinger (and especially in the case of Ezra Pound who wrote "on behalf of" George Antheil), it was sometimes just as important or more important to describe what music should sound like in a perfect system of modernist composition as it was to actually compose according to that system. And, after all, Einstein also took it for granted that his theories were correct well before Eddington came along to prove them. Thus even in this the futurists and the musical modernists had Einstein and his theories to thank for a model.

Literary Arts

Some scholars in the field of Literary Studies have already examined the influence of relativity theory on modernist poetry and fiction writing. This area of study is perhaps even more important to the current study of Einstein and music because so many of the musicians and composers involved in this dissertation had strong personal and artistic ties with writers. Ezra Pound and George Antheil became close friends while Antheil was in Paris, and both author and composer were part of the same circle as James Joyce (one orbiting, so to speak, around Jean Cocteau). William Carlos Williams and Pound were also friends before Pound moved to Paris and joined the aforementioned circle. Also, unlike in the visual arts, the literary arts—and their scholarly study—provide us with some clues as to how to parse out relativity's influence. Although many schools of

[53] Leonard Shlain, *Art and Physics*, 205.

painting and a few individual artists responded to Einstein and his theories in their abstract works, this influence was not often verbalized. Like the composers I will discuss later, however, writers not only voiced their aesthetic goals, but also self-consciously borrowed Einsteinian ideas and placed them prominently in their works. They did so in addition to unconsciously subsuming Einstein's theories. Thus, writers, like composers, made both conscious and unconscious references to relativity in their art form and writings about art.

Recent scholarly approaches to unpacking the influence of relativity on literature vary as widely as writerly approaches to appropriating the theories did. Julie M. Johnson focuses her study on how writers encountered Einstein's scientific theories as proof of the validity of metaphysical and philosophical notions of relativism. She explains:

> The extent to which relativity theory and its distortions have influenced modern literature is not easily definable. Confronted with a mathematical construct which has been transmuted into a metaphysical theory and blended with parallel philosophical and psychological ideas, it is often difficult to separate one thread from another and trace it directly back to its origins. However, in general, individual writers reacted to relativity theory as did the world at large: they welcomed or opposed or ignored it. Those writers who chose to confront it usually did so in one of two ways: they used their work to comment upon it, or they used it as a rationale for their art; or, like e. e. cummings, they simply accepted as a given what cummings, in "pity this busy monster manunkind," called the "curving wherewhen" of the new universe.[54]

In both of Johnson's formulations, authors responded to Einstein and his theories consciously.

Another scholar, Daniel Albright, has explored the more subtle ways in which writers adopted Einsteinian conceptions. In *Quantum Poetics: Yeats, Pound, and the*

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[54] Julie M. Johnson, "The Theory of Relativity in Modern Literature: An Overview and 'The Sound and the Fury'," *Journal of Modern Literature* 10/2 (June 1983), 220.

Science of Modernism, Albright discusses the similarities between modernist poets' use of small, "elementary particles" of language in their works, what he calls poememes, and the observations of the new science of quantum mechanics, developed by Max Planck in 1900. Though Albright focuses on this brand of physics, related indirectly to Einstein and relativity, he does mention a few poetic responses to Einstein, most often negative: "[d]uring the 1920s . . . Einstein's physics became a serious literary anxiety."[55] According to Albright, Einstein was portrayed negatively by authors like Wyndham Lewis and Ezra Pound in part because of his perceived "destruction of space and time."[56]

Michael H. Whitworth contributes an excellent study of the impact of Einstein on modernist literature, discussing how key concepts related to relativity theory served as metaphors for modernist poets and novelists including Joseph Conrad, Virginia Woolf, T.S. Eliot, D.H. Lawrence, and to a lesser extent James Joyce.[57] Instead of focusing on abstract ideas like "relativity" and "space-time" like I do in this dissertation, Whitworth focuses on how certain aspects of the scientific and intellectual significance of Einstein's theories had for literature (for example, what it meant that perception was not always the best method of scientific observation).

Like both Whitworth's and Albright's texts, author Ian F. A. Bell's text on Ezra Pound focuses on the British literary scene, despite Pound's American heritage and, for all intents and purposes, European citizenship.[58] Because of this, we encounter Pound

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[55] Daniel Albright, *Quantum Poetics: Yeats, Pound, and the Science of Modernism* (Cambridge: Cambridge University Press, 2003), 13.

[56] Daniel Albright, *Quantum Poetics*, 13–14.

[57] Michael H. Whitworth, *Einstein's Wake: Relativity, Metaphor, and Modernist Literature* (Oxford: Oxford University Press, 2001).

[58] Ian F. A. Bell, *Critic as Scientist: The Modernist Poetics of Ezra Pound* (New York: Methuen, 1981).

from 1910 to the late teens—during his London years—and just before he would have encountered Einstein. Thus while it prepares the idea of a scientific Ezra Pound, it does not offer any clues into his later Einsteinian intellectual forays, which we will see in relation to his text on George Antheil.

Like composers, writers commented on their own art form, not necessarily in aesthetic tracts as modern musicians did, but in criticism of contemporary literature. These reviews reveal underlying notions about the role of relativity in literary composition. Authors identified and analyzed a canon of literary devices that held Einsteinian significance. One of the main techniques recognized in this critical discourse (and later identified by current literary scholars) was the use of multiple narrative perspectives within one larger work of fiction. Jean-Paul Sartre wrote, of Francois Mauriac's novel *La fin de la nuit*:

> Like most of our writers, he had tried to ignore the fact that the theory of relativity applies in full to the universe of fiction, that there is no more place for a privileged observer in a real novel than in the work of Einstein, and it is no more possible to conduct an experiment in a function system in order to determine whether the system is in motion of at rest than there is in a physical system.[59]

In criticizing (in the negative sense) the writings of Mauriac's doggedly first-person work, Sartre is explaining the inherent relevance of Einstein's new theory to literature. And, for Sartre, Einstein's ideas apply easily to the world of modern writing, as if the relativity of perspective were a thing that happened to be uncovered in science around the same time authors happened to employ multi-point perspectives in novels.

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[59] Jean-Paul Sartre, "Francois Mauriac and Freedom," in his *Literary and Philosophical Essays*, trans. Annette Michelson (Criterion Books, 1955), 23. Quoted in Julie M. Johnson, "The Theory of Relativity and Modern Literature," 222.

With the example of the literary scholar and the introduction of the literary practitioner, we get a glimpse of how Einstein and his theories of relativity have been incorporated into yet another art-form. This introduction to a verbal art will be helpful as I begin to examine theories of music as artistic texts unto themselves. Each treatise or theory of music represents a conscious, creative attempt by its author to incorporate in some way the scientific ideas of Einstein. For many of the authors I am about to discuss, this prose composition will be their only Einsteinian composition—the fanciful inclusion of Einstein's ideas never reached a note on the pages of their musical works or of the musical works inspired by the texts. These Einsteinian theories of music will therefore—like their literary colleagues—be crafted out of metaphor and allusion and intended to make significant intellectual statements about music by borrowing popular ideas about relativity.

III. Theories of Musical Relativity

For modernist composers working in the United States, relativity was part of the fabric of intellectual and philosophical life in the 1920s and 30s. Composers were probably exposed to relativity in both their artistic and non-artistic circles, just as writers and visual artists were. Like many of the writers and visual artists discussed above, a number of modernist musicians sustained lifelong intellectual and ideological interests in scientific thought. This predisposition to scientific endeavors probably helped to ignite these composers' interest in relativity. Henry Cowell, for example, was considered scientifically-minded from his youth and maintained an interest in science as an adult. Joseph Schillinger professed an interest in science in general, as did Charles Seeger, George Antheil, and Dane Rudhyar. In fact, Rudhyar became a sort of populist scientist—an astrologer—later in his life, and is rather well-known for his numerous publications on the subject.

In addition to piquing composers' curiosity because of their underlying interests in the scientific world, the ideas of Einstein's relativity and their popular reception were particularly well-suited to modernists' ideological and aesthetic desires. For modernist composers working in America, the notion that a pair of unknown theories could reshape our understanding of the world seemed remarkably similar to their own goals for modernist theories of music. By borrowing the same revolutionary rhetoric used to popularize Einstein's theories, composers were able to capitalize on the scientific weight that the theories held. As they conceived of their own radical theories of music in the language of Einstein's relativity theories, modernists were able to place themselves in positions of authority and importance both within and outside the musical world. I say outside the musical world, because the popularity bestowed upon Einstein's highly abstract, mathematical theories also played a part in composers' attraction to them.

A close reading of the sources reveals that modernist and ultramodernist composers consciously adopted relativity theory and its attendant rhetoric in order to bring both scientific weight and popular recognition to their writings. They recognized the "hype" surrounding relativity and used it to their advantage, not only amongst their compositional peers but ostensibly also to gain a broader audience outside of the immediate world of ultramodernism. We can see this, for example, in Rudhyar's writings and in Cowell's basic adoption of the language of relativity theory as popularly conceived. Yet, composers also experienced an intellectual synergy with Einstein's ideas—seen most prominently in Cowell's and Antheil's somewhat unconscious adoption of the underlying principles of relativity theory. These composers explored in their art the questions that plagued and intrigued many thinkers of this time period. We can see in hindsight (like these composers, in fact, did themselves) that many of their ideas about music were parallel to Einstein's with no conscious effort, but because they shared with Einstein's certain cultural concerns.

This scholarly leap, which allows us to approach parallel and concurrent modes of thought of individuals that had very little conscious intellectual contact with one another, is not new. In fact, the method has recently served as an avenue for Einstein scholars to approach and acknowledge the ways his theories tie in with other intellectual trends. Scholars like Peter Galison have explored the particular circumstances that led Einstein to formulate his ideas of relativity—like the development of a standardized world clock and the increased presence of technology and industry in everyday life.[60] In the same way, I argue that the parallels between relativity and modernist theories of music developed out of similar intellectual positions within in a modernizing world. In looking into the varying relationships that modernist composers had with relativity and Einstein, we encounter them not only coping with the scientifically-dominated, early twentieth-century intellectual landscape, but also truly thriving in it.

In addition to the interest in the theories as models for the scientific organization of musical ideas, and certainly differing from the use of "relativity" in the sense of "relativism," some composer-writers also incorporated, consciously or subconsciously, some elements of relativity theory. Surprisingly, these composers—particularly, Henry

[60] Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W. W. Norton and Company, 2003).

Cowell and George Antheil—did not seem to have any more exposure to relativity than the average person did. They probably read the same newspaper articles and non-specialist books that other composers did; however, each of these composers maintained a fascination with scientific frameworks throughout their careers.

Musical Revolutions: Dane Rudhyar and Relativity

Dane Rudhyar began his professional musical career in Paris as Daniel Chennevière, a composer and music critic who published one of the earliest biographies of Claude Debussy, *Claude Debussy and His Work*, in 1913. Three years later, at the age of twenty-one and with a few thousand francs unexpectedly inherited from an uncle in his pocket, Rudhyar traveled to New York City. He eked out a living by copying music, giving lectures on music, and composing the occasional commissioned work. He traveled a great deal in the U.S. and Canada, staying with friends for periods of a few months, before becoming an American citizen in 1926.

Although Rudhyar made very interesting contacts in musical and spiritual circles during his early years in America, he did not seem to have had any direct contact with members of the scientific community before 1951, when he met physicist Henry Margenau.[61] We can assume, then, that his interest in the sciences developed from his personal reading of non-specialists' literature and journalism on the subject, or was obtained in mediated form from within his musical and social circles. Rudhyar also developed strong intellectual and social ties to theosophy beginning in 1918. His contact with theosophy, a "synthesis of science, religion, and philosophy," might have brought

[61] Margenau was a German-American physicist that worked primarily on quantum mechanics, but also published widely on the relationship between science and philosophy, between science and ethics, and science and religion.

Einstein and relativity theory to the composer's attention.[62] It also brought Rudhyar into contact with other musicians who probably helped cultivate his interest in science and music. He met Henry Cowell in 1920 at a theosophical convention, and the two immediately became friends.[63] Cowell, as we will see, was greatly interested in the interaction of music and science at this time, so it is possible that the two exchanged thoughts on this matter.

Rudhyar's interests spanned a great scientific breadth—from biology, chemistry, and physics to the more dubious field of astrology, in which he later made quite a name for himself as an author. Rudhyar borrowed scientific terms freely, combining different elements of scientific discourse without much regard for accuracy. For example, Rudhyar blends astronomy (or maybe astrology) with biology when describing the upper and lower partials of a tone:

> In fact, the prime sound—the only one we consider now—will appear then as a radiating center of a dynamic tonal energy, as a Sun surrounded by the double series of planets, the over- and under-tone. Each compound-tone, therefore will be a microcosm, living of its own life, expanding a certain vital energy, acting powerfully over all cosmic organisms.[64]

In another article of roughly the same time period, Rudhyar seamlessly blends ideas about electricity and magnetism, as well as evolution, race, and botany into an argument about "Creators and Their Public."[65]

[62] Deniz Ertan, *Dane Rudhyar: His Music, Thought, and Art* (Rochester: University of Rochester Press, 2009), 30.

[63] Deniz Ertan, *Dane Rudhyar: His Music, Thought, and Art*, xx.

[64] Dane Rudhyar, "The Relativity of Our Musical Conceptions," *Musical Quarterly* 8/1 (1922), 116.

[65] Dane Rudhyar, "Creators and Their Public," *Musical Quarterly* 10/1 (January 1924), 120–130.

In an article entitled "The Relativity of Our Musical Conceptions," which appeared in *Musical Quarterly* in 1922, Rudhyar described the significance of relativity theory, becoming one of the first composers to publically engage with the theory. He noted the importance of relativity theory for the intellectual and musical worlds in the introductory paragraph of the article:

> The theory of Relativity is sweeping the intellectual world of to-day. For centuries our thoughts and feelings have been molded over certain definite basic structures which have crystallized along certain lines, and the characteristic fluidity of early times has now been transmuted into a state of utter rigidity, so that they appear to us as mysterious and most sacred idols. . . Yet in these musical axioms which tyrannically rule over European music there lies no more absoluteness, no more certainty than in the axioms of physical science, which have so utterly vanished before a closer and more daring investigation lately.[66]

Rudhyar draws a clear parallel between the engrained tenets of Newton's "classical" mechanics and the laws of Classical tonality. Furthermore, just as Einstein's "daring investigation" created a revolution in physics, modern music would stage a similar revolt against the "musical axioms which tyrannically rule over European music." Leon Botstein summarizes Rudhyar's relationship with Einstein as revealed in this article saying,

> Though his argument was based on a complete misunderstanding of relativity, he used its authority to declare the equivalence of all rules regarding the nature of music and musical form, thereby demolishing the priority of the traditions of European music making. Not only that, but Rudhyar denied the essential claims of European musical theory, which, in his view, wrongly insisted on the primacy of the note as opposed to sound.[67]

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[66] Dane Rudhyar, "The Relativity of Our Musical Conceptions," *Musical Quarterly* 8/1 (1922), 108.

[67] Leon Botstein, "Einstein and Music," in *Einstein for the 21st Century: His Legacy in Science, Art, and Modern Culture* (Princeton: Princeton University Press, 2008), 172.

Botstein points out Rudhyar's creative and powerful use of the rhetoric of relativity theory to justify his modernist ideas about music. Rudhyar's early engagement with the theories was unusual; in general, it was not until the late 1920s and 30s—after the theories were accepted by the scientific world—that artists and intellectuals began noticing parallel ideological tenets between their theories and Einstein's.

Colin McAlpin was one of the later music writers acknowledging the relationship between modernist musical revolutions and scientific revolutions brought about by Einstein's theories of relativity.[68] In 1930, well after relativity was accepted by the scientific community at large, McAlpin, a British composer and music critic pointed out the parallel quite clearly in an article in *Musical Quarterly* entitled "Musical Modernism: Some Random Reflections." McAlpin begins:

> It is obvious that musical "legalism" has, these last few years, received a very rude shock, if not a veritable deathblow. For what have been taken to be inexorable "laws" in music have turned out to be but transient tendencies.[69]

The musical laws of the tonal system, McAlpin seems to be saying, have been shown not to be laws at all, but merely one method of organizing musical sounds. McAlpin reveals his knowledge of new discoveries in science that parallel this change in art a few

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[68] Very little is known about Colin McAlpin as a composer. He has been written about in one non-doctoral dissertation by David J. Fisher "Colin McAlpin: His Music to 1903" (University of Sheffield, 1989) and his only mention in the Oxford Dictionary of Music is under the entry for English soprano Fanny Moody, who starred in McAlpin's opera *The Cross and the Crescent*, which premiered at Covent Gardens in the 1902–3 season. See Harold Rosenthal, "Moody [Manners], Fanny," *Grove Music Online* [accessed on 9 January 2011]. He seems to have made more of a name for himself as a critic and author in the 1910s through the 30s. His articles are featured frequently in the British journal *Musical Times* and the American music periodical *Musical Quarterly*, however, and make general observations about current trends in music. He is the author of *Hermaia: A Study in Comparative Aesthetics* (Dent), a bold attempt at a theory of aesthetics based on the visual, literary, and musical arts. A review can be found in L. H., "Review," *The Burlington Magazine for Connoisseurs* 29/162 (September 1919), 259–260.

[69] Colin McAlpin, "Musical Modernism: Some Random Reflections," *Musical Quarterly* 16/1 (January 1930), 1.

paragraphs later saying "If, again, science can advance, why not art?" The scientific advancement he means is clarified shortly thereafter:

> If, moreover, an Einstein can give to the Newtonian principle of "mechanical relativity" an immeasurably wider scope, why should not a Strauss unfold the chordal "relativities" inherent in a Beethoven? But there are still some scientists who shut their eyes to anything new, just because it is new; even as there are still some antiquated harmonists who deliberately close their ears to the more delicate effects attendant on the subtler modes of music.[70]

In the previous chapter, I explored the implications that this particular passage had for composers and the possibility of using Einstein as a revolutionary model. We can now delve into McAlpin's insights about musical revolutions further. Rather than viewing Einstein's new ideas as a complete break from the science of Newton, McAlpin correctly points out that relativity theory has broadened our picture of the universe, as if switching from a telephoto lens to a panoramic one. Relative motion was acknowledged and understood in Newton's system, but Einstein widened our view of the universe to include the relativity of entire inertial systems.[71] In McAlpin's estimation, if we recalculate our view of the musical world as Einstein did the natural world, tonality would be seen as one organizational system within a larger musical universe. In this, McAlpin seems to be keenly aware of the nature of Einstein's scientific revolution (and perhaps also conscious of Einstein's new work on a unified field theory). Even more keenly than Rudhyar, McAlpin sees a parallel between relativity's revolution and the nature of musical change and progress.

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[70] Colin McAlpin, "Musical Modernism: Some Random Reflections," 4.

[71] With Einstein's general theory of relativity, a more comprehensive view of relative motion arose. With his new calculations, scientists were able to calculate the relative motion between two moving systems, not just motion as observed from a fixed point.

Returning to Rudhyar, however, we can see that unlike McAlpin the composer made some of the first attempts not only to compare musical and scientific revolutions, but to incorporate some of Einstein's ideas about space and time into his theoretical work. Botstein noted Rudhyar's comparison of Einstein's ideas in general and the composer's musical revolution:

> In a haze of rhetoric, Rudhyar … projected that once the absolute priority of the European system of music had been destroyed, a new order (or rather lack thereof) would emerge from the chaos. Rudhyar anticipated a unified field theory of sound that, in stark contrast to Einstein's goal, had no organizing logic.[72]

In contrast to Botstein, however, I contend that Rudhyar attempted to incorporate some of Einstein's ideas about relativity on a more specific level. Rudhyar does this in two ways in "The Relativity of Our Musical Conceptions": the adoption of cultural relativism in music and attempting to theorize a new kind of non-absolute musical space.

Rudhyar develops his sense of musical cultural relativism out of an embrace of relativity in its colloquial or philosophical (mis)usage. He demands the acknowledgement of relativity amongst the various musical systems of the world (mainly East and West). In explaining the lack of "absoluteness" in European music, parallel with the lack of certainty "in the axioms of physical science," Rudhyar continues:

> There is no excuse, really, for the perpetuation of such axiomatic creeds now that the discovery of Oriental civilization, art, science, which are so utterly different from ours, shows us that, if during these last centuries of European culture we have discovered ONE Truth, there is the possibility of *another* Truth.[73]

[72] Leon Botstein, "Einstein and Music," 172.

[73] Dane Rudhyar, "The Relativity of Our Musical Conceptions," 108.

This cultural relativism is directly related to his idea of musical relativity. As discussed, it was not at all uncommon to view Einstein's theory of relativity as scientific proof of the validity of interpersonal or cultural relativism. In misunderstanding Einstein's scientific reassessment of the universe, related socio-cultural theories were often tied in and validated.

Rudhyar's ideas about the nature of musical sound, influenced by his personal study of Eastern traditions, challenged traditional notions about Western music and informed his sense of musico-cultural relativism. He believed that Westerners experienced an ignorant, sheltered musical life in which they understood their own conceptions of tonality and pitch to be the sole truths of music. These conclusions seem like simple cultural relativism, yet they may have deeper ties to Einsteinian relativity. His fundamental conclusion in this essay is that what we (Westerners) think of as a "note," the building block of all music, is really a "compound-tone," made up of all the partials contained within the tone. The note "a" is a fictional musical sound that does not account for tone quality, the aspect of musical sound that is, for Rudhyar, a type of magical, life-giving essence (and something that Eastern musicians value more than any abstract pitch or interval). Because our "notes" are really compound-tones, a revolutionary revision of the concepts of chords and polyphony becomes necessary.[74] In rethinking the concept of the note to more broadly encompass what we think of as both vertical and horizontal motion in music, both harmony and melody, Rudhyar is suggesting a new notion of musical space. For him, there can no longer be a notion of "absolute pitch." Pitch must be considered different for every timbral variation possible in the natural world; for each vocal or instrumental act of tone production, pitch must be processed within its own

[74] Dane Rudhyar, "The Relativity of Our Musical Conceptions," 113–14.

frame of tone quality. Like Einstein's dismissal of absolute space with the introduction of relativity theory, Rudhyar's new conception of the "compound-tone" forces the listener (or theorist) to reevaluate the fixity of the fundamental building blocks of the musical universe.

Joseph Schillinger's General and Special Theories of Harmony

As a modernist composer, music teacher, and author, Joseph Schillinger sits at the nexus of a complex web of discourse about music. But more than any interactions between his varied musically-related pursuits, his self-defined role as "music scientist" makes him a very interesting case for examining the relationship between relativity and musical modernism. Schillinger developed his own "system" of music, applying it to his compositions and musical analyses. After his death in 1943, his students published the majority his writings in a massive, two-volume work entitled *The Schillinger System of Musical Composition*. What is not revealed immediately in the bland title given to these 3000-plus pages is the intriguing structural correspondence between Schillinger's theories and Einstein's theories of relativity.

Schillinger's educational and professional lives straddled the fields of science and music. After completing his education in St. Petersburg first at the Classical College and then at the Imperial Conservatory of Music, Schillinger began teaching composition and served as a consultant for state musical agencies in the Ukraine. He soon went on to professorships at various institutions before leaving for the United States in 1928. He moved to New York and worked closely with Leon Theremin on the construction of electronic instruments. He also served as one of the founding members of the New York

Musicological Society (later, the AMS) and began teaching composition in his private studio throughout the 1930s. In addition, he gave lectures on the physics of music, musical perception, and other innovative music-science hybrid subjects at a number of

Joseph Schillinger, scientist of music

Figure 3.6 - *The Baltimore Sun* (10 August 1941)[75]

local universities, including The New School of Social Research, New York University, and Columbia University.[76] His teachings were also the subject of newspaper articles that summarized his ideas about music, noting, for example that "Mr. Schillinger's idea is that music can readily be reduced to a science."[77]

The Schillinger System of Musical Composition is prefaced with two introductions, one by Henry Cowell and the second by Arnold Shaw and Lyle Dowling.

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[75] "He Marries Math to Music," *The Baltimore Sun* (10 August 1941), M3.

[76] Warren Brodsky, "Joseph Schillinger (1895–1943): Music Science Promethean," American Music 21/1 (Spring 2003), 47–51.

[77] "He Marries Math to Music," M3.

The latter pair summarizes the book's purpose at the very outset of their introductory material:

> The Schillinger System is a synthesis of musical theory and the most recent discoveries of modern physics, psychology, and mathematics. Historically, it represents the first successful effort to classify scientifically the resources of our musical system.[78]

This synthesis of art and science is also praised by Cowell, who remarks that Schillinger's work is the "single exception" to the general problem that "writers on theory have not been scientists, and no scientist has tried to make a complete and coordinated system of musical possibilities."[79] Cowell thus emphasizes Schillinger's scientific background, insisting that he is uniquely equipped to pen this important theoretical work.

Schillinger attempts to highlight his own scientific status and to elevate the vaguely scientific elements of the treatise by invoking Einstein's relativity theories at the structural and methodological levels. One glance at the Table of Contents of the two-volume work reveals Schillinger's desire to relate his work to Einstein's.

VOLUME 1

Book I – Theory of Rhythm
Book II – Theory of Pitch-Scales
Book III – Variations of Music by Means of Geometrical Projection
Book IV – Theory of Melody
Book V – Special Theory of Harmony
Book VI – The Correlation of Harmony and Melody
Book VII – Theory of Counterpoint

VOLUME 2

Book VIII – Instrumental Forms

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[78] Arnold Shaw and Lyle Dowling, "Introduction," in Joseph Schillinger, *The Schillinger System of Musical Composition*, Vol. 1 (New York: C. Fischer, Inc., 1946), XI.

[79] Henry Cowell, "Overture to the Schillinger System of Musical Composition," IX.

Book IX – General Theory of Harmony (Strata Harmony)
Book X – Evolution of Pitch Families (Style)
Book XI – Theory of Composition
Book XII – Theory of Orchestration

His "Special Theory of Harmony" and "General Theory of Harmony" reference Einstein's two relativity theories (and occur in the same order that Einstein's do as well). In fact, as one of the few musicians to adopt the terms "special" and "general" in an Einsteinian reference, it is clear that Schillinger was familiar with the physicist, or at least paid more attention to detail than many of the "headline readers" probably did. Shaw and Dowling, writing from the retrospective point of December 1945, discuss the System's relationship with Einstein in their introduction.

> While the influence of modern physics in Schillinger's thinking is methodological, the impact of modern mathematics is conceptual. Schillinger makes direct use of the theory of interference. He does not use any of the special techniques of the mathematics of relativity. The impact of relativity is through its underlying ideas. . . .
>
> For our purposes, the significant aspect of relativity is its new treatment of time and space. Einstein demonstrated that measurements of space and time are not independent and absolute properties of the object measured—but properties of the relation between the observer and object. Having "relatived" all measurements by projecting the observer into them, Einstein searched for invariant measurements not dependent on the observer. These he discovered by emphasizing the fourth dimension (time) in relation to space. Thus, we no longer talk of time and space, but of space-time, and we designate events through space-time coordinates. Now, Einstein demonstrated that such space-time coordinates express both the *metric* properties of space and the *physical* properties of the natural universe. Nature (including music) was grasped as measure relations. In other words, it became possible to study natural phenomena—or, as Schillinger concluded, artistic phenomena—through analyzing the coincidence and correspondence of their space-time coordinates.[80]

They position Schillinger's work as embracing the major tenets of relativity theory and discuss their teacher's knowledge of and theoretical use of Einstein's new conceptions of

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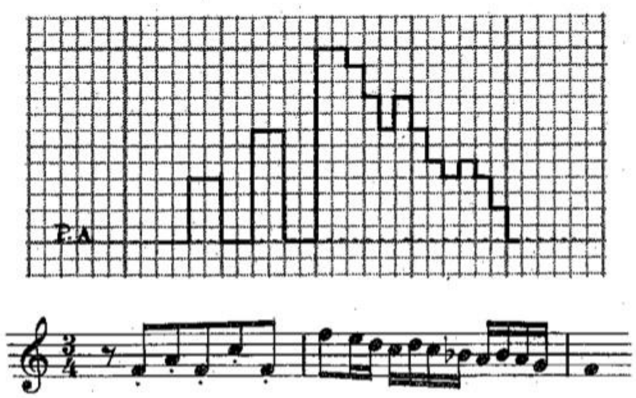
[80] Arnold Shaw and Lyle Dowling, "Aristotle, Einstein and Geometry," in Joseph Schillinger, *The Schillinger System of Musical Composition*, XVIII.

space and time. However, when describing how these ideas are put into musical practice by Schillinger, it becomes clear that the focus on space and time is fairly conventional. They remark that "Schillinger's idea was to transform musical qualities into time-space structures, i.e., into geometric relations of their components." That is, simply put, that he developed a simple graphic notation for music, with one axis representing duration and one representing pitch, so that any passage written in traditional notation could be transcribed onto graph paper and made to show its "time-space structures."[81]



Musical Example 3.1 - Schillinger, Graph of Bach's *Two-Part Invention No. 8* (1946)[82]

Above all, it must be remembered that this graphic notion, as much as Schillinger's students point to its "space-time" implications, is a drawing in two dimensions.

Within the text, Schillinger uses a mathematical approach to musical composition and analysis—these volumes are more ridden with mathematical formulas with strange variables than any popular Einstein text of the same time period. Even so, the composer-theorist's approach to music is conventional: time is rhythm, space is pitch, and the two entities may be analyzed and observed separately. In talking about rhythm, Schillinger's adoption of scientific ideas is helter-skelter. He uses the concept of simultaneity—an

[81] Arnold Shaw and Lyle Dowling, "Aristotle, Einstein and Geometry," XIX.

[82] Arnold Shaw and Lyle Dowling, "Aristotle, Einstein and Geometry," XIX.

extremely provocative one for artistic moderns in this time period—as if Einstein had not called the concept into question. He says,

> The temporal structure of music, usually known as *rhythm*, pertains to two directions: *simultaneity* and *continuity*. The rhythm of *simultaneity* is a form of coordination among the different components (part). The rhythm of *continuity* is a form of coordination of the successive moments of one component (part).[83]

This rather conventional, non-Einsteinian view is followed in another section by a more Einsteinian discussion of "the velocities of rhythms." He begins his discussion of the rate of change in rhythms by saying, "The only constant velocity known in the physical world is that of light." And then, as if to acknowledge the special case of this type of constant unaltered speed, claims that musical rhythms should rather be composed using variable speeds, following the patterns of movement offered in the natural world by things like biological growth and gravitation.[84] Schillinger is clearly aware of Einstein's work, but does not appear to want to incorporate the scientist's theories into the musical treatise.

His "special theory of harmony" is defined as a subset of his "general theory of harmony," that is, as diatonic composition within the broader scope of all that is possible in the tonal-harmonic world. While the special theory is able to account for composers like Bach, and simple works by Mozart and Beethoven, the more general theory of harmony

> gives us direct interpretations of musical facts found in such remote regions of musical creation as the polyphony of Palestrina, the symphonic style of Mozart, the "bizarre" harmonies of Ravel, or the tone-clusters of some of our contemporaries. Besides covering all known styles of music. Both in folklore and in the creations of individual composers, it shows that an inexhaustible number of *new* individual styles is available, and that the

[83] Joseph Schillinger, *The Schillinger System of Musical Composition*, Vol. 1, 34.

[84] Joseph Schillinger, *The Schillinger System of Musical Composition*, Vol. 1, 90.

> possibilities of the twelve-unit equal temperament scale can outlive the life-span of music itself.[85]

Here we can see again that Schillinger has adopted Einstein's terminology simply to relate the part-to-whole structure of his theory of music in which diatonic composition is a special case belonging to the larger arena of all composition based on twelve tones.

Nevertheless, this simplistic adoption of Einstein's ideas into a method of graphic notation and the System's section titles betrays Schillinger's and his students' knowledge of Einstein's work.[86] Even before this tome was published, there circulated a rumor that Einstein himself approved of Schillinger's treatise. In the *Baltimore Sun* article quoted above, the unnamed reporter mentions the far-reaching support that Schillinger and his ideas on music had received saying, "Professor Albert Einstein, who is also a musician of parts, approves this mathematical method of composition."[87] While Warren Brodsky points out that this was likely "a creative legend that could be characterized in Hollywood language as a 'buildup'," it speaks to the fact that the intended parallels between the organization scheme of Schillinger's text and Einstein's theories were readily apparent to those who came in contact with the treatise.[88] Thus it is clear from both Schillinger's chapter titles and his students' methodological justifications that both Schillinger's teachings and, later, the published *System* that reiterated those teachings were meant to

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[85] Joseph Schillinger, *The Schillinger System of Musical Composition*, Vol. 2, 1063–1064.

[86] In all 1640 pages of the two-volume work, the name Einstein only appears in the introduction written by Schillinger's students. Thus even though Schillinger makes it clear that he is familiar with Einstein's work through the technical terminology he borrows, the overt link between the composer's treatise and Einstein's theories does point to a conscious decision by his students. The reason behind this decision could be tied to publicity or legacy concerns for their teacher, but in any case this conscious effort to tie Schillinger to Einstein speaks to the physicist's extreme cultural value in this time.

[87] "He Marries Math to Music," *The Baltimore Sun* (10 August 1941), M3.

[88] Warren Brodsky, "Joseph Schillinger (1895–1943): Music Science Promethean," 45, 46.

invoke the popularity and scientism of Einstein's theories of relativity. This invocation drew the attention of music critics like Marion Bauer who commented on the text and considered it a valiant effort in incorporating scientific study with musical composition:

> He applied mathematics to music, showing the unifying principles behind its functions. He explained the old, and opened unlimited possibilities for new materials. It represents a lifetime of research and discovery. One goal was the uncovering and classifying of all available resources of our tonal system. But scientific analysis was not enough; he constructed a synthesis in which he applied his mathematical findings to composing. Here is where he may run into conflict with tradition.[89]

This last part is certainly putting it lightly; Schillinger angered a number of his musical colleagues during the course of his career by implying that all classical music was built on a mathematical formula, and that, with the simple knowledge of this formula, one could compose infinite numbers of pseudo-classics (in fact, he frequently tried to fool musicological audiences by playing fake pieces by classical composers). Nevertheless, that Bauer mentions this so casually speaks to her views on the importance of this controversial figure's text.

Charles Seeger and Unified Field Theories

As a theory, relativity gave music writers a lofty goal: to develop a unified theory of music, one which could overturn the tired conventions of the tonal system that had been in place for centuries but worn thin by Romantic composers. Einstein's own work on developing a unified field theory, a theory of the universe that would explain how what we perceived as different types of force were all part of a larger unified system, grew out of his work on relativity. By the 1930s, both General and Special relativity had been substantively proven and more or less accepted by the scientific community. Einstein set

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[89] Marion Bauer, *Twentieth Century Music: How It Developed, How to Listen to It* (New York: G. P. Putnam's Sons, 1947), 267–8.

to work on his unified field theory, which would link his two propositions about relativity and join these new suppositions with established classical mechanics. His new studies were widely publicized and seen as an extension of his already very popular ideas about relativity. As composers continued to adopt relativity as a model for their musical theories throughout the 1930s and into the early 1940s, they had to contend with Einstein's updated notions of relativity and their place in the larger scientific context of a unified field theory.

Many composers who responded early on to relativity can be seen to incorporate these newer notions of an all encompassing theory. Dane Rudhyar, in addition to acting as an early proponent of a theory of musical relativity, began working towards a type of unified theory of art.[90] He not only began exploring other arts creatively—including painting as well as poetry and fiction writing—but also published extensively on the underlying principles behind creativity in the arts and sciences. His biologically-leaning *Seed Ideas* were a series of self-published pamphlets organized around the links between painting, music, and the natural world. He sought to uncover the laws that governed these different realms, often tending towards the fantastical.

Charles Seeger, on the other hand, approached the unified field theory of Einstein in a manner similar to composers who had related to relativity in its early years of popularity. The American musicologist and folk-song collector borrowed the Einsteinian language associated with the theory and applied it to his own theory of music, or in his case, to his own theory about the intellectual study of music. Seeger was exposed to a number of scientifically-oriented intellectual traditions during his young adult life,

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[90] This was also noted by Leon Botstein in his article "Einstein and Music," 172.

especially during his travels in Europe (according to biographer Ann M. Pescatello). In addition to familiarizing himself with Freud and new schools of psychology, Seeger became interested in the philosophy of Wilhelm Dilthey. Pescatello explains the impact these ideas had on Seeger: "These new ideas regarding the subjectivity of social science and history—blurring the lines between art and science—strongly affected the young musician as he absorbed the intellectual currents of prewar Europe."[91] In sum, she says, "he matured in the heady atmosphere of European thought at a time of Europe's political and cultural preeminence. Radical ideas about process, scientific method, criticism, aesthetics, and value changed Seeger's own thinking."[92] Pescatello explains that, once back in America, Seeger began the process of expanding on "his rudimentary knowledge of science, showing particular interest in scientific method and current scientific advances," as part of his personal protocol for developing a new American field of musicology.[93] Pescatello is not specific about *which* current scientific advances Seeger was familiarizing himself with around 1914 (his second year at Berkeley), although it was unlikely that he knew of Einstein at this point. Nevertheless, this interest in current scientific debate shows a propensity for, and desire to keep up with, scientific current affairs and—more importantly—to incorporate this new knowledge into his own field of study.

After teaching at Berkeley for a number of years, Seeger moved to New York and served as one of the founding members of the fledgling American Musicological Society.

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[91] Ann M. Pescatello, *Charles Seeger: A Life in American Music* (Pittsburgh: University of Pittsburgh Press, 1992), 49.

[92] Ann M. Pescatello, *Charles Seeger: A Life in American Music*, 49.

[93] Ann M. Pescatello, *Charles Seeger: A Life in American Music*, 59.

The application of current scientific thought was often a part of the early meetings held by the society. In the process of searching for a set of fundamental methods of musicological study, a study which was often referred to at this time as "the science of music," many scholars looked to established scientific fields, including those with some relation to music (like psychology and acoustics/physics) and a number of seemingly more distant fields like evolutionary biology, chemistry, and physics.[94] At these early meetings in the late 1930s, figures such as John Redfield were often present and it was not uncommon to hear papers concerning the application of scientific methods to musicological study at these meetings.[95] Within the bulletins of the AMS, we find references to papers given on scientific topics, but it is Charles Seeger's notice of a paper presented in December 1944 that stands out in terms of Einstein. His paper, entitled, "Toward a Unitary Field Theory for Musicology" offers a mature look at the state of musicology in America.[96] While the young Seeger published a number of idealistic articles in the 1920s, often prescribing the incorporation of a number of disparate disciplines into a theoretical canon of musicological research methods, by 1944 the more established musicologist sees a clear path to musicological study.[97] His abstract, reproduced in the June 1947 *Bulletin of the American Musicological Society*, begins:

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[94] For a summary of the relationship between established scientific study and new musicological methods see Louis Harap, "On the Nature of Musicology," *Musical Quarterly* 23/1 (January 1937), 18–25.

[95] Original attendance for the first meeting of the AMS shows the names of these musicological and scientific figures. Found in the AMS archive.

[96] According to Lawrence M. Zbikowski, the typescript for this paper has been lost, only the abstract remains. "Seeger's Unitary Field Theory Reconsidered," in *Understanding Charles Seeger: Pioneer in American Musicology*, eds. Bell Yung and Helen Rees (Urbana: University of Illinois Press, 1999), 132.

[97] See, for example, Charles Seeger, "On the Principles of Musicology," *The Musical Quarterly* 10/2 (April 1924), 244–250; Charles Seeger, "On Style and Manner in Modern Composition," *The Musical Quarterly* 9/3 (July 1923), 423–431; and Charles Seeger, "Systematic and Historical Orientations in Musicology," *Acta Musicologica* 11/4 (1939), 121–128.

> In this paper no application of Einsteinian theories to musicology is intended, but rather a contribution is offered towards the devising of a frame of reference that may serve musicology in a manner homologous to that in which Einstein intends his theory to serve the natural sciences.[98]

Although Seeger makes it plain that his "unitary field theory" of musicology does not depend on the principles contained within Einstein's work, it nevertheless acknowledges the structure and scope of the scientist's theories as invaluable as models for the field. Perhaps the quick denial of a substantively Einsteinian music theory is a reference to another paper (mentioned in the same AMS *Bulletin*) given a few months before Seeger's. Noel Heath Taylor's "Semantics in Musicology" seeks to incorporate "Korzybskian General Semantics" into musicology. Taylor's paper argues that the linguistic work of Alfred Korzybski, based on "its mother scientific theory, Relativity," should be applied to the interpretive study of music.[99] This type of direct application of Einstein's principles is likely what Seeger was opposing in his paper on "unitary field theory."

For Seeger, Einstein's unified field theory served as a model for musicological study overall. Just as Schillinger borrowed relativity theory as a methodological framework for his theories of music, so too does Einstein's later work serve as a technical framework for Seeger. He explains his idea further:

> The task of a unitary field theory is understood to be definition and systematization of a field, more particularly where a duality or plurality is evident—such as appears in the field of musicology between extrinsic (non-musical) and intrinsic (musical) materials of music and studies thereof, between form and content of music, content of music and speech,

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[98] Charles Seeger, "Toward a Unitary Field Theory for Musicology," *Bulletin of the American Musicological Society*, No. 9/10 (June 1947), 16.

[99] Noel Heath Taylor, "Semantics in Musicology," *Bulletin of the American Musicological Society*, No. 9/10 (June 1947), 29.

> scientific and critical methods of musicological study, structural and functional analysis, etc.[100]

Here, Seeger proposes an approach to musicology (which in this definition of "intrinsic" and "extrinsic" studies seems to imply the more music-theoretical and historical approaches to the study of music) that borrows Einstein's unified field theory. Seeger's adoption of Einstein's term certainly makes the most of the double entendre of a "field" theory, since he is theorizing about the many paths the academic field of musicology is taking. But more than a clever pun, Seeger actually wants scientific method to unite the sometimes-divergent paths that musicological study follows. A few years earlier, in 1939, Seeger can be observed arguing for a scientifically-oriented revolution in the field of musicology that would unify the efforts of "systematic" and "historical" musicologists. He recommends a tripartite approach to the study of music:

> (1) More attention to critical method. The method of science has, of course, been developed to a degree far exceeding that to which critical method has been led, Indeed, I believe much of the trouble we have today in reconciling our two diverse pursuits is due to an unbalance in respect to critical method. . . .
> (2) More attention to the matter of focus in viewing our field, with emphasis upon the development of the synoptic vision, especially in scientific work. . . . Like history and system, science and criticism, so the synoptic and the research types of focus should be balanced off against one another. . . .
> (3) More attention to the methodology of musicology. The conflicts, apparent or real, in respect to history and system . . . have usually been referred to as inherent in the object or field of study. . . . Historical and systematic orientations are complements—not mutually exclusive opposites of each other. One leads continually and inevitably into the other. . . . It does hold that musicological work of either kind will be the better if done in the perspective afforded by its complementary study and in the light of the knowledge of the filed of musicology as a whole.[101]

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[100] Charles Seeger, "Toward a Unitary Field Theory for Musicology," 16.

[101] Charles Seeger, "Systematic and Historical Orientations in Musicology," 127–128.

Seeger develops this model for the holistic study of music from methods used in, as he says in this article, "physics and biology, economics and philosophy."[102] He even sees popular interest in science as a hopeful sign for musicology: "One of the healthiest signs of our day is the popular interest in the sciences and the wealth of good popular books upon them by outstanding scholars." He seems optimistic at this time (in 1939) that this interest will lead to a more comprehensive and unified study of music. Thus in 1944, when he proposes a "unitary field theory" for musicology, I cannot help but believe that in the longer form of this address Seeger employed not just Einstein's ideas as a metaphor for the unification of the field of musicology, but also as a true methodological model.

In 1951, just a few years after Seeger proposed his unitary field theory before the American Musicological Society, he presented and then published an article in the society's journal employing elements from Einstein's theories explicitly. Interestingly, the article seems to be a sum of both his thoughts presented in 1939 about the relationship between systematic and historical musicology and those presented in 1944 about a unified field theory:

> The aim of the present undertaking, therefore, is to propose a sound theoretical basis for systematic musicology in terms of which improved relationship may be established (1) between musical and non- or extra-musical viewpoints, (2) between scientific and critical methods, and (3) between scientific and critical methods. It is hoped that this apparatus will serve as the base for the description of any music with maximum objectivity.[103]

[102] Charles Seeger, "Systematic and Historical Orientations in Musicology," 125.

[103] Charles Seeger, "Systematic Musicology: Viewpoints, Orientations, and Methods," *Journal of the American Musicological Society* 4/3 (Autumn 1951).

In describing how the three parts of this apparatus will improve the study of music, Seeger adds his own concept, which he uses throughout: general and musical space-time. He uses these two interlocking terms to describe the study of music: historical musicology focuses on music as occurring in general space-time, that is, as dependant on a particular time and place. Systematic musicology, on the other hand, focuses on music in music space-time, that is, on its own terms. The latter term needs quite a bit more unpacking. While Seeger employs Einstein's definition of a four-dimensional space-time for his more general concept, for his music space-time concept he develops a six-dimensional (!) fabric of interrelated elements. They consist of the three elements of musical time (tempo, movement, and duration) woven together with the three elements of musical space (tone, dynamics, and timbre).[104] Music space-time occurs within general space-time. Two things are important to note: first, in describing both historical and systematic musicology Seeger uses this Einstein-infused terminology. Neither is more advanced, scientifically-speaking, than the other. Second, musical space-time, the network of musical elements most frequently analyzed by systematic musicologists, exists not beside but *within* general space-time, the concept that most concerns historical musicologists. Thus Seeger employs the common part-to-whole relationship between systematic musicology and historical musicology.

Seeger's clear knowledge of Einstein's relativity theories is evident in this article and, for author Bell Yung, the implications of Seeger's notion of music space-time went beyond its relevance as a parallel model for systematic and historical musicology. He notes the importance of Seeger's music space-time for music theory as well:

[104] Charles Seeger, "Systematic Musicology: Viewpoints, Orientations, and Methods," 241.

> …the special theory of relativity as a source for inspiration is clear. In proposing a musical space-time, his obvious implication is that these six dimensions of musical sound cannot be separately perceived or analyzed and must be treated as a whole just as physical space and time have to be. Since the special theory of relativity and the space-time concept have been validated by many experiments, its use as an analogy states as strongly as possibly the inseperableness [sic] of the musical space and musical time. Although he does not explicitly say so, Seeger uses the theory to comment on the kind of musical analysis that singles out one musical dimension, say harmonic structure, for discussion, without relating it to the other five dimensions. Just as in discussion of the physical space-time, such an analysis will distort the representation of a musical experience in musical space-time.[105]

Thus while Seeger uses the model of space-time for musicological parallels, it certainly does have some potential as a theory of musical space-time. Unfortunately, it is unclear just how far-reaching the compositional or analytical impact of his theory of music space-time was.

Returning to the importance of Seeger's conceptions of space-time for musicology, we can see that Seeger unifies systematic and historical musicology in two ways: they are both scientifically-oriented disciplines (or, at least, they should be according to Seeger) and they are fundamentally intertwined through their methodological focus on space-time. While it may seem as if Seeger, in 1951, is progressing backwards scientifically by so clearly using the idea of space-time from Einstein's theory of relativity, it must be remembered that Einstein's unified field theory was meant to incorporate his theories of relativity into a larger scientific worldview. This article, then, is the beginning of the fulfillment of Seeger's unified field theory of musicology. Seeger would return again to his "unitary field theory" much later, in the

[105] Bell Yung, "From Modern Physics to Modern Musicology: Seeger and Beyond," in *Understanding Charles Seeger: Pioneer in American Musicology*, Eds. Bell Yung and Helen Rees (Urbana: University of Illinois Press, 1999), 179–180.

1970s, and attempt to globalize his ideas about musicology study even further.[106] In this we find an aging Seeger much like Einstein was in his later years, always in pursuit of a grander theory that could account logically for all phenomena.

Henry Cowell's Theory of Musical Relativity

In their theories of music and musicology Rudhyar, Schillinger, and Seeger related to relativity theory mainly as a source of inspiration for the structure and scope of their work. Like composers' responses to Einstein's persona, these three musicians' used relativity because of its availability as a model for a complex, far-reaching, and highly technical theory that nevertheless had immense popular interest. They drew, for the most part, on the reception of relativity rather than the ideas contained within the theories. The connotations associated with the theories—that they were revolutionary, scientific, popular—were most critical for the authors who borrowed the language of Einstein to help construct their theories of music and of musicology. And, although in examining the writings of each of the three, I did reveal some parallels between their ideological stances and those implied by Einstein's theories, it is difficult to say to what extent these parallels were purposefully constructed, or merely the visible waves made by a deeper social and intellectual undercurrent. However, in the case of the composer discussed in this section, the ultramodernist Henry Cowell, an intentional, well-constructed parallel between relativity theory and music theory is too compelling to be dismissed.

Henry Cowell's *New Musical Resources* (1930) provides one of the best examples of Einstein's impact on composers' conceptions of their own art. In this musical treatise, the close relationship between Cowell's and Einstein's theories can be

[106] This continued research into a unitary field theory of music is the subject of Lawrence M. Zbikowski's article "Seeger's Unitary Field Theory Reconsidered," 130–149.

seen in the scientific language, with a particular emphasis on relativity theory, as well as in the theoretical similarities between Cowell's aesthetic concept and Einstein's relativity theories. The majority of *New Musical Resources* was written by Cowell in 1918 and 1919, although it was not published until 1930. Most of the materials from this theory of new music were developed during his studies at the University of California Berkeley under Charles Seeger, who, as I argued, also had an important relationship with Einstein's theories.[107] Cowell worked with the young professor for two years beginning in the fall of 1914 and then completed a draft of the book with the help of Samuel S. Seward, an English professor at Stanford University.

The use of general scientific language throughout the monograph about the materials of modern music is a testament to the composer's lifelong interest in science. He was notably singled out as a scientifically-minded youngster when he met Professor Lewis Terman at Stanford, who evaluated the young Henry saying

> As the result of many hours of conversation over a period of many months, we are convinced that his ability in science was almost as great as in music. . . . If he attains fame as a musician, his biographer is almost certain to describe his musical genius as natural and inevitable, and to ignore the scientist that he might have become.[108]

[107] We know, of course, from the previous section of this chapter that Seeger had an immense interest in the application of Einstein's theories to musical analysis and musicology. Because Seeger worked with Cowell before Einstein's theories became known in America, it is somewhat unlikely that the two discussed the physicist at this early date. They may have discussed it later as colleagues in New York, however. No correspondence exists to support this assumption, but the adoption of Einsteinian ideas by both parties in later decades suggests it.

[108] Lewis Terman (1919), 246–251 in Daniel Schuyler Augustine, "Four Theories of Music in the United States, 1900–1950: Cowell, Yasser, Partch, Schillinger" (PhD Dissertation, University of Texas at Austin, 1979), 4.

And while the biographers of recent decades may not have focused on Cowell's scientific tendencies, contemporaneous music writers, immersed in the modernist music scene and familiar with Cowell, did recognize his scientific preoccupations.

Aaron Copland employed scientifically-oriented language to describe the up-and-coming Cowell in an article entitled "America's Young Men of Promise," in *Modern Music* in 1926:

> Like Schoenberg, Cowell is a self-taught musician, with the auto-didact's keen mind and all-inclusive knowledge. But Cowell is essentially an inventor, not a composer. He has discovered "tone clusters," playing piano with the fore-arm, and the string piano. Yet from a purely musical standpoint his melodies are banal, his dissonances do not "sound," his rhythms are uninteresting. Cowell must steel himself for the fate of the pioneer, opposition and ridicule on the one hand, exploitation and ingratitude on the other. His most interesting experiments have been those utilizing the strings of the piano.[109]

Cowell is an inventor, a discoverer, and an experimenter. In fact, Copland's assessment almost verges on the derogatory as he implies that Cowell's treatment of and experimentation with the basic materials of music had little regard for artistry. This sentiment was echoed by critics as well. In *American Composers on American Music* (1933), Nicholas Slonimsky describes the composer's compositional impetus:

> This scientific procedure Henry Cowell unashamedly resumes. If there is one rule in his creative art, it consists in taking nothing for granted. Harmony, rhythm, tone-color—Henry Cowell submits them to a test as though they were mere human beliefs, not laws.[110]

Within *This Modern Music* (1944), John Tasker Howard quotes from Slonimsky and echoes the critic's assessment, dubbing the composer "the scientific and mathematical

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[109] Aaron Copland, "America's Young Men of Promise," *Modern Music* 3/3 (March/April 1926).

[110] Nicholas Slonimsky, *American Composers on American Music* (Stanford University Press, 1933), quoted in John Tasker Howard, *This Modern Music* (New York: Thomas Crowell, 1942), 199.

Henry Cowell" and describing the theories of music put forth in *New Musical Resources* as a set of "scientific laws" that a composer of modern music might follow.[111] Howard also describes Cowell as "one of the leaders of American modernists in the experimental field" and he tells readers that, as the "inventor of so-called tone-clusters," Cowell "has gone about their development more scientifically than his predecessors, and has devised a logical basis and explanation for their use."[112]

Perhaps one of the reasons why both critics and composers saw Cowell as first a scientist and only then a composer was the fact that his specific ideas about modern music were much more easily explained than put into practice. Cowell's theories about music were logical and elegant when spoken about in prose, but because of this, some parts were probably seen as incongruous with his (and others') modern compositions. *New Musical Resources* was the grand statement of his aesthetics. Within this text, Cowell constructs a set of scientific laws (to borrow John Tasker Howard's phrase) according to which he believed music should be composed. Even more specifically, Cowell models this theoretical tract on the work of Einstein. It was perhaps his attempt to incorporate relativity theory at both on the structural and internal levels that made a perfect mesh between theory and practice difficult. Nevertheless, *New Musical Resources* represented an important theoretical attempt to blend music and science, and presents us now with one of the most compelling cases of the integration of modern musical aesthetics and ideologies with Einstein's theory of relativity.

To turn now to the text of *New Musical Resources*, we can begin by looking at one very rich paragraph that summarized the scope and content of the book. This

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[111] John Tasker Howard, *This Modern Music* (New York: Thomas Crowell, 1942), 198, 200.

[112] John Tasker Howard, *This Modern Music*, 194–5.

paragraph highlights the two main ways in which *New Musical Resources* relates to relativity: first, Cowell borrowed scientific language, particularly the language of relativity theory; and second, he attempted to integrate certain fundamental ideas of Einstein's into his theoretical stance. In effect, the theoretical backbone of the book is described by Cowell as "a theory of musical relativity."

> The result of a study of overtones is to find the importance of relationships in music and to find the measure by which every interval and chord may be related. It is discovered that the sense of consonance, dissonance, and discord is not fixed, so that is must be immovably applied to certain combinations, but it is relative. It is also discovered that rhythm and tone, which have been thought to be entirely separate musical fundamentals (and still may be considered so in many ways) are definitely related through overtone ratios. Therefore the theory proposed may be termed a theory of musical relativity.[113]

From the outset, Cowell uses scientific language to describe his approach to musical analysis and composition. His book is a "study of overtones" that precisely measures the relationships between intervals and chords. The air of scientism is heightened through Cowell's use of passive, objective language, especially the phrase "it is discovered." In using this phrase Cowell removes himself as a subjective agent (even a scientifically-oriented one) in order to suggest that his theoretical findings are matters of fact that he, the investigator, simply had to uncover.

If we dissect what exactly is "discovered," we arrive at the first instance of the term "relative." Cowell uses the word in two separate sentences and in both instances the term refers to Einstein's relativity theory. We can be sure of this because each definition corresponds precisely to the popular and scholarly meanings of relativity theory, respectively. And, to make things perfectly clear, Cowell ends the paragraph by asserting

[113] Henry Cowell, *New Musical Resources*, xi.

that is it because of the two cases of music being "relative" (to be discussed momentarily) that his theory of music may be termed a "theory of musical relativity."

The first instance of the relative in music is described as follows: "It is discovered that the sense of consonance, dissonance, and discord is not fixed, so that is must be immovably applied to certain combinations, but it is relative." In disputing the notion that intervals are inherently consonant or dissonant and instead asserting that these value judgments are relative, Cowell is employing the popular notion of relativity. He uses the misunderstood, but widely believed idea that "everything is relative." Unlike the relativism implied by Rudhyar, who mainly maps cultural relativism on to relativity theory, Cowell believes that the relativity of consonance and dissonance is a combination of cultural difference as well as the inherent acoustical properties of the overtone series. On the first subject, Cowell notes that musical cultures around the world have found certain intervals consonant or dissonant, and that within one musical culture the attitudes towards the quality of intervals changes over time (for example, the increased leniency towards certain intervals in Baroque counterpoint as compared to Renaissance counterpoint). He also remarks that the ear can become more familiar with certain combinations of tones higher and lower in the overtone series.

> The points in the series, therefore, where consonant chords leave off and dissonance begins, and where dissonance leaves off and discord begins, are not rigidly fixed, as was assumed by most theorists, but depend upon the ear of the particular listener, who is in turn influenced by the musical age in which he lives. It is this fact, proved by the history of musical progress, in conjunction with the fact that, acoustically speaking, there is no point at which any other than an arbitrary difference between them can be shown, which establishes the relativity of consonance, dissonance, and discord.[114]

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[114] Henry Cowell, *New Musical Resources* (1930, 1994), 10–11.

Cowell's relativism is both cultural and musical. Through the combination of overtones in different spacings, says Cowell, and an individual's relative familiarity with these combinations, dissonance can be considered a relative phenomenon.

In the following sentence, Cowell makes it clear that his discovery—and the focus of the book—of the fundamental interconnectedness of rhythm and pitch through the overtone series is also a relationship that can be described as "relative." To review: "It is also discovered that rhythm and tone, which have been thought to be entirely separate musical fundamentals (and still may be considered so in many ways) are definitely related through overtone ratios." Cowell's idea about the relationship between pitch and rhythm, the discussion of which forms the vast majority of this theory of music, is that in viewing the ratios of the overtone series as rhythmic proportions, each pitch can be considered fundamentally a rhythm as well. For example, if we view the overtone series itself, starting from the beginning, we have the fundamental pitch followed by a pitch whose frequency is two times faster than the fundamental's. Cowell views this relationship as a rhythmic one, as if the fundamental were a whole note and the first partial, the octave, was, rhythmically speaking, a half note. The same principle works for the more complicated ratios found as we travel upwards in the series, including 4:3 (a perfect fourth) and 3:2 (a perfect fifth), which map onto the rhythmic juxtapositions of three against four or two against three. Cowell's notions of the rhythmic, mathematical nature of pitch also apply to the idea that in the non-synthetic production of pitch (that is, on acoustic instruments) each "individual" pitch is actually a collection of overtones, with the fundamental sounding most loudly and various other overtones sounding at particular volumes, making up the timbre of the specific instrument. These less audible overtones are critical to Cowell's conception of new music and are, in fact, what shape his first notion of the "relative" in music, the idea that what we think of as dissonances actually are not, because between the first tone (containing its overtones) and the successive tone, the pitch of the seemingly dissonant second tone (the fundamental) was contained in the upper partials of the first tone. Therefore, what might be aurally jarring is, acoustically and theoretically speaking, perfectly consonant because of the links in the overtones of the two pitches. This rhythmic aspect of each tone, then, is one of the most important "discoveries" of Cowell's theoretical work. The idea that pitch is rhythm and, inversely, the rhythm (when played fast enough) is pitch is presented as Cowell's valuable addition to the scientific study of music. This use of the term relativity is specifically Einsteinian. Cowell is adopting Einstein's notion that time and space are woven together in the fabric of the universe.

After Einstein, space and time could no longer be considered absolute. What this meant was that although in Newton's view space could be observed and measured by different observers and at different times with the same results, in Einstein's picture of the world, different observers and observations made at different times would alter the measurements of space. Space would not only appear, but actually *be* smaller or larger depending on the frame of reference of the observer and the speed at which the observer moved through a space. Shlain clarifies this point very well, so it is useful to quote him here:

> The truly astonishing thing about these deformations [of space] is that for the observer the objects themselves actually change shape due to a plastic transformation in the space in which they reside. . . . The notion that space is interactive with the volume, shape, and size of objects residing within it is one of the crucial insights of Einstein's special theory of relativity.[115]

[115] Leonard Shlain, *Art and Physics*, 126.

The same type of destruction of absolute time took place with the introduction of relativity theory. For Newton (and according to common sense), time always moved in one direction and it always progressed at the same rate, unaffected by anything. In Einstein's view, time could theoretically stand still or even move backwards (if you could approach or exceed the speed of light—a very different task). Relativity suggested that time was dependent on an observer's speed traveling through space. Most importantly, as we can see, with Einstein's removal of their absolute nature, space and time must be understood in a reciprocal relationship, always influencing one another. Again to quote Shlain, "[O]nce we break free from the very slow speeds of our earthbound experience, time and space are a complementary pair, intimately intertwined: As time dilates, space contracts; as time contracts, space dilates."[116]

While the exact nature of the relationship between space and time according to relativity theory might not have been understood, the headlines of the day (which are the most likely candidates for mass readership) made the general idea clear: space and time could no longer be thought of as absolute entities, but rather in interdependent phenomena. When composers like Cowell encountered these dramatic headlines, it is likely that their musical minds begin pondering the implications that a changed view of space and time would have for musical space and time, i.e. pitch and rhythm.[117] For radical ultramodernist thinkers, ready to adopt Einstein's new views of the universe, the next step would be a test of how these fundamental musical elements might fare in an

[116] Leonard Shlain, *Art and Physics*, 132.

[117] It is certainly possible for Cowell especially to have read a great deal more than the headlines, including perhaps a book about Einstein or relativity theory like those mentioned in the previous chapter and in the beginning of this chapter. I have not, however, been able to identify particular works that would have been in his personal library.

Einsteinian universe and to explore to possible impact that this would have on composition. The easiest way to do so was to play with the traditional connections between space, or pitch, and time, or rhythm.[118]

Cowell's ideas about the interconnectedness of pitch and rhythm both point out the metaphorical nature of spatial and temporal descriptions of pitch and rhythm, but reconfigure the metaphors to conform to an Einsteinian picture of the world. In showing that pitch is a fundamentally temporal mode of sound production, that is, technically speaking pitches are created in terms of vibrations per second, he not only highlighted the imperfect spatial metaphor for pitch, he also showed that our spatial conception of pitch is inherently tied to its temporal or rhythmic production. Our "higher" pitches are, temporally speaking, faster rhythms. We could rephrase Cowell's idea by saying that pitches and rhythms are produced in an interconnected environment of time-space.

Thus when Cowell finished this paragraph by saying "therefore the proposed theory may be called a theory of musical relativity," he acknowledged the intellectual debt his work had to Einstein. It is clear that he was familiar with the many connotations and denotations that relativity had, and he attempted to embrace the multiplicity of those definitions in his work. From this textual analysis of Cowell's writings, the composer's adoption of Einstein's principles appears perfectly clear, but the nature of this seemingly direct relationship between Cowell and Einstein must be nuanced slightly.

To start, the time frame for the construction of *New Musical Resources* is important to note. In a handwritten note by Sidney Cowell, contained in a folder of promotional materials for *New Musical Resources,* she states that the book was finished

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[118] I will take a much closer look at these concepts throughout musical history, both before and after Einstein, in the following chapter on space-time.

in 1919, but does not give a specific month. She jotted a quick note to say that in 1929, the book was "revised in presentation and cut in 1929 for publication by Knopf that year (or maybe 1930 was publication date). But no essential changes Henry thinks." [119] Even if the book were completed in the months after Eddington's November 1919 announcement, it would be a stretch to say that Cowell incorporated the newly introduced phrase "theory of relativity" into the book that quickly. This phrase, however, only appears in the "Introduction" to *New Musical Resources*, not within the body of the book. As it happens, this "Introduction" was only added by Cowell in the later draft of the book written in 1929 ("Draft II"), not even in the early draft of the same year ("Draft I").[120] Draft I includes a page-long opening section that Cowell called a "Personal Introduction." It does not include any reference to relativity theory. It does, however, outline the scientific sentiments with which Cowell penned the book, given as they were with ten years distance from the original text. In explaining his impulse to write the book, Cowell returns again and again to the place of his compositions and theoretical thought in the context of a dominant set of musical laws. He begins:

> In the course of my composition I have felt impulses to express myself in ways that have not always fallen with the commonly accepted laws of musical theory and, in some cases, were incapable of being written down in the forms of correct practice. . . . I found that at every point where I had departed from musical practice in the subjects of harmony, counterpoint, rhythm, tempo, etc., what I had done was not to reject law in favor of a sort of willful anarchy, but to carry well-accepted principles into further

[119] Sidney Rose Cowell, "Promotional Materials, 1929," in the "Henry Cowell Papers, 1851–1994" (Music Division, New York Public Library), Box 141, Folder 28.

[120] "Draft II, 1929" can be found in Box 141, Folders 17–21 of the "Henry Cowell Papers, 1851–1994" held at the Music Division of the New York Public Library. "Draft I, 1929" is contained in Box 141, Folders 11–16 of the "Henry Cowell Papers, 1851–1994" (Music Division, New York Public Library).

> stages of development harmonious with the tendencies of past musical history.[121]

The idea of breaking with the accepted laws of music is very much in line with the rhetoric used to describe Einstein's theoretical break with Newtonian laws of mechanics. Cowell could not explain his music theoretically within the given system, but believing that his music was not wrong, he sought to uncover the flaw in the system as it was understood. Just as Einstein saw unexplained natural phenomena that could not be accounted for using Newton's laws (for example, the bending of light at a certain angle), Cowell needed to find a theoretical justification that could accommodate his musical ideas.

Cowell even seems to view the relationship between his new theoretical concepts and those of the past in the same way that Einstein viewed his work in light of Newton's more accepted worldview. Einstein's relativity theory was an expansion of Newtonian laws; Einstein's theories applied to the motion of objects approaching the speed of light, but at most speeds, Newton's laws held up perfectly well. Cowell seems to be picking up on this idea in his statement that his new theory is simply taking a broader view of the musical universe, not destroying an old set of laws. In fact, the relationship between classical, or Newtonian, mechanics and relativity was a topic that received a great deal of attention in 1929, as Einstein had just announced that he had completed the first draft of his Unified Field Theory in this year, his first attempt at uniting Newton's and his own theories into a functional theory of motion that could explain motion and force in all possible circumstances. It seems quite likely that Einstein's renewed popularity on the newsstands is showing up in these rather cloaked references to Einstein through the

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[121] Henry Cowell, "Draft I, 1929," in the "Henry Cowell Papers, 1851–1994" (Music Division, New York Public Library), Box 141, Folder 11, 1.

invocation of the term “laws.” In the later draft, Draft II, we find the “Introduction” that has been used in all the published versions of *New Musical Resources*. Written later in 1929, it contains the first use of the term “relativity” and the paragraph that describes the book as a “theory of musical relativity.” What was merely implied in Cowell’s discussion of musical laws is now boldly stated. With nearly a decade of intellectual access to Einstein and his theories, it is more than plausible to claim that Cowell consciously and intentionally used the term relativity to invoke all of the ideological and cultural weight that Einstein and relativity carried.

Yet, although the time frame for the construction of the final published book clarifies Cowell’s use of the term relativity, it still leaves one important question. How indebted were the theories contained within Cowell’s chapters to Einstein if they were finished in 1919 without any “essential changes” in the 1929 drafts? We can begin to discuss some possible answers with a second look at the “Introduction,” for Cowell himself attempts to explain the relationship between the opening material and the body of the book. The “Introduction” is clearly written from a point in the future, with respect to the theoretical assertions contained within the chapter (although the exact future date is not given in the published versions). Nevertheless, Cowell does not in any way conceal the temporal distance and because of this, he leaves us with an interesting picture of how he sees his own theories of music. In what appears to be a later version of his “Personal Introduction” that we encountered in Draft I, Cowell offers the reason he wrote *New Musical Resources*:

> My interest in the theory underlying new materials came about at first through wishing to explain to myself, as well as to others, why certain materials I felt impelled to use in composition, and which I instinctively felt to be legitimate, have genuine scientific and logical foundation. I

> therefore made an investigation into the laws of acoustics as applied to musical materials. Some of the results of the investigation convinced me that although my music itself preceded the knowledge of its theoretical explanation, there had been enough unconscious perception so that the means used were not only in accordance with acoustical law, but are perhaps the best way of amalgamating sounds formerly considered discords; namely, by sounding together an number of tones related through the higher reaches of the overtones, in the same spacing in which they occur in the overtone series.[122]

Cowell himself sees that his ideas about music, contained within his early compositions, "preceded the knowledge of [their] theoretical explanation" and came out of a type of intuitive knowledge of the nature of the musical world. Cowell seems to believe the same instinctual relationship exists between his theories (contained within the body of the book and developed by 1919) and the fact that he sees them as constituting a theory of musical relativity (contained only in the 1929 "Introduction"). This becomes evident when he assesses his already written book using a parallel construction to the one above.

> In this early form [1919] it embraced most of the applications given here of the theory of musical relativity. Many of the materials which it predicted would come into music have since been adopted many materials which were only vaguely suggested in music at the time, and which were pointed out as valid, have since been developed to such an extent that it is difficult to realize with what suspicion they were regarded in 1919. [. . .] Such progress is encouraging and seems to give further proof that the theory as postulated has validity.[123]

Cowell believed that the bulk of the theoretical materials adhered to his assessment of the book as a "theory of musical relativity." Indeed, although his music was written before he could verbalize a theoretical justification, and his theory of musical relativity was developed before he could have expressed it in such terms, his intuitive knowledge of the

[122] Henry Cowell, *New Musical Resources* (1930, 1969), xxi.

[123] Henry Cowell, *New Musical Resources* (1930, 1969), xxii–xxiii.

musical universe, as a scientist-composer led him to discovering a theory of musical relativity.

Kyle Gann summarizes the main points of Cowell's argument and even projects the musical impact that the composer's theory had.

> Therefore, degrees of consonance and dissonance in the overtone series are not absolute, as had been widely assumed, but relative, and starting with the 1929 revision Cowell calls his theory "a theory of musical relativity"; in physics, Einstein's own theory of special relativity had appeared in 1905. What Cowell promises is nothing less than a kind of "unified field theory" for harmony, melody, and rhythm, for the overtone series, he says, "is a scale in its upper reaches, a harmony in its lower reaches, and a basis for rhythmical co-ordination." In finding a theory to unify the treatment of both rhythm and pitch, Cowell anticipated questions that would greatly occupy composers such as Pierre Boulez, Karlheinz Stockhausen, and Milton Babbitt in the 1950s.[124]

While Cowell's theory may have had an impact on later theories of music (and, in fact, I will draw a few connections along these lines in the conclusion of this dissertation), one of the primary questions that remains might be: In what way was Cowell's theory of musical relativity related to his compositional output? This question of the relationship between theory and practice will serve as one of the central inquiries of the following chapter, and I will indeed return to the case of Cowell.

Pound and the Supremacy of Musical Time

A final theoretical response to Einstein's theory of relativity, one that forms the opposite side of the coin from Cowell's, came from an unusual source: American poet, expatriate, music critic, and sometimes composer Ezra Pound. In the previous section on poets' reactions to Einstein, I discussed some of the ways in which Pound responded to the

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[124] Kyle Gann, "Subversive Prophet: Henry Cowell as Theorist and Critic," in *The Whole World of Music: A Henry Cowell Symposium*, ed. David Nicholls (Amsterdam: Overseas Publishers Association, 1997), 175.

scientist with the written word. Pound was immersed in a diverse artistic community of writers, painters, musicians, and poets, many of whom had something to say (be it positive or negative) about Einstein. It should come as no surprise, then, that Pound's work in the musical world touched upon relativity as well—apart from the surprise that Pound was involved in this world as a musician at all, that is.

Pound was an active critic of modern music in a number of music journals between 1917 to 1921, including the *New Age*, the *New Masses*, and *The New Criterion*, under the name William Atheling (many of these articles reappear in *Antheil and A Treatise on Harmony* with comments by Antheil included).[125] William Walter Hoffa notes that "these pieces of commentary cover recital, concert, and operatic music, and, despite their occasional obtuseness and pose, they reveal that Pound indeed was not only familiar with musical history, but that he often had advanced ideas on music theory, composition, and performance."[126] In his introduction to the 1968 reissuing of *Antheil and the Treatise on Harmony*, Ned Rorem's comments provide another view of the poet-turned-music-critic:

> A cultured and imaginative lay genius like Pound can insist on learning the hard way (*i.e.*, on his own) what a trained professional was quite simply taught at school and takes for granted. They lay genius will present the professional with his "unique" discoveries; but the professional, dull though he be, heaves a plaintive sigh for the genius, who could have saved so much time merely by opening a book.[127]

Thus Pound's music criticism must have reached different audiences with varying success. For the literary set, his music criticism and the ties that might have been

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[125] See Ezra Pound, *Antheil and the Treatise on Harmony*, 67–126.

[126] William Walter Hoffa, "Ezra Pound and George Antheil: Vorticist Music and the Cantos" *American Literature* 44/1 (March 1972), 56.

[127] Ned Rorem, "Introduction" in Ezra Pound, *Antheil and the Treatise on Harmony*, 5–6.

perceived between this work and his poetic work were seen as insightful, if idiosyncratic. Perhaps for the trained musicians reading his music criticism, Pound's self-taught theories of music came off as a poet's whimsical musings. In either case, Pound's dedication to modern music as an important part of early twentieth-century artistic life was unequivocal.

Pound's status as a musician was less clearly drawn, but nevertheless played a role in his commitment to modernist musical life. Pound was the friend and student of instrument-maker and early-music revivalist Arnold Dolmetsch. The poet played the piano, clavichord (obtained from Dolmetsch), and recorder with "at least a measure of fluidity and talent."[128] The poet acted as tour manager for American pianist Katherine Ruth Heyman and was the long-time lover of renowned violinist Olga Rudge. Pound even began work on an opera *Le Testament* in the 1920s, with the notational help of George Antheil. The work was performed in Paris in 1926 and revived in 1962 by R. Murray Schafer. Virgil Thomson, who attended the Parisian premiere, remarked that "the music was not quite a musician's music, though it may well be the finest poet's music since Thomas Campion . . . and its sound has remained in my memory."[129] And, despite his cheeky remarks about Pound's overall musicality given in the introduction to *Antheil and a Treatise on Harmony*, Ned Rorem still admitted that "the opera is of genuine and hauntingly unclassifiable beauty."[130]

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[128] William Walter Hoffa, "Ezra Pound and George Antheil," 56.

[129] Virgil Thomson, *Virgil Thomson* (New York: Random House, 1966), 83.

[130] Ned Rorem, "Introduction" in Ezra Pound, *Antheil and the Treatise on Harmony*, 4.

In 1927, Pound published a text that took the form of a theory of music amalgamated with a biography of fellow American in Paris, George Antheil. This book, *Antheil and A Treatise on Harmony* (1927), offers an Einsteinian theory of music that focuses on the supremacy of time in music. As we will see in the next chapter, in which I will discuss Antheil's own prose and musical ideas about Einstein, Pound's theory of time in music was closely aligned with Antheil's theory of time-space, a fact that explains some creative borrowing of the composer's ideas.

Ezra Pound, described by Daniel Albright as a "genius-krank," was a close friend and early advocate of Antheil.[131] The two met when Antheil first moved to Paris, where he lived from 1923 to 1927, after Pound was introduced to the composer through Margaret Anderson, editor of "The Little Review." Antheil recalls this first meeting, noting the preconceptions that Pound may have had about him in *Bad Boy of Music*:

> Preceding my entry, Margaret had given Ezra quite a spiel about me; according to her I was a "genius," and Ezra was vastly intrigued by all this, for, as everyone knows, Ezra was at that time the world foremost discoverer of genius; in fact he frankly called himself "an expert in genius."[132]

Pound became fascinated with this latest musical genius and asked, a short while later, to hear about Antheil's ideas on music. The young Antheil provided Pound with some thoughts he had written down on the subject, and it was from these cursory theoretical notes that Pound developed his book *Antheil and a Treatise on Harmony*. Pound's book consisted of four parts: a theory of harmony, a hagiographic account of the young composer's early years in the United States and Paris, a series of articles on music

[131] Daniel Albright calls Ezra Pound (and Henry Cowell) a "genius-krank" in *Modernism and Music: An Anthology of Sources* (Chicago: Chicago University Press, 2004), 163.

[132] George Antheil, *Bad Boy of Music* (1945), 164–5 (in galley proofs at NYPL).

criticism by William Atheling (a.k.a. Ezra Pound) with marginalia by Antheil, and finally a section called "Varia."

From the book, it is unclear whether the theory of harmony is Pound's own or Pound's translation of Antheil's ideas. According to Antheil in *Bad Boy*, the ideas were taken—much to Antheil's later dismay—from the typed notes the composer gave the poet when they first met in Paris:

> . . . I had purchased a typewriter in Berlin and had occasionally amused myself with typing out pronunciamentos on art and music which would have blown the wig off any conventional musician; among other things I said that melody did not exist, that rhythm was the next most important thing to develop in music, and that harmony after all was a matter of what preceded and what followed.[133]

Although he recants and revises some of this anti-melodic theory later in this section, attributing his early writings to "adolescent effervescence," Antheil seems still (in 1945) rather proud of his iconoclastic theoretical stance.[134] And, in any case, these theoretical statements have a strong connection with the music of this time period, particularly his *Ballet Mécanique* (1924-5).

The content of the "treatise on harmony" deals mainly with the concept of time and music, but like Cowell's theories, it is an attempt by Pound on behalf of Antheil to unite the concepts of space and time in music. While Cowell begins with space/pitch and tries to integrate time/rhythm into our ideas about pitch, Pound/Antheil work from the

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[133] George Antheil, *Bad Boy of Music* (1945), 117 (in published version), 165 (in galley proofs at NYPL).

[134] "I had gotten this particular sort of adolescent effervescence out of myself by capturing it on paper so that it could be read over once or twice, then destroyed. I had, I have mentioned, written that 'melody does not exist.' Of course I did not mean that melody did not exist; I meant, rather, that a new melodic aesthetic had come gradually into being, invalidating many older ideas concerning it. But how can one explain the writings of one's youth—poems, love letters, high-school articles, etc.? Also, much of what I had written was stuff which I had formulated only in order to combat the aggressive anti-Antheil musical arguments of some of Boski's Hungarian musician friends in Berlin." George Antheil, *Bad Boy of Music* (1945), 166 (in galley proofs at NYPL).

other side. They (Pound and Antheil) start with time and attempt to explain the importance of time in our concepts of musical consonance and dissonance between pitches. Just as with Cowell, consonance and dissonance are relative, but the reasoning behind this relativity is different for Pound and Antheil. Pound states that certain intervals are relativity consonant or dissonant because of their placement in a musical context. For Pound, relative dissonance or relative consonance is a function of time. The treatise begins with an imaginary dialogue taking place between an "élève" and Pound about "the element grossly omitted from all treatises on HARMONY" to which Pound's answer is, of course, "TIME."[135] Pound goes on shortly thereafter to make his official thesis statement (again in his quirky, poetic combination of upper and lowercase letters):

> A SOUND OF ANY PITCH, or ANY COMBINATION OF SUCH SOUNDS, MAY BE FOLLOWED BY A SOUND OF ANY OTHER PITCH, OR ANY COMBINATION OF SUCH SOUNDS, providing the time interval between them is properly gauged; and this is true for ANY SERIES OF SOUNDS, CHORDS OR ARPEGGIOS.[136]

Thus according to Pound, it seems that the longer the space between two given notes, the more acceptable or consonant an interval may appear. This is explained as a function of both musical acoustics and human cognition.

In dealing with these two fundamental elements of music and finding a theoretical way to bind them together, Pound is responding to Einsteinian notions of space and time. Like Rudhyar and Cowell, Pound (and Antheil) link space and time with pitch and rhythm, respectively. And like Cowell, Pound is showing that space and time must now be reevaluated and understood as interrelated concepts. We cannot understand harmony simply as pitches occurring successively in space. They must be understood with a keen

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[135] Ezra Pound, *Antheil and the Treatise on Harmony* (New York: Da Capo Press, 1968), 9.

[136] Ezra Pound, *Antheil and the Treatise on Harmony*, 10.

observational ear attuned to time, for it is this element that produces consonance or dissonance, not merely the intervals (or space) produced between the notes in one chord and the notes of the next.

In the context of Cowell's *New Musical Resources* and its analysis as an Einsteinian work, Pound's *Treatise* comes across as a similar approach based on contemporaneous notions about relativity theory. But, lest the reader miss the theoretical connections between Pound's time in music and Einstein's new conception of time, Pound makes the link clear with a self-conscious reference or two to Einstein. After discussing the basics of his theory of time and music, Pound notes the four professional opinions he has received in reaction to the treatise (ostensibly given to the author before the book was put in print):

> To the above treatise I received four answers:
>
> 1.—Antheil: had known for some time that the duration of the notes and the duration of the time-intervals between them made a difference to the way the harmony sounded.
>
> 2.—A violinist: had not thought of the matter but tried various combinations of notes and found that my statement applied.
>
> 3.—Author of a work on Einstein: approved the treatise; thought it ought to be longer; doubted whether the statement was true for *all* possible combinations of notes.
>
> (This, I take it, was due to his ignoring my restrictive clause.)
>
> Perhaps I might better my statement. Perhaps I should say: There are no two chords which may not follow each other, if the sequence of time-intervals and durations is correct.
>
> 4.—Then there was the gent who found the treatise interesting but who (as who should prefer to study the circulation of the blood from corpses exclusively) preferred to study his harmony "separate," i.e. static
>
> Which might be very nice if it could be done or if there were any essential difference between one part of harmony and the other.[137]

In this list, we see Pound angling to show the validity of his treatise from a number of different outside perspectives. The treatise is acknowledged to be true by a composer,

[137] Ezra Pound, *Antheil and the Treatise On Harmony* (1927), 22–3.

Antheil, the composer held in highest esteem by Pound. Pound did show the book to Antheil before its publication, a fact that Antheil mentions briefly in his autobiography: “Two months later [after Antheil gave Pound the notes] Ezra was to bring me proof sheets with big black letters on the front page: *Antheil and the Theory on Harmony*.”[138] Although Antheil noted that he was “scared” that the book was to be published in Paris, he did not object to its publication because he was coming to realize that in Paris fame and infamy were one in the same—a fact that would be confirmed with the performance of his *Ballet Mécanique* at the Théâtre Champs-Elysées in 1926. Pound’s theory is also found to be applicable for the practical purposes of a musician who has, supposedly, tested the idea out by playing a few notes. The violinist mentioned in this passage is most likely Olga Rudge, the American concert violinist and frequent collaborator with Antheil, who sustained a long-term romance with Pound during these years in Paris. The anonymous “gent” who rejected the treatise could be basically anyone, or it could simply be Pound’s straw man, standing in for the probably great number of people who would disagree with the poet’s bold statements about music.

The “author of a work on Einstein” is an interesting case, because in this statement, Pound adopts a kind of pseudo-scientific language, noting that the Einstein author “approved” the treatise and addressing the qualms raised by the author in a direct, qualified response (quite the contrast from his idiosyncratic use of “prose” throughout the text). As for the identity of the author, it is as yet unclear. Nevertheless, the purpose of making this direct reference to Einstein could not be more transparent. Pound is attempting to make three things obvious to the reader. First, that Pound is familiar with Einstein and relativity theory. Second, that this book’s focus on the interconnectedness of

[138] George Antheil, *Bad Boy of Music* (1945), 166 (in galley proofs at NYPL).

time and space in music is an Einstein concept. And, third, that those familiar with Einstein's theories can and will endorse the theoretical concepts described by Pound.

In the next chapter, my discussion of the role that Einsteinian space and time played in actual compositions of the day will lead us to see that Antheil's adoption of Einstein's principles runs very deep. He specifically attempts to incorporate the scientist's ideas about time and time-space into *Ballet Mécanique*, and it is in observing and trying to understand this attempt that we will encounter one of the most important questions associated with this study: Can we hear Einstein in modernist music?

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The different approaches to the incorporation of ideas from Einstein's theories of relativity into theories of music reveals the pervasiveness of relativity in American culture. It was culturally relevant enough to appeal to those with even tiny degrees of interest in scientific culture, but also stable enough as a concept that it could be adapted to suit the intellectual needs of those composers who wanted to mold Einstein's theories to their own complicated theories of music.

As one of the earliest adopters, so to speak, Dane Rudhyar approached relativity from his own unique perspective as an amateur ethnographer and eccentric scientist. He adapted relativity to conform to his musical world-views that touched on the musics of other cultures, embracing cultural relativism. But in theorizing about the nature of the "note" we can see that he was also attempting to integrate some of Einstein's key concepts, in addition to his relativistic concepts, into a new look at the materials of music. Rudhyar (and Colin McAlpin) also bring out the idea the revolutionary nature of a theory of musical relativity. They make it clear that the adoption of Einstein's ideas in a musical context would make a social, cultural, and political statement.

In Joseph Schillinger and Charles Seeger, we find a pair of scholars and teachers, both borrowing the ideas of Einstein to help give methodological and structural support to their very different pedagogical agendas. In his massive *System of Composition*, Schillinger utilized Einstein's technical language in order to impose the weight of scientific objectivism. And, although it was made clear by his students and editors that Schillinger understood the fundamentals of Einstein's theories in terms of their relevance to musical time and space, Schillinger's compositional and pedagogical goals spoke to the fact that that his use of Einstein was merely descriptive of older practices of composition and older notions of space and time. Charles Seeger, too, took a rather cautious approach to Einstein's theories, using them for structural models rather than heralds of a new mode of musicological study. In outlining a "unitary field theory" of musicology, Seeger embraced the structural components of one of Einstein's theories as a model while consciously eschewing any ideological ties with Einstein.

Finally we encountered two self-consciously Einsteinian theories of music: Cowell's "theory of musical relativity" and Antheil's theory of "time-space" in music. For both of these composers, the use of the popular rhetoric of relativity in their variously constructed theories of music was only the tip of the iceberg in how their theories and Einstein's related. Both had deeper intellectual connection to relativity, as the above textual analyses have shown. Cowell's revolutionary idea centered on a re-conceptualization of musical space, one in which the fundamental interconnectedness of time and space was based on the mathematical and acoustical properties of the overtone series. Antheil's musical rebellion came in the form of a reevaluation of the primary elements of music. He insisted on the primacy of time within a musical fabric of time-space (using an appropriately textile-related metaphor, the time canvas). Both composers approached Einstein's new notions of space and time and attempted to construct parallel theories of space and time in music. I believe that in doing so, these composers intentionally flaunted their cultural savvy (in both the scientific and artistic realms) and boasted their revolutionary—and uniquely modernist—ideological viewpoints. They had found in Einstein's theories an inroad to certain artistic circles, also fascinated with the promise of scientific thought for modernist agendas, and a potential avenue to the popular audience.

CHAPTER 4

SPACE-TIME

Music exists in a dimension that we may, without parodying Einstein, call time-sound. If we are to interpret form in any but a superficial cataloguing way, we must accept the implications of this time-sound dimension.[1]

- Mark Brunswick, *Musical Quarterly*, October 1943

We have encountered a number of different responses to Einstein and his theories: composers and critics hoping for a revolutionary figure, composers compared to Einstein by themselves and others, theories of music aiming for the same broad appeal as Einstein's theories, and musical aesthetics adopting new ideas about space and time. Yet, up until this point, I have not explored the music itself. But as we have seen, this absence has led to the fruitful exploration of the discourse networks of musical modernism. For many modernists and ultramodernists, it was nearly as important to express their artistic agendas, manifestos, and aesthetic ideologies in print as it was to have their musical ideas heard in the concert halls. American modernists considered the written word as a way of staying in touch with musicians and other artists in the cosmopolitan, trans-Atlantic environment of the 1920s and early 1930s. It also served as a means of building a uniquely American musical dialogue which could incorporate the voices of native and émigré American composers, as well as those of the bourgeoning scholarly community,

[1] Mark Brunswick, "Tonality and Perspective," *Musical Quarterly* 29/4 (October 1943), 426–7.

those young music writers and composition teachers who began shaping the new academic field of musicology in universities.

In the previous chapter, I explored the use of Einstein's theories in aesthetic treatises, whether in the form of articles or books. Composers like Dane Rudhyar and Henry Cowell applied Einstein's ideas to their theories of music on the most theoretical of levels; Rudhyar and Cowell did not mention specific pieces of music in their discussions of musical relativity. It appears that their desire for theoretical elegance encouraged these composers to avoid mentioning individual works. Rather, the construction of a clear parallel between relativity and music theories was a priority—for it could show their cultural savvy and achieve such modernist goals as creating revolutionary new theories of music that questioned centuries of musical habit. Nevertheless, the desire to have their theories conform to their aesthetics (and not the other way around) was probably the most crucial factor. This is one reason why we will see parallels between these composers' musical fruits and their theoretical labors as I explore these connections further in this chapter.

For many of the composers discussed in the previous chapter, including Cowell, the written word made the ultimate statement in musical relativity. But for other composers, the implementation of Einstein's theories directly into their musical works was most important. This strategy—using Einsteinian ideas of space and time to fashion new modernist works—will be the eventual focus of this chapter, with two case studies of important works by George Antheil and Edgard Varèse. The desire to make Einsteinian art reveals, in many cases, a composer's artistic commitment to approach Einstein's ideas from an experimental and creative angle. Instead of designing theories of music to match theories of science (and often to match their existing compositional bent), we find a handful of composers, Varèse and Antheil among them, who saw composing with the idea of space-time in mind as an artistic means of grappling with Einstein's concepts.

Interestingly, my scholarly point of access to these and other compositions most often comes from the written word. Both composers discuss their music in letters, essays, and written exchanges with other artists. They still theorize about space and time, just as many of the composer-theorists of the previous chapter do. Unlike those composers, however, Varèse and Antheil theorize about space and time (or space-time) concurrently with the process of writing their music. We also find self-critical assessments after the fact, like those by Cowell, but it seems for Varèse and Antheil that the compositional working out of a musical space-time preceded any written conclusions made about the facts. Because we first enter into their compositional processes through the written word, it is helpful, however, to begin by examining other critical instances in which Einsteinian ideas of space and time were recognized in music. For this reason, before focusing on Varèse and Antheil, I will explore the critical analysis of the music of two native U.S. composers and two immigrant composers: Charles Ives and Cowell, on the one hand, and Igor Stravinsky and Arnold Schoenberg, on the other. The American press viewed these compositional greats as the musical equivalents of Albert Einstein, but as we will see, it was the details of their compositional methods that earned them this title of distinction.

Before discussing these musical details, however, the first task will be to look back at the notions of time and space before Einstein developed his theories of relativity. Not only is it useful to see the changes in these concepts in order to highlight the revolutionary nature of Einstein's newer notions of space and time, but previous notions of space and time also had ties to the musical world. As discussed briefly in the previous chapter, space and time have served as central metaphors for musicians and theorists. These two concepts functioned as tools for the description of two of the key elements of the aural art form: pitch and rhythm. My discussion of how earlier musicians and theorists have approached space and time will provide a background against which both Einstein's new ideas in physics and modernists' new—and corresponding—ideas in music can be observed.

After a brief summary of the pre-Einsteinian ideas of space and time, I will look at the many ways in which Einstein's new notions of space and time were discussed in the general press. The various facets of this public discourse about the implications of Einstein's theories shaped how composers reacted to, and played with, notions of space and time in their new works. In the press, the seemingly simple parameters of the universe were spun into a complicated web of scientific speculation and philosophical fancy. This verbal and ideological space-time network, as I will show, invited artistic exploration and spawned musical innovation.

I. Space and Time Before and After Einstein

Classical Space and Time

Before Einstein developed and popularized his theories of relativity, a very different conception of the physical world existed. Einstein, like so many other scientists, considered Galileo to be the "father of modern physics" as the Italian scientist developed the first modern laws of motion.[2] Galileo also insisted on building up a knowledge of the

[2] Andrew Robinson, "The World of Physics Before Einstein," *A Hundred Years of Relativity* (New York: Harry N. Abrams, Incorporated, 2005), 14.

world from experimentation and observation rather than logical thinking. Yet certain questions could not be answered by Galileo, particularly those related to the movement of the heavenly bodies. It was not until Newton that we saw a comprehensive account of movement in space and time. In his *Principia Mathematica*, published in 1687, Newton elaborated upon his three laws of motion and his theory of gravitation. This was the beginning of "classical" mechanics.

In Newton's system, space and time were absolutes. Space was measurable; a foot was always a foot—so long as one always used the same ruler. Time, too, was regular and calculable. It always continued at the same pace, never slowing, speeding up, standing still, and certainly not reversing. The Newtonian system was a system of common-sense observability.

For the most part, the tenets of classical mechanics can be summarized by a look at Newton's three Laws of Motion:

> 1. A body in motion remains in motion unless acted upon by an outside force; a body at rest remains at rest unless acted upon by an outside force. *This is the idea of inertia.*
>
> 2. A body (with mass m) acted upon by an outside force (F) undergoes an acceleration (a) that has the same direction as the force and a magnitude equal to the force and inversely proportional to the mass of the body. *This can be summarized in one of most-memorized formula for high school physics students: F = ma.*
>
> 3. The mutual forces of two bodies are equal and opposite. *That is, every action has an equal and opposite reaction.*

In Newton's world, the motion of objects obeyed these fundamental rules to such an extent that the rules themselves could be considered laws. These laws of mechanics were thought to be applicable to all objects in all circumstances.

Newton's organization of the world into calculable actions and reactions was a product of an emerging culture of objectivity and rationality. It also helped shape a new worldview. This approach to the universe extended well beyond the realm of scientific thought, however; the entire universe was how thought to run in a deterministic, clockwork fashion. For example, according to astronomer and mathematician Pierre Simon de Laplace,

> Newton's laws would allow a supreme intelligence, if it were to be apprised of the position and forces of all things in the universe at one instant, to predict the entire course of events from "the greatest bodies of the universe [to] those of the lightest atoms; nothing would be uncertain, and the future, like the past, would be present to its eyes."[3]

While we have focused a great deal on the populist and philosophical interpretations of Einstein's theories, it is important to remember that other scientific viewpoints were also both shaped by and helped to shape the "big picture" of the culture and time in which they were conceived.

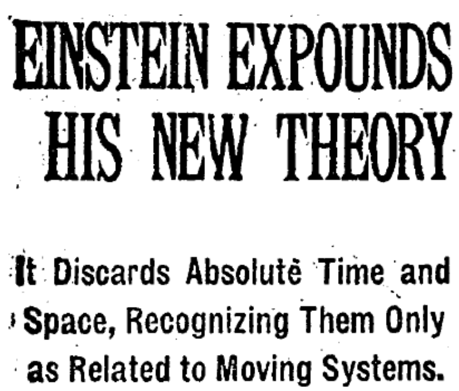
The mechanic concept of the universe remained the predominant worldview in Western culture from the time of Newton to Einstein's development of the theory of relativity. Although the press would emphasize the "destruction" of classical mechanics through the theory of relativity, Newton's views retained their place as the most applicable rules for describing the way the physical world worked. Even Einstein insisted that Newton's "laws" remained valid for most everyday matters. Yet while the three laws of motion could still describe movement in space and time, Einstein's theories did offer a radically new perspective. His views on space and time, as we will now see, provided ample opportunities for the public, especially the artistic public to imagine a new layout

[3] "The World of Physics Before Einstein," *A Hundred Years of Relativity*, 16.

for the universe, even if they continued to memorize Newton's tenets at school and relied on them to know at what rate they had to slow down their bicycles to avoid a collision.

Einstein's Space and Time

After the initial discussions of Eddington's experiments in the press during November of 1919, the newspapers quickly moved on to the possible implications of the theory for the public. It quickly became apparent that Einstein's relativity theory had the power to reshape our notions about space and time. The first idea that caught the imagination of the press, and presumably the public, was the end of the notions of absolute time and absolute space. A 3 December 1919 article in the *New York Times*, which contains an interview conducted with Einstein in Berlin captures the destruction of the "absolute" in a nutshell within its title series:


EINSTEIN EXPOUNDS HIS NEW THEORY

It Discards Absolute Time and Space, Recognizing Them Only as Related to Moving Systems.

Figure 4.1 - *New York Times* headline (3 December 1919) [4]

The next day, the *New York Times* follows up with another famous scientist's perspective, this time, humorous (perhaps even more so because of the way it is captured in run-on the headline series):

[4] "Einstein Expounds His New Theory," *New York Times* (3 December 1919), 19.

HOW TALL ARE YOU, EINSTEIN MEASURE?

Professor Eddington, 6 Feet to the Eye, Explains How It May Be Really Only 3 Feet,

IF HE HAS LIGHT'S SPEED

That's New-Style Space—Under the New Concept of Time Who Can Answer "How Old Is Ann?"

Figure 4.2 - *New York Times* (4 December 1919) [5]

The article relays the points made by Eddington in a lecture given at Trinity College in Cambridge to hundreds of undergraduates in a standing-room-only dining hall. The purpose of the lecture was to "explain that according to Einstein's theory distances in space and durations in time, as we understand them and speak of them, do not exist in nature as absolute facts. Space and time are conceptions of the human mind." While it is unclear whether this made for a particularly satisfying dinner conversation, it is certainly true that the idea of the removal of absolute time and space, conceived in those terms, remained a hot topic. The prospect of the dissolution of ideas of the absolute space and time obviously raised new philosophical questions and tied in with current debates on the subjectivity of human experience (despite it never being intended to be extended to this

[5] "How Tall Are You, Einstein Measure?," *New York Times* (4 December 1919), 19.

realm of intellectual query).[6] The 7 December 1919 article "Assaulting the Absolute" attempted to counteract the (evidently) popular opinion that Einstein's relativity theory had destroyed the idea of the absolute, reminding readers that metaphysicians could clearly see that Einstein's ideas were "a tempest, if not in a teapot, at most in a telescope."[7] However, despite the reminders from intellectuals of all breeds—and Einstein himself—non-scientific applications of the idea abounded. At the very least, the much-talked-about destruction of absolute time and space allowed public and intellectuals alike to contemplate the possible implications of a new conception of time and space. One method of working through these possibilities was artistic creation.

Another popular notion that appeared and reappeared in the news regarding Einstein's new ideas of space and time was the impossibility of simultaneity. American mathematician Robert Daniel Carmichael explained the conundrum of simultaneous events imposed by Einstein's relativity theory in a *New York Times* article of 7 December 1919.[8] On the topic of "the puzzle of simultaneity" he wrote:

> If two things happen which are far removed from each other, I do not have a direct perception of both of them in such a way that I perceive them as simultaneous. When should I consider such events to be simultaneous? The difficulty of this question is analyzed by the theory of relativity. It appears that the notion of simultaneity is relative to the system on which it is determined. In other words, there is no such thing as the absolute simultaneity of events which happen at different places. The only meaning which simultaneity can have is that which is given to it by convention of agreement.[9]

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[6] These notions related closely to the philosophy of Henri Bergson (a philosophical opponent of Einstein's) as well as new philosophical trends in phenomenology.

[7] "Assaulting the Absolute," *New York Times* (7 December 1919), X1.

[8] The article notes at the outset that "the writer of this article is the author of the first book on the theory of relativity published in the English language. It was issued by Wiley & Son of New York in 1918."

[9] R. D. Carmichael, "Give the Speed, Time is Naught," *The New York Times* (7 December 1919), 18.

As Carmichael explains, it is impossible to achieve true simultaneity in Einstein's picture of the universe. While it might be possible for one observer within an inertial system (one of uniform, constant motion) to perceive two events as simultaneous, the fact that an observer outside this system (moving at a different pace) would not observe the events as simultaneous calls into question the first observer's account. During the first weeks of Einstein's visit to the U.S., he lectured on the main principles of his theories to students and professors at Columbia University. His talk somewhat clarifies the idea of the impossibility of simultaneity:

> Relativity relinquishes the absoluteness of simultaneity. In explaining this, Prof. Einstein drew a stick, its middle point to be determined by measurement. Simultaneous events take place at the ends when seen together from the middle, thus furnishing a criterion of simultaneity. To find the center there must be a measure. Simultaneity holds only for the special coordinate system. If it is simultaneous for one system it is not for the other, because by the time the light reached the observer at the middle of the stick he would have moved with respect to the other system.[10]

This description of simultaneity was taken to be the shorthand for the theory of relativity itself and took on a life of its own in the press. As one reporter put it:

> One is tired of hearing that nobody can understand Prof. Einstein's theory. He himself has reduced it to a sentence: "Relativity relinquishes the absoluteness of simultaneity." And, lest that be not plain enough, he reduces it still further, to one word. That word is all-embracing: "Allgemeinrelativitaetsgrundgesetztheorie."[11]

The *Los Angeles Times* included in its "Pen Points," a list of quick quips related to the current news: "According to the Einstein theory relativity relinquishes the absoluteness of

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[10] "Einstein Puts His Theory Into Simple Words," *The New York Times* (16 April 1921), 2. A similar report is given in the article "Einstein in Lecture Explains His Theory," *The New York Times* (16 April 1921), 10. It is also given in an article summarizing Einstein's lecture at the College of the City of New York a few days later. See "Einstein Defines the Speed of Light," *New York Times* (19 April 1921), 16.

[11] Ted Robinson, in the *Cleveland Plain Dealer*, quoted in "Copy-Boy Makes Good," *The Sun* (9 May 1921), 8.

simultaneity. That seems easy enough."[12] The idea of the impossibility of simultaneity, which as many of the sympathetic and less-than-sympathetic newspaper authors imply, was a difficult one to grasp, for simultaneity seemed like a readily observable phenomenon. Thus with this correlate of Einstein's new ideas of space and time, it was also most often in the *act of exploring* the idea—either in philosophical musings or in creative endeavors like musical composition—that we see the new idea's greatest impact.

The third major theme in the popularization of Einstein's new ideas about space and time was, of course, the notion of "space-time." In *The A B C of Relativity*, Bertrand Russell noted that the term was easily adopted, without much thought, by those with some knowledge of relativity: "Everybody who has ever heard of relativity knows the phrase 'space-time,' and knows that the correct thing is to use this phrase when formerly we should have said 'space *and* time.'" Russell, who believes that "from a philosophical and imaginative point of view" the term is "perhaps the most important of all the novelties that Einstein has introduced," goes on to explain the concept.[13] In essence, he says, "we need four measurements to fix a position, and four measurements to fix the position of an event in space-time, not merely of a body in space."[14] In other words, "space-time" was the term used to describe the interwoven fabric of the universe; a system of coordinates that accounted not just for three dimensions but all four, with the fourth measuring time. "Space-time" became a regularly deployed phrase in the American press—and probably at diners, at dinner tables, and on the downtown thoroughfares of Everytown, U.S.A. It served first and foremost as a catchphrase that

[12] "Pen Points by the Staff," *Los Angeles Times* (22 May 1921), II4.

[13] Bertrand Russell, *The A B C of Relativity*, 58.

[14] Bertrand Russell, *The A B C of Relativity*, 70.

could quickly describe Einstein's new conception of space and time. Even the hyphenated spelling of the word displays orthographically that idea that space and time must now be considered fundamentally inseparable entities. Though simple sounding, the idea that space and time were connected was a remarkable change, marking an important paradigm shift, not only for the scientific world, but also for the artistic one.

For artists working in the visual arts, whether in the business of producing representational or even abstract art, the conveyance of space and time through a purely visual medium was a perpetual concern. Likewise, though composers had to contend with their aural medium's "invisibility," space and time had served music through the centuries as important metaphors for understanding pitch and rhythm, but also musical form and movement.[15] Mark Evan Bonds notes that spatial terms have marked musical discourse for almost as long as people have been talking about music.

> Theorists had certainly never hesitated to depict . . . aspects of music in spatial terms, using diagrams and images to illustrate a variety of phenomena, from Pythagorean ratios to the division of the octave, from the Guidonian hand to systems of temperament and tuning, from the system of modal hexachords to the circle of fifths. . . . Notation itself emerged out of a certain sense of depicting melodic motion as both up-and-down and left-to-right, as well as a system of graphically representing the distance between any two simultaneous pitches.[16]

Yet, with Einstein's insistence on the combination of space and time into a single, multidimensional system, musicians were enabled to reconsider how these concepts might function in their artistic products. Just as previous scientific thought accepted that space and time functioned well enough on their own, previous generations of musicians

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[15] Mark Evan Bonds notes that while the use of temporal metaphors to describe musical form were common for centuries (form-as-process), the use of spatial metaphors (form-as-structure) to describe form did not arise until the late-nineteenth and early-twentieth centuries. Mark Evan Bonds, "The Spatial Representation of Musical Form," 266, 268.

[16] Mark Evan Bonds, "The Spatial Representation of Musical Form," 268.

accepted the idea that musical space and time, while both necessary for the construction of a musical piece, were two separate entities to consider.[17] Before Einstein, pitch/space was one thing and rhythm/time another. And while it cannot be stated across the board that, following Einstein, pitch and rhythm became fundamentally inseparable in the minds of all composers, musicians, and music critics, we can see from their discussions that the *question* was on their minds. In hypothesizing about new theories of the (inter-) relationships between pitch and rhythm, by testing these theories in a wide range of modernist musical practice, and by developing new formulas for music, modernists asked whether there could be a musical space-time.

In addition to serving as a new notion to be explored through artistic means, the idea of space-time also represented an important intellectual turning point in the field of not just physics, but also philosophy, literature, art, and music. To put it simply, space-time was a notion of abstraction. Whereas relative motion and relative time, the newly conceived "opposites" of absolute space and time, could be demonstrated with some finesse to even the average person, space-time was not itself an observable phenomenon. Rather, it was a difficult (if not impossible) idea to grasp with its truly paradoxical nature being that space-time could describe the true nature of the universe, and simple space and time, separately observed as we are able to do, are the real abstraction. The idea of the abstract nature of the measurable phenomena in the world rocked physicists everywhere; for modernist artists, the idea of abstraction and that of the paradox of the true universe versus an observable abstract universe must have been simply amazing.

[17] This can be seen in many aspects of music history, from the separation of rhythmic and melodic modes in medieval music to common-sense ideas in the Baroque and Classical periods like the nature of melody as a combination of discrete pitches and rhythms.

Arthur Eddington, who tried valiantly in books, articles, and lectures to explain many of the intricacies of Einstein's theories to a popular audience, was able to convey this paradox that had such phenomenal impact on modernist aesthetics. His success as a writer comes from the understanding tone he adopts; just as he tries his best to explain Einstein "in simple language in not more than 500 words," for example, he only expects that his curious readers strive to comprehend the popular theories. In a February 1920 article in the *Chicago Tribune,* he explains space-time in such a tone. He says:

> [Einstein] assigns space and time solely to the observer; in nature there is left something which for want of a better name we may call space-time. In a sense it is a combination of space and time, but it has lost the more familiar qualities of both. It arouses curiosity because it has four dimensions.[18]

What Eddington explains well in this easily accessible article is the idea that space and time, because they can be measured using our individual perceptive capabilities, can only be considered products of the senses. Thus he distinguishes (as Einstein did in his relativity theories) between the space and time, which we can observe and attempt to measure, and space-time, which happens in spite of us and is the true coordinate system of the universe. This duality is quite a difficult one to grasp—an understatement!—but Eddington continues to explain the role of observation and reality. Luckily, he lets the readers off the hook by the end, reminding them that there is not much point in trying to "picture" this universe as they try to grasp Einstein's new concept of space-time.

> There is no illusion in these phenomena, except in so far as all our acquaintance with nature is illusion. But they do not imply that anything extraordinary is happening in the external world, because the length of a man, or the duration of an action, are not in the external world, but are something superadded by the sense-processes or the measuring appliances of the particular onlooker.

[18] A. S. Eddington, "Einstein's Theory," *Chicago Daily Tribune* (1 February 1920), E7.

> Relegating space and time to their proper source—the observer—Einstein bids us contemplate the residuum of what we observe. This residuum is the true world. It is shapeless, because we have abstracted space; but it is metrical and has quantitative properties which can be expressed in mathematical terms. Clearly we cannot describe this true world in terms of familiar things, because the whole point of Einstein's theory is that we must abstract the ideas which we ourselves have added in order to form familiar things.[19]

This idea, so eloquently explained by Eddington, must have shaken the foundations of artistic practice. As observers, we have made the concepts of space and time abstract in order to understand them. Yet, even if we can understand on an intellectual level that, as observers, we have abstracted space and time, on a practical level, space-time still seems like the more "abstract" concept to grasp. In consequence, just as the field of physics became increasingly theoretical or abstracted (even in describing the reality of the universe), the arts saw a similar shift. John F. Spratt notes:

> The greater degree of abstraction involved in twentieth-century science is rather obviously accompanied in the visual arts by the emergence of "abstract" art, a commonplace term. It is accompanied in music by the greatest emphasis on relational, i.e. abstract, devices seen since the Middle Ages.[20]

This license for abstraction came, I believe, from the complexities surrounding the idea of space-time and the inherent paradox of describing the "real" universe after Einstein. The interconnectedness of space and time was one thing, but the idea that this new concept of "space-time" was the true universe may well have excited modernists. Thus with Einstein's ideas about space-time, artists and musicians were free to experiment in the language of the abstract. As with other new concepts related to space and time, this

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[19] A. S. Eddington, "Einstein's Theory," *Chicago Daily Tribune* (1 February 1920), E7.

[20] John F. Spratt, "Science and Music," *Interdisciplina* 1/1 (1975), 75.

experimentation often came in the form of exploration: modernists played with the idea of the abstract in music, creating new timbres, new and unconventional relationships between tones, and new complex rhythmic and metrical ideas. But at the same time, as we saw in their theories of music in the previous chapter, many argued that these new abstract musical sounds were the *true* musical universe or a broadening of musical reality.

Even from this relatively brief survey of the discourse generated by Einstein's new conceptions of space and time, one overarching fact becomes clear: new ideas about the nature of the universe after Einstein were best conveyed in one-liners and bold-faced headlines. It is from these easily accessible fragments of scientific language that most people—including composers—received their knowledge of space-time. This is clear not because of any specific mentions of reading headlines by any composers but because of a lack of depth in many composers' references to science. This surface-level interest is what has caused many historians to overlook the role of scientific thought in composers' aesthetic perspectives and worldviews. But, as I have argued and will continue to demonstrate in this chapter, the cursory knowledge of certain scientific concepts related to relativity did not by any means diminish the importance of these concepts for the composers who embraced them. Rather, they took these distilled versions of very complicated scientific theories and experimented with them in the verbal and musical arenas.

Rhythm and Time

As I have discussed in the previous chapter, the main draw for modernists to Einstein's theory of relativity was its focus on time and space. The centrality of these ideas within the theory—and its dissemination to the public—suited the needs of composers, especially those concerned with the careful analysis of their own work. That is because metaphors related to time and space have, for centuries, served musicians, composers, and the writers who loved them.

The pulse of a piece could be considered the regular marking of time. This underlying pulse, which for the most part kept an even pace, was a forward-moving dimension atop of which rhythms were created and executed. Although tempo changes did occur within pieces, as in moments of acceleration or gradual slowing down, these changes were implemented across all instrumental voices. Michael Spitzer points out that rhythm itself is a metaphor related to the natural world:

> At every period in which people have considered music's position in the world, the metaphor of rhythm has provided an interface between the patterns of stress peculiar to music and the cycles of life and the universe. Musical rhythm has been compared to the beating of the heart; the intake and exhalation of breath; the body in motion, gesturing, walking, and dancing; metrical patterns of poetry and speech; the alternation of night and day; and the cycle of the seasons.[21]

These metaphors compare musical rhythms to natural rhythms. Yet, in the Baroque and classical period, we see an increased emphasis on the link between time or temporality and rhythm with the advent of mathematical theories of music. Rhythm was viewed as having a "dynamic nature, as a pattern unfolding, and comprehended, through time."[22] This unidirectional time corresponds quite nicely with the view of time as an unwavering, onward march that characterized Newton's thought.[23]

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[21] Michael Spitzer, *Metaphor and Musical Thought* (Chicago: University of Chicago Press, 2004), 212.

[22] Michael Spitzer, *Metaphor and Musical Thoughts*, 212.

[23] David Trippett discusses musicians' awareness of this linear notion of time (and modern musicians' desire to upend it) in his article, "Composing Time: Zeno's Arrow, Hindemith's 'Erinnerung,' and Satie's 'Instantanéisme'," *Journal of Musicology* 24/4 (Fall 2007), 522-580.

With modernist musical practices, the notion of rhythm as time was brought to the forefront again. I have already explored the emphasis given to temporality in music by Ezra Pound whose entire "Treatise on Harmony" is concerned with the "element of time," based on the argument that this had been left out of all harmony treatises to that time. George Antheil, too, emphasized the temporal element of music and made a clear connection between time and rhythm. Antheil recalled in his autobiography that his earliest theories of music focused on rhythm and time, no surprise given what he later termed his principle of "time-space," which will be discussed later in this chapter. In *Bad Boy of Music*, Antheil recalled his youthful exaggeration of the importance of time in musical composition: "Among other things I said that melody did not exist, that rhythm was the next most important thing to develop in music, and that harmony after all was a matter of what preceded and what followed."[24] His earliest theories of music, then, radically disavowed melody entirely and grouped what pitch-related material was left of music in a rhythm-time complex. His observation that "harmony after all was a matter of what preceded and what followed" turned harmonic development—and by extension any formal structure—into a temporal process, that is, rhythmic patterns. Ultramodernists like Pound and Antheil relied on the commonly understood connection between time and rhythm and used this link to iterate the importance of time in music for the purposes of creating an Einsteinian musical time.

[24] George Antheil, *Bad Boy of Music* (NYPL typescript), 165. In the modern edition it reads: "I had, I have mentioned, written that 'melody does not exist,' Of course I did not mean that melody did not exist; I meant, rather, that a new melodic aesthetic had come gradually into being, invalidating many older ideas concerning it." George Antheil, *Bad Boy of Music* (1945), 118.

John Tasker Howard, who chronicled the modernist musical revolution in his book *This Modern Music*, reminded readers of the primacy of rhythm, echoing the age-old treatment of rhythmic metaphors. Howard noted in *This Modern Music* that:

> Rhythm existed before melody; it was present in the universe before man came into being—in the movement of the planets and the recurrence of seasons. It is the basic of vital functions—beating of the heart, breathing, as well as of such conscious activities as walking and speech. Even the cries of animals are rhythmic.
>
> Although melody cannot exist without some sort of rhythm, rhythm is able to stand on its own feet without melody, or even without musical tone.[25]

In adopting metaphors from the natural world, Howard revives the timelessness (no pun intended) of musical rhythm as natural rhythm as distinctive signifiers. He is also able to attribute to rhythm a place of importance within the apparent hierarchy of musical materials while adopting an objectivist, scientific air. In fact, he states bluntly, "Without rhythm there is no music; the entire contour of any melody is determined by the regular or irregular succession of beats in which it is played or sung."[26]

In an essay describing the unique circumstances in which American composers struggle and ultimately thrive, composer and writer Roy Harris discusses the importance of rhythm. He implies that an emphasis on the rhythmic component of music is seen to a greater extent in American music, and that this has to do with our physical and cultural environment. He states:

> Our rhythmic impulses are fundamentally different from the rhythmic impulses of Europeans; and from this unique rhythmic sense are generated different melodic and form values. Our sense of rhythm is less symmetrical than the European rhythmic sense. European musicians are

[25] John Tasker Howard, *This Modern Music*, 173

[26] John Tasker Howard, *This Modern Music*, 172

> trained to think of rhythm in its largest common denominator, while we are born with a feeling for its smallest units.[27]

In Harris's view, the primacy of rhythm is a uniquely American trait. Although he does not mention how this innate rhythmic sense affects American modernists, he does apply the concept to modernist music (in critiquing the awkward and "unnatural" sounding new rhythms of Stravinsky, who is at least *trying* to rid himself of European rhythmic convention).

Harris's views are tied closely to fellow American composer Aaron Copland's thoughts about rhythm and jazz. In attempting to create a type of music that Elizabeth Bergman Crist called "unabashedly modern and identifiably American" Copland began adopting the musical language of jazz.[28] Crist notes that Copland thought of jazz as "an easy way to be an American in musical terms."[29] In a January 1927 article appearing in *Modern Music*, Copland remarked that "the essential character of jazz is its rhythm."[30] Stanley V. Kleppinger summarizes Copland's own definition of jazz rhythm as "the organization of melodic patterns to produce metrical strata that move in and out of phase with an unchanging, periodic, simple-meter accompaniment."[31] This description reveals the importance of perceived temporal shifts imposed by the rhythmic play over an underlying pulse. Annegret Fauser is able to solidify the relationship between Copland's

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[27] Roy Harris, "Problems of American Composers," in *The American Composer Speaks*, ed. Gilbert Chase (Louisiana State University Press, 1966), 149.

[28] Elizabeth Bergman Crist, *Music for the Common Man: Aaron Copland During the Depression and War* (New York: Oxford University Press, 2005), 3–4.

[29] Aaron Copland, "Composer from Brooklyn," *Magazine of Art* (1939). Quoted in Elizabeth Bergman Crist, *Music for the Common Man*, 4.

[30] Aaron Copland, "Jazz Structure and Influence," *Modern Music* 4/2 (1927), 9,10.

[31] Stanley V. Kleppinger, "On the Influence of Jazz Rhythm in the Music of Aaron Copland," *American Music* 21/1 (Spring 2003), 75.

strategically nationalist use of jazz back to his modernist aesthetic. His particular approach to jazz rhythms, he notes, were informed by his studies with Nadia Boulanger:

> Musically, jazz offered a rhythmic complexity that Boulanger herself highlighted as a strong attribute. However, she avoided the taint of primitivism by her emphasis on *la grande ligne*, which led directly to rhythmic counterpoint as a significant device of modern composition. Jazz thus modified made it suitable for musical modernism . . . .[32]

In other words, Copland believes that the jazz rhythms he borrows in his modernist, uniquely American compositions challenge the underpinnings of an absolute musical time.

The emphasis on rhythm as the primary element of modern music—especially modern American music—retained the metaphorical connections to the idea of time. Later in this chapter, I will discuss how the music of George Antheil reflects this modernist emphasis in order to fashion a rudimentary version of musical "space-time." George Antheil's was a self-consciously Einsteinian emphasis of time and rhythm, but I will also show that the assessment of the rhythmic approaches of composers like Stravinsky led audiences and critics to consider his work Einsteinian. In both cases, the changing notion of time at the height of Einstein's popularity encouraged composers and critics alike to reexamine the way that time functioned in modernist music.

Pitch and Space

The idea of pitch as spatial is built out of a number of interconnected metaphors. The metaphors used to define pitches and the relationships between them are usually related to orientation in space: high, low, above, beneath, etc. Movement between the pitches indicates the direction in space of the imaginary journey between note: up, down, higher,

[32] Annegret Fauser, "Aaron Copland, Nadia Boulanger, and the Making of an 'American' Composer," *Musical Quarterly* 89/4 (2006), 541.

lower, rising, falling. Certain spatial metaphors for pitch even live in the three-dimensional world: pitches are sharp or flat. Much theoretical work has been done in the use of these metaphors. Michael Spitzer summarizes the commonly held view that these spatial metaphors are the unavoidable mapping on of the listener's physical world to their sonic world. He states:

> It is often said that music behaves like the body in motion, and that listeners project their experiences of bodily movement onto their audition of musical processes, which are heard as "rising" and "falling," "traversing physical space," "leaping," and so on.[33]

While Spitzer argues against the idea that these spatial metaphors are an inherent part of the listener's interpretive process, his description of these common spatial interpretations (both for listeners and theorists) is revealing. The language of a "body in motion" comes straight from the most commonly used descriptions of Newton's Laws of Motion. This historical reference is no accident (and, within his book *Metaphor and Musical Thought*, Spitzer presents a historical survey of musical metaphors). The spatial metaphors for pitch seem to have crystallized around the same time that Newton's laws emerged: the late seventeenth century.

Michael Duane Jones connects the music of Bach, Mozart, and Beethoven with Newton's laws of motion.[34] Starting with the Baroque period, Jones states, composers and theorists conceived of tones as masses moving in space and time. These tones had weight and mass, they were subject to a type of musical gravitation that drew them towards the tonic of a piece, and with forces applied to them they acted just as bodies would according Newton's three laws. In Jones's view, these metaphors, which were

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[33] Michael Spitzer, *Metaphor and Musical Thought* (Chicago: University of Chicago Press, 2004), 10.

[34] Michael Duane Jones, "The Dynamics of Physical Force in the Modeling of Tonal Melodic Motion," PhD Dissertation (University of Iowa, 2009).

used by contemporaneous theorists to describe the movement of the tones in the tonal system, have influenced music theory. Maybe so; however, for our purposes we can begin to see how the connections between spatial and temporal metaphors have played a key role over the course of music history and how they were undoubtedly influenced by the prevailing scientific worldviews.

While it is easier to see how the historical ideas of musical time and space coexisted with time and space in classical mechanics, it is less immediately obvious how Einstein's ideas about space and time affected and transformed these musical metaphors. On the one hand, the difficulty arises from the fact that, like in physics with Newton's Laws of Motion, the original connections between space and music were not abandoned in music theory when Einstein came along. The metaphor of music in space still "works" for describing most of what we hear in Western music. The change that attended the popularization of the theory of relativity in the early twentieth century was the possibility of adapting space-time to music.

With the introduction of Einstein's ideas about space and time—their relativity and their interconnectedness—came new options for composers in both talking about and composing music. Existing metaphors of space and time were not simply discarded in favor of newer ones reflecting Einstein's notion of space-time. Instead many composers co-opted the existing metaphors and experimented with these conventions in such a way that some of Einstein's ideas could be expressed to their musical audience.[35] Thus for

[35] For example, Ezra Pound and George Antheil both embraced the traditional metaphors of space/pitch and time/rhythm. Then, in elevating the importance of the temporal and rhythmic elements in their music theories and compositions above pitch, they were able to upend the more conventional balance between rhythm and pitch and emphasize "the fourth dimension" in accordance with popular notions about Einstein. Pound's approach was discussed in "Chapter 3: Relativity" and Antheil's take will be discussed later in this chapter.

many, space and pitch remained tied, as did time and rhythm. In retaining these metaphors, composers were able to play with the expected relationships of these musical building blocks to put forth Einsteinian views of music that reflected their modernist musical aesthetics. Often, but not always, these connections were made subconsciously by the composer and recognized by later generations of audience members, critics, and scholars.[36] In a few exceptional cases, we encounter composers who attempted to reconfigure both the music and the metaphors. Two such composers, Edgard Varèse and George Antheil, expressed interest in a metaphorical space-time in music, and an interconnected web of musical time and space not necessarily bound to traditional ideas about rhythm or pitch. Furthermore, they attempted to bring these theoretical ideas to musical fruition. The works of these two composers will serve as the final case studies of this chapter.

The contemplation in particular of the nature of time and space in music became a preoccupation of early twentieth-century composers. Composers' interest in reevaluating these concepts was linked to a larger modernist cultural exploration. Glenn Watkins observes how certain musical interests relating to space and time were also concerns for other creators and scholars across various artistic and intellectual realms:

> The agencies of polychords, polytonality, and polystylistic reference as employed by the composers in promoting illusions in space and time during the first years of the century reflect a powerful and universal concern. Proust, Bergson, Picasso, Cendrars, Delaunay—they all pondered

[36] Among the composers who did not consciously adopt Einsteinian modes of composition were Charles Ives, Henry Cowell, Igor Stravinsky, and Arnold Schoenberg. Of those four, only Cowell self-consciously recognized Einstein's ideas in his earlier writings on music. For the other three, both contemporaneous critics and current scholars have observed the commonalities between the composers' work and Einstein's concepts of space and time. All four cases will be explored in greater detail later in this chapter.

> the imponderability of nonlinear time and intimated their suspicion that the answers were to be found not in science but in art.[37]

Composers, like artists and philosophers, were concerned with representing multiple perspectives in time and space in order to explore new ideas that rejected absolute time and space. Watkins sees these artists as believing that the answers to their questions about the nature of time and space were "to be found not in science but in art," but we will also see that for many musical modernists, part of creating that artistic answer was creating explicit relationships with Einstein and his theories. So while it may be that composers' ultimate goals were late in finding ideological resolutions for their questions about the nature of time and space in their music, we will see that they did look to science first.

II. Recognizing Space-Time in Music

In order to begin analyzing the ways in which the elements of Einstein's theories—with their new conceptions of space and time—affected musical composition directly, we must start with an examination of those works that were thought to be examples of composition in space-time—even in spite of what the composers of those works may have intended. These were compositions that were picked out by contemporaneous listeners as well as later scholars as musical parallels to Einstein's new conception of the universe. In a sense, then, these works might be *more* important to modern scholars looking to construct a narrative of parallel developments in music and science than works designated as such by their creators. However, since it is my intention to examine the ways in which modernists in America saw themselves in light of the popular scientific discussions relating to Einstein (and how these discussions might have shaped their very

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[37] Glenn Watkins, *Pyramids at the Louvre: Music, Culture, and Collage from Stravinsky to the Postmodernists* (Cambridge, MA: The Belknap Press of Harvard University Press, 1994), 226.

ideas about what a modernist revolution in music might be), the unintentionally Einsteinian works discussed in this chapter serve as analytical models. By dissecting the works identified as Einsteinian (whether by contemporaneous listeners or contemporary scholars—or both), we can begin to see the ways in which new ideas about space and time were understood in specifically musical terms.

For the most part, the composers discussed in this section can be seen as having composed a number of Einsteinian works of music, as it was often a particular musical technique or style developed by the composer that led to an Einsteinian reputation for certain pieces. For Charles Ives, it was his play with simultaneous sounds, whether it be layered melodies or layered pitch centers, as in his *Three Quarter Tone Piano Pieces* (1923–24) discussed below. For Henry Cowell, two techniques, both relating, at least in Cowell's mind, to the all-important overtone series were identified as Einsteinian: the use of tone clusters and the development of dissonant counterpoint. As I will explore, his works containing tone clusters and dissonant counterpoint were *self-identified*, in this case, as Einsteinian. For Igor Stravinsky, the condensation of musical time in polyrhythms and polymeter led to his music being termed Einsteinian, in particular those works identified as cubist. Lastly, I will turn to Arnold Schoenberg, the most famously Einsteinian composer, frequently called *the* Einstein of Music. His twelve-tone technique was considered a musical parallel to Einstein, and critical analysis of his twelve-tone works forged the connection between the composer and the famous scientist.

The techniques of these four composers' works have marked them as Einsteinian composers, but some were also marked as Einsteinian figures. As we progress from Ives through Cowell, then to Stravinsky and Schoenberg, we will see that as the compositions became more strongly associated with relativity, the composers' reputations as Einsteinian geniuses strengthened as well. These associations differ from earlier comparisons made between Einstein and composers—earlier, that is, in this dissertation, but also chronologically. Because Ives and Cowell composed concurrently with the development of Einstein's scientific theories, the associations between their musical ideas and Einstein's scientific ones were formed later. This delay also led to fewer comparisons between the composers themselves and Einstein. These composers composed throughout the earlier period of American modernism, during the time modernists were in the process of looking for an Einstein figure (as discussed in "Chapter 2: Einstein"). It was only later that specific composers were called Einsteins of Music, as is the case with Stravinsky and Schoenberg. This required a type of hindsight that relied not only on the composers' established status of genius (rather than revolutionary), but also on the connections forged between their musical aesthetics and Einstein's well-accepted theory of relativity.

Simultaneous Musical Realms: Time and Space in Ives

Contemporaries never compared Charles Ives to Einstein, he never penned a formal theory of music that resembled relativity theory, and he never composed a work consciously adopting Einstein's new conceptions of time and space. Yet, his works display many of the same preoccupations with space and time that we find in the work of other composers that did have more deliberate relationships with Einstein and his intellectual work. Ives and his music have an important parallel in the arts, one that help us unravel this conundrum.

Turn-of-the-century painters like Manet, Monet, and Cezanne have a similar relationship with more modernist schools of painting like cubism to Ives' relationship with modernist music. For Leonard Shlain and Arthur I. Miller, among others, the Impressionists displayed in their art many of the techniques that, when used by later painters, might be considered parallel with Einstein's ideas.[38] Shlain summarizes their artistic foresight:

> Manet first curved the straight line of the horizon, Monet blurred his straight boundaries, and Cezanne splintered the straight edge of his tables. . . . Their revolutionary assaults upon the conventions of perspective and the integrity of the straight line forced upon their viewers the idea that the organization of space along the lines of projective geometry was not the only way it can be envisioned. Once people began to *see* in non-Euclidean ways, then they could begin to *think* about it in new ways too. . . . It would take the elegant calculations of an Einstein years later to provide the proof in black and white of what had been stunningly accurate artistic hunches expressed in form and color.[39]

For Shlain and other historians, it is not necessary to argue that the earlier painters had some secret access to Einstein's ideas or anything else that preposterous. Rather, they view this precursory work as part of the shared culture that influenced later painters, authors, musicians, and even scientists. In fact, Shlain even seems to imply that these artistic manifestations of a new vision of space and time contributed to the imaginative pre-conditions necessary for conceiving of a theory of relativity.

If we examine the music of Charles Ives in this way, similar conclusions suggest themselves. Like Monet, Manet, and Cezanne, Ives was not exposed to Einstein's ideas before he began composing what seem now to be Einsteinian works of music. Instead, his music is part of the cultural "working out" of ideas that led other key figures of the early

[38] See Leonard Shlain, *Art & Physics: Parallel Visions in Space, Time, and Light*, 102–118.

[39] Leonard Shlain, *Art & Physics: Parallel Visions in Space, Time, and Light*, 117–118.

twentieth century to contemplate the nature of space in time in their art—whether their art was constructing an overtly Einsteinian work of music or a scientific theory of the universe.

The description of Ives's life as a composer and the relationship between his personal life and his compositions has frequently had a mythological tone to it. In 1943, John Tasker Howard was the first of many to call Ives a "rugged pioneer" of American modernist music.[40] His experiments with polytonality, polyrhythms, and quartertone composition predated those by European composers, a fact attributed to his unique upbringing in Connecticut with a musically rather radical father. Howard notes:

> It may have been the musical impressions of his youth that shaped Ives's extraordinary music: the effect of two bands at opposite ends of the village green, each playing a different piece; reed organs out of tune; the music of country fiddlers; soldiers and bands marching, some out of step and trying to get in pace with their fellows.[41]

Ives's music was heard as an imaginative, but literal translation of real musical events from his childhood into modernist gestures. The polytonal and polyrhythmic effects had descriptive or narrative purpose. Howard describes how variations in musical time re-create a sense of actual time and space in the opening movement of the *Holiday Symphony*, "Washington's Birthday":

> At one point the orchestra changes from a rapid allegro to a slow pace. The viola, however, is unaware of the change and continues at the rapid tempo. At another place, when the orchestra is playing at a brisk speed, the flute feels that the pace should be a trifle faster, and as a result, finishes ahead of the others. The effect is that of a village parade where the marchers have difficulty in keep step with their fellows.[42]

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[40] John Tasker Howard, *This Modern Music*, 131.

[41] John Tasker Howard, *This Modern Music*, 133.

[42] John Tasker Howard, *This Modern Music*, 179–80.

The real-life image derived from the musical gestures is so vivid for Howard that the instruments themselves are acting out the drama; Ives is removed even as storyteller. Yet, despite the heavy-handed, biographically-centered analysis, the musical technique has been rightly identified: in his use of polytonality and polyrhythm, Ives is able to experiment with the idea of musical space. Unlike the programmatic works of the past, Ives is creating a spatio-temporal environment that sounds familiar to twentieth-century ears—ears that are ready to identify the dissonance of modern life.

Ives's first biographer (and devoted follower) Henry Cowell recognized and appreciated the musical experiments of his compositional predecessor with less regard for biography and more attention to the pioneering place of Ives in music of the twentieth century. He takes note of Ives' innovativeness in a 1932 article in *Disques*:

> He has carried rhythmical harmony, or the combining of different simultaneous rhythms, farther than anyone else in the world ever has—and this is something that can be measured definitely, because rhythm is mathematical as well as musical. He originated polyharmonies and tone clusters and almost every conceivable sort of dissonance when they were essential to his expression.[43]

The techniques mentioned by Cowell here are important for two reasons: first, they are the very techniques that the younger composer later experiments with himself, and secondly, they are techniques that explore new ideas about space and time. It is clear from this quotation that Cowell placed his own experimental, mathematical, and—as I have discussed—Einsteinian music as a direct descendant of Ives's works.

Later scholars have continued to identify these unique spatio-temporal techniques in Ives's music. Robert P. Morgan summarizes Ives's musical techniques saying:

[43] Henry Cowell, "Charles Ives," *Disques* (November 1932), 374–76, in J. Peter Burkholder, *Charles Ives and His World* (Princeton: Princeton University Press, 1996), 370.

> There are aspects of his compositional approach that seem to be designed to minimize the sequential, temporal nature of the music. Or, stated from a listener's point of view, these aspects seem to minimize our experience of time when listening to his work and, correspondingly, to suggest a simultaneous, nontemporal quality, a quality of space.[44]

Morgan concludes with the assertion that Ives created musical relationships "that are simultaneous, reciprocal, and reflective in nature rather than successive, sequential, and unidirectional."[45] Although he never mentions the words relativity or space-time, Morgan's description of Ives's techniques clearly reflects Einsteinian sensibilities of time and space.

Morgan notes the influence of Ives's spatial-temporal techniques (among them harmonic stasis, the tendency to fragment existing tunes, and the inclination towards serial thinking)[46] extends to later composers like Stravinsky and Varèse.[47] J. Peter Burkholder traces similar techniques in Ives to Henry Cowell (and, as I noted above, Cowell himself implies this same lineage).[48] It is no accident that these composers appear later in my chapter as primary examples of composers who were either identified by outsiders as Einsteinian (as in the case of Stravinsky's American reception) or self-identified composers of music in space-time (as is the case of Varèse). Ives's musical techniques, as Morgan said, reject the more traditional, unidirectional notions of time and space and, instead, adopt non-absolute conceptions of time and space. And, although

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[44] Robert P. Morgan, "Spatial Form in Ives," *An Ives Celebration: Papers and Panels of the Charles Ives Centennial Festival-Conference*, H. Wiley Hitchcock and Vivian Perlis, Eds. (Urbana, IL: University of Illinois Press, 1977), 146.

[45] Robert P. Morgan, "Spatial Form in Ives," 146.

[46] Robert P. Morgan, "Spatial Form in Ives," 148, 149, 153.

[47] Robert P. Morgan, "Spatial Form in Ives," 154.

[48] J. Peter Burkholder, "Ives and the Four Musical Traditions," in *Charles Ives and His World*, J. Peter Burkholder, Ed (Princeton: Princeton University Press, 1996), 14.

Morgan does connect these to Einstein, he correctly identifies Ives's liminal role in the musical transition from pre- to post-Einsteinian notions of space and time by positioning him in the musical lineage that leads to Stravinsky's and Varèse's experiments in space-time.[49]

Because of his innovative approaches to musical space and time, both contemporaries and later scholars recognized Charles Ives as composer that pre-figured modernist musicians and their concerns. There are, however, some more recent suggestions of the direct parallel between Ives's compositional strategies and the scientific ideas of Einstein. J. Peter Burkholder discusses Ives's so-called "experimental music" in scientific terms noting that "for Ives, these pieces seem to have been laboratories for trying out new effects." Burkholder clearly derives the description of Ives's laboratory-like compositional studio from the practices of the composer:

> In Ives's early experiments, he typically preserves most rules of traditional music theory but changes one or more to see what happens. In this way, the music serves not only as test of new procedures, but as a critique of traditional ones.[50]

Burkholder only hints at the scientific side, but Glenn Watkins makes a slightly more explicit link in his discussion of Ives. He includes the American composer in his broader discussion of modernist reevaluations of musical space, citing Ives' upbringing as a source for inspiration:

> And for Ives, the competing brass bands converging on the village square, the holiday celebrations with their boisterous collision of national tunes, and the flooding reverie of familiar Sunday School hymns from childhood

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[49] Interestingly, Morgan also compares Ives and his music to the work of contemporaneous painters and their works of visual art. He also connects specific techniques in Ives to the cubist works of Picasso. Robert P. Morgan, "Spatial Form in Ives," 154, 157.

[50] J. Peter Burkholder, "Ives and the Four Musical Traditions," 15.

> days all provided a rich resource for his early recognition of the value of temporal/tonal collage in testing the relationships of memory and experience. Ives' investigating of the spatial component as well as his invocation of vernacular styles promoted a rethinking of the forming process in music.[51]

Ives's musical preoccupation with the depiction of space and time in music is portrayed, once again, as a phenomenon arising from his lived experience at the turn of the twentieth century. But Watkins takes this analysis one step further than contemporaries like John Tasker Howard: Watkins ties Ives's explorations with space and time with the "powerful and universal concern" held by composers, artists, philosophers, and scientists (described at the end of Section I).[52] Like the painters who offered reconceptualizations of space and time on canvas, Ives comes by his re-imaginings of the universe in tandem with Einstein's own discoveries. And as with Shlain's retrospective look at these painters' works, we find in Watkins' assessment of Ives an assertion of a similar place in musical and intellectual history for the composer. For Watkins, Ives is the musical forebear of Einsteinian modern music and perhaps, too, the intellectual predecessor to an Einsteinian reworking of the universe. And, although this assessment was not made during Ives's lifetime, it is important to take into account the ways in which his "pioneering" techniques in modernist musical language fed into later "Einstein works."

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[51] Glenn Watkins, *Pyramids at the Louvre*, 227.

[52] Glenn Watkins, *Pyramids at the Louvre*, 226.

Collapsing Space and Time: Cowell's Tone Clusters

Henry Cowell, like Charles Ives, attempted to create a novel conception of musical space and time. But unlike Ives, Cowell saw the explicit connections between his musical ideas and Einstein's ideas about space and time. Even so, it was only later that he identified the intellectual connections between Einsteinian scientific thought and his own theories and compositions. One specific technique—Cowell's use of tone clusters—and the intellectual path that Cowell traveled to get to it highlight the composer's complicated relationship with relativity theory.[53] As the musical equivalent of collapsed time and space, tone clusters can be seen as reflecting Einsteinian notions of the two concepts, but we know that Cowell both theorized and composed with tone clusters before he could have known about Einstein. Thus an analysis of the intellectual kinship between Cowell's music and Einstein's theories is a snapshot of the transitional period between the artistic and intellectual world within which Einstein developed his ideas, on the one hand, and the cultural world consciously enraptured with Einstein, on the other. Thanks to Cowell's later preoccupation with relativity and Einstein's new ideas about space and time—and his subsequent recognition of the ways in which his own early compositions played into Einstein's ideas—we are able to take a close look at one composer's approach to reconceiving of musical time and space.

In the process of completing the introduction to *New Musical Resources* in 1929 and 1930, Cowell reappraised both his theory of music and his compositions related to it. He provides a kind of intellectual timeline for the development of his musical materials and his theoretical contemplation of them. He stated that:

[53] For more on the specific works of Cowell's that employed tone clusters see Michael Hicks, "Cowell's Clusters," *Musical Quarterly* 77/3 (1993), 428–58.

> My interest in the theory underlying new materials came about at first through wishing to explain to myself, as well as to others, why certain materials I felt impelled to use in composition, and which I instinctually felt to be legitimate, have genuine scientific and logical foundation. … Some of the results of the investigation convinced me that although my music itself preceded the knowledge of its theoretical explanation, there had been enough unconscious perception so that the means used were not only I accordance with acoustical law, but are perhaps the best way of amalgamating sounds formerly considered discords.[54]

Among the "new materials" are, of course, tone clusters, the topic that forms the final chapter of *New Musical Resources*. Cowell seems to imply that he came by tone clusters instinctually. This is supported by the fact that Cowell's first public use of these clusters seems to have occurred in 1912 when he performed a concert of his own piano works in San Francisco at the age of fifteen, a concert musically—and visually— so memorable that it allegedly earned him the moniker "The Cluster Man."[55] In fact, he may have come by his "discovery" of tone clusters as a child, according to one of the more biographically and pragmatically driven explanations. David Ewen first offered an explanation of the intellectual origins of Cowell's tone clusters in 1936 when he asserted that Cowell played with clusters of notes on an old piano as a child, and perhaps even used clusters specifically because he was plagued by St. Vitus's Dance, a disease that caused his hands

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[54] Henry Cowell, *New Musical Resources*, ed. David Nicholls (Cambridge: Cambridge University Press, 1996), xv.

[55] Gilbert Chase, *America's Music: From the Pilgrims to the Present* (New York: McGraw-Hill Book Company, 1966), 578.

to clench shut with spasms.[56] Cowell himself had claimed that he developed tone clusters to match the "sounds first heard in his own brain."[57]

When Cowell met Seeger and began working on *New Musical Resources* in 1914, the elder composer, according to Gilbert Chase, "encouraged his experimental inclinations and urged him to find a theoretical basis for his innovations."[58] Whether it was the case of an incidental childhood "invention" or that of an ultramodernist genius in his infancy, Cowell set out to justify with scientific theory the tone clusters that he was already using in practice. Even following this drafts the body of *New Musical Resources,* we find Cowell composing with tone clusters. According to Michael Hicks, Cowell used many of the techniques discussed in his theoretical tract as a response to Seeger's counsel that "having devised new techniques, he had to write pieces to illustrate those techniques and then perform them himself."[59]

As I discussed in "Chapter 3: Relativity," by 1930, having become familiar with Einstein, Cowell began to consider his work a theory of musical relativity: it was not just the theoretical material that, in Cowell's mind, meshed with Einstein's theories—it was also the proposed musical material. How, then, can we view the important techniques of employing tone clusters as Einsteinian? And what does it mean that Cowell considered them Einsteinian—but only after the fact?

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[56] An overview of this theory is given in Michael Hicks, *Henry Cowell, Bohemian* (Urbana, IL: University of Illinois Press, 2002), 46–7. Michael Hicks favors the former explanation and remarks that Cowell's "discovery" of tone clusters was as much a discovery as Columbus's was of the New World.

[57] This is Homer Henley's 1932 recollection of what Cowell had explained to him. Quoted in Michael Hicks, *Henry Cowell, Bohemian*, 47. It is interesting to note that Cowell explains the musical technique as following the theoretical one. The same relationship exists between the musical materials implied by his *New Musical Resources* and the theoretical materials so clearly stated within it.

[58] Gilbert Chase, *America's Music*, 578.

[59] Michael Hicks, *Henry Cowell, Bohemian*, 100.

In a musical world where listeners expected to hear tones and well-spaced harmonies successively, sound clusters create the sensation of a collapsed musical space and time—or even noise. Dane Rudhyar stated, in his 1922 "The Relativity of Our Musical Conceptions," that in using tone clusters, Cowell "imperiled [the] existence" of "the musical unit, the note"—this is, of course, a positive thing for Rudhyar: the first steps in a musical revolution.[60] In other words, his tone clusters endangered the absoluteness of pitch. In Cowell's use of this musical technique, we can see that he was exploring one of the aspects of Einstein's soon-to-be conceived ideas of space and time; tone clusters might be a musical meditation on the nature of simultaneity. Like the works of numerous artists (in various media) in the early twentieth century, Cowell's compositions involving tone clusters experiment with what it means aesthetically to produce a simultaneously occurring phenomenon. Does the ear (or brain) perceive the simultaneity of so many tones, or does it (do they) pick out the more familiar sonic combinations? Does every listener hear in the same way or do different hearing perspectives exist—and if so, is that culturally or acoustically related or both? Just as cubist painters collapsed visual perspectives to explore the nature of time and space and our abilities to perceive them, Cowell's use of clusters reveals his wrestling with ideas of musical space and time and the listener's role in constructing (and reconstructing) these notions.

With both tone clusters, Cowell was also able to experiment with the boundlessness of dissonance, a concept he attributed the relation of all the tones through the overtone series. In Cowell's view, any two pitches could be combined to form a kind

[60] Dane Rudhyar, "The Relativity of Our Musical Conceptions," *Musical Quarterly* 8/1 (January 1922), 108–9. Quoted in Michael Hicks, "Cowell's Clusters," 440.

of consonance—regardless of traditional academic or sonic indications of dissonance—because at some point, these pitches could be related through their partials. This idea comes out primarily in the notion that tone clusters could serve as "harmonies." It also applies to the idea that any one pitch could follow another, a thought experiment that led Cowell to develop his technique of dissonant counterpoint (in which the traditional rules of counterpoint were purposefully reversed).

Tone clusters, as tangible musical materials derived from Cowell's unique view of the overtone series, can be viewed as Einsteinian musical techniques if we reconnect them with Cowell's larger ideas expressed in his "theory of musical relativity." In a nutshell (since I have already discussed this issue in great detail in the previous chapter), Cowell tied space and time together through the overtone series, believing that all tones were first and foremost rhythms. In his statement of purpose, Cowell says, "It is also discovered that rhythm and tone, which have been thought to be entirely separate musical fundamentals (and still may be considered so in many ways) are definitely related through overtone ratios."[61] This prima-facie statement, and its explicit connection to Einstein's theory of relativity, implicates both the techniques of tone clusters and dissonant counterpoint, since both ideas grew from the composer's aesthetically central overtone series. According to Hicks, Cowell envisioned his development and use of tone clusters as a "system."

> His theory of clusters linked his ingenuous hand and arm chords to a long historical chain of musical science. Tone clusters became a stage in a harmonic evolution, a step up the overtone-ladder in pursuit of new musical resources. Thus, his childlike "playing" at the piano became "experimentation"; his "adventures" in harmony became "inventions" of

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[61] Henry Cowell, *New Musical Resources*, xi.

> harmony; he had not merely "discovered" clusters, but "constructed" them.[62]

As Hicks notes, Cowell reassessed his own work with the specific intention to construct a scientific legacy for his theories and musical ideas—and the perception of them. Perhaps this system of tone clusters, then, is the reified form of his theory of musical relativity.

One of the most fascinating aspects of the assessment of Cowell's musical techniques as Einsteinian, however, is the fact that Cowell himself presented this judgment. As scholars, we sometimes assume that those composers whose work fits most neatly (if uncomfortably) into the *Zeitgeist* category of cultural parallelism never recognized the parallels between their output and the output or ideas of their contemporaries. Yet Cowell did look back at his own work with a critical eye and saw some evidence in it that lead him to believe that he was exploring musically a scientific idea he had yet to encounter. This offers an interesting narrative possibility for musico-cultural scholarship—one that I will consider when exploring, at the end of this chapter, the later self-assessments of both Varèse and Antheil. Cowell became aware of his musical space-time explorations *avant la lettre*, but this was applied analytically only later in his aesthetics of music. Varèse and Antheil, as we will see, look back at specific compositions and recall (or maybe "recall," in a skeptical view) specific aesthetic stances of their earlier compositional periods. This begs the question of whether Einsteinian notions of space and time have to be consciously explored at the time of composition or whether a work may be considered Einstein after the fact. Indeed, what makes an Einsteinian composition Einsteinian? Lest we get ahead of ourselves, we will look at two

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[62] Michael Hicks, "Cowell's Clusters," 452.

more composers whose works were understood, in some sense, to be Einsteinian compositions by the American public: Stravinsky and Schoenberg.

Condensing Time: Stravinsky's Cubist Poly-Music

When Stravinsky died in 1971, his notoriety and cultural impact were eulogized for the American public by way of comparison with another famous émigré, that of Albert Einstein. In the Associated Press article that was featured in the *Baltimore Sun* and the *Los Angeles Times*, Igor Stravinsky was called "the Einstein of musical art" and "the foremost composer of the Twentieth Century."[63] While it might seem as though the genius of both figures in their own fields would link the two, I think it is also possible to see that Stravinsky was compared to Einstein because the public recognized the inherent similarities between the composer's music and the physicist's scientific contributions. A year after Stravinsky died, the comparison between Einstein and the composer was elaborated upon in the *Wall Street Journal*:

> Among the small band of undisputed geniuses who are the makers and finders in this century, a few have a special vividness of personality and a gift for communications beyond their field that endears them to their admirers with particular intensity. As Albert Einstein was pre-eminently such a one in science, so Igor Stravinsky was one in music.[64]

In this instance, the author's reference to both figures being "makers and finders" hint at a comparison that went beyond personality traits.

This type of broad-stroke comparison was also a part of the American press's depiction of Stravinsky during his lifetime. In relating Stravinsky's status as genius and

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[63] "A Genius of Modern Music, Igor Stravinsky, Dies at 88," *The Sun* (7 April 1971), A1. "Stravinsky Dies at 88; Hailed as Musical Genius," *Los Angeles Times* (7 April 1971), 1.

[64] Edmund Fuller, "Stravinsky's Wit and Wisdom," *Wall Street Journal* (29 June 1972), 10.

his popularity to Einstein's, modern-music critic Isabel Morse Jones implied, in 1935, that Stravinsky and Einstein had not just fame in common but also similar ideas in their respective fields. Upon his visit to Los Angeles to conduct the Philharmonic, she remarked:

> Stravinsky, genius of modern music, conducts the Philharmonic Orchestra of Los Angeles tonight. He has been in Los Angeles four days and the town is agog. Only the visit of Einstein, the other man whom only three people in the world understand, has created as much interest.[65]

Morse Jones' humorous comment referring to the equal difficulty in understanding both Einstein and Stravinsky places them in the same category as intellectuals and suggests that there is more common ground to be discovered between the pair's ideas than their complexity.

Stravinsky's contemporaries recognized an ideological relationship between the composer's music and Einstein's theories through his reworking of musical time. Stravinsky's role in changing the listening world's concept of musical time was noted by a number of composers and critics—although not always with Einstein in mind. Writing in 1964, Milton Babbitt remarked that

> in his music and in his writings [Stravinsky] was so involved with and aware of the nature and resources of musical temporality, rhythm in every sense of the concept, on all levels, in a multitude of extensions. No composer's work has reflected more of an awareness that "music moves only in time," a consciousness of the capacity of music to provide specified control of time passage, and that a musical composition may be regarded in some significant sense as a time series.[66]

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[65] Isabel Morse Jones, "Modern Musical Genius, Igor Stravinsky, Will Conduct Philharmonic," *Los Angeles Times* (21 Feb 1935), 13.

[66] Milton Babbitt, "Remarks on the Recent Stravinsky," *Perspectives of New Music* 2/2 (Spring-Summer 1964), 36–7.

Babbitt praises Stravinsky's innovative approach to musical time as a grateful disciple. Babbitt does not consider this focus on time particularly Einstein.[67] For other contemporaries, Stravinsky's compositions with a new sense of musical time did have Einsteinian implications. A few years before Babbitt, in 1948, we find émigré Nicholas Nabokov describing Stravinsky's music in grandiose terms connecting the composer to Einstein's ideas (but not his name).[68] He wrote,

> Stravinsky is not concerned with the further evolution of harmony, but with the problem of musical time and its measurement, the function of the interval, the extension of a phrase, the juxtaposition in *time* of several melodic lines. The whole question of time + space + linear and chordal harmony which creates the fourth dimension of music-rhythm is the real preoccupation of Stravinsky's art. In this, Stravinsky is a real innovator, akin to Monteverdi, who also stood at the beginning of a new cycle in musical history.[69]

In his focus on musical time, Stravinsky creates a fourth dimension in music, earning him the title of a "real innovator" for Nabokov. We must note that, at this time, Stravinsky is not described as an Einstein of music, but rather a composer whose techniques reflect Einstein's ideas, as demonstrated by Nabokov's use of Einsteinian language. Returning

[67] Interestingly, Babbitt does compare Stravinsky to Einstein later in the article, creating an analogy between Stravinsky's worthwhile forays into twelve-tone music after Schoenberg had already made a name for himself with this style of composition, likening this to Einstein's work in quantum mechanics in the wake of his elder colleague Max Planck. "That Igor Stravinsky should now be creating works which were instances of a musical system originally associated with the name of Arnold Schoenberg appeared o destroy a fundamental preconception of how the activity of contemporary music had long since been compartmentalized and assigned, and how the issues had been partly and permanently drawn. Composers, presumably, are competitors, and never colleagues; their primary activity is that of consolidating their holdings while attempting to depreciate the value of the holdings of other composers. I can find no evidence of a similar response when, say, Albert Einstein—who already had created the theory of special relativity—turned his mind to matters in the field of quantum theory, and, incidentally, made such fundamental contributions as the theory of the specific heats of solids, for all that quantum theory was associated widely and previously with the name of his older colleague, Max Planck." Milton Babbitt, "Remarks on the Recent Stravinsky," 45–6.

[68] The Russian composer Nabokov moved to the United States in 1933 to teach music in New York City. He became a U.S. citizen shortly before Schoenberg did in 1939. Nabokov's statements about Stravinsky are part of a larger published argument between the composer and the French theorist and composer Réné Leibowitz about Stravinsky and Schoenberg.

[69] Nicholas Nabokov, "The Atonal Trail: A Communication," *Partisan Review* (1948), 584.

to Ezra Pound's *Antheil and a Treatise on Harmony*, we find Pound discussing musical time in the compositions of Antheil and Stravinsky, both of whom highlight the time element in their compositional practices and call their listeners' attention to music's temporal aspect. He writes:

> This is not a simple question of playing "in time" or even "in time with each other".
>
> It means that, via Stravinsky and Antheil and possibly one other composer, we are brought to a closer conception of time, to a faster beat, to a closer realization or, shall we say, "decomposition" of the musical atom.[70]

Pound's atom-splitting analogy alludes to Stravinsky's reconceptualization of time; in breaking down musical time into its smallest units and reorganizing it in unusual ways (for example, when keeping a constant eighth note beat but grouping it in surprising polymetric ways), Stravinsky is playing with Einstein's "destruction" of absolute time through his theory of relativity. Like Einstein's time, Stravinsky's musical time seems to bend and shift; he has broken it down to its fundamental components and reorganized it.

Within *Antheil and a Treatise on Harmony* we also find Antheil's own perspective on Stravinsky, whose music was, for this native New Jersey composer, the epitome of modern compositional practice. Antheil states: "Has anyone beyond Stravinsky brought forward a new propulsion of time-space, a new comprehension of musical mechanism?"[71] Using his own adaptation of an Einsteinian term, "time-space," we find Antheil stating unequivocally, as early as 1924, that Stravinsky was working within Einsteinian parameters. Antheil's time-space concept, discussed in much greater detail later in the chapter, puts forth the idea that the fundamental aspect of music is its

[70] Ezra Pound, *Antheil and a Treatise on Harmony*, 148–9.

[71] Ezra Pound, *Antheil and a Treatise on Harmony*, 59.

existence on a temporal level. Antheil insists that to ignore music's primary existence in time is to work against the matter of music—it was Antheil's personal goal to construct music so that its temporal aspect could be highlighted. What he probably heard in Stravinsky in the 1920s is what he himself wanted to explore: the idea of simultaneous temporal perspectives in music, of composing music on a "time canvas" that both moved ahead and yet could be perceived all at once.

Antheil's assessment of his compositional idol is telling. In discussing time in Stravinsky's music using a term that related to simultaneity, Antheil was linking the fellow composer's music with an artistic movement that shared ideological roots with relativity theory: cubism. As discussed in the previous chapter, cubist painters struggled with the simultaneous representation of multiple perspectives. In attempting to visually represent different spaces and times simultaneously, they explored artistically the philosophical importance of relativity theory by contemplating the subjectivity of viewing a painting. But as Leonard Shlain implied, to do so was to grasp also the scientific implications of the theory, since different perspectives on space and time were theoretically possible if two observers were moving at different speeds. Stravinsky's play with time through techniques like polyrhythms and polymeter can be seen as a musical version of cubism in the visual arts.

Tom Gordon surveys the relationship between Stravinsky and cubism in an article about the ties made by critics between Picasso and the composer.[72] Gordon chronicles the reception of Stravinsky's music in Europe during his lifetime, noting that from the premiere of *Le Sacre du printemps* on, Picasso's name was frequently aligned with

[72] Tom Gordon, "The Cubist Metaphor: Picasso in Stravinsky Criticism," *Current Musicology* 40 (1985), 22–33.

Stravinsky's. He also unearths more recent criticism that was published at the time of Stravinsky's death that continues the tradition of linking the twentieth-century compositional genius with the genius in painting—articles that are strikingly similar to those that link the composer with Einstein (quoted above). Gordon notes the ways in which Picasso and Stravinsky were joined by critics: through their personal working relationship, through biographical coincidence, and, finally, through stylistic and aesthetic similarities. Regarding the latter, Gordon reviews several technical similarities between cubism and Stravinsky's musical style that were highlighted by his critics including their similar uses of color (or timbre in Stravinsky's case) and formalist design. Most important for our purposes is the similarity in their play with time and space. Gordon writes:

> The critics found the formalism of Stravinsky and Picasso unique because it made conventional continuities of space and time disjunct. Coeuroy called it "a peculiar use of rhythm." Ansermet found that, in Stravinsky's polyphony, what should have been successive was simultaneous, while what should have been simultaneous was successive."[73]

These reviews of Stravinsky were penned in the late 1920s and included direct assertions about the relationship between Stravinsky's music and cubist painting.[74] Gordon notes, however, that later critics, with hindsight, did recognize the triangular connections between Stravinsky, cubism, and Einstein's relativity. This was the case for Léon Oleggini who wrote in 1952 that Stravinsky's music and Picasso's paintings were "the much further into the musical details that might have made Oleggini posit the link first

[73] Tom Gordon, "The Cubist Metaphor: Picasso in Stravinsky Criticism," 28.

[74] Original sources are given by Gordon: André Coeuroy, "Stravinsky and Cubism," *Modern Music* 5/2 (January 1928), 5. Ernest Ansermet, "Introduction a l'oeuvre de Stravinsky," *La revue Pleyel* 18 (March 1925), 19.

application of a relativist or Einsteinian conception of space and time to the arts."[75] Because Gordon's purpose is to provide an outline of cubist criticism, he does not delve between Einstein, cubism, and relativity. However, this link between the three points is extended by later scholars.

Glenn Watkins explores Stravinsky's personal and artistic relationships with a number of cubists, including but not limited to Picasso, whom he met in 1917.[76] Stravinsky was so immersed within the art world that a number of visual artists produced portraits of him; between 1913 and 1916 his countenance was immortalized by Pierre Bonard, Modigliani, Jacques-Émile Blanche, Léon Bakst, Michel Larionov, Paulet Thevenaz, and, in 1921, celebrated Parisian painter Robert Delaunay portrayed Stravinsky as well.[77] Stravinsky was also painted in true cubist style by Albert Gleizes (see Figure 4.3).[78] This painting can itself be analyzed with telling results. The human figure that presumably represents Stravinsky (given the title, since not much visual information tells us who the man is) is seen in the typical cubist manner: blocks of color create unnatural angles in the human form that make it appear as though we can see the figure from multiple perspectival points. This unsurprising depiction raises questions, however, about the part of the portrait that does not appear to be treated in the cubist style: the small sheet of music. Since the object is contained within Stravinsky's portrait,

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[75] Tom Gordon, "The Cubist Metaphor: Picasso in Stravinsky Criticism," 28. This comes from Léon Oleggini, *Connaissance de Stravinsky* (Lausanne, France: Editions Maurice et Pierre Foetisch, 1952), 140–144.

[76] Glenn Watkins, *Pyramids at the Louvre*, 230.

[77] Glenn Watkins, *Pyramids at the Louvre*, 243–52.

[78] For more on this painting see Glenn Watkins, 253–5.

Figure 4.3 - Albert Gleizes, *Portrait of Igor Stravinsky* (1914)[79]

we can assume that it is probably a representation of him in some way and, because he is a composer, the most likely guess is that it is meant to represent his music. The short motive certainly seems to indicate a Stravinskian musical idea. The fact that the bit of sheet music does not appear to be treated in the same cubist style as the rest of the portrait might suggest that this musical idea is in some way already cubist. Gleizes seems to be commenting on Stravinsky's compositional affinity with cubist art. The Stravinskian four-note motive is as cubist as a blocky representation of Stravinsky's bust.

In his analysis, Watkins notes that Stravinsky's music was often compared by European music critics to cubist paintings. Both *Le Sacre du printemps* and *L'Histoire du soldat* became objects of comparison with the painterly technique, encouraging one critic to explain Stravinsky's compositional method in *Le Sacre* as "a kind of musical

[79] Albert Gleizes, *Portrait of Stravinsky* (1914), ARTstor : ARTSTOR_103_41822001179686 < http://library.artstor.org/library/secure/ViewImages?id=8CJGczI9NzldLS1WEDhzTnkrX3gre1Nzdyg%3D [Accessed on 28 December 2010]

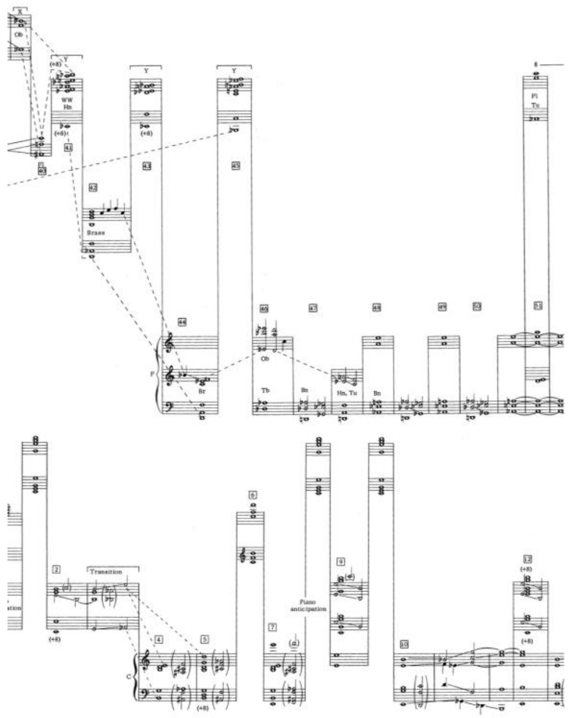
cubism."[80] Watkins analyzes Stravinsky's *Three Pieces for String Quartet* as a direct counterpart to the portrait that Gleizes created of the composer and discusses its ties to Jean Cocteau's cubist-influenced stage text for *David*. In both the painting and the text, Watkins sees an emphasis on simultaneity of temporal perspectives and it is this aspect that he sees Stravinsky adapting to music in this work. His analysis reveals that the piece contains three essential layers that "establish their independence through different phraseological lengths, variable periodicity, and independent tonal orientation until they locate a logical terminating point."[81] The overlapping of these independent layers creates the effect of multiple perspectives in time *and* space.

Edward Cone's 1962 analysis of Stravinsky's music shows, graphically, the influence that cubist analogies comparing Stravinsky and Picasso had on Stravinsky's reception. In his *Perspectives of New Music* article "Stravinsky: The Progress of a Method" Cone asserts that Stravinsky's compositional method was parallel to Picasso's.[82] He also analyzes the composer's *Symphonies of Wind Instruments* and *Symphony of Psalms* by sketching out certain key details in a large fold-out diagram in the journal (a portion of this can be seen in Musical Example 4.1).

[80] Glenn Watkins, *Pyramids at the Louvre*, 233.

[81] Glenn Watkins, *Pyramids at the Louvre*, 262.

[82] Edward T. Cone, "Stravinsky: The Progress of a Method," *Perspectives of New Music* 1/1 (Autumn 1962), 18.



Musical Example 4.1 - Edward Cone, analysis excerpt (1962)[83]

About this unique analysis, Cone says:

> The sketch of the *Symphonies of Wind Instruments* is not meant to serve as a complete linear and harmonic analysis but is rather intended to make clear to the eye the way in which the strata are separated, interlocked, and eventually unified.[84]

Cone's analytical series of interlocking blocks not only reflects Stravinsky's composition using a similar mode, it also represents a cubist method of musical analysis. This 1960s analytical example shows that the connection of Stravinsky's music to cubism was an important part of the American view of the composer. Thus when the press explores Stravinsky's overall output at the time of his death, his cubist—and Einsteinian—leanings would have remained in mind.

[83] Edward T. Cone, "Stravinsky: The Progress of a Method," 20-21.

[84] Edward T. Cone, "Stravinsky: The Progress of a Method," 21.

Daniel Albright compares Stravinsky's music to the visual arts without specifically mentioning cubism or the composer's personal ties to it. Nevertheless, his analysis of Stravinsky's music identifies certain techniques used by the composer that encouraged the listener to reflect on notions of musical time (and thus space). Instead of focusing on producing the aural illusion of multiple perspectives using groups of instruments, as Watkins noted in *Three Pieces for String Quartet*, Albright hones in on the ways in which Stravinsky juxtaposes distinct musical motives linearly, his observations of this very different technique arriving at a similar analytical result.

> In a piece such as the burlesque *Renard* (1915–16), Stravinsky abuts one abrupt section against the next, as if he were stringing beads on a necklace instead of composing music with the usual fluency, the usual sensitivity to transition; the music seems to dwell in the continual present tense, because one music-bit seems to take no notice of previous musical events—there is neither retrospection or anticipation. . . . In *Renard* the listener can, so to speak, hear the scissors and the glue pot at work.[85]

In juxtaposing musical sections without transitions, the composer has produced, in Albright's words, a "flattened musical surface."[86] Though the technique is different than the one identified by Watkins, Stravinsky's music has the same effect: non-linear, non-absolute time is emphasized.[87]

What Stravinsky's critics—contemporaneous and current—recognized was the composer's tendency to play with small musical motives in order to fracture musical time. As these distinct fragments were placed on top of one another through polymetric and/or polyrhythmic techniques, it sounded as if multiple temporal perspectives in music

[85] Daniel Albright, *Modernism and Music*, 69.

[86] Daniel Albright, *Modernism and Music*, 69.

[87] Interestingly, Albright's analysis seems to suggest a connection with another modernist artist venture: futurist painting. His recourse to ahistorical artistic techniques like jewelry making and simple collage are odd here.

were being represented simultaneously, the same way that fragmented bits of images were "layered" in cubist paintings to show multiple distinct temporal perspectives. While Watkins' focus on "simultaneity" implies an emphasis on the temporal aspect of Stravinsky's relationship with cubism, this relationship could be easily extended to pitch, or musical space, as well. Cubist painting inherently explored the possibility of multiple temporal and spatial perspectives, as the two necessarily went hand in hand.[88] In the case of Stravinsky's music, this shines though in the way in which he represents different temporal perspectives through the use of polymetric or polyrhythmic ideas, setting up different spatial perspectives through polytonal or bitonal works. In addition, in many of his works, Stravinsky employs multiple "poly-" techniques, which could further strengthen his associations with cubism and its aesthetic philosophies.

Stravinsky's ties to cubism—itself linked to Einsteinian concepts of space and time, as I have discussed in "Chapter 2: Relativity"—formed a central aspect in his association with Einstein and relativity theory. In adapting cubist ideas to music, Stravinsky modeled Einsteinian modes of space and time in his works, if unintentionally. This mediation through cubist ideologies is important in the case of Stravinsky because the composer expressed very little interest in science and was not known to have commented on Einstein or relativity theory (even though the artists and intellectuals in his circle were quite familiar with the popular scientist and his theories). But while Stravinsky himself may not have recognized the inherently Einsteinian notions present in his music, some of his contemporaries did. In his *Philosophy of Modern Music* (1949),

[88] Representing this correlation on canvas was one of the ways that cubist painting reflected Einstein's conception of an interwoven space-time, in addition to the representation of the dissolution of absolute space and time.

Theodor Adorno comments on Stravinsky's musical preoccupation with the nature of time and space.[89] He remarks (with the cynicism typical of his comments about Stravinsky): "One trick characterizes all of Stravinsky's formal endeavors: the effort of this music to portray time as in a circus tableau and to present time complexes as though they were spatial."[90] The "development of a spatial perspective in music" as heard in the works of Stravinsky was, according to Adorno, the direct effect of "a pseudomorphism of painting in music."[91] For Adorno, too, the link between Stravinsky's music and the visual arts was strong. But Adorno reads into Stravinsky's emphasis on time, offering a deeper analysis that cuts right to the temporality issue's Einsteinian roots. He states: "Stravinsky and his school bring about the end of musical Bergsonianism. They play off *le temps espace* against *le temps durée*."[92] In recognizing Stravinsky's use of *le temps espace*—that is, space-time—in his music instead of the concept of duration, Adorno is acknowledging the debate between Einsteinian and Bergsonian concepts of time—and placing Stravinsky squarely on the side of Einstein. In his assessment of Stravinsky's sense of musical time, made within a discussion of the influence of art on the composer, Adorno drew a direct line to Einsteinian concepts.

Thus in many different ways, contemporaneous and contemporary critics have noted that Stravinsky's compositional predisposition towards poly-music shows an Einsteinian sense of space and time. Whether it was the triangulation between Stravinsky,

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[89] This full length book, published in German in 1949, focuses its attention on Arnold Schoenberg and Igor Stravinsky. Richard D. Leppert, "Introduction," *Essays on Music: Theodor W. Adorno* (Berkeley: University of California Press, 2002), 8–9, 13, 15.

[90] Theodor Adorno, *Philosophy of Modern Music*, in Daniel Albright, 77.

[91] Theodor Adorno, *Philosophy of Modern Music*, in Daniel Albright, 74.

[92] Theodor Adorno, *Philosophy of Modern Music*, in Daniel Albright, 76.

cubism, and relativity or the direct assertion—that I have observed in the criticism of Adorno—that Stravinsky's musical time was his artistic representation of Einsteinian time-space, these observations formed a common Stravinsky reception that stuck with the composer until his death and even afterwards. Thus when American critics assessed the impact of the composer in his later years and at the time of his passing, easy comparisons could be made between composer and the physicist. Both were seen as re-imagining the physical world—one through music, one through scientific theories—and both had thus related ideas about how the world worked.

Twelve-Tone Relativity

Late in his life, Schoenberg assessed his compositional career and the notoriety it brought him by pondering a time "when everybody made believe he understood Einstein's theories and Schoenberg's music."[93] In fact, Schoenberg was not the first to build a parallel between himself and the famous physicist. Of the many composers who lived and worked in America during the time period of Einstein's fame, Schoenberg was the one whose music was thought to resemble most the tenets of relativity theory. His strict twelve-tone technique was considered by many at the time (and even today) to be the musical embodiment of Einstein's ideas. In giving each of the twelve tones equal importance (or equal lack thereof, in that none of them adhered to a tonal hierarchy), Schoenberg's dodecaphonic music was thought to have made the relationships between the tones a relative one. For the most part, this view of twelve-tone music borrowed the popular notion of relativity as having made or proven that everything was relative. Yet,

[93] Arnold Schoenberg, *Style and Idea: Selected Writings of Arnold Schoenberg*, ed. Leonard Stein, trans. Leo Black (Berkeley: University of California Press, 1984), 51–2. Quoted in Daniel Albright, *Modernism and Music*, 5.

some of the more scientifically-oriented listeners, critics, and composer-critics who discussed Schoenberg in the context of Einstein's theories identified a more scientifically-grounded parallel between relativity and twelve-tone music. In addition to the associations made between twelve-tone music and relativity, however, Schoenberg the man was linked repeatedly with Einstein's persona.[94] But unlike with other potential "Einsteins of Music," it was, I argue, Schoenberg's actual music that initiated the comparison between the composer and the scientist. Thus, I will start by examining some of the instances in which Schoenberg was identified as the "Einstein of Music," but focus on how these comparisons differed from other strictly persona-based ones. From there I will discuss the specifically musical comparisons made between twelve-tone music and relativity, both in contemporaneous and current scholarship (the latter of which reveals a long legacy of Schoenberg-Einstein associations).

Many of the composers or composers-of-the-future who were compared to Einstein, as discussed in "Chapter 2: Einstein," were linked to the scientist through one of the five facets of Einstein's public persona. For the most part, these identifications were

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[94] Schoenberg and Einstein were also acquainted on a personal level. They met, according to Malcolm MacDonald, for the first time in March of 1934: "On 6 March 1934, at Princeton University, [Schoenberg] gave his first English lecture on the subject of 'Twelve-Tone Music.' In the audience was Albert Einstein, and now if not before Schoenberg made the personal acquaintance of the great physicist, whom he had attempted to meet during the 1920s to exchange ideas on music, science, and the destiny of the Jewish people. Three weeks later Schoenberg and Einstein were together again at Carnegie Hall in New York, to support a concert on behalf of Jewish and Zionist bodies, organized by Leopold Godowsky, to raise money for the resettlement of German Jewish children in Palestine." Malcolm MacDonald, *Schoenberg* (New York: Oxford University Press, 2008), 75. The two were photographed together, along with Leopold Godowsky at Carnegie Hall in 1934. This photo is held at the Arnold Schoenberg Institute (1473) and reproduced in *Arnold Schoenberg: The Musical Idea and the Logic, Technique, and Art of Its Presentation*, eds. Patricia Carpenter and Severine Neff (Bloomington: Indiana University Press, 2006), 87. For more on the Zionist ties that connected Schoenberg and Einstein see E. Randol Schoenberg, "Arnold Schoenberg and Albert Einstein: Their Relationship and Views on Zionism," *Journal of the Arnold Schoenberg Institute* 10/2 (Nov. 1987): 134–87. For more on their correspondence see Albrecht Riethmueller, "Schoenberg schreibt an Einstein: Die Briefe im musikalischen Kontext," in *Musizieren, Lieben und Maulhalten! Albert Einsteins Beziehungen zur Musik* (Basel: Schwabe, 2006), 43–61.

formulated just after Einstein became famous and dwindled in the following decades. The comparisons between Schoenberg and Einstein, however, were mostly made in the mid-to-late 1930s, by American critics and composers, and only after Schoenberg began working in America.[95] In terms of personality traits, the parallel between Schoenberg and Einstein was easy: both were considered geniuses in their fields. Yet unlike with other composers or would-be composers, Schoenberg was not compared to Einstein as a person to make a point about the type of figure needed for a modernist musical revolution. Nor was his name used to bring scientific or cultural clout to the artistic work of the composer; Schoenberg was well-established in his career at this point, even by definition of his new American audiences.[96] Instead, Schoenberg was compared to Einstein because of the similarities perceived in their intellectual contributions.

While nearly all of the composers discussed thus far have had personal interests in or connections with science, Schoenberg did not profess a particular love for the field. He did, however, possess some popular scientific knowledge, and from this knowledge he often plucked interesting scientific metaphors. Because of his progression into adulthood at the turn-of-the-century, his scientifically-oriented figures of speech tended to center on ideas about astronomy, light and/or electricity, and evolution. Severine Neff has created a comprehensive catalog of these metaphors and has discussed Schoenberg's use of planetary and light-related figures of speech in Schoenberg's description of his Second

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[95] Schoenberg moved to Los Angeles in September 1934. He taught at the University of Southern California in 1935 and 1936 and became a full professor at the University of California at Los Angeles in 1936. See Dorothy Lamb Crawford, "Schoenberg in Los Angeles," *Musical Quarterly* 86 (2002), 6–48.

[96] For a comprehensive picture of the reception of Schoenberg in America see Sabine Feisst, "Schoenberg Reception in America, 1933–1951," in *The Cambridge Companion to Schoenberg*, Jennifer Shaw and Joseph Auner, Eds. (Cambridge: Cambridge University Press, 2010), 247–57.

String Quartet.[97] Schoenberg mentioned Einstein and relativity only in passing in his writings, but never as a stated source for any artistic inspiration, theoretical archetype, or ideological model.[98]

The comparison of Schoenberg to Einstein was often made by critics and was always within the context of a discussion of the composer's twelve-tone technique. The first comparisons of the two figures occurred in 1930 in a review found in *The Living Age*, just a few years before Schoenberg moved to the United States.[99] In the article about Schoenberg's strictly twelve-tone opera *Von heute auf morgen*, the reviewer describes Schoenberg as "the most modern of all modernist composers" and cites another critic's description of the opera as a "work as comparable to that of Einstein, in that it is superlatively excellent of its kind, but difficult to understand."[100] This unnamed critic set the stage for numerous comparisons between the twelve-tone composer and theorist of relativity. And, in making the Einsteinian comparison one between the intellectual output of the two figures (the twelve-tone opera and the difficult-to-understand theories), this

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[97] I am grateful to Severine Neff for sharing a compiled catalog of the scientific metaphors used by Schoenberg in his writings. For an example of one such metaphor, see Arnold Schoenberg, *Second String Quartet in F-Sharp Minor, Op. 10: Authoritative Score, Background and Analysis, Commentary*, ed. Severine Neff (New York: W. W. Norton & Company).

[98] For example, in the phrase cited at the beginning of this section. Arnold Schoenberg, *Style and Idea: Selected Writings of Arnold Schoenberg*, ed. Leonard Stein, trans. Leo Black (Berkeley: University of California Press, 1984), 51–2. Quoted in Daniel Albright, *Modernism and Music*, 5. In his forthcoming article, "Schoenberg, Weill, and the Federal Arts Projects in Los Angeles, Spring 1937," Tim Carter also notes Schoenberg's oft-cited remark in a letter to Hermann Scherchen of 16 March 1936 that "my work is as much a waste of time as if Einstein were having to teach mathematics at a secondary school." Contained in *Arnold Schoenberg Letters*, ed. Erwin Stein (London: Faber and Faber, 1964), 198. See Carter, "Schoenberg, Weill, and the Federal Music Project," fn 26.

[99] *The Living Age* was published out of Boston, Massachusetts. In its origins, it was a periodical that republished British journalism for an American audience. In its later years (it had its last run in 1941), and at the time of this article, it was owned by The World Topics Corporation.

[100] "Letters and the Arts," *The Living Age* (1 April 1930), 157.

critic solidifies the nature of the comparison of Schoenberg to Einstein as more than merely a personal one.

Another reference to Schoenberg's twelve-tone method and its relationship with relativity occurred in 1932 in an issue of *Modern Music*. Willi Reich discusses the negative reception of some of Schoenberg's new works, describing "the principle objection to the composer's latter works," which was a lack of "spiritual resonance." Reich responds to this negative critic with a question:

> But have not all really new and great achievements, scientific as well as artistic, met a similar reception in their contemporary world? . . . The work of our famous contemporary, Albert Einstein, despite the popularity of his name, is completely uncomprehended [sic], outside the limited circle of his colleagues, and he is made to father absolutely irrelevant catchwords.[101]

While Reich seems a bit jaded by the trendy use of Einsteinian terminology, he nevertheless goes on to construct an elegant parallel between Einstein and Schoenberg. About the relationship, Reich says:

> The mention of Einstein could lead us to a far-reaching parallelism, for the possibility developed by Schoenberg of relating all musical happenings to a twelve-tone series is indeed analogous to the conception of all physically related systems as projected by Einstein. But in principle Schoenberg transcends a mere relativity of musical coordinates, using his twelve-tone series not only as a scale but also as a motive on which to build the whole thematic development. He requires the interpreter to handle the fundamental series according to the necessities of the composition, that is, with the ultimate disposal of this material clearly in mind.[102]

From this passage, the type of misappropriation of Einstein that Reich is wary of becomes clearer. He admits the important parallel between the twelve-tone method of the Viennese modernist and the scientist's theories; however, he seems to argue that

[101] Willi Reich, "Schoenberg's New Männerchor," *Modern Music* 4/2 (1927), 62.

[102] Willi Reich, "Schoenberg's New Männerchor," 62.

Schoenberg's musical method is more than a simple reinterpretation of a scientific idea. In saying that "the mention of Einstein could lead us"—that is, anyone familiar with Einstein—to this parallel, Reich implies that others were discussing Schoenberg's relationship with the popular Einstein as well.

By the time Schoenberg had established himself in the United States, his reputation as an Einsteinian composer had been set. In 1935, just after he settled down in the city, the *Los Angeles Times* announced an upcoming concert featuring the music of Schoenberg and his transcriptions of Bach.[103] The article described the composer as "the Einstein of composers"—using quotation marks to delineate the phrase, suggesting the common occurrence of this moniker amongst reading audiences.[104] A short while later, the *Los Angeles Tribune* used a similar phrase to announce a 1937 concert held as part of the Los Angeles Federal Music Project: "Arnold Schoenberg, torch-bearer of modern composition known as the 'Einstein of music,' will appear for the second time with the Los Angeles Federal Music Project symphony orchestra at its next concert Wednesday, April 14, at Trinity Auditorium."[105]

In 1938, Los Angeles music critic Isabel Morse Jones compared Schoenberg's role in the history of musical ideas to Einstein's in science. In a discussion of new music

[103] Tim Carter also notes Schoenberg's participation in a discussion on "Science and Music" that was described in the *Los Angeles Times* on 10 February 1935, just before this article was published. Within the article, Dr. Rene Engel, formerly on the faculty of the California Institute of Technology, "discussed the close alliance existing between sciences and arts in general and music in particular, illustrating with the analogy between such mathematical and musical minds as Helmholtz, Einstein, Urbain and others." See Carter, "Schoenberg, Weill, and the Federal Music Projects," fn 25.

[104] "Dusolina Giannini to Appear as Soloist With Symphony," *Los Angeles Times* (10 March 1935), A8.

[105] *Los Angeles Tribune* (12 April 1937). This quotation was found by Tim Carter in the clippings of the press books for the Federal Music Project at the National Archives. NARA/FMP, Box 48.

trends being heard in Southern California, written just after the premier of Schoenberg's *Kol Nidre* in October, she discussed the roots of atonal music. She said:

> Atonalism is only another name for chromaticism. There is no mystery. Schoenberg, like Einstein, is essentially a simple man of truth. He makes the clear statement: "The alleged tones believed to be foreign to harmony do not exist; they are merely tones foreign to our accepted harmonic system." It is, then, the experimental impetus we must acquire by listening. We must make an effort to forget our "accepted harmonic system," at least when listening to the new music.[106]

In this passage, we find a depiction of Schoenberg as a genius figure whose music opened the world's ears to a new, broader view of music, just as Einstein expanded our understanding of the physical world of Newton to incorporate other perspectives of motion. Morse Jones explains that the twelve-tone system, which might be aptly called "the Schoenberg law," is "a musical state in which all twelve tones of the chromatic or half-toned scale are of equal importance." She borrows a telling quotation to summarize Schoenberg's influence through the twelve-tone system: "As Louis Danz aptly sums it up after studying Schoenberg: 'Now let music be called a science instead of art.'"[107]

Some critics, in comparing Schoenberg and Einstein, began to describe what exactly in Schoenberg's music made it Einsteinian. In Danz's chapter of Merle Armitage's 1937 biography of Schoenberg, we find a discussion of the fundamental change in compositional practice compelled by Schoenberg's development of the twelve-tone system. In doing so, Danz explains how the tones have a new relation to one another

[106] Isabel Morse Jones, "Music and Musicians: New Music Nurtured in Southland," C5. Quoted in partial form only in Dorothy Lamb Crawford, "Arnold Schoenberg in Los Angeles," *The Musical Quarterly* 86/1 (Spring 2002), 9.

[107] Isabel Morse Jones, "Music and Musicians: New Music Nurtured in Southland," C5.

in Schoenberg's twelve-tone system, a change in musical practice comparable to that ignited by Einstein in the field of mathematics:

> From now on music will no longer be what it was, but has become what it will be. This change can be likened to the change from the Euclidian geometry to the higher mathematics of a Minkowsky—an Einstein. Teutonic music was built upon a Euclidian geometric key relation of note to note. The cycle of fifths determines its limits. The new music of Schoenberg is built on a structural principle just as true, just as logical and just as musical. It is built on the relation of number to number—whose total content is sound. By the removal of the tonic Schoenberg freed the upper partials so they can move in any direction determined by the structural feeling of the composer unhampered by key relations.[108]

In comparing "Teutonic" music of the past to Euclidian geometry, Danz is setting up a clear parallel between Schoenberg's new music and Einstein's new physics, which refuted Euclid's previously accepted idea of flat space, rather than curved space of Einstein.

Schoenberg himself occasionally appeared to be aware of the comparisons made between him and Einstein, and he seems to have recognized some of the characteristics of his music that led to their Einsteinian associations. Writing within Armitage's biographical volume, Schoenberg compares his contributions in music to those made by Einstein in physics. He notes the (problematic) "relationship between the science of mathematics as expressed by Einstein and the science of music as developed by myself."[109] Glenn Watkins points out that Schoenberg "retrospectively registered his interest in and concern for the larger issues of musical time in relation to its spatial deployment" in reconsidering how musical space-time worked in his *Jacobsleiter* (1917–1922). Watkins identifies Schoenberg's "relativistic view of space and time" in the

[108] Louis Danz, *Schoenberg*, Ed. Merle Armitage (Westport, CT: Greenwood Press, 1937), 212.

[109] Arnold Schoenberg, *Schoenberg*, ed. Merle Armitage (New York: G Schirmer, 1937), 249.

following passage from the composer's article "Composition with Twelve Tones" from 1941:

> The unity of musical space demands an absolute and unitary perception. In this space . . . there is no absolute down, no right or left, forward or backward. Every musical configuration, every movement of tones has to be comprehended primarily as a mutual relation of sounds, of oscillatory vibrations, appearing at different places and times.[110]

Although Watkins does not associate this attitude with Einstein or relativity directly, he does link Schoenberg's musical concerns with early twentieth-century artistic culture that recognized that "the New Physicists were currently proposing ideas that could have appealed only to the painters, the poets, and the musicians."[111] While it was more often the case that others identified twelve-tone relativity in Schoenberg's music and writings, the composer seems to have been aware of it to a certain degree.

When a translation of Schoenberg's *Treatise on Harmony* was published in the U.S. in 1948, the reviewer summed up Schoenberg's fame (or infamy) as a composer in the first sentence saying:

> For nearly forty years Arnold Schoenberg has been famous mainly as the bloody but unbowed advocate of a method of musical composition known as "atonality" or "the twelve-tone system"—a method regarded by its adherents as music's equivalent of the Einstein theory, and by its detractors as a theoretically high-sounding but actually very simple recipe for systematic noise making.[112]

The reviewer implies that Schoenberg's music has been known to many as the musical equivalent of relativity. Similarly, conductor Dimitri Mitropoulos remarked in 1951 that

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[110] Glenn Watkins, *Pyramids at the Louvre: Music, Culture, and Collage from Stravinsky to the Postmodernists* (Cambridge, MA: Belknap Press of the Harvard University Press, 1994), 227.

[111] Glenn Watkins, *Pyramids at the Louvre,* 226.

[112] Winthrop Sargeant, "A Composer's Treatise on Harmony," *New York Times* (8 August 1948), BR10.

"Schoenberg was to music in the 20th century what Einstein is to science."[113] Thus we can take even the few mentions of Schoenberg as Einstein and twelve-tone music as musical relativity to be only scratching the surface of what must have been said of the composer and his music. It seems that these analogies were common parlance in discussions of Schoenberg and his music in America.

Interestingly, Schoenberg was not the only twelve-tone composer to be recognized as creating a type of musical relativity, further evidence that it was the technique itself that became associated with relativity theory, rather than one specific composer. In an article about Alban Berg's *Lulu* that appeared in 1936 in *Musical Quarterly*, the German musicologist Willi Reich explained Berg's "tonality-free" principles in relation to Einstein:

> It is to be borne in mind that the twelve-tone row itself, being the so-called "underlying form," in extended use takes over certain keynote function, since the entire progress of the music can be related to it. [Continuing in a footnote:] The step from keynote to underlying form may be said to be analogous to the step accomplished by Einstein in his general theory of relativity in passing from the rectilinear, right-angled Cartesian co-ordinates to the curvilinear, oblique-angled Gaussian co-ordinates; the invariability of the underlying form in twelve-tone music corresponding to the invariable line-element in the relativity theory. The invariable quantity is also made clear since in twelve-tone music, besides the underlying form itself, only the mirror [retrograde], the crab [inversion], and the crab-mirror [retrograde inversion] of that form occur, that is, only those transformations in which the geometric form of the twelve-tone row remains unaltered.[114]

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[113] Seymour Raven, "Music, Theater News of City, and the Nation," *Chicago Daily Tribune* (30 July 1951), B6. In the *Los Angeles Times* version that mentions Mitropoulos' views on Schoenberg the conductor is both paraphrased and quoted exactly: "The conductor believes that Schoenberg was to music in the 20th century what Einstein is to science. 'He was one of our greatest geniuses.'" This version certainly emphasizing the connection between the composer's and scientist's genius personas, but it does not remove the idea that Schoenberg's *music* is parallel to Einstein's *scientific ideas.* Albert Goldberg, "The Bowl—Schoenberg and Mitropoulos," *Los Angeles Times* (12 August 1951), D7.

[114] Willi Reich, "Alban Berg's 'Lulu'," Translated by M. D. Herter Norton, *Musical Quarterly* 22/4 (October 1936), 392.

In Reich's assessment, the twelve-tone technique is to relativity theory's new ideas of curved space what tonality was to Cartesian geometry. The twelve-tone row represents the underlying form of the musical world created in a dodecaphonic piece. It elegantly accounts for all possible musical movements in the system—even when the row is transposed, inverted, and retrograded—just as Einstein's General Theory of Relativity accounts for motion in all systems contained within the universe.

Fellow composers, in looking back at Schoenberg's contributions to music in the light of his "discovery" of the twelve-tone technique, have linked his compositional strategies with Einstein.[115] Karlheinz Stockhausen remarked that,

> The universe seemed, then, to reflect Einstein's concept of a unique formula. The first composers disposed to derive new musical method from such indications were Matthias Hauer and Arnold Schoenberg. . . . Note that I'm not speaking at all of formula, but rather of form; an entire period of this history of music began to develop from that moment on the basis of the so-called series. . . . Every score was to be developed on the basis of that small nucleus, that small structure, that form no one had the right to alter.[116]

Here Stockhausen compares the tone row of Schoenberg to the nucleus of an atom. By placing Schoenberg's development on the twelve-tone row as the basis for all compositions within Einstein's realm, he seems to be implying that an Einsteinian worldview had a formative role in Schoenberg's twelve-tone aesthetics. In other words, Einstein's "unique formula," or his view that an overarching, unified principle dictated

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[115] For a full discussion of the use of the term "discovery" by Schoenberg in describing the inception of twelve-tone music, see Arved Ashby's comprehensive article "Schoenberg, Boulez, and Twelve-Tone Composition as 'Ideal Type'," *Journal of the American Musicological Society* 54/3 (Autumn 2001), 585–625.

[116] Quoted in Arved Ashby, "Schoenberg, Boulez, and Twelve-Tone Composition," 600.

the behavior of space, time, and everything in them, had a key role in allowing Schoenberg to develop his twelve-tone technique.

Similarly, Boulez classified his own serial works in an Einsteinian-Newtonian dualism. Arved Ashby notes that Boulez's frequent reference to relative processes in describing Schoenberg's work acknowledges the relativism inherent in the twelve-tone technique. Ashby states:

> But then Boulez might prefer to say . . . that his theory takes Schoenberg as a premise in the same sense that a scientific theory is both based on and supplants an earlier one: the Schoenbergian gives way, in Boulez's own simile, just as the Newtonian world and its basis in ideas of universal law and uniformity and immutability of natural processes cede to the Einsteinian understanding of relativity. (Indeed, Boulez's frequent invocation of relative processes implicitly acknowledges Einstein, and he links the Schoenbergian "principle of allegiance of structures to a central authority" with superseded, Newtonian modes of thought.)[117]

In this analogy, Boulez compares his relationship with Schoenberg to that between Einstein and Newton; Einstein was Newton's opponent and yet he built his theories upon the indispensible theories of the elder physicist. In making this comparison, Boulez acknowledges that both his and Schoenberg's twelve-tone work is Einsteinian. This updated metaphor continues the tradition of Schoenberg's twelve-tone system being compared to relativity theory and also allows the comparison to live on in the technique itself, being passed on from generation to generation.

In addition to contemporaneous critics and composers who knew of Schoenberg's work, scholars in the last few decades have continued to recognize the twelve-tone technique as an attempt at musical relativity. William Eamon names Schoenberg among the many artists and thinkers of "Einstein's generation." Like Picasso, Joyce, and

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[117] Arved Ashby, "Schoenberg, Boulez, and Twelve-Tone Composition as 'Ideal Type'," 612.

Wittgenstein, Schoenberg's musical revolution had inherent parallels with those concurrently explored by the famous physicist's.[118] In fact, this "generation" was recognized for their related cultural products only a few decades after their respective artistic, intellectual, and philosophical revolutions of the teens and twenties. In the mid-60s, critic Lawrence Morton makes the link saying, "Listening to Schoenberg in 1966 is like looking at the paintings of Kandinsky and Klee, reading Joyce and Eliot, learning at least the rudiments of what Freud and Einstein mean to contemporary thought."[119]

Musicologist John F. Spratt speaks of the parallel between Schoenberg's ideas and Einstein's as a given. He compares Schoenberg's twelve-tone revolution as the pinnacle of abstraction in music, a "cultural concomitant" to the increasing level of abstraction in the theoretical physics of the twentieth century.[120] According to Spratt, both Einsteinian physics and Schoenbergian music dispel the notion of an absolute "law" and replace this infallible view of the universe with a more nuanced, relativistic one. He states

> The central feature is the reduction of a previously-held absolute norm to the status of a relative special case. Schoenberg never tires of pointing out that tonality is not an absolute law. It is noteworthy that this "tonality" is described by Bukofzer as a "law of attraction," overtly suggesting a connection with Newtonian law; Grout states that the period of tonality roughly corresponds to that of Newtonian physics. Both of these systems began to lose their absolute status in the late nineteenth century. . . . At any rate, Schoenberg observes that by the end of the nineteenth century harmony had "become so ambiguous that any note could go with any chord." The solution in music was analogous to that in science, namely, the formation of a more abstract system under which previous systems

[118] William Eamon, "Inventing the World: Einstein and the Generation of 1905," *Antioch Review* 43/3 (Summer 1985), 341.

[119] Quoted in Martin Bernheimer, "The Philharmonic Season in Retrospect," *Los Angeles Times* (8 May 1966), M1.

[120] John F. Spratt, "Science and Music," 75.

> could be, not necessarily rejected, but subsumed as special cases. Thus there arose in the twentieth century a "music of intervals," to use Stravinsky's phrase, with respect to which tonality and even medieval modality were seen as special, limited cases.[121]

Thus in Spratt's estimation, Schoenberg's twelve-tone "music of intervals" heralds a new perspective on music which removes tonality as *the law* of musical construction and instead attempts to view all of music as the relationship between intervals, with tonality and even modality representing just specific practices within a larger universe of musical composition. Spratt does not offer any explanation for the similarities between Schoenberg and Einstein, only that they occurred.

Some scholars take a more nuanced approach to the relationship between Schoenberg's twelve-tone technique and relativity theory, but nevertheless acknowledge the common assumption that the two are linked. After dismissing any type of one-to-one comparison between new scientific thought and dodecaphonic music, Mark Delaere and P. H. Daly admit that "it does seem to us possible to conduct a plausible inquiry into whether there is some connection between the fact that historically classical physics and classical tonality were called in question at roughly the same time." The authors identify the links established between Einstein and Schoenberg over time:

> At various stages in the past links were posited between for example the theory of relativity and Schoenberg's dodecaphony. This may have been on the basis of Schoenberg's concept of the "relativity of the dissonance" (a phenomenon which is actually due to the historical changes effected within it), or has it perhaps more to do with his opinion regarding the "unity of the musical space" (in which the equalization of horizontalism and verticalism is strictly speaking actually theoretically mistaken, and in which the series may well be at the origin of the "musical system," but is by no means identical with it)? This correlation between dodecaphony and

[121] John F. Spratt, "Science and Music," 75–6.

> relativity theory has virtually always been posited on the basis of a superficial knowledge of both elements in the equation.[122]

The authors thus admit that, although the relationship is superficial, it has nevertheless been an association made by many listeners. For these scholars—and I think this is a observation worth noting for this study—the importance of recognizing the association made between Schoenberg and Einstein lays not in examining how it came to be that two cultural spheres overlapped, but rather in acknowledging that they were perceived to have overlapped.

Another nuanced scholarly approach to the relationship between Einstein and Schoenberg can be found within Leon Botstein's excellent analysis of the relationship between Einstein and music. Botstein is able to discuss the intellectual parallel between Einstein's relativity theory and Schoenberg's twelve-tone technique in spite of the fact that, as Botstein admits, "Einstein seems to have been oblivious to [Berlin's] modernist musical life" including the music and writings of Schoenberg.[123] He first posits a link between Einstein's notoriously conservative musical tastes and Schoenberg's compositional milieu:

> Einstein's aesthetic conservatism was, however, not entirely reactionary for the 1920s. His contemporary Schoenberg was, after all, notorious in the Berlin of the 1920s as a radical conservative. Schoenberg's leap into a system and method of twelve-tone composition was put forward as a means of restoring an 18th-century aesthetic akin to Mozart's. . . . Schoenberg's rationalism was not distant from Einstein's. The key

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[122] Mark Delaere and P. H. Daly, "Mutations in Systems in the Natural Sciences and Music in the First Half of the Twentieth Century," *International Review of the Aesthetics and Sociology of Music* 21/2 (June 1990), 4.

[123] Leon Botstein, "Einstein and Music," *Einstein for the 21st Century: His Legacy in Science, Art, and Modern Culture*, eds. Peter Galison, Gerald Horton, and Silvan S. Schweber (Princeton: Princeton University Press, 2008), 167.

> difference was that in place of tonal logic, Schoenberg posited an invented, rational system of organizing and combining pitches.[124]

He goes on to explore the similarities in formal patterning between Einstein's theories and Schoenberg's music. In describing Schoenberg's 1911 textbook *Harmonielehre*, Botstein uses distinctly Einsteinian terms to summarize the main tenets of the text:

> It argued for what he called the emancipation of the dissonance or the notion that there is no normative, tonal, gravitational pull. In each formal context, any pitch eventually creates its own frame of reference. In this way, the distinction between consonance and dissonance becomes contextual, if not relative, and certainly not objective. Schoenberg's later formulation of the so-called twelve-tone system of writing took this notion further. It assumes that all notes are of equivalent value. Their interrelated functionality is generation by the series, the tone row, on which each piece is based.[125]

Although Botstein specifically states that Einstein was ignorant of the work summarized above, he does claim that Schoenberg's development of the twelve-tone method "would overlap with [Einstein's] greatest scientific achievements."[126] Botstein does allow, however, for an important intellectual parallel to come out. The similarity between Einstein's musical tastes and Schoenberg's own beliefs about his new musical system suggests an underlying intellectual synergy, perhaps created by shared cultural horizon, that explains the unintentional parallels between relativity and the twelve-tone system. Thus with a historical leap of faith, Botstein is able to adopt Einsteinian terms to describe the system without having to prove a direct intentionality or causality.

The parallels observed and constructed between Schoenberg and Einstein reveal that his twelve-tone method was perceived by many as the musical equivalent to

[124] Leon Botstein, "Einstein and Music," 169.

[125] Leon Botstein, "Einstein and Music," 174.

[126] Leon Botstein, "Einstein and Music," 173.

relativity theory. Thus in numerous reviews or overviews of the composer's work, we find a comparison made between both Schoenberg himself and Einstein, but more often between the elements of his music and the contents of Einstein's theories. The twelve-tone method was considered the musical embodiment of relative time and space; no longer was musical space an absolute given. The relationships between notes were reconfigured each time a twelve-tone row was devised and used to build a new musical environment. Within each "special" row—to borrow Einstein's term for his more specific theory—the tones were in a different relationship. Not only were the traditional intervallic patterns of tonality made meaningless, even the intervallic relationships contained in multiple dodecaphonic works were given different meanings. Additionally, and most recognizably, without a tonal center around which pitches gravitated, musical space (in intervals) could not be measured in the same way that it could in tonal music. Rather than allowing listeners to be aurally able to recognize distance from the tonic, twelve-tone music forced listeners to think in all relative intervals between pitches. This musical revolution in pitch space, we have seen, was readily perceived by critics, fellow composers, scholars, and amateur audience members. For the latter group, especially, being able to associate the complicated listening experience of Schoenberg's twelve-tone works with the complex reading experience of learning about Einstein's theories in the newspapers was probably a helpful way of understanding both areas of cultural production. Although twelve-tone music and relativity theory had aspects that were difficult to grasp, both could be placed within the larger cultural and intellectual shifts of the early twentieth century.

III. Composing Space-Time in Music

Already I have shown that numerous relationships between Einstein's theories and modernist musical compositions have been perceived by critics and audience members. For Ives, who professed no interest in science or Einstein, all assertions that his music was Einsteinian, particularly in its ability to question the perception of simultaneity, occurred in later assessments of his compositional career. Something similar is true of Cowell's Einsteinian tone-clusters: Cowell himself, an advocate of a scientific and even Einsteinian approach to music, only later realized the Einsteinian traits of his musical techniques. Contemporaneous critics considered Stravinsky an "Einstein of Music" at the time of his death, and I argued that this stems from the composer's earliest associations with cubism and the Einsteinian reputation tied to that visual artistic style. Schoenberg earned the name the "Einstein of Music" as a practicing composer and, much like in the case of Stravinsky, I conclude that this name was bestowed upon him for specific musical reasons. In each of these cases, a defining musical technique encouraged a critical comparison of a modernist composer and his music to Einstein and his theories.

In this, the final section of this chapter, I will explore two more composers and two more Einsteinian musical techniques: first, Varèse and "sound projection" and, second, Antheil and "time-space". I will delve further into specific compositions for these two musicians since they present the special cases of attempting to create a more overtly Einsteinian mode of composition in space-time. As I analyze the two composers' unique techniques, I will refer to the ways in which each reflects popular understandings of space, time, and most importantly space-time.

Space-Time: Varèse and Espace

Edgard Varèse was outspoken about his interest in the scientific world, though many scholars today still regard his adoption of scientific terminology in the context of his music as a type of mystical pseudo-science.[127] I would like to reopen the discussion of Varèse's relationship with science—especially by offering new observations about his intellectual relationship with Einstein—so that we might better be able to understand the composer's music and his place in the larger Einstein-modernism cultural sphere explored in my dissertation. The reasons for the scholarly dismissal of Varèse's use of scientific ideas in his writings and music have already been called into question by my approach to composers' and science. As we have seen in my exploration of the scientific interests of other composers and their subsequent attempts at applying these interests to their theoretical and aesthetic ideas about music, the point is not how accurately a composer relates to scientific ideas but rather the (often idiosyncratic) process of assimilating scientific theories into musical practice. Composers and writers adopted and adapted Einsteinian ideas to music in a variety of ways, not many of which would be considered "getting Einstein right." Rather than attempting a perfect translation of science into music, these composers and music writers were using Einstein and relativity theory to show cultural knowledge and scientific acumen in both an Einstein-obsessed popular culture and a scientifically-inclined modernist artistic culture. For Varèse, who

[127] For example, in his recent biography of Varèse, Malcolm MacDonald regards Varèse's use of scientific rhetoric as a response to the composer's interest in the "magical" and "wondrous" possibilities of science, rather than their mathematical, technical, or practical implications for the artistic world. Malcolm MacDonald, *Varèse: Astronomer in Sound* (London: Kahn and Averill, 2002), xv. John D. Anderson makes note of this problem as well stating that "From the earliest days of Edgard Varèse's compositional career in America, critics and theorists have argued over the connection between his music and science. . . . Varèse himself referred to several specific sources of scientific influence, but many subsequent writers who investigated these sources concluded that Varèse's pseudo-scientific terminology is a fanciful metaphor of hazy ideas, not translated well by the actual music." Anderson takes as his goal a reevaluation of this attitude. John D. Anderson, "Varèse and the Lyricism of the New Physics," 31.

was familiar with Einstein and the developments of the New Physics, we can infer the same goals.

The young Varèse, pushed towards scientific study by his engineer father, studied at the Technical Institute in Turin. Though he left this school for the Conservatoire in Paris, Varèse took classes in mathematics and physics at the École Polytechnique because of a vested personal interest in the subjects. Varèse maintained a healthy curiosity for a number of scientific movements and studies as a young adult, especially the work of Polish mathematician Joseph Maria Hoene-Wronsky and physicist and musical-acoustician Herrmann von Helmholtz.[128] Both of these figures played critical roles in shaping Varèse's attitudes towards his own music.

Varèse believed the work of the scientist and the musician went hand in hand. The composer spoke of the similarities between the compositional and experimental impetus:[129]

> The emotional impulse that moves a composer to write his scores contains the same element of poetry that incites the scientist to his discoveries. There is solidarity between scientific development and the progress of

[128] Varèse's own explanation of his interest in these two figures is recalled by biographer Fernand Ouellette: "When I was about twenty, I came across a definition of music that seemed to throw light on my gropings toward a music I sensed could exist. Hoene-Wronsky, physicist, chemist, musicologist, and philosopher of the first half of the nineteenth century, defined music as 'the corporealization of the intelligence that is in sounds.' It was a new and exciting conception and to me the first that started me thinking of music as spatial—as moving bodies of sound in space, a conception I gradually made my own. Very early musical ideas came to me which I realized would be difficult or impossible to express with the means available, and my thinking even then began turning around the idea of liberating music from the tempered system, from the limitations of musical instruments and from years of bad habits, erroneously called tradition. I studied Helmholtz, and was fascinated by his experiments with sirens described in his *Physiology of Sound*. Later I made some modest experiments of my own and found that I could obtain beautiful parabolas and hyperbolas in the visual domain." Edgard Varèse to Ouellette in *Visages d'Edgard Varèse*, ed. Fernand Ouellette (Montreal: Editions de l'Hexagone, 1959), 9-10. Quoted from Fernand Ouelette, *Edgard Varèse* (New York: Orion Press, 1968), 17–18. For more on the relationship between Varèse and Helmholtz see Benjamin Steege, "Varèse *in vitro*: On Attention, Aurality, and the Laboratory," *Current Musicology* 76 (Fall 2003), 36–41.[128]

[129] Date given in Olivia Mattis, "Varèse's Multimedia Conception of 'Deserts'," *Musical Quarterly* 76/4 (Winter 1992), 583 (footnote 74).

> music. Throwing new light on nature, science permits music to progress—or rather to grow and change with changing times—by revealing to our senses harmonies and sensations before unfelt. On the threshold of beauty science and art collaborate.[130]

In this statement, Varèse unites his youthful interest in science with his professional activity in music. For him, music and science must progress together—but with science at the fore. Only in using what science has to offer to music can music stay current. In fact, Varèse believed music to be an "art-science."[131] Gerard Pape restates this elegantly saying, "Varèse considered musical composition as an artistic/scientific research."[132]

His view that music and science were inherently tied led Varèse to explore the work not just of Hoene-Wronsky and Helmholtz, but also less overtly music-related scientific figures: he was also quite familiar with Einstein. Varèse was aware of Einstein's personal and scholarly reception on a general level and, importantly, he believed he understood the physicist's theories to an extent. On the most general level, contemporaries of the composer, as well as current scholars, have implied that Varèse was familiar with Einstein and his rise to fame or, at the very least, that he was influenced by the same cultural givens that brought about Einstein's theories. Fernand Ouellette articulates it this way: "We must not forget that he had studied physics quite extensively, and above all that he was a contemporary of Einstein."[133] Ouellette also notes that Michel

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[130] Edgard Varèse, "Music and the Times," in Daniel Albright, *Modernism and Music,* 185. This is a section of a larger talk entitled "New Instruments and New Music" given in Santa Fe in 1936 and edited later by Chou Wen-Chung. The full version can be found in "New Instruments and New Music" in *Contemporary Composers on Contemporary Music,* ed. Elliott Schwartz and Barney Childs (New York: Holt, Rinehart and Winston, 1967), 196–97.

[131] Fernand Ouellette, *Edgard Varèse*, 16.

[132] Gerard Pape, "Varèse the Visionary," *Contemporary Music Review* 23/2 (June 2004): 24–5.

[133] Fernand Ouellette, *Edgard Varèse*, 17.

Seuphor called Varèse Einstein's "compliment."[134] Malcolm MacDonald notes that Varèse "was accepted as a student at the Conservatoire in 1905, when Einstein first formulated the Special Theory of Relativity. He was literally a child of the modern age, and lived to become the most radical pioneer . . . of 20th-century music."[135] In other words, Varèse was immersed in a world where Einsteinian physics came about, and he, because of his love of the subject, began to reflect on some of the same ideas that Einstein stood for.

As John D. Anderson points out in "Varèse and the Lyricism of the New Physics," Varèse was familiar with the revolution attendant with the development of relativity theory.[136] Varèse often kept abreast of current scientific developments and considered their implications for the world and for his art-form. We can see an example of this in Varèse's own words in a published interview from the mid-1940s in which the composer discusses new trends in the field of physics and the paradigm shifts they suggested:

> How little our music reflects the stupendous physical discoveries that have so fundamentally altered most of our inherited scientific beliefs which the nineteenth century regarded as axioms. Music, the most physical (and most abstract) of the arts, should be the first to reflect this revolution, as it could be the art to benefit the most.[137]

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[134] Quoted in Fernand Ouellette, *Edgard Varèse*, 72. Originally from Michel Seuphor, *Le Style et le cri* (Paris: Seuil: 1965).

[135] Malcolm MacDonald, *Varèse: Astronomer in Sound*, xii.

[136] He also notes Varèse's interest in the emerging studies of atomic structure, radioactivity, and quantum mechanics. John D. Anderson, "Varèse and the Lyricism of the New Physics," 40.

[137] Edgard Varèse, "Edgard Varèse and Alexei Haieff Questioned by 8 Composers," *Possibilities: An Occasional Review* 1(1947–8), 96. Quoted in John D. Anderson, "Varèse and the Lyricism of the New Physics," 37 and fn 18.

This revolutionary rhetoric, implicating both the physical sciences and twentieth-century musical modernism, is the same that surrounded Einstein. Varèse, then, in addition to standing as a musical counterpart to Einstein, consciously kept up with the news of Einstein's theories.

In terms of specific ideas from Einstein that led Varèse to develop certain musical ideas, Anderson suggests two. He highlights two concepts from Einstein's work that sparked the composer's interest: the speed of light as a constant and the impossibility of simultaneity.[138] Anderson implies that these two ideas were the most salient features of relativity theory for Varèse. He then argues that they served as the "operative basis of Varèse's concept of 'metrical simultaneity' [which] places different voices in different frames of reference with respect to motion and time."[139] My examination of Varèse's own writings about his music shows that these two temporal concepts play an important role in shaping the composer's ideas about the existence of music in space.

In a lecture given about current music entitled, "Music and the Times" (given in Santa Fe, New Mexico in August 1936), Varèse reveals familiarity with the world-wide debates surrounding Einstein's theories of relativity. He makes his knowledge of Einstein's work clear through the adaptation of terms related to relativity theory in a discussion of musical space. Varèse writes:

> We have actually [i.e. currently] three dimensions in music: horizontal, vertical, and dynamic swelling or decreasing. I shall add a fourth, sound projection—that feeling that sound is leaving us with no hope of being reflected back, a feeling akin to that aroused by beams of light sent forth

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[138] John D. Anderson, "Varèse and the Lyricism of the New Physics," 43–4.

[139] John D. Anderson, "Varèse and the Lyricism of the New Physics," 44.

> by a powerful searchlight—for the ear as for the eye, that sense of projection, of a journey into space.[140]

In referring to a "fourth dimension" Varèse seems to be invoking Einstein—but certainly on his own terms. Varèse's fourth dimension, after all, is not time per se. Instead, it is the closest thing to time that Varèse brings into discussions on his pieces: sound projection. This movement of sounds in space has an implied temporality to it, but it is strangely linear—the "sound is leaving us with no hope of being reflected back." In comparing this invariably moving sound to a beam of light, however, Varèse seems to be acknowledging the "constant" that helped Einstein discover the flexibility of time and space: the speed of light.[141] While others had determined the speed of light a few years early, Einstein determined that this value was a constant, no matter what inertial frame of reference it was being observed from. This idea was critical to Einstein's formation of the concept of space-time. In comparing the constant linear motion of light to the projection of sound in space, Varèse is making reference to the axis around which Einstein's notion of space-time revolves (the constant speed of light). The acknowledgement of this constant implicitly recognizes an Einsteinian concept of musical space.

The idea of Einsteinian space (that is, space that is fundamentally interwoven with time) in the music of Varèse can be further confirmed by a look at a quotation that is remarkably similar to the one discussed above. In a *New York Times* interview in December 1936, within the article "Varèse Envisions Space Symphonies," Varèse gives

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[140] Edgard Varèse, "Music and the Times," in Daniel Albright, *Modernism and Music*, 186.

[141] Anderson notes that the "beam of light" related to "a journey into space" was adapted from Arthur Eddington's popular book *The Nature of the Physical World* (1928). "In discussing the quantum transmission of light, Eddington uses the example of a beam of light leaving the star Sirius and striking the eye of an observer on earth: 'For all they knew they were bound on a journey through endless space.'" John D. Anderson, "Varèse and the Lyricism of the New Physics," 45.

an account of a concert he heard in Paris during which he noticed the effects that the unusual acoustics of the hall had on his listening experience:

> Probably because the hall happened to be over-resonant, I became conscious of an entirely new effect produced by this familiar music. I seemed to feel the music detaching itself and projecting itself in space. I became conscious of a third dimension in the music.
>
> I call this phenomenon "sound projection," or the feeling given us by certain blocks of sound. Probably I should call them beams of sound, since the feeling is akin to that aroused by beams of light sent forth by a powerful searchlight. For the ear—just as for the eye—it gives a sense of prolongation, a journey into space.[142]

In this quotation, the time element is not so removed. In fact, sound projection—what he calls the third dimension of music in this article, but was called the fourth dimension in the lecture previously discussed—gives a "sense of prolongation" rather than a "sense of projection" as the lecture states. Additionally, the author of the newspaper article sets up this extended quotation from the composer by explaining that "Mr. Varèse said he first realized the possibility of capturing space-rhythms." This rhythmic aspect is connected in the article to both time and space when the author discusses the composer's approach to music: "Mr. Varèse's particular interest is in composing rhythms in space as well as rhythms in time."[143] The disparities between the two similar statements about the spatial aspects of music help to reconfigure Varèse's "purely" spatial approach avowed in the lecture. If we regard the lecture in light of the article quotation, it is easier to see that a temporal element was implied in the lecture's discussion of sound projection. Rather than discussing rhythm or time directly, Varèse adopts Einstein's fourth dimensional terminology and implies temporality in doing so.

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[142] "Varèse Envisions 'Space' Symphonies," *New York Times* (6 December 1936), N7.

[143] "Varèse Envisions 'Space' Symphonies," *New York Times* (6 December 1936), N7.

It is possible, then, to reconsider Varèse's space-centric philosophy of music. By isolating the more direct temporal associations made in the article version and pairing these with the less overt references to Einstein's notions of time, we can begin to think of Varèse's aesthetic goals on a larger musical space-time continuum. In describing his attraction to the sciences, Varèse stated that "I often borrow from higher mathematics or astronomy only because these sciences stimulate my imagination and give me the impression of movement, of rhythm."[144] For Varèse, creating musical resonances with the sciences inherently brought a sense of rhythm and time. Thus even in his highly spatialized composition, the element of time is woven in. Of course the piece most spatialized was his unfinished work, *Espace*.

This work, however, was not the first piece that Varèse used to explore space in music. John Strawn has analyzed Varèse's 1924 composition *Intégrales* in great depth, revealing the extent to which the composer constructed the piece to reflect his ideas of "sound-masses" moving—and projecting—in space.[145] In Varèse's program notes for the piece's 1925 premiere and in a retrospective look at the piece given in a lecture in 1939 (just after he spent years working out the never-finished *Espace*), he makes his intentions clear:

> *Intégrales* was conceived for a spatial projection. . . . Whereas in our musical system we divide up quantities whose values are fixed, in the realization I wanted, the values would have been continually changing in relation to a constant. . . . In order to make myself better understood—for the eye is quicker and more disciplined than the ear—let us transfer this conception into the visual sphere and consider the changing projection of a

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[144] Quoted in John D. Anderson, "Varèse and the Lyricism of the New Physics," 36. Taken from the program notes written by Varèse for the premiere of *Intégrales* with regards to the title of that piece.

[145] John Strawn, "The *Intégrales* of Edgard Varèse: Space, Mass, Element, and Form," *Perspectives of New Music* 17/1 (Autumn-Winter 1978), 138.

> geometrical figure and plane surface moving in space, but each at its own changing and varying speeds of lateral movement and rotation. The form of the projection at any given instant is determined by the relative orientation of the figure and the surface at that instant.[146]

Like Einstein, Varèse employs a visual metaphor to illustrate a complicated problem in the perception of space. Varèse pictures a geometrical figure and the plane, both of which move with respect to each other and to a constant. Again we can see that Varèse picked up on the importance of the speed of light in Einstein's thinking about the fabric of space-time. Varèse specifies that we envision a geometrical figure and a plane—perhaps an object and space. The figure moves with respect to the plane—regular motion, which we can easily comprehend in a Newtonian world—but additionally, Varèse notes, that the plane appears to shift as well when both the figure and the plane are examined with respect to the constant—relative motion in Einsteinian terms which allows for entire planes of space, that is inertial frames, to move with respect to light. Not only that, Varèse seems to imply that the figure and the plane mutually shape one another; in Einstein's view of the world, a mass has the ability to "bend" space, just as space has the ability to alter the appearance of a mass. We can see then, that Varèse is attempting to translate some rather complicated notions in theoretical physics into some (perhaps even more complicated) notions in "theoretical music." These ideas were circulating in his mind before he began work on *Espace*, as he was thinking about the nature of space and music in *Intégrales*, but may have been solidified through his attempts at composing *Espace*.

Varèse worked on *Espace* throughout his "silent period," which began after the premiere of *Density 21.5* and lasted into the 1940s. He had moved to the United States

[146] Quoted in John Strawn, "The *Intégrales* of Edgard Varèse: Space, Mass, Element, and Form," 139.

from France in 1915 and lived mainly in New York City, composing and conducting. In 1936 and 1937, Varèse lived in New Mexico where he gave lectures and classes, but completed no musical compositions.[147] *Espace* was conceived during this period, over and over again, as Varèse supposedly tore up the score every night (although some sketches survive now). It had an unconventional chorus (with text and noise-making) that was, at one point, supposed to be heard at the end of a large symphony, "a space-age Beethoven's *Ninth*."[148] The work was to be heard simultaneously across the world, using radio waves to allow the symbolically united choir to "erupt into a 'final crescendo . . . projecting . . . into space.'"[149] Varèse's student Chou Wen-Chung called the work "a sound montage in space."[150] Varèse poetically described the work as "voices in the sky, filling all space, crisscrossing, overlapping, penetrating each other, splitting up, superimposing, repulsing each other, colliding, crashing together."[151] This statement remarkably parallels Varèse's ideas about the movement and projection of sound masses in space as laid out in "Music and the Times:"

> When these sound-masses collide, the phenomena of penetration or repulsion will seem to occur. . . . In the moving masses you would be conscious of their transmutation when they pass over different layers,

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[147] For a full and concise timeline see Chou Wen-Chung, "A Varèse Chronology," *Perspectives of New Music* 5/1 (Autumn-Winter 1966), 7-10.

[148] Olivia Mattis, "Varèse's Multimedia Conception of 'Deserts'," *Musical Quarterly* 76/4 (Winter 1992), 558.

[149] Olivia Mattis, "Varèse's Multimedia Conception of 'Deserts'," 573.

[150] Chou Wen-Chung, "Varèse: A Sketch of the Man and His Music," *The Musical Quarterly* 52/2 (April 1966), 166.

[151] Edgard Varèse, cited in Chou Wen-Chung, "Varèse: A Sketch of the Man and His Music," *The Musical Quarterly* 52/2 (April 1966), 166. Original source not given.

> when they penetrate certain opacities, or are dilated in certain refractions.[152]

We would be justified, then, to view *Espace* in light of the recognizably Einsteinian traits outlined in that essay and above. The work can be considered Einsteinian in a number of ways, both philosophically and in the various ways the work attempts to achieve Varèse's truly Einsteinian aesthetics of space-time in music.

The title *Espace*, which literally means "space," indicates a musical exploration of the concept so important to Varèse's aesthetic philosophies. The work was, at times, a stage work, a one-movement symphony, and a choral-orchestral work. It also went by several other titles at certain points of its inception, including: *The-One-All-Alone, Sirius, Il n'y a plus de firmament,* and *L'Astronome*. Although the work was known by the title *Espace* at the time in which it got the most attention in the press, especially when it seemed to Varèse that he had a possibility of performing it in 1934, each version presents fascinating elements that tie them to Einstein's theories. When I analyze some of the textual and metaphorical content of *Espace,* I will refer to versions that may be known by other titles. Although there is some scholarly dissent about how related these multiple unfinished works were, I believe this nebula of pieces all represent Varèse's attempts to fully realize his concept of sound projection in space in response to Einstein. I think the scientific focus that turns up in these pieces sets them apart as his test of Einsteinian methods in music.

One of the earliest incarnations of the cluster of works known as *Espace* was a stage work. This is most often referred to as *L'Astronome*. It deals with an eccentric astronomer's preoccupation with the star Sirius, which seems to be communicating with

[152] Edgard Varèse, "Music and the Times," quoted in Daniel Albright, *Modernism and Music: An Anthology of Sources,* 186.

the earth-bound astronomer via mysterious numerical signals. Varèse drafted a number of scenarios with text and stage directions. The scientist figure in this version presents the possibility of an interesting comparison: the astronomer could represent Einstein. Varèse jotted down notes, which were later transcribed by Ouellette:

> Discovery of instantaneous radiation – speed 30,000,000 ties that of light. Rapid variations in the size of Sirius (explosion) which becomes a Nova. All the astronomers examine the Companion – this is where signals are being transmitted from. (The Companion is the active agent).
>
> . . .
>
> Regular messages from Sirius. Mysterious – in musical waves (supple, fluctuating). The Wise Men study them. Perhaps it is the acoustical language of Sirius. [Crossed out by Varèse:] Its song envelops the Earth. Haunting – yet elastic – subject to variations – according to the action – for [indecipherable] triumphant at the end – when it accompanies the luminous envelope which absorbs the Astronomer.[153]

Could this be Einstein in search of proof for his theory in the form of light bending around a star? This possibility, interestingly, has come very close to being recognized by MacDonald. The author notes that at the head of the passage given above Varèse had jotted, among other terms, the word "Eddington." This prompts MacDonald to explore Sir Arthur Eddington's connection to this work by examining contemporaneous research into the stars Sirius A and Sirius B (the "companion"). This research, conducted by American astronomer Walter Adams in 1925, applied Einstein's theories of relativity, at the prompting of Eddington who had, of course, confirmed Einstein's theories in 1919.

To take things another step further, I think it is possible to view the Astronomer character as Einstein himself. A closer analysis of this scenario brings out the Einsteinian aspects. The Astronomer discovers mysterious radiation that moves at the same speed as

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[153] Edgard Varèse, "The first sketch of l'Astronome," in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 220–21. This version contains Varèse's crossed out portions that were not included in the Fernand Ouellette transcription (on p. 115).

light. The scientist is obsessed with light that comes from the companion star to Sirius and can be seen when observing the major star. The light "absorbs the Astronomer" towards the end of the scenario after "haunting" him, but in the end the Astronomer is "triumphant." Varèse seems to have meant that the light would, at the climax of the stage work, literally absorb the Astronomer, turning him into light, and "vanish into the atmosphere."[154] This language is reminiscent of one of Einstein's most well-known thought experiments: Einstein riding a beam of light in order to see what moving at the speed of light would feel like. Perhaps Varèse was trying to add another Einsteinian element, then, as he allowed his protagonist to become one with the beam of light radiating from space.

The proposed orchestration—brass, extended percussion, and low strings—and the staging for *The One All Alone*/*Sirius* were intended to be unconventional, yet according to Alejo Carpentier, "a sort of summa of Varèse's aesthetic." About the set design, he wrote:

> Synthetic décor, built by engineers, not painters, exploiting every possibility offered by the use of electricity on stage, with superimposed planes, various parts of the action taking place simultaneously, and heavy velvet curtains as a backcloth.[155]

Varèse's idea to include simultaneous, superimposed images as well as certain scenes taking place at once suggest an aesthetic that explored simultaneity in art, adding additional Einsteinian traits.

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[154] From Alejo Carpentier's description of the action. Alejo Carpentier, "Edgar Varèse Escribe Para El Teatro," *Social* 16/4 (April 1931) quoted in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 231.

[155] Alejo Carpentier, "Edgar Varèse Escribe Para El Teatro," quoted in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 227.

A related stage work, known principally as *Il n'y a plus de firmament,* was a collaboration between Varèse and Antonin Artaud, noted French avant-garde dramatist. In this version, the Astronomer character becomes the "Scientist," recasting the more mythical character of the earlier version in modern terms. Some of Artaud's text, words that were to be part of a repeated utterance over a loudspeaker, seems to reflect an Einsteinian sensibility: "STUPENDOUS DISCOVERY. SKY PHYSICALLY ABSOLISHED. EARTH ONLY A MINUTE AWAY FROM SIRIUS. NO MORE FIRMAMENT."[156] This "discovery" sounds like a fanciful version of Einstein's own ideas about space and time. With his discovery, absolute space and time became relative. It seems like Varèse/Artaud have poetically transcribed the idea of the end of absolute space in the abolishment of the sky and the firmament, and the end of absolute time in proclaiming the Earth was only a minute from Sirius, a fact tied to the discovery of a beam of radiation moving at the speed of light. Even in this short-lived incarnation of the work, then, we find suggestions of Einsteinian metaphors in the text.

Varèse spent the most effort in trying to bring the choral-orchestral version to fruition and it is this version, going by the title *Espace*, that received so much publicity in the press in the mid-1930s. Varèse wished to have the piece performed simultaneously in multiple cities across the globe, including London, Moscow, New York, and Beijing by means of radio waves (and high levels of precision and coordination amongst conductors). Ouellette describes Varèse's grand vision:

> The choirs, each singing in its own language, would have made their entries with mathematical precision. The world would have been divided up into seconds, with the greatest exactitude, so that the chorus in Paris—or Madrid, or Moscow, or Peking, or Mexico City, or New York—would

[156] Given in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 238.

> have come onto the air at exactly the right moment. All men could have listened simultaneously to this song of brotherhood and liberation.[157]

While this work was never performed, Varèse's vision for it reflects Einsteinian traits.

This version, sometimes referred to by scholars as a "choral symphony," also included many of the dramatic elements of the previous version in the sung text for the choirs. While working on *Espace*'s text, Varèse wrote to his wife Louise saying, "More than ever only the epic interests me—and the great cries into space. For no one—or only for those capable of understanding the signal."[158] These sentences closely reflect the texts of the earlier stage works, showing that as he was working on the choral-orchestral work, the themes continued to resonate for the composer. In a collaboration that never panned out with Henry Miller, the American writer drafted some text for *Espace* including elements that reflected Varèse's earliest texts: "The sky turns white. The air grows chill. Suddenly a knife flashes and in the sky a gleam of light appears. A blue star coming nearer and nearer—a dazzling, blinding star."[159] The image of a beam of light remains and, as we can see in some of Miller's text that most closely resembles Artaud's text in *Il y'a plus de firmament*, so does the Einsteinian theme of the destruction of absolute space and time. Miller's text relates these new ideas even more explicitly: "Only the chorus is left. And the elements: helium, oxygen, nitrogen, sulfur et cetera. Time rolls away. Space folds up. What is left of man is pure MAN…"[160] These images and themes not only

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[157] Fernand Ouellette, *Edgard Varèse*, 132.

[158] Quoted in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 306.

[159] Henry Miller, 176. Quoted in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 309.

[160] Henry Miller, 178. Quoted in Malcolm MacDonald, *Varèse: Astronomer in Sound*, 310. Although Varèse did not choose to use this text in the end, MacDonald believes the composer "approved of the sentiments." Malcolm MacDonald, *Varèse: Astronomer in Sound*, 310.

confirm the connections between the stage works and the choral-orchestral work, but also show Varèse's continued interest in making the latter work Einsteinian.

Additionally, the choral-orchestral version reflects many of the philosophical implications of Einstein's relativity theory. In choosing a performance format that required simultaneous radio transmission of multiple live performances, the piece explored the philosophical (and scientific) ideas of simultaneity. This concept was, of course, a hot topic at the time of the work's composition; Einstein's assertion that true simultaneity was not possible was still very current. The work certainly highlights the impossibility of true simultaneity, since a simultaneous broadcast would have required the different musical groups, already separated geographically and spatially, to perform at different times, for they would have to account for the different time zones across the globe (which was, as we learned from our discussion of Einstein's preoccupation with time zones and train travel, a relatively new phenomena).[161]

The use of metaphor of light through the various versions of *Espace* reveals Varèse's attempts to incorporate his most profound ideas about musical space and time into this work.[162] In the earlier stage versions of *Espace*, *L'Astronome*/*Sirius* and *Il n'y a plus de firmament*, the idea of light takes the shape of a beam of light. One that mesmerizes the Astronomer/Scientist and that eventually consumes him, both figuratively

[161] One might even say, with hindsight, that the failed work truly does highlight the impossibility of simultaneity. The completion and performance of the work were put off, among other reasons, because of the war—something that would have made this modernist display of the brotherhood of man via radio waves quite difficult as well.

[162] Olivia Mattis argues that this preoccupation had come about "because Varèse, like Scriabin, Messiaen, and a few others, imbued his compositions with a synaesthetic aspect." Olivia Mattis, "Varèse's Multimedia Conception of 'Deserts'," 573. Varèse was interested in the idea of light, it seems, from an early time in his compositional career. He also composed a work in 1911 called *Mehr Licht* in which, according to Ouellette, "Varèse intended to signify *more light*, as though it were a question of filtering the raw material of sound in order to render it more and more luminous." Fernand Ouellette, *Edgard Varèse*, 37.

and literally. This idea of a beam of light projecting into space is closely allied with Varèse's musical idea of sound projecting into space. In fact, the absorption of the Astronomer by the light—the transformation of mass into energy—furthers this metaphor for Varèse, since his precise idea in his aesthetics of music was to create an aural experience of "sound-masses projecting into space." We can read his use of this beam of light, then, as the visual manifestation of his important musical idea. When we reconsider how light tied to Einstein in these stage works, we come to some interesting conclusions. If the beam of light represents Varèse's sound-masses projecting into space, then Varèse makes the Astronomer/Scientist—arguably, Einstein—into the main protagonist not just in his music-drama, but also in his theory of music. It is Einstein, then, whose "stupendous discovery" brings the beams of sound to the world's attention.

In the choral-orchestral *Espace*, Varèse's vision of sound-masses projecting into space was even more fully achieved. Varèse wrote of the first movement that it was "built on the shifting play of planes, volumes, masses in space."[163] While some of the light-related texts remained, especially with regards to the observer of the distant star, his sonic material was literally to be projected into space were the work to be performed over the radio as planned. In this most ambitious version, the radio waves would allow Varèse's sound-masses—actually the sounds of quite massive choirs from all over the globe—to reach audiences in real time, ignoring the most traditional bounds of space and time required for a more conventional compositional premiere. This work was truly to embody Varèse's Einsteinian vision of music.

[163] Edgard Varèse to Ouellette quoted in Fernand Ouellette, *Edgard Varèse*, 134.

Time-Space: George Antheil and the Ballet Mécanique

Because of his clear scientific interest, Varèse's sometimes-fanciful descriptions of his musical aesthetic were more easily deciphered as references to Einstein and his contemporaneous theories of time and space. American ultramodernist George Antheil was not necessarily as scientifically oriented (although we have already been introduced in "Chapter 1: Introduction" to his techno-centric upbringing).[164] However, Antheil's Einsteinian aesthetics could not have been more bluntly stated by the composer; in the mid-1920s he developed a theory of music called "time-space."

For Antheil, invoking this Einsteinian terminology offered the possibility of making important advances in his career. It certainly gave him an inroad into the diverse artistic world of Paris—into the world of poets, artists, and fellow avant-garde intellectuals like Ezra Pound, James Joyce, and Jean Cocteau—which was abuzz with debates about Einstein, Henri Bergson, and new theories of time, space, and the universe. Antheil may also have thought that his Einsteinian references would allow him the opportunity to bring his more radical musical ideas to the larger public, which was, of course, just as intrigued by Einstein's theories. Antheil also kept well in touch with his musical and artistic comrades in New York, where he lived in the early part of the 1920s and where he returned following his years in Paris. He must also have known that Einstein was the talk of composers, artists, intellectuals, and the general public on American soil as well.

Antheil, like many of the composers I have examined here, was most likely introduced to Einstein and his ideas through popular newspapers, both in the United

[164] Antheil was also an inventor. In fact, he invented and patented a torpedo guiding device with actress Hedy Lamarr.

States and in France. He was almost certainly exposed to debates about Einstein's notions of time and space-time through his acquaintances in Paris, including Pound who discusses Einstein quite explicitly in his theory of music. From his general introduction to Einstein through the press and friends, Antheil must have picked up on the common distilled version of Einstein's relativity theory: Einstein's new concepts of space and time.

Fortunately, we have many points of access to Antheil's theory of time-space and I will explore several. The first comes in the form of a theory of music *cum* biography by the American poet, expatriate, and friend of Antheil's, Ezra Pound, whose own theory of music, penned as the opening section of a biography of Antheil, was discussed in the previous chapter. Another source is Antheil's letters and other writings. One of the most important points of access, of course, is Antheil's music. After exploring the significance of the term time-space for Antheil, I will discuss the specific ways in which the composer attempted to incorporate his idea of time-space into his *Ballet Mécanique* (1923–25).

Many of the first indications of Antheil's personal definition of time-space fall within the biographical portion of Pound's book on Antheil. Within this section, Pound draws a great deal from Antheil's personal notes about music that the composer had given Pound shortly after their first meeting in Paris. Often Pound paraphrases Antheil's ideas and, as the section goes on, directly quotes bits and pieces of Antheil's thoughts about contemporary music. This access to Antheil's original thoughts was heavily mediated by Pound (through both his own artistic prejudices and simply through his cumbersome and dramatic prose). Pound mentions Antheil's theory of time-space in a few places in this section, explaining very little about the concept directly.

In the first instance, Pound situates the composer's idea of time-space in its broader artistic context, saying,

> He has, in his written statements about music, insisted that music exists in time-space; and is therefore very different from any kind of plastic art which exists all at once.
>
> Just as Picasso, and Lewis, and Brancusi have made us increasingly aware of form, of form combination, or the precise limits and demarcations of the flat forms and of volumes, so Antheil is making his hearers increasingly aware of time-space, the divisions of time-space.[165]

Pound seems to be doing little else than emphasizing the fact that Antheil's compositional and ideological focus (as contained in his theory of time-space in music) is time in music. Since music unfolds over time, it must be heard and analyzed this way (in effect, this is almost the exact opposite from Antheil's own explanation of time-space, as we will see). Later, Pound discusses the composer's theory in its scientific context, pointing out the relationship between time-space and Einstein's relativity (this is also the second direct reference to the physicist in the book).

> Antheil is supremely sensitive to the existence of music in time-space. The use of the term "fourth dimension" is probably as confusing in Einstein as in Antheil. I believe that Einstein is capable of conceiving the factor time as affecting space relations. He does this in a mode hitherto little used, and with certain quirks that had not been used by engineers before him; though the time element enters into engineering computations.
>
> The x, y, and z axes of analytics would appear to me to provide for what Antheil calls the fourth dimension of music, the "oblique," but technical mathematical language is almost as obscure as Antheil's. The first of his piano sonatas shows perfectly clearly what he means. And a gang of African savages would probably illustrate what he means by the 'hole in time-space.'[166]

Again, Pound reiterates Antheil's insistence that time is the most important element of musical form and composition. Moreover, we can see that Pound wanted to highlight

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[165] Ezra Pound, *Antheil and the Treatise on Harmony*, 41–2.

[166] Ezra Pound, *Antheil and the Treatise On Harmony* (1927), 56.

Antheil's relationship with the term time-space as both a writer/analyst and composer by emphasizing Antheil as being "sensitive" to the existence of music in time-space. Antheil thus shows an analytical "sensitivity"—he has a keen ear for other composers' innovations in music with regard to time-space—and an aesthetic "sensitivity"—he is uniquely aware of music's existence in time-space. Like Einstein, then, Antheil has the ability to see (or hear) in the world what most of its other inhabitants cannot. For Pound, this is reflected in the language that Antheil uses to describe his theories and his compositions. The two geniuses, Antheil and Einstein, communicate in uncommon or even uncanny terms—the fourth dimension or holes in time-space. Yet, Antheil's compositions in time-space, condensed by Pound into the idea of time-focused composition, are the perfect artistic parallel to Pound's theory of music.

Antheil uses the term time-space frequently in his reprinted musings. It is worthwhile to examine their use here, in order to understand how Antheil sees his work in relation to the work of others. He singles out Debussy for his "new propulsion of time-spaces"[167] as well as Bartók, saying: "Bartók, while sense of time-space in the violin sonata is essentially masterful and probably his own, has done much bird-stuffing with folksongs of Hungary."[168] Antheil sees the most effective use of time-space in the music of Stravinsky, his youthful hero, whom he followed to Paris. "Has anyone beyond Stravinsky brought forward a new propulsion of time-space, a new comprehension of musical mechanism?"[169] These pronouncements certainly highlight the composers who

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[167] Ezra Pound, *Antheil*, 58.

[168] Ezra Pound, *Antheil*, 60.

[169] Ezra Pound, *Antheil*, 59.

Antheil held in highest esteem—for upon them he bestowed his beloved concept and term—but the term itself is still somewhat out of focus.

Luckily, further evidence is yet available in the Pound text. In describing the nature of contemporary composition in a negative sense—what not to do—Antheil uses the concept of time-space as a contrasting, preferable alternative.

> Two ways music cannot go: first, purely vertically—one is no longer satisfied with static sensuality that lacks adequate machinery to move it. Second, the purely horizontal, organization of time-spaces in single plane is no longer interesting.[170]

He is rejecting here "purely vertical," or, perhaps music that tends only to the sensuous harmonies it contains, as well as music that is "purely horizontal," which suggests a melodically-dominated lyrical style or, possibly, an emphasis on linear counterpoint. He considers both of these "single plane" styles boring or flat, to take his visual plane metaphor more literally. Instead, he implies an alternative; composition with attention to time-spaces, which is suggested here to be the true nature of the raw musical materials, is preferable.

Antheil's comments about time-space can also be found in a number of his letters, published articles, and in drafts of articles about music (including those that Pound was given by Antheil). Many of Antheil's discussions of time-space relate to his controversial composition *Ballet Mécanique*. In his letters penned around the time of the Paris and New York premieres of the composition, Antheil discussed the role of time in music and the idea of time-space. He most often uses these terms in the context of *Ballet Mécanique.* Antheil frequently penned letters to his primary benefactress Mary Louise Curtis Bok about his principle of time-space with regards to his controversial

[170] Ezra Pound, *Antheil*, 60.

composition *Ballet Mécanique*. In one such letter, dated July 1925, Antheil writes: "Here . . . is a real germ of revolution in music for you—here is the beginning of space and time in music—abstraction, completion. But a thousand words will do no good."[171] Antheil's assertion that *Ballet Mécanique* marks the "beginning of time and space in music" and its equivalence with a musical "revolution" is unmistakably a reference to Einstein. Carol Oja notes that Antheil also linked time and space in a 1927 essay saying, "Time is the principle subject of my meditations. Time! Time must be filled—'it is the space of our musical canvas.'"[172] Here Antheil's typical focus on time is posed as a metaphorical conflation of both space and time. He seems to be saying here: time *is* space.

Antheil also discussed *Ballet Mécanique* with respect to time-space in retrospective discussions of the work. About ten years after the work's Paris premiere, Antheil expounds upon the work in a letter to critic Nicolas Slonimsky, dated 21 July 1936. Here Antheil brings in the terms "time canvas," an idea that he associated with his term time-space. Antheil looks back on the revolutionary work, saying:

> I personally consider that the *Ballet Mécanique* was important in one particular and this is that it was conceived of in a new form, that form specifically being the filling out of a certain time canvas with musical abstractions and sound material composed and contrasted against one another with the thought of time values rather than tonal values. . . .Now in order to paint musical pictures one must admit right at the outset that the only canvas of music can be time. Music does not exist all at once like a painting but it unrolls itself. Nevertheless, we must consider it in the terms of painting as something that exists all at once. In other words, time is our musical canvas, not the notes and timbres of the orchestra or the melodies and tunes of the tonal forms handed down to us by the great

[171] George Antheil to Mary Louise Bok, July 1925, Music Division, Library of Congress, George Antheil Correspondence, ML 94.A65. Quoted in Linda Whitesitt, *The Life and Music of George Antheil, 1900–1959* (Ann Arbor, MI: UMI Research Press, 1983), xviii.

[172] George Antheil, "Untitled manuscript beginning 'The Drawings of Miro'," in *Making Music Modern: New York in the 1920s* (New York: Oxford University Press, 2005), 84. Also quoted in Linda Whitesitt, *George Antheil*, 104-5.

> masters. In the *Ballet Mécanique* I used time as Picasso might have used the blank spaces of his canvas. I did not hesitate, for instance, to repeat one measure one hundred times; I did not hesitate to have absolutely nothing on my pianola rolls for sixty-two bars; I did not hesitate to ring a bell against a certain given section of time or indeed to do whatever I pleased with the time canvas as long as each part of it stood up against the other. My ideas were the most abstract of the abstract.[173]

Antheil makes it clear that time is the primary element of musical composition, especially in the phrase "I did not hesitate to ring a bell *against a certain given section of time*."[174] For example, it is apparent that aural clashes that might occur in the "most abstract of the abstract" of musical works occur when time clashes with time, not when dissonances are created between certain pitches. Antheil's musical canvas analogy also removes the absolutism of time, for time cannot be considered an even, unidirectional background in Antheil's conception. In insisting that time is the canvas, and that a piece of music must be viewed "all at once" rather than from instant to instant, Antheil is echoing Einstein's often-repeated mental exercise that he employed to help the general public understand relative time. If we imagined ourselves on a train moving away from a clocktower at the speed of light, time would stand still, Einstein said. In conceiving of his compositions as paintings on a musical time canvas, Antheil was (theoretically) doing in sound what

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[173] George Antheil to Nicolas Slonimsky (1936) in Daniel Albright, *Modernism and Music: An Anthology of Sources* (Chicago: Chicago University Press, 2004), 71. Also quoted in Linda Whitesitt. The omitted portions marked by an ellipsis in the Albright and above are: "Up until the *Ballet Mécanique* I think that nobody actually thought of music particularly in the time sense. That is to say, they thought of it as notes and sound and various pleasant and unpleasant arrangements but not from the viewpoint of the whole musical canvas. Or to state the case a trifle more simply, let us consider that we are painting instead of composing, and that instead of using oil colors we are using tone. Upon what would we paint? What is our canvas? How would Picasso tackle a painting if he had musical colors to paint with? Picasso was interested in form primarily, the new form. He looked at his canvas. There it was blank, so and so many feet square. What was he to do with it? Was he simply to contrast one group of colors against the other? No. Picasso, like all great painters of this period, was interested in the form." See Linda Whitesitt, *The Life and Music of George Antheil*, 105–6.

[174] Emphasis mine.

cubists were doing in paint.[175] In thinking of time—the primary stuff of music—not as absolute, but as something that could be heard all at once, Antheil was developing his own Einsteinian perspective on composition.

In his letters and articles, Antheil pushes for the dominance of the temporal aspect of music, noting its diminutive place in most previous theories of music (something also remarked upon by Pound). While we have direct references to Einstein in Pound's *Treatise*, Antheil's indirect references to Einstein and relativity (through the use of terms like time-space and the fourth dimension) form an even stronger case for intellectual borrowing. Although he did not use the term relativity or invoke Einstein's name (in fact, neither term appears in Linda Whitesitt's comprehensive, source-rich biography of the composer!), it is clear that Antheil was deeply indebted to the physicist's theories as a model for his own.

Antheil composed *Ballet Mécanique* while living and working in Paris between 1923 and 1925. It was an extraordinary work—in the composer's vision—that required sixteen player pianos, a hugely extended percussion section, and a number of electric sirens and bells. Antheil adapted the work more than once to fit performance needs and, perhaps, in an effort to shrink the significant margin of error in trying to synchronize sixteen mechanical player pianos (pianolas). The piece was first premiered privately in the summer of 1925 at the Maison Pleyel by Bravig Imbs, a friend of Antheil's, for a small audience of James Joyce, Jacques Benoist-Mechin (to whom this version is

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[175] In addition to the reference to Picasso in the quote discussed above, and the comparison made by Ezra Pound to Picasso, Antheil frequently made mention of Picasso. The composer must have perceived a similar aesthetic stance to his own in Picasso's works and the ideologies behind them. In a letter to Bok in 1922, Antheil explains the kinship he felt with Picasso, which was stronger than any he felt with another composer, even his idol Stravinsky. He said: "We of the future find our sense of organization from Picasso rather than Beethoven or Stravinsky for that matter. We should find our sense of forms and time-spaces molded by month and months of studying the sculptures of Brancusi or Lipchitz..." Letter from Antheil to Bok, August 1922, LOC, quoted in Linda Whitesitt, *The Life and Music of George Antheil*, 69.

dedicated),[176] Sylvia Beach, Elliot Paul, Adrienne Monnier, and several critics—Antheil himself was in Tunisia at the time.[177] Several more private performances of *Ballet Mécanique* were given in Paris before its public premiere on 19 June 1926 at the Théâtre des Champs-Elysées.[178] Even this version used a reduced orchestration of the full scoring Antheil had in mind—only one amplified pianola and a pared-down percussion and xylophone section.[179] The audience shouted and whistled, but in the end, gave Antheil a standing ovation. A month later, Antheil arranged a salon performance with Virgil Thomson that used eight pianolas and a full percussion section (leaving barely any room for the audience).[180] The American premiere was quite a bit more disastrous than the Parisian one. On 10 April 1927 *Ballet Mécanique* was performed at Carnegie Hall, conducted by Eugene Goossens, and presented alongside a number of Antheil's other works including his *Jazz Symphony*. Antheil seems to have intended the concert to be a publicity stunt to make him either famous or infamous—either would do—amongst American audiences.[181] The pre-concert press sensationalized the Parisian reaction and, when the New York premiere did not elicit any riotous behavior, the post-concert press criticized him for his showboating (not to mention the few musical mishaps that occurred

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[176] At the top of this score, held at the New York Public Library Performing Arts Division, Antheil has written notes on how to cut the pianola roll and the inscription "for my best of friends Jack Benoit-Mechin." JPB 94-1 no. 11 (1924–25).

[177] Linda Whitesitt, *The Life and Music of George Antheil*, 22.

[178] Linda Whitesitt, *The Life and Music of George Antheil*, 23.

[179] The score most closely resembling the one used for this version is also held at the New York Public Library in the Performing Arts Division. JPB 94-1 no. 6 (1926 holograph score).

[180] Linda Whitesitt, *The Life and Music of George Antheil*, 25–6.

[181] See Linda Whitesitt, *The Life and Music of George Antheil*, 31.

due to last-minute additions to the instrumentation).[182] This publicity scandal—much more so than any scandal of a musical variety could have—sent Antheil back to Paris for a number of years.

The earlier versions of the scores were used primarily for performance and were frequently changing in instrumentation and length to reflect the changing needs of a particular performance. They are helpful resources for seeing just how fluid the work was along certain lines and how constricted it was along others. For example, Antheil frequently had to adapt the number of pianolas used or replace pianolas with pianos; even in changing them, however, the rhythmic gestures remain true across parts. Rhythmic patterns and patterns of metric shifts are more or less consistent between versions. This brings out Antheil's musical bias: for him, the rhythmic and metric elements—and how these elements combine—are of the utmost importance. Antheil's 1952–3 re-editing of the score is most important for my analysis. Although many of the musical elements are the same, in this version, Antheil consciously reflected upon editing the score and upon the musical choices he made in his "youth." Luckily he both records these thoughts and analyzes some of the music in the form of his introduction to the piece and a guide to performing it.

In the reflective notes by Antheil, the composer discussed his original compositional intentions in the published notes that accompanied the score. He recalls the ways in which his notion of time-space played out in the score. He states this as directly as possible:

> Interpretively speaking, the Ballet Mécanique was never intended to demonstrate (as has been erronously [sic] said) "the beauty and precision

[182] Linda Whitesitt, *The Life and Music of George Antheil*, 31–41.

> of machines." Rather it was to experiment with and, thus, to demonstrate, a new principle in music construction, that of "Time-Space", or in which the time principle, rather than the tonal principle, is held to be of main importance.[183]

At this retrospective stage Antheil could not be clearer about three important facts: first, his work is not meant as a programmatic interpretation of the sound or movement of machines; two, this work was purposefully constructed to demonstrate his idea of time-space; and, three, for Antheil time-space means a method of composition in which the element of time is more important than the element of tonality.

In her discussion of *Ballet Mécanique*, Carol Oja notes the two places where Antheil plays with the idea of the "fourth dimension" in this piece.[184] The first instance is that of the long stretches of silence that Antheil composed in at the end of the piece. Oja writes, "Through his passages of silence, then, Antheil aimed to project the fourth dimension by essentially suspending time."[185] In looking at the manuscript for the pianola score (1924–5), it is easy to see that Antheil quite consciously composed in this silence. To notate these sections, he used extremely long strings of eighth-note rests, when he could have much more easily used rests in larger note values (especially since this was a

183 George Antheil, "BALLET MECANIQUE 1952-3 RE-EDITING," JPB 94-1 no. 27 (1952–3 re-editing**),** b. New York Public Library Performing Arts Division.

184 Oja analyzes the moments during which Antheil brings time to the forefront for the listener. She states correctly that this is part of Antheil's fascination with the concept of the "fourth dimension," one closely linked with his own idea of time-space. However, her idea of the fourth dimension is slightly misleading, both in historical scientific terms and in terms of Antheil's relationship with these historical terms. She writes, "...in the early twentieth century, it was the fourth dimension that loomed as an unseen component of space, beyond height, width, and depth. It hovered on a hazy border between true physics and pop cosmology." While it is true that the term originated in H. G. Well's fictional tale *The Time Machine*, Antheil would have been well aware of the scientific usage by Einstein and his popularizers. The fourth dimension meant, quite simply, time. From this misunderstanding of the term's scientific context Oja seems to think that Antheil's use of "the temporal facet of the fourth dimension" made him unique among his artist contemporaries who also borrowed the terminology of the fourth dimension. Carol Oja, *Making Music Modern*, 84.

185 Carol Oja, *Making Music Modern*, 84.

handwritten manuscript!). He begins by using groups of ten, fifteen, and even twenty-five eighth rests in a row.[186] By the end of the piece, he is even more drastic: a grouping of thirty-two eighth rests, followed by one of forty, and finally by sixty-four eighth-note rests in a row.[187] As if to clarify his intentions beyond any doubt for the cutter of the pianola roll, he notates each passage of rests within a single measure. Thus for the most grand pause in the final moments of the piece we see sixty-four eighth rests handwritten in to a measure with the time signature of 64/8.[188] Antheil's carefully notated silences highlight the passage of musical time as heard in the real time of the concert hall.[189]

Another instance of Antheil's experiments with the fourth dimension noted by Oja is his extreme use of repetition. This obviously played a role (at least in terms of notation) in the passages of rests mentioned above—although Oja does not discuss this—but it also became audible in the passage that Oja notes about "three fifths of the way through the piece where a fluctuating pattern of clusters is repeated an extraordinary total of thirty-four times."[190] This passage certainly highlights the role of perception in any discussion of musical time; Oja quotes one listener's reaction to these thirty-four

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[186] George Antheil, Ballet Mécanique, JPB 94-1 no. 11 (1924–5), *New York Public Library Performing Arts Division*, 73–75.

[187] George Antheil, Ballet Mécanique, JPB 94-1 no. 11 (1924–5), *New York Public Library Performing Arts Division*, 81–82.

[188] George Antheil, Ballet Mécanique, JPB 94-1 no. 11 (1924–5), *New York Public Library Performing Arts Division*, 82.

[189] Quite unfortunately, this never would have been heard in the American premiere at Carnegie Hall (so it is interesting to read of Oja's emphasis on it). During that disastrous performance, Antheil had decided to use real on-stage sirens instead of off-stage recorded sounds. These "instruments" had not been tested in rehearsal and when the performers forgot to account for the time it took to hand crank each siren, the delay was so severe that the sounds continued well after the final notes had been struck by any performers. See Linda Whitesitt, *The Life and Music of George Antheil*, 36.

[190] Carol Oja, *Making Music Modern*, 85. The musical example is given by Oja as Example 5.4 on page 86 and comes form page 220 of the autograph score.

measures: "This was the 'final ten minutes [that] pounded away,' as one reviewer complained."[191] The dizzying or time-altering effect that Antheil's focus on repetition played certainly brought ideas of time and music to the forefront.

I want to point out one final musical passage that, I believe, holds the most importance for understanding Antheil's vision of time-space in his *Ballet Mécanique*. In the "Instructions for Performance" that accompanied his 1952–3 revisions, Antheil gives a number of practical details learned, presumably, the hard way through his performances of the work in Paris and New York. One note stands out, however, because of its more interpretive or analytical side in addition to the instructive:

> (6) At 6 bars before number 50, on page 70, a new pattern of 2/8, 3/8, 4/8, 5/8, 6/8, 7/8, 8/8, etc. begins lacing in the "time-space" formula. Wherever it occurs, it should be given special attention. Also, at number 53, onwards, the percussion (in L.A.P) begins in patterns of four long whole notes, which gradually double up, compress, then spread out again. These, too, should be given special emphasis against the rest of the composition.[192]

This note points out *precisely* where Antheil intended to employ his time-space principle. In looking at this passage of metric modulations described in the first sentence of the note, we see that Antheil has constructed a complex interplay between the pitched instruments (the glockenspiel, xylophones, and pianos) and the un-pitched instruments (the military drum and the tenor drums). Beginning at eight measures before Rehearsal 50, marked "Presto," the pitched instruments begin a regular pattern of eighth notes and quarter notes that emphasize the notated time signature of 3/4. Two-and-a-half measures into this, on the third eighth note of the measure, the military drum and tenor drum begin

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[191] Carol Oja, *Making Music Modern*, 85.

[192] George Antheil, "Instructions for Performance," JPB 94-1 no. 27 (1952–3 re-editing**)**, b. New York Public Library Performing Arts Division, c. "L.A.P." stands for the sound of a large airplane propeller.

the pattern of metric shifts mentioned by Antheil in his explanatory note: 2/8, 3/8, 4/8, 5/8, 6/8, 7/8, 8/8. However, rather than notate these perceived metric groupings with changing time signatures, Antheil has written them as a long series of eighth notes in the military drum, with all but the first pair beamed together (the tenor drum strikes on the beginning of each grouping as well). He delineates each "meter shift" (both notationally and aurally) with a pair of grace-note sixteenths at the beginning of each grouping.[193]

Musical Example 4.2 - George Antheil, *Ballet Mécanique*, eight measures before Reh. 50

In this way, Antheil creates a play of one temporal plane against the other, of the regular metric pulse against the expanding "bars" in the un-pitched percussion. After the groups of eighth notes in the military drum reach eight, Antheil starts the pattern again two more times (for a total of three). Because of the number of eighth notes used in the full series, the pattern is shifted back in the bar each time in restarts, creating another moment of temporal slippage. At six before Rehearsal 50 the pattern begins on the fourth eighth note of the bar, at Rehearsal 50 it begins on the third, at seven after 50 it begins on the second eighth.[194]

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[193] George Antheil, *Ballet Mécanique (Rev. 1952)*(Delaware Water Gap, PA: Shawnee Press, Inc., 1959), 77–78.

[194] George Antheil, *Ballet Mécanique (Rev. 1952)*, 77, 78, 79.

Following this passage, at Rehearsal 51, Antheil begins a new, yet similar musical idea. He maintains his “time-space” idea of expanding meters, however, in this instance, he employs notated time signatures: 2/8, 3/8, 4/8, 5/8, 6/8, 7/8, 8/8. In each measure the time signature changes, while a constant eighth-note pulse is beaten in the tenor drum. Each meter change is emphasized by the bass drum, which is struck on the first eighth note of every bar, and by Piano IV, whose left hand emphasizes the metric character of each bar with precise rhythms.[195]

Musical Example 4.3 - George Antheil, *Ballet Mécanique*, Excerpt from Reh. 51

The pattern of meter changes is repeated eight bars later and again, immediately following that, at Rehearsal 52. With each subsequent repetition, the tenor and bass drum lines remain the same, offering the constant underlying pulse and the metric shifts, respectively. However, the piano and xylophone lines become increasingly complex, rhythmically speaking, and conform less and less to the metric character of the bars their lines inhabit.[196]

[195] George Antheil, *Ballet Mécanique (Rev. 1952)*, 80.

[196] George Antheil, *Ballet Mécanique (Rev. 1952)*, 81.

Musical Example 4.4 - George Antheil, *Ballet* Mécanique, eight measures after Reh. 51

This second musical idea, beginning at Rehearsal 51 and extending to Rehearsal 53, has the same effect of shifting temporal planes that Antheil's noted passage of time-space at "six before Rehearsal 50." In the earlier passage, the shifting meter (heard in the military drum) was heard against the musical backdrop—or, to use Antheil's own term, the time-canvas—of regular pulses (heard in the glockenspiel, xylophones, and piano). In the passage that follows it, the changing meter acts as the time-canvas (constructed out of the tenor and bass drums rhythmic patterns), while a sense of temporal movement is created on top of it by the increasingly-complex and decreasingly-metric passages (heard in the pianos and xylophones).

To confirm the Einsteinian aspect of this principle of time-space, two things must be addressed: the ideas embodied in the work and the language the composer used to conceive of them. First, the notion that time should be of utmost importance in the piece without regard to tonality. I have already interpreted this idea in terms of Ezra Pound's similar principle of time in music. The idea that time should be elevated in music after so many decades focusing on the importance of tonality—or even the unimportance of tonality, say, for Schoenberg—seeks to bring the recognition and interpretation of musical time to an unprecedented level. I believe this idea, in both Pound and Antheil, is a response to the popular notion that Einstein's relativity theory destroyed notions of absolute space and time.

The terminology used is also central in the case of Antheil. In elevating time, he did not simply decide to call his music "time music" or his principle the "time principle" in music. Instead, he boldly asserted that this theory of composition be called the time-space principle. This obvious reference to Einstein's term space-time makes explicit what Pound only hinted at by comparison. To elevate time to a level more important than tonal principles was to make it time-space—to make it Einsteinian. It is almost as if Antheil is purposefully complicating the terminology of musical time in order to add intellectual (or pseudo-intellectual) depth—to add another dimension to it.

This last linguistic move was, in fact, one that Antheil made himself within his notes on the 1952–3 re-editing. When looking back at the musical materials in the process of revising the work, he reevaluated his musical aesthetics during this period. In doing so he employs even more language borrowed from the popular reception of relativity theory.

> Rather than to consider musical form as a series of tonalities, atonalities with a tonal center, or a tonal center at all, it supposed that music actually takes place in time; and that, therefore, time is the real construction principle, "stuff of music," as it unreels. It is the musician's "canvas." The tones which he uses, therefore, are merely his crayons, his colors. The "Time-Space" principle, therefore, is an aesthetic of "looking," so to speak, at a piece of music "all at once." One might propose, therefore, that it is a sort of "Fourth Dimension"-al way of looking at music; its

> constructive principles may, or may not have been touched in this work, but they have been attempted.[197]

In describing his theory of time-space in music as “Fourth Dimension”-al, it is clear that Antheil was familiar with relativity theory and the way it was popularized in the United States. In the press, a special emphasis was given to the term the “fourth dimension”—i.e. time—in connection with Einstein’s relativity theory. In Einstein’s system the “fourth dimension” was seen as the element which truly separated Einstein’s revolutionary theory of the universe from Newton’s classical one. Antheil recognized the ways in which his ideas about music during the time in which he composed *Ballet Mécanique* were subconsciously in line with Einstein’s relativity.

As scholars, we can see that *Ballet Mécanique* stands out amidst those works that we might dub Einsteinian because it is both a representation of a work whose guiding principles attempt to embody or highlight a specific notion of Einstein and, importantly, we are able to say with some confidence that the composer himself consciously attempted to compose with Einstein in mind. It is interesting to note that Antheil regularly used the term time-space from the early 1920s on, but did not, as far as I can tell, employ the term fourth dimension in reference to his music until this later period. Although he claims in this re-editing text to not have realized *Ballet Mécanique* was fourth dimensional until much later, his use of the term time-space speaks to another more nuanced reality. Perhaps at the time, immersed in the culture of Einstein’s popularity, to state the Einsteinian nature of a term like time-space would have been redundant, but with Einstein’s public scientific career waning in the early 1950s it seemed more appropriate

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[197] George Antheil, “BALLET MECANIQUE 1952-3 RE-EDITING,” JPB 94-1 no. 27 (1952–3 re-editing**),** b. New York Public Library Performing Arts Division. Also reproduced as “Composer’s Notes on 1952–53 Re-Editing” [of *Ballet Mécanique*] (1953), in Daniel Albright, *Modernism and Music: An Anthology of Sources* (Chicago: Chicago University Press, 2004), 71.

to be explicit. Or, perhaps Antheil, despite consciously borrowing some Einsteinian terminology, was less aware of how closely his musical ideas resembled Einstein's until later investigation. In either case, the ideological parallel between Einstein's theories and Antheil's compositional and theoretical work speaks to the deep connection between relativity theory and modernist music.

CHAPTER 5

CONCLUSIONS

He who joyfully marches to music in rank and file has already earned my contempt.
- Albert Einstein

The sentence above begins a well-known quotation by Einstein. I use it here, so that it can be purposefully misread, for in the misreading, we can understand the change in Einstein's public persona over the tenure of his fame. What would this sentence appear to say in the first or second chapters of this dissertation? Perhaps even in spite of Einstein's professed distaste for modern music, it could have been argued that the radical and individualistic tendencies present in this statement would justify its association with modernist aesthetic ideas. Even though Einstein preferred to play Bach and Mozart on his violin, we might still have been able to link this radical statement about an uncritical response to music to the parallel revolution happening in modernist musical America. If only it could have served as the key piece of textual evidence—heretofore misread!—documenting the ideological connection between modern musical aesthetics and relativity theory.

Unfortunately, it is hard to continue to (mis)read this sentence as evidence of a firmer intellectual connection between music and relativity when placed in its full context:

> He who joyfully marches to music in rank and file has already earned my contempt. He has been given a large brain by mistake, since for him the spinal cord would fully suffice. This disgrace to civilization should be done away with at once. Heroism at command, senseless brutality, and all the loathsome nonsense that goes by the name of patriotism, how violently I hate all this, how despicable and ignoble war is; I would rather be torn to shreds than be part of so base an action! It is my conviction that killing under the cloak of war is nothing but an act of murder.

Within the fuller context, the sentence still reflects Einstein's non-conformity and revolutionary attitude, but it does not necessarily refer to revolutionary music.[1] But even in the context of a new, non-scientific revolution, the quotation has the possibility to inform us about Einstein and music. This quotation, which came from a speech by Einstein in 1953, sums up Einstein's new public persona, one that did, in fact, shape musical responses to the man and his theories.

In this conclusion, I want to explore briefly the post-1945 reception of Einstein and its relationship with musical life in order to highlight both what made the period from 1919 to 1945 so unique and what is unsurprising about it. As I have shown, the interwar musical reception of Einstein occurred because of the particular cultural concerns shared by the modernist musical community and the scientific community. A look at how these concerns changed after the war will help to solidify the reasons we have explored in the previous chapters. Yet, to some extent, these developments were, indeed, unsurprising: after looking at the post-1945 context related to Einstein and other scientific currents, we will see that the Einstein/modernism connection is one of many historical instances in which these two fields have overlapped and formed intricate relationships with one another. In this discussion I will return to the larger goals of my project: to encourage

[1] Although I think Einstein's use of the phrase "marches to music" might be metaphorical, it is also possible that he is thinking more literally of militaristic marches to music.

cross-disciplinary scholarship between arts and sciences, especially highlighting the underutilized field of the history of science.

In the summer of 1939, Einstein became personally entangled in the war that the United States was soon to join. He spent the warm months on Long Island—on the beach, among other places—but it was here that he was contacted by longtime friend and fellow physicist Leo Szilard. Szilard had just realized that his own experiments with nuclear reactions at Columbia University might be harnessed for a potentially devastating bomb. He encouraged Einstein to draft a letter to President Roosevelt, explaining the implications for bomb making and the possibility that the Nazis were working on this technology already. After receiving the letter in October 1939, Roosevelt convened a committee of physicists to investigate these matters, a committee which would become the top-secret Manhattan Project, the covert project that developed the atom bomb, in November 1941. After the bomb was dropped on Hiroshima in August 1945, Einstein was linked to the bomb's creation in the report written by the physicists of the Manhattan Project although Einstein never directly worked on the secret project. Walter Isaacson explains:

> Between the influence imputed to that letter and the underlying relationship between mass and energy that he had formulated forty years earlier, Einstein became association in the popular imagination with the making of the atom bomb, even though his involvement was marginal.[2]

Einstein was famously pictured on the cover of *Time* magazine with a mushroom cloud behind him and $e=mc^2$ tattooed on it in July of 1946.[3] Einstein was quite disturbed with not just the reputation he was given because of this press, but also his feeling of personal

[2] Walter Isaacson, *Einstein: His Life and Universe* (New York: Simon and Schuster, 2007), 485.

[3] Walter Isaacson, *Einstein: His Life and Universe,* 471–485.

guilt. In May 1946 Einstein founded the Emergency Committee of Atomic Scientists, a group dedicated to nuclear arms control and the establishment of a world (as opposed to nation-based) government.[4]

Einstein became outspoken in his political views through the Committee for Atomic Physicists, but also through other avenues. While his fame was taken and used against him in discussions of the atomic bomb, Einstein took a more proactive approach later in the 1940s and early 1950s to speak out in magazines, newspapers, and on the radio. He actively opposed racial segregation, continued to advocate for pacifism in the face of the Cold War, and was active with Zionist organizations even though he opposed the establishment of the state of Israel. Einstein retained his reputation as an active physicist in spite of his retirement from the Institute for Advanced Study at Princeton after the war; in fact, his passion for discovery a unified theory of the universe was renewed and he continually toiled away at this until his death in 1955.

The traits that once marked Einstein—the revolutionary, the hero and savior, the genius, the understandable intellectual, and the musician—began to take on a new meaning. Yes, they were still a part of what defined Einstein the man, but his outspoken pacifism and his renown as a Zionist figurehead pushed these previous identity markers into relief. Einstein also had a new role in the scientific world. While he was still considered first and foremost a physicist, he was no longer a revolutionary one. As the study of quantum mechanics was pressed further by the next generation of famous physicists such as Werner Heisenberg, Niels Bohr, and Erwin Schrödinger (who were consciously opposed by Einstein), the revolutionary and heroic side of Einstein's scientific persona began to fade. Even his status as a musician was altered in the post-war

[4] Walter Isaacson, *Einstein: His Life and Universe,* 490.

years; by the 1950s, Einstein's failing health kept him from playing the violin. The Zionist and pacifist aspects of his persona also retreated into the background after a relatively short time. The only elements that remained pretty well intact were his status as genius and as an understandable intellectual. What was left was Albert Einstein: the American Idol.

The summation of Einstein's new persona can be observed in the iconic photograph taken on March 14, 1951 by UPI photographer Arthur Sasse. The photographer was attempting to get Einstein to smile, but instead the physicist stuck his tongue out creating one of the most well-known images of the scientist (or probably any scientist) of all time.

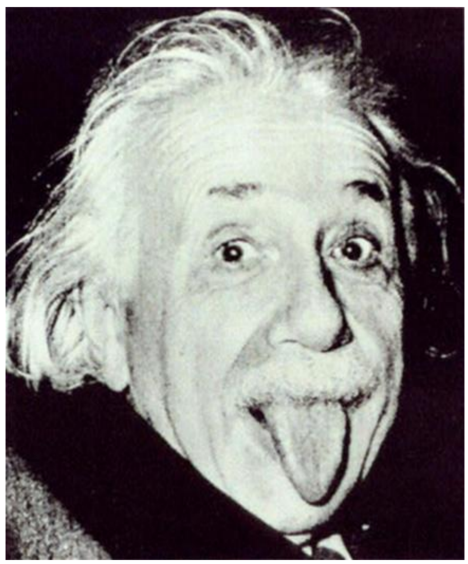

Figure 5.1 - Arthur Sasse (14 March 1951)

This image represents the transformation of a revolutionary Einstein, whether his revolution was made in physics or politics, into a non-conformist Einstein. Adding the pacifism and political involvedness to the original concoction—with a dash of old age—Einstein became the non-conformist, loveable, and distinctly American genius his name now embodies.

Einstein's new image allowed for a different kind of musical influence. Rather than serving as an ideal composer-figure, metaphorically bound up in the actual work of creating a musical revolution, Einstein was able to stand apart from the compositional process and serve simply as a public icon ready to be depicted in a musical setting. His persona was now freed from the weight of serious revolutionary discourse—and for the most part, musical works dealing with Einstein the man followed suit. Similarly, Einstein's theories of relativity were no longer tied exclusively to composers' aesthetics of music. Instead of serving as true models for revolutionary theories of music, the theories of relativity could, after 1945, serve as neatly packaged cultural signifiers of learnedness, scientism, and cleverness.

The issue of space-time, as we will see, took off in a different direction in post-war musical culture. Before 1945, the ideas of Einstein and relativity were cultural commodities, embraced by composers for their specific cultural values; when these values changed after 1945, composers still reacted to these concepts as commodities, but responded to them based on their new meanings. Space-time, however, was a concept deeply engrained in the compositions of the early twentieth century; the parallels between Einstein's ideas of space and time and composers like Antheil and Varese's ideas about space and time had more to do with shared intellectual and ideological concerns than a direct appropriate of a cultural signifier. For this reason, ideas developed in the 1920s, 30s, and 40s about new modes of space and time in music weathered the change in Einstein's public persona much better. Because the new concepts of space and time in modernist aesthetics were *fundamentally musical*, and because the composers who worked with new concepts of space and time were so influential, the legacy of Einstein's space-time in music can be seen in later compositions of the twentieth century. I will explore briefly some of the ways in which space-time compositions of the pre-45 Einsteinian variety lived on in later works, creating a key intellectual lineage in modernist, scientifically-oriented music.

I. Pop Einstein, Pop Music?

As conceptions of Einstein changed, a broad array of responses to the physicist's new persona arose. Some dealt directly with the new aspects of Einstein's public life, including his ties with Zionism, as well as his widely publicized pacifism. Stefan Wolpe was one of the first to address some of the newer aspects of Einstein's public person in his 1950 piece "Einstein's Address About Peace." The song, written for mezzo-soprano and piano, was based on the words of a speech given by Einstein in a televised interview with Eleanor Roosevelt about his views on pacifism. In March of 1950, the work was performed in a concert held at Columbia University with other pieces by Wolpe and one by Rudhyar.[5] The piece has been called "Wolpe's vigorous protest against the Hydrogen bomb," indicating that the composer chose the text for political reasons.[6] However, Wolpe seems to have had scientific affinities with Einstein—at least according to a set of program notes for his first symphony, performed in 1964. In an article reviewing the premiere of his first symphony (1964), the critic Harold Schonberg recalls the explanatory program notes that accompanied the performance:

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[5] "Concert is Devoted to Wolpe, Rudhyar," *New York Times* (13 March 1950), 14.

[6] This is mentioned in a review of the recording of this piece on the album *Stefan Wolpe: Excerpts from Dr. Einstein's Address about Peace and Songs* (Bridge 9209, 2007). "Recordings," *The Stefan Wolpe Society Newsletter* (2007), 14.

> Mr. Wolpe's own notes to his symphony are interesting. In the 19th century, composers who wanted to suggest where their inspiration came from generally mentioned nature: the nature of mountains, oceans, trees, sun, moon and stars. Mr. Wolpe, very much of the 20th century, also mentions nature. But his is the nature of Einstein, Planck, Bohr and Cantor. Mr. Wolpe view his "structured field of pitches" as analogous to "those of physical bodies in a force field."[7]

According to Schonberg, Wolpe intended his work to "invoke force fields and quantum mechanics."[8] While Wolpe compared his musical conceptions in his first symphony with the theoretical conceptions of Einstein. his knowledge of Einstein, however, was very much post-relativity fame; from Schonberg's description, Wolpe seems to be invoking Einstein's late attempts at a unified field theory, one that would combine his notions of relativity with quantum discoveries. This scientific knowledge reveals an understanding of Einstein in his later years (roughly 1945–1955) and adds a layer of depth to our look at the pacifist composition "Einstein's Address about Peace." In this 1950 piece, Wolpe was invoking the political, pacifist Einstein, but he captured Einstein in a transitional period, one in which the physicist had the political voice that he did because of his renown as a physicist and his conspicuous involvement in and then rejection of the use of atomic energy.

Two operatic treatments of Einstein explore the famous physicist's life and legacy. The first was Paul Dessau's opera *Einstein*, a German-language opera based on Einstein's life composed between 1971 and 1973 and premiered in 1974. The most famous opera on Einstein is, of course, Philip Glass's *Einstein on the Beach* (1976). The work extracts Einstein's symbolic capital and exploits it for all its allegorical potential.

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[7] Harold C. Schonberg, "Music: Two-Thirds of a Symphony," *New York Times* (17January 1964), 25.

[8] Schonberg, "Music: Two-Thirds of a Symphony," 25.

Glass notes that he was drawn to Einstein, whom he described chiefly as “a Dreamer,” from a young age:

> When I was growing up in Baltimore in the 1940s, Einstein was the first celebrity from the world of science. I read his books and was very affected by the birth of the nuclear age which this gentle man had indirectly instigated.[9]

When it was time to choose a character for his first major theatrical work, Glass eventually settled on Einstein as “someone who would resonate with the population at large.”[10] This resonance was necessary for musical reasons, according to Glass, but it also provided a link between the musical and the thematic elements of the opera:

> I suppose Einstein also seemed an appropriate choice of subject because the type of work we were creating was rather radical. [*Einstein on the Beach*] had an abstract structure and no actual plot; the spoken text had no explicit connections to Einstein, and their phrases were repeated to fill the allotted time, the whole work taking more than five hours. Our thinking was that everyone already knew who Einstein was; the audience would complete the work by determining the meaning for themselves.[11]

The success of this new post-modern approach to opera as seen in *Einstein on the Beach* relied on the audience’s familiarity with the protagonist. Because of Einstein’s iconic status, the audience would they be able to fill in the blanks that were inherently part of the minimalist work (or that arose from the fact that one could get up and leave the theater for a stretch of time during the five hour production). But, Einstein’s notoriety *as a radical* connected the post-modern opera’s unconventional musical elements with broader themes in the opera’s content (though it was mainly audience-derived meaning);

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[9] Philip Glass, “Einstein and Music,” in *Einstein: A Hundred Years of Relativity,* Andrew Robinson, Ed. (New York: Harry N. Abrams, 2005), 153.

[10] Robert Wilson, the theater director and Glass’s collaborator suggested Charlie Chaplin, Adolf Hitler, and finally Gandhi, before the two decided on Einstein. Philip Glass, “Einstein and Music,” 153.

[11] Philip Glass, “Einstein and Music,” 154.

in other words, Einstein gave justification to the opera's unusual format. Glass's opera invokes a version of the physicist's public persona that spans his entire life: Einstein the physicist, Einstein the radical pacifist, and—of course—Einstein the musician. Glass's treatment of Einstein in this work, like the famous photograph of Einstein with his tongue out, is the perfect musical embodiment of Einstein's post-1945 public persona. Glass's Einstein is a hyperreal Einstein.[12]

There are also a number of lesser-known works that deal with the new pop persona of Einstein. A few vocal works set Einstein's words to music, following in Wolpe's path: Sri Chinmoy's *Albert Einstein, Scientist-Sage: Songs Dedicated to Albert Einstein*, a portion of Gottfried von Einem's *Gute Ratschläge* (1983) contains text from Einstein, David Little's *Three Great Men* (1984) has a section about Einstein using Einstein's words, in *Lux/Licht/Light* (1990) composer Paul Evenblij takes English words by Einstein for his four-part a capella piece, and Ichiro Nodaira composed *Parole d'un savant* as recently as 2006 containing quotations by Einstein. Thomas Tierney and Ted Drachman wrote a musical *The Amazing Einstein* in 1987, adding to the stage works that deal with the famous scientist. Peter Schickele, also known as P.D.Q. Bach, composed the humorous "Prelude to *Einstein on the Fritz*: *S.* $e=mt^2$" for piano and orchestra. In the realm of popular music, Bob Dylan mentions Einstein in his 1965 song "Desolation Row" with an interesting lyric about Einstein's musical legacy (with a timely reference to

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[12] There are a number of studies with detailed discussions of Glass's *Einstein on the Beach* and its musical and cultural contexts. Two examples are David Cunningham, "Einstein on the Beach," in *Writings on Glass: Essays Interviews, Criticism*, eds. Richard Kostelanetz and Robert Flemming (Berkeley: University of California Press, 1997), 152–166 and, for more on the work in the context of scientific representation, see Sue-Ellen Case, *Performing Science and the Virtual* (New York: Routledge, 2003), 182–4

"going electric"): "Now you would not think to look at him/ But he was famous long ago/For playing the electric violin/ On Desolation Row."[13]

Two things are important to note about these pieces that depict Einstein: first, they all deal, in varying degrees, with his new public persona; second, they take Einstein the man as their subject. Neither of these responses would have been possible (or desirable) before 1945. It was only after Einstein's image had shifted into one of an American idol that pieces *about* the scientist were valuable as cultural objects. Before this iconic status, composers responded to the man as a contemporary who shared ideological stances with their own. Although he was being idolized—as a hero and genius—even by 1921, he was considered an intellectual and even controversial contemporary; his personality traits could be emphasized and reused to describe the scientific, heroic, and even understandable elements of the modernist composer-figure. The drastic shift in Einstein's public persona to impersonal icon and the attendant shift in musical responses to the physicist highlight, in retrospect, the personal connection that modernist composers felt they had with Einstein and his public persona in the early decades of his fame.

The relationship between Einstein's theory of relativity and music also changed after 1945. When Einstein's famous pair of theories was making headlines for toppling Newtonian physics, they could serve as an ideal model for modernist aesthetics in its ability to be both complex and popular, to herald an intellectual revolution and carry out a revolution in popular culture through its mass appeal. But, following the influx of newer theories of the universe based on the quantum mechanics of other physicists, however

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[13] The note of sympathy we can perceive in Dylan's reference to Einstein in this song might have something to do with the anti-war politic shared by these two famous "long hairs". Even further, Dylan's anti-atomic stance (as seen in his "Blowin' in the Wind") is very much in line with Einstein's personal and political views.

Einstein's relativity theory began to serve less as a model for a popular, yet rigorous theory and more as an abstract concept that could signify science or intellectualism generally. Like Einstein's persona, therefore, "relativity" became a handy cultural signifier that could turn up in a number of musical works abstracted from its theoretical significance.

There are a number of jazz pieces that refer to relativity theory, including an instructional piano work called "Relativity" (1949) by Stanford King, the "Relativity Suite" (1973) by Don Cherry, and a song called "Relativity" heard first at the Montreux Jazz Festival with Andrew Hill and Duke Ellington in 1975 and performed subsequently by a number of players. A jazz trio named "Relativity" also formed in 1997.[14] In a similar proliferation of titles, there exist a number of chamber-music works including *A Matter of Relativity: A Ballet for Chamber Orchestra* (1979) by Laurie Schwartz, "Relativity's Rainbow" (1980) for bassoon and viola by Robert Adamy Duisberg, "Relativity: A Piece for Flute and Clarinet Duet" (1982) by Simon James Gray, and the "Relativity Variations" (1994) by Pierre Jalbert.

These new responses came from a range of compositional perspectives: amateur composers, "serious" composers, pop musicians, and everyone in between. They also represented numerous genres: instrumental chamber music (with a heavy emphasis on compositions for the violin, of course), art song, opera, jazz tunes, pop songs, and orchestral works. The diversity of responses in terms of authorship and genre reveals the extent to which Einstein's persona became smoothed over from a scientific genius figure into a polished mass-marketable icon. These responses to Einstein and relativity theory

[14] Perhaps the jazz world's seeming fixation on Einstein and relativity are part of a larger discourse linking jazz and science in the late twentieth century. The same focus on scientific metaphors is observed in the language of Afro-Futurism and later in science-themed hip-hop lyrics.

reveal just how special the time period from 1921–1945 was. Marking both the height of American modernist composition and the pinnacle of relativity's popularity, this period saw an unusual intellectual synergy between science and the arts. Rather than coincidence, I think we can attribute this synergy to two important factors. First, modernist music and the theory of relativity had common intellectual roots in turn-of-the-century attitudes towards cultural change and a new "techno-scientism" that resulted from the influx of modern technologies. Second, as participants in mass culture (in one way or another) each "camp" used the other's intellectual cache to increase their own cultural capital: modernists embraced the extremely popular scientific theory to add an air of objectivity and to try to ride the wave of popularity relativity was on; the builders of Einstein's public persona—the authors and article writers—used Einstein's status as a musician to make him appear more personable and in turn make his theory more palatable (and to keep both the man and his theory in the newspapers and on the bookshelves). Both the inherent, unconscious connections and the more calculated and strategic ones could only have arisen when they did. As we can see from our brief look at what happened after the war with the reception of Einstein in music, things rapidly shifted away from the heady days of early American modernism and ultramodernism and into new aesthetic and intellectual directions.

II. New Directions in Space-Time

When Einstein became less of a symbolically revolutionary figure after 1945, his relevance to modern music diminished greatly. However, around this same time, "modern music" itself was being reconceived. Just when new physicists like Bohr, Schrödinger, and Heisenberg made their names with newer, more radical theories of the universe, new composers like Morton Feldman, Earle Brown, Iannis Xenakis, and John Cage began to take over the reins as the most provocative, innovative, and revolutionary figures in the musical scene. Before looking at some of the ways in which new ideas in physics interacted with new paths in modern music, it is useful to consider the nature of this post-war transition in musical culture.

As we already know, early-twentieth century modernists were fighting against the perceived excess of romanticism and working toward undoing the more oppressive elements of the tonal system. Einstein and relativity theory served as the perfect symbols of this modernist musical revolution. By contrast, mid-century modernist composers kept the radical attitude of the early-twentieth century and aimed, we might say, to make it even newer. These composers attempted to modernize modern music. They strove, in different ways, to create an even more objective musical aesthetic, to compose a music that might be suitable for composing, in Adorno's words, "after Auschwitz." Their continued desire for innovativeness allowed for a continued parallel with the scientific world and the world of physics in particular. Modernists in the 1920s and 30s looked to and saw parallels in Einstein that added objective scientism to their discussions of music; post-45 modernists turned to even newer principles in science and saw startling similarities.

One of the new directions in modern music following 1945 had strong musical ties to the Einsteinian compositions of the earlier period. Following the example of composers like Henry Cowell, George Antheil, and Edgard Varèse, a number of mid-century modernists explored new concepts of space and time in music. Unlike their predecessors, however, composers like Feldman, Brown, and Xenakis were not making direct connections with the scientific content of Einstein's relativity theory in their works that explored new ideas of musical space and time. Rather, they took up the aesthetic work of earlier ultramodernists and experimented with the full possibilities of their new notions of space-time. These composers were part of what we think of as the American experimentalist tradition, and it was the example of the earlier modernists and ultramodernists—and their successful alliance with scientific thought and metaphor—that ignited this tradition.

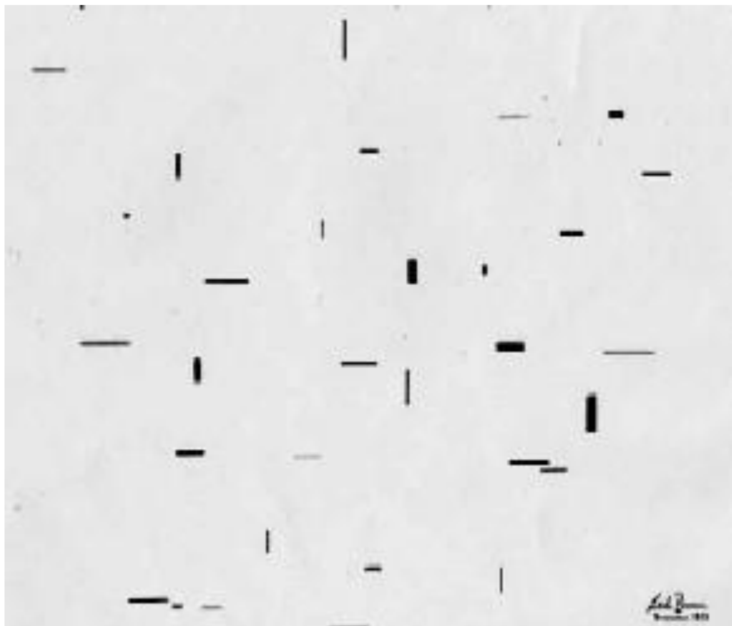
Morton Feldman built on George Antheil's notion of the "Time Canvas" in music, a notion that, as we have seen, was tied to Antheil's idea of time-space in music. Feldman took Antheil's metaphorical idea and extended it to a new form of graphic notation, based on his affinity with visual artists of the same time period. He recalled later,

> In thinking back to that time I realize now how much the musical ideas I had in 1951 paralleled [Jackson Pollack's] mode of working. Pollock placed his canvas on the ground and painted as he walked around it. I put sheets of graph paper on the wall; each sheet framed the same time duration and was, in effect, a visual rhythmic structure. What resembled Pollock was my "all over" approach to the time-canvas.[15]

Feldman's more literal interpretation of Antheil's time canvas nevertheless captures the earlier composer's fascination with spatial and temporal relationships. Earle Brown explored space-time and music through his graphic scores around the same time as Feldman. His *December 1952*, for example, offers a range of performance possibilities based on the performer's interpretation of the score (see Musical Example 5.1). Its two-dimensional visual presentation not only suggests a three-dimensional space because of the varying thicknesses of the lines, but also implies a fourth dimension. The temporal

[15] Morton Feldman, "Time-Canvas," in *Essays*, ed. Walter Zimmerman (Kerpen: Beginner Press, 1985), 136–7). Quoted in Daniel Albright, *Modernism and Music: An Anthology of Sources*, 80.

dimension is unique in that it is inherently tied to the piece's spatial make-up: all temporal ideas in the piece must be determined by the performer based on his or her interpretation of the meaning of the two-dimensional lines in the graphic score.



Musical Example 5.1 - Earle Brown, *December 1952* (1952)

Iannis Xenakis has expressed an interest in exploring space and time in music, a fact that some attribute to his work as an engineer and architect in Le Corbusier's office during the same period when he began composing in earnest, roughly 1947–1959.[16] Sven Sterken sees Xenakis's architectural concerns in the composer's *Polytopes,* the series of sound installations from the 1960s and 70s:

> Xenakis has transposed his temporal thinking into three-dimensional space; these art works can thus be considered as the return to architecture of a composer who, in his mind, has always remained an architect and an engineer.[17]

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[16] Sven Sterken, "Towards a Space-Time Art: Iannis Xenakis's *Polytopes*," *Perspectives of New Music* 39/2 (Summer 2001), 262–3.

[17] Sven Sterken, "Towards a Time-Space Art," 263.

In these sound installations, "architecture becomes an art of time and music an art of space."[18] Daniel Albright explains that Xenakis attempted to translate certain architectural ideas into music by creating a catalogue of corresponding shapes and sounds.

> Xenakis was fascinated by the notion that a single idea might develop itself in two different media—might take shape as either a musical composition or a building. He therefore sought equivalents between spatial extension and music, such as line = glissando, or point = string pizzicato.[19]

These calculated techniques found their way into a number of works by the composer. Albright notes that Xenakis's mathematical tendencies offered his music "the rigor of science—but a science of rifts and indeterminacies, of probability distributions, not a science of predictable motions and logical designs."[20] Though non-Einsteinian, his explorations in space-time still reveal a relationship with scientific thought.

In fact, the connection between newer notions of time and space in musical and non-Einsteinian science was not a coincidence. The compositions of Xenakis, Feldman, and Brown, while building on the work of earlier Einsteinian composers, are representative of a new relationship between music and science that developed after 1945. Their space-time explorations were part of a larger mid-century aesthetic exploration of indeterminacy in performance and composition, an exploration that paralleled a new concern over uncertainty in quantum mechanics.

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[18] Sven Sterken, "Towards a Time-Space Art," 263.

[19] Daniel Albright, *Modernism and Music: An Anthology of Sources* (Chicago: University of Chicago Press, 2004), 81.

[20] Daniel Albright, *Modernism and Music*, 81.

III. Music and Science Post-Einstein

After the popularity of Einstein's theory of relativity died down, a new set of scientific concerns arose that piqued the public's interest. While relativity was being read about in the newspapers in the 1920s and 30s (after Einstein worked out the ideas in 1905), a new set of physicists—including Bohr, Schrödinger, and Heisenberg—had been working on the sub-field of quantum mechanics. Quantum mechanics deals with the movements of sub-atomic particles—of protons, neutrons, and electrons within individual atoms. While this branch of physics seems even more abstract and even further removed from everyday life than relativity theory was, it caught the imagination of everyday people. While Bohr and Schrödinger contributed important concepts to the world of physics, there was one physicist's paradigm shifting theory that really caught the attention of the general public: Heisenberg's "Uncertainty Principle."[21] The basic idea of the principle is that it is impossible to know both the location and the velocity of an electron, for to attempt to observe one factor would alter the other. Additionally, the principle posited that it was impossible to determine the starting position of an electron and was impossible to predict the path of one. The theory questioned the most basic notions of observability and measurability in scientific experimentation.

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[21] Niels Bohr (1885–1962) developed the idea of "complementarity," which can be summarized as the notion that certain objects can embody two contradictory properties—for example, light can behave as, and thus must be considered, both a wave and a particle. The idea of "complementarity" is often called "wave-particle duality" for this reason. Erwin Schrödinger (1887–1961) is best known for the "Schrödinger Equation," which helped to define the motion of particles in quantified values. Among non-physicists, he is known for his thought experiment (now dubbed "Schrödinger's Cat") that pointed out the flaws in Einstein's views of quantum mechanics because of their inapplicability to larger system. In the thought experiment, he purports that a cat inside a sealed black box can be considered *both* alive and dead to an outside observer until the box can be opened, thereby allowing the cat to reside in two contradictory states of being.

It could also be used to call into question many philosophical, theological, and psychological pursuits related to ideas of predictability and cause and effect. Like Einstein's idea of relativity, Heisenberg's "Uncertainty Principle" spurred more popular concern about its potential to change the way we thought about the universe in general—from sub-atomic particles on up to individuals and societies. And because the popular reception of relativity was well known, critics predicted that Heisenberg's principle would "let loose a veritable intellectual spree."[22]

In his article entitled "Music and Science," John F. Spratt considers the many ways in which new ideas in music paralleled Heisenberg's principle and quantum mechanics in general. Chance music compositions echo certain philosophical ideas implied by quantum mechanics including new perspectives on the impossibility of simultaneity (an extension of Einstein's Special Theory of Relativity). In compositions with indeterminate performances, for example, the idea of simultaneous musical events is not just played with, as it was in earlier Einsteinian compositions, it becomes irrelevant, since any events perceived as simultaneous would only happen through coincidence.[23] Additionally, the idea of "initial states" and predictability in quantum physics are paralleled in both performance-based and compositionally indeterminate pieces. The listener, in a role comparable to the scientist, has no way of knowing or predicting the musical content of a given piece within this aesthetic framework.[24] Spratt also offers the case of the "effect of the observer" as a parallel between chance music and quantum

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[22] P. W. Bridgman, "The New Vision of Science," *Harper's Monthly Magazine* 158/946 (March 1929), 443. Quoted (without original source location) in John F. Spratt, "Science and Music," *Interdisciplina* 1/1 (1975), 67.

[23] John F. Spratt, "Science and Music," 78–9.

[24] John F. Spratt, "Science and Music," 79–80.

mechanics. He considers the role of the performer as analogous to that of the scientist who, based on the new knowledge of quantum mechanics and the unpredictability of certain fundamental states, must rely instead of statistical probability.[25] Spratt states:

> The connection between such musical indeterminacy and quantum mechanics may be merely metaphorical. However, experimental results which are never twice the same and must consequently, as Bohr says, be expressed by statistical laws, are match by musical compositions which can never sound twice the same, even approximately, in extreme cases.[26]

Spratt's work opens the door for a much larger study on indeterminate composition and the Heisenberg "Uncertainty Principle." For one, much could be added to a study of this interaction by examining the role of another observer of chance music: the audience member. It is clear from Spratt's surface-level analysis of the music and the philosophical interactions that this intellectual overlap was quite deep and would make a very rich future study.

In looking at the relationship between later modernist music and later scientific culture—and the continued correspondences between the two fields—we can again take stock of the place of Einstein, modernism, and music in intellectual history. The first group discussed in this section—Feldman, Brown, and Xenakis—explored space-time in music, following in the footsteps of many of the composers I have identified as "Einsteinian." In doing so, we can trace a smooth transition from the Einsteinian physics that interested their musical predecessors to the quantum mechanics and principles of uncertainty that piqued the later composers' imagination. Other composers, like Cage, came by their interest in uncertainty quite naturally, so to speak. He turned to chance music not because he was picking up the torch of expressing new ideas of the space-time

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[25] John F. Spratt, "Science and Music," 80–1.

[26] John F. Spratt, "Science and Music," 81.

in music, but because he was interested in the philosophical and aesthetic implications of aleatoric music. In the relationship between his chance music and the "Uncertainty Principle," we can see much of the same story as we had with Einstein, relativity, and the earlier modernists: shared intellectual roots caused parallel developments to grow and, once in bloom, musicians allowed it to flourish by consciously adopting scientific language that would reinforce their aesthetic goals. This, then, reflects the other side of the coin: while the relationships between Einstein, modernism, and music were unique to the time period in which they developed, the scientific-artistic relationship as a whole is not unusual in the larger picture of intellectual history.

IV. Conclusions

This brief overview of the developments in music and science after relativity reveals some of what made the interwar interaction between Einstein and modernist music both different from, and similar to, other periods in music history. It stands out as a unique period in intellectual history because of the extent to which science and the arts interacted and influenced one another. Specifically, Einstein served as the idealized model for a musical revolution; his theories as perfect examples of complex and intellectual, yet popular ideological tracts; and his concepts as uniquely applicable to the aesthetics of modern music and the reworking of space and time in a post-Romantic world. Yet, in looking at what came after relativity and music, we can begin to see that this highly charged period of intellectual exchange was only one of many in-depth relationships between music and science.

Both of these observations—singularity and sameness—apply to the study of this history as well as its content. I would like to reemphasize the importance of the study of music in its full intellectual context, especially the often-overlooked context of scientific history. As it stands now, my study is among only a limited few that tackle the shared history of music and science, but I hope that it will be the first among many in this interdisciplinary pairing. Additionally, while the study of the close interaction of music and science is rare, the apparatus is quite familiar—I have used the tools offered to me by the disciplines of musicology and the history of science, most of which are shared by the vast majority of humanities scholars, and painted a new picture of the early twentieth century. Using familiar strategies, I have reexamined familiar pieces of music history. And yet, in reviewing certain scientific and historical aspects of music I think I have presented them in a new light.

BIBLIOGRAPHY

Primary Sources

"Accepts Einstein Gravitation Theory." *The New York Times*, 11 November 1919, 17.

"Activities of Musicians." *New York Times*, 27 October 1935, X7.

"Assaulting the Absolute." *New York Times*, 7 December 1919, X1.

"Composers' Forum-Laboratory." *New York Times*, 29 September 1935, X7.

"Composers' Laboratory." *New York Times*, 24 November 1935, X8.

"Concert Devoted to Wolpe, Rudhyar." *New York Times*, 13 March 1950, 14.

"Copy-Boy Makes Good." *The Sun*, 9 May 1921, 8.

"Display Ad 11." *New York Times*, 10 February 1923, 10.

"Display Ad 64." *New York Times*, 18 February 1923, X3.

"Display Ad 75." *New York Times*, 11 February 1923, X3.

"Don't Worry Over New Light Theory." *New York Times*, 16 November 1919, E1.

"Dr. Einstein's Theory." *The Times*, 28 November 1919, 13.

"Dusolina Giannini to Appear as Soloist With Symphony." *Los Angeles Times*, 10 March 1935, A8.

"Eclipse Showed Gravitation Variation." *New York Times*, 9 November 1919, 6.

"Einstein in Lecture Explains His Theory." *The New York Times*, 16 April 1921, 10.

"Einstein is Coming Here." *New York Times*, 22 February 1921, 11

"Einstein Defines the Speed of Light." *New York Times*, 19 April 1921, 16.

"Einstein Due Today; Leaders Await Him." *New York Times*, 2 April 1921, 11.

"Einstein Explains Relativity Theory." *Philadelphia Public Ledger*, 3 April 1921, 2.

"Einstein Expounds His New Theory." *The New York Times*, 3 December 1919, 19.

"Einstein Here with Weizmann to Aid Zionism." *The New York Call*, 3 April 1921, 1.

“Einstein Inspires Play.” *New York Times*, 23 April 1924, 24.

“Einstein Puts His Theory Into Simple Words.” *The New York Times*, 16 April 1921, 2

“Einstein Sails for America March 23.” *New York Times*, 9 March 1921, 2.

“Einstein Sees End of Space and Time.” *New York Times*, 4 April 1921, 5.

“Einstein Theory Means Acceptance of Queer Things.” *Atlanta Constitution*, 22 December 1919, 2.

“Einstein to Visit America.” *The Washington Post*, 22 February 1921, 6.

“Einstein’s Music Excels Science in Wife’s Opinion.” *New York American*, 3 April 1921, 3.

“Einstein’s Theory Discussed Here.” *The New York Times*, 2 December 1919, 12.

“The Fabric of the Universe.” *The Times*, 7 November 1919, 13.

“A Genius of Modern Music, Igor Stravinsky, Dies at 88.” *The Sun*, 7 April 1971, A1.

“Germans Use Films to Explain Einstein’s Theory of Relativity.” *The Washington Post*, 13 May 1923, 37.

“Has Einstein Turned Physics into Metaphysics?” *Current Opinion* 70/6 (1921): 803–5.

“He Marries Math to Music.” *The Baltimore Sun*, 10 August 1941, M3.

“How Tall Are You, Einstein Measure?” *New York Times*, 4 December 1919, 19.

“Just a Note.” *The Independent*, 29 November 1919, 115.

“Letters and the Arts.” *The Living Age*, April 1930, 157.

“Lights All Askew in the Heavens.” *New York Times*, 10 November 1919, 17.

“A New Physics Based On Einstein.” *New York Times*, 25 November 1919, 17.

“New Theory of Space.” *The Washington Post*, 14 December 1919, E5.

“News Caught as It Happens.” *The Washington Post*, 17 April 1921, 67.

“Newton and Einstein – Historical Theories of Space – To the Editor of the Times.” *The Times*, 25 November 1919, 8.

“Pen Points by the Staff.” *Los Angeles Times*, 22 May 1921, II4.

“Picture Plays and People.” *New York Times*, 3 December 1922, 100.

“Prof. Einstein Here; Explains Relativity.” *New York Times*, 3 April 1921, 1.

“Professor Einstein Given Ovation.” *The Campus*, 26 April 1921, 2.

“Relativity and the City Hall.” *New York Times*, 7 April 1921, 14.

“Relativity in the Films.” Edited by The Einstein Editor, *Scientific American*, August 1922, 92.

“‘Relativity’ Film.” *New York Times*, 18 June 1922, 89.

“Relativity, Filmed, Is as Lucid as Ever.” *New York Times*, 4 February 1923, E1.

“The Revolution in Science – Einstein v. Newton – Views of Eminent Physicists.” *The Times*, 8 November 1919, 12.

“Revolution in Science – New Theory of the Universe – Newtonian Ideas Overthrown.” *The London Times*, 7 November 1919, 12.

“The Screen.” *New York Times*, 12 February 1923, 13.

“Screen the First Quarter.” *New York Times*, 18 March 1923, X3.

“Stravinsky Dies at 88; Hailed as Musical Genius.” *Los Angeles Times*, 7 April 1971, 1.

“Thousands Greet Einstein at Pier.” *The Washington Post*, 3 April 1921, 5.

“Topics of the Times,” *New York Times*, 6 February 1923, 18.

“Topics of the Times: Amateurs Will Be Resentful.” *New York Times*, 11 November 1919, 12.

“Ulysses and Einstein: A Dialogue Between George Bernard Shaw and Archibald Henderson.” *Forum* 72/4 (1924):453–462.

“The Unpromising Career of Einstein.” *Current Opinion* 68/5 (1920): 651.

“Varèse Envisions ‘Space’ Symphonies.” *New York Times*, 6 December 1936, N7.

“Why Einstein’s Theory Is So Hard to Explain.” *Current Opinion* 69/1 (1920): 77–8.

Adler, Guido. “Internationalism in Music.” Translated by Theodore Baker. *Musical Quarterly* 11/2 (1925): 281–300.

Adorno, Theodor. *Philosophy of Modern Music*. Edited by Anne G. Mitchell and Wesley V. Blomster. New York: The Continuum International Publishing Group, 2004.

Antheil, George. *Bad Boy of Music* (Galley Proofs 1945). George Antheil Collection. New York Public Library.

Antheil, George. *Bad Boy of Music*. Garden City, NY: Doubleday, Doran, and Company, 1945.

Antheil, George. “Ballet Mécanique (1924–5)” George Antheil Collection. New York Public Library.

Antheil, George. “Ballet Mécanique 1952–3 Re-Editing.” George Antheil Collection. New York Public Library.

Antheil, George. *Ballet Mécanique (Rev. 1952)*. Delaware Water Gap, PA: Shawnee Press, Inc., 1959.

Antheil, George. “Composer’s Notes on 1952–53 Re-Editing.” In *Modernism and Music: An Anthology of Sources*, edited by Daniel Albright. Chicago: Chicago University Press, 2004.

Babbitt, Milton. “Remarks on the Recent Stravinsky.” *Perspectives of New Music* 2/2 (1964): 36–7.

Barbee, David Rankin. “Mathematician’s Human Side Shows His Tastes Are Simple.” *Washington Post*, 14 December 1930, M22.

Bauer, Marion. “The Case for a Music Laboratory.” *Modern Music* 5/4 (1928): 36–38.

Bauer, Marion. *Twentieth Century Music: How it Developed, How to Listen to It.* New York: G. P. Putnam’s Sons: 1947.

Bergson, Henri. *Duration and Simultaneity: Bergson and the Einsteinian Universe*. Edited by Robin Durie. Manchester, UK: Clinamen Press, 1999.

Bernheimer, Martin. “The Philharmonic Season in Retrospect.” *Los Angeles Times*, 8 May 1966, M1.

Beta. “Relativity and Life.” *The Scientific Monthly* 22/2 (1926): 170–172.

Birkoff, George David. *The Origin, Nature, and Influence of Relativity*. New York: The Macmillan Company, 1925.

Borowski, Felix. "John Alden Carpenter." *Musical Quarterly* 16/4 (1930): 449–468.

Bridgman, P. W. "The New Vision of Science." *Harper's Monthly Magazine* 158/946 (1929): 443.

Brunswick, Mark. "Tonality and Perspective." *Musical Quarterly* 29/4 (1943): 426–437.

Carmichael, R. D. *A Debate on the Theory of Relativity*. Chicago: Open Court Publishing Co., 1927.

Carmichael, R. D. "Given the Speed, Time is Naught." *New York Times*, 7 December 1919, 18.

Carpentier, Alejo. "Edgar Varèse Escribe Para El Teatro." *Social* 16/4 (1931).

Carr, H. Wildon. *The General Principle of Relativity in its Philosophical and Historical Aspect*. 2nd Edition. London: Macmillan and Company, 1922.

Carr, H. Wildon. *Henri Bergson: The Philosophy of Change*. London: T. C. and E. C. Jack, 1911.

Carr, H. Wildon. *A Theory of Monads; Outlines of the Philosophy of the Principle of Relativity*. London: Macmillan and Co, Limited, 1922.

Carr, H. Wildon. "Newton and Einstein – Historical Theories of Space – To the Editor of the Times." *The Times*, 25 November 1919.

Chavez, Carlos. *Toward a New Music: Music and Electricity*. New York: W. W. Norton and Company, Inc., 1937.

Coeuroy, Andre. "The Aesthetics of Contemporary Music." Translated by Theodore Baker, *Musical Quarterly* 15/2 (1929): 246–267.

Cone, Edward T. "Stravinsky: Progress of a Method." *Perspectives of New Music* 1/1 (1962): 18–26.

Copland, Aaron. "America's Young Men of Promise." *Modern Music* 3/3 (1926): 13–20.

Copland, Aaron. *Our New Music: Leading Composers in Europe and America*. New York: McGraw-Hill Book Company, 1941.

Cowell, Henry. "Charles Ives." *Disques* (1932): 374–76.

Cowell, Henry. "Introduction to the Schillinger System of Musical Composition." In Joseph Schillinger, *The Schillinger System of Musical Composition*, edited by Arnold Shaw and Lyle Dowling. New York: C. Fischer, Inc., 1946.

Cowell, Henry. "New Musical Resources, Draft I, 1929." Henry Cowell Papers, 1851–1994. New York Public Library.

Cowell, Henry. "New Musical Resources, Draft II, 1929." Henry Cowell Papers, 1851–1994. New York Public Library.

Cowell, Henry. *New Musical Resources*. New York: Cambridge University Press, 1930, 1996.

Cowell, Sidney Rose. "Promotional Materials, 1929." Henry Cowell Papers, 1851–1994. New York Public Library.

Danz, Louis. *Schoenberg*, edited by Merle Armitage. Westport, CT: Greenwood Press, 1937.

Davidson, Charles. "Science Weighs Light." *Washington Post*, 7 December 1919, E5.

Downes, Olin. "Alfredo Casella Surveys the Past and Forecasts the Tonal Future." *New York Times*, 5 October 1924, X6.

Downes, Olin. "J. A. Carpenter, American Craftsman." *Musical Quarterly* 16/4 (1930): 443–448.

Downes, Olin. "Laboratory For Native Composers." *New York Times*, 10 January 1937, 159.

Durell, Clement V. *Readable Relativity: A Book for Non-Specialists*. London: G. Bell and Sons, 1931.

Earhart, Will. "Review of *Music: A Science and An Art*." *Music Supervisors' Journal* 15/1 (1928): 89–91.

Eddington, A. S. "Einstein's Theory." *Chicago Daily Tribune*, 1 February 1920, E7.

Einstein, Albert. *Relativity: The Special and the General Theory* (1916). Accessed 1 March 2009. www.Bartleby.com/173.

Einstein, Alfred. "Art and Technology." *Modern Music* 12/2 (1935): 55–61.

Fadman, Edwin Miles. "The Art in Pictures." *New York Times*, 18 November 1923, X5.

Farwell, Arthur. "Roy Harris." *Musical Quarterly* 18/1 (1932): 18–32.

Feldman, Morton. "Time-Canvas." In *Modernism and Music: An Anthology of Sources*, edited by Daniel Albright. Chicago: University of Chicago Press, 2004.

Freundlich, Edwin. "Albert Einstein: On the Victory of His Theory of Relativity." *Vossische Zeitung*, 30 November 1919, morning.

Fuller, Edmund. "Stravinsky's Wit and Wisdom." *Wall Street Journal*, 29 June 1972, 10.

Garbedian, H. Gordon. *Albert Einstein: Maker of Universes*. New York: Funk and Wagnalls Company, 1939.

Goldberg, Albert. "The Bowl—Schoenberg and Mitropoulos." *Los Angeles Times*, 12 August 1951, D7.

Goldschmidt, Alfonz. "In Einstein Music and Mathematics Blend: The Same Rhythmic Force That Governs His Scientific Work Is Active Within the Professor When He Plays on His Violin." *The New York Times*, 1 April 1934, SM18.

H. L. "Review." *The Burlington Magazine for Connoisseurs* 29/162 (1919): 259–260.

Harap, Louis. "On the Nature of Musicology." *Musical Quarterly* 23/1 (1937): 18–25.

Harris, Roy. "Problems of American Composers." In *The American Composer Speaks*, edited by Gilbert Chase. Louisiana State University Press, 1966.

Harrow, Benjamin. *From Newton to Einstein: Changing Conceptions of the Universe*. New York: D. Van Nostrand Company, 1920.

Henderson, Archibald. *Relativity: A Romance of Science*. Chapel Hill, NC: University of North Carolina Press, 1923.

Howard, John Tasker. *This Modern Music: A Guide for the Bewildered Listener*. New York: Thomas Y. Crowell Company, 1942.

Jean-Desthieux, F. *L'incroyable Einstein: ses theories scientifiques et leur consequences; de Leibnitz à Bergson; une métaphysique nouvelle*. Paris: Carnet critique, 1922.

Jones, Isabel Morse. "Modern Musical Genius, Igor Stravinsky, Will Conduct Philharmonic." *Los Angeles Times*, 21 Feb 1935, 13.

Jones, Isabel Morse. "Music and Musicians: New Music Nurtured in Southland." *Los Angeles Times*, 9 October 1938, C5.

Krenek, Ernst. *Music Here and Now*. New York: W. W. Norton and Company, 1939.

Krenek, Ernst. "New Humanity and Old Objectivity." In *Modernism and Music: An Anthology of Sources*, edited by Daniel Albright. Chicago: University of Chicago Press, 2004.

Lowell, Amy. "Some Musical Analogies in Modern Poetry." *Musical Quarterly* 6/1 (1920): 127–157.

Lorentz, H. A. "Dutch Colleague Explains Einstein." *New York Times*, 21 December 1919, 20.

Ludwig, Emil. "Ludwig on the Greatness of Einstein." *New York Times*, 10 March 1929, 81.

Marianoff, Dimitri and Palma Wayne. *Einstein: An Intimate Study of a Great Man*. New York : Doubleday, Doran, and Co., 1944.

McAlpin, Colin. "Musical Modernism: Some Random Reflections." *Musical Quarterly* 16/1 (1930): 1–20.

Nabokov, Nicholas. "The Atonal Trail: A Communication," *Partisan Review* 15 (1948): 580-585.

Newman, Frances. "Carnegie Library Notes: Einstein Without Tears." *The Atlanta Constitution*, 6 June 1920, 4K.

Noble, Eugene A. "American Ideal Seen as Big Need in Making Us a Musical Nation." *New York Times*, 11 March 1923, X13.

Oleggini, Léon. *Connaissance de Stravinsky*. Lausanne, France: Editions Maurice et Pierre Foetisch, 1952.

Peare, Catherine Owens. *Albert Einstein: A Biography for Young People*. New York: Henry Holt, 1949.

Pettis, Ashley. "The WPA and the American Composer." *Musical Quarterly* 26/1 (1940): 101–112.

Pound, Ezra. *Antheil and the Treatise on Harmony*. New York: Da Capo Press, 1924.

Price, Clair. "Fourth Dimension Proved to Exist Beyond a Doubt." *Atlanta Constitution*, 14 December 1919, D7.

Raven, Seymour. "Music, Theater News of City, and the Nation." *Chicago Daily Tribune*, 30 July 1951, B6.

Redfield, John. *Music: A Science and An Art*. New York: Tudor Publishing Co., 1928, 1949.

Reich, Willi. "Alban Berg's 'Lulu'." Translated by M. D. Herter Norton. *Musical Quarterly* 22/4 (1936): 383–401.

Reich, Willi. "Schoenberg's New Männerchor." *Modern Music* 9/2 (1932): 62–66.

Reis, Claire. *Composers in America: Biographical Sketches of Contemporary Composers with a Record of Their Works*. New York: MacMillan, 1947.

Reiser, Anton. *Albert Einstein: A Biographical Portrait*. New York: Albert and Charles Boni, 1930.

Rosenfeld, Paul. *An Hour with American Music*. Philadelphia: J. B. Lippincott Company, 1929.

Rosenfeld, Paul. *Musical Portraits: Interpretations of Twenty Modern Composers*. New York: Harcourt, Brace, and Howe, 1920.

Rudhyar, Dane. "Creators and Their Public," *Musical Quarterly* 10/1 (1924): 120–130.

Rudhyar, Dane. "The Relativity of Our Musical Conceptions." *Musical Quarterly* 8/1 (1922): 108–118.

Russell, Bertrand. *The A B C of Relativity*. New York: Harper and Brothers, 1922.

Sageret, J. *La révolution philosophique et la science: Bergson, Einstein, Le Dantec, J.-H. Rosny*. Paris: Alcan, 1924.

Sargeant, Winthrop. "A Composer's Treatise on Harmony." *New York Times,* 8 August 1948, BR10.

Sartre, Jean-Paul. "Francois Mauriac and Freedom." In *Literary and Philosophical Essays*, trans. by Annette Michelson. New York: Criterion Books, 1955.

Schillinger, Joseph. *The Schillinger System of Musical Composition*, edited by Arnold Shaw and Lyle Dowling. New York: C. Fischer, Inc., 1946.

Schloezer, Boris de. "Man, Music, and the Machine." *Modern Music 8*/3 (1931): 3–9.

Schoenberg, Arnold. *Schoenberg*, edited by Merle Armitage. New York: G. Schirmer, 1937.

Schoenberg, Arnold. *Style and Idea: Selected Writings of Arnold Schoenberg*, edited by Leonard Stein, translated by Leo Black. Berkeley: University of California Press, 1984.

Schonberg, Harold C. "Music: Two-Thirds of a Symphony." *New York Times,* 17 January 1964, 25.

Seeger, Jr., Charles Louis. "On the Principles of Musicology" *The Musical Quarterly* 10/2 (1924): 244–250.

Seeger, Jr., Charles Louis. "On Style and Manner in Modern Composition." *The Musical Quarterly* 9/3 (1923): 423–431.

Seeger, Charles. "Systematic and Historical Orientations in Musicology." *Acta Musicologica* 11/4 (1939): 121–128.

Seeger, Charles. "Systematic Musicology: Viewpoints, Orientations, and Methods." *Journal of the American Musicological Society* 4/3 (1951): 240–248.

Seeger, Charles. "Toward a Unitary Field Theory for Musicology." *Bulletin of the American Musicological Society* 9/10 (1947): 16.

Slonimsky, Nicolas. *American Composers on American Music*. Stanford, CA: Stanford University Press, 1933.

Slosson, Edwin E. *Easy Lessons in Einstein: A Discussion of the More Intelligible Features of the Theory of Relativity*. New York: Harcourt, Brace, and Howe, 1920.

Slosson, Edwin E. "Eddington on Einstein." *The Journal of Philosophy* 18/2 (1921): 48–51.

Slosson, Edwin E. "Can You Tell the Difference Between Rest and Motion? Does the Earth Move Round the Sun or the Sun Move Round the Earth? Do Two Parallel Lines Ever Meet? Do We Need a Fourth Dimension?" *The Independent,* 13 December 1919, 174.

Slosson, Edwin E. "The Most Sensational Discovery of Science: The Weight of Light." *The Independent*, 29 November 1919, 136.

Slosson, Edwin E. "That Elusive Fourth Dimension." *The Independent,* 27 December 1919, 274.

Slosson, Edwin E. "Things You Can't Be Sure Of." *The Independent,* 20 December 1919, 236.

Taylor, Noel Heath. "Semantics in Musicology." *Bulletin of the American Musicological Society* 9/10 (June 1947): 29–30.

Thomson, Virgil. *Virgil Thomson*. New York: Random House, 1966.

Varèse, Edgard. "Edgard Varèse and Alexei Haieff Questioned by 8 Composers." *Possibilities: An Occasional Review* 1 (1947–8). Quoted in Fernand Ouellette. *Edgard Varèse*. New York: Orion Press, 1968.

Varèse, Edgard. "Music and the Times." In Daniel Albright, *Modernism and Music: An Anthology of Sources*. Chicago: University of Chicago Press, 2004.

Varèse, Edgard. "New Instruments and New Music." In *Contemporary Composers on Contemporary Music*, edited by Elliott Schwartz and Barney Childs. New York: Holt, Rinehart and Winston, 1967.

Wen-Chung, Chou. "A Varèse Chronology." *Perspectives of New Music* 5/1 (1966): 7–10.

Wen-Chung, Chou. "Varèse: A Sketch of the Man and His Music." *The Musical Quarterly* 52/2 (1966): 151–170.

Williams, William Carlos. "St. Francis Einstein of the Daffodils." In *The Collected Poems of William Carlos Williams*, Vol. 1: 1909-1939, edited by A. Walton Litz and Christopher MacGowan. New York: New Directions Publishing, 1986.

Williams, Wythe. "Einstein Distracted By Public Curiosity." *New York Times*, 4 February 1929, 1, 3.

Secondary Sources

"Recordings." *The Stefan Wolpe Society Newsletter* (2007): 14.

Albright, Daniel. *Modernism and Music: An Anthology of Sources*. Chicago: Chicago University Press, 2004.

Albright, Daniel. *Quantum Poetics: Yeats, Pound, and the Science of Modernism*. Cambridge: Cambridge University Press, 2003.

Anderson, John D. "Varèse and the Lyricism of the New Physics." *Musical Quarterly* 75/1 (1991): 31–49.

Anderson, John D. "The Influence of Scientific Concepts on the Music and Thought of Edgard Varèse," D.A. diss., University of North Colorado, 1984.

Ashby, Arved. “Schoenberg, Boulez, and Twelve-Tone Composition as ‘Ideal Type’.” *Journal of the American Musicological Society* 54/3 (2001): 585–625.

Augustine, Daniel Schuyler. “Four Theories of Music in the United States, 1900–1950: Cowell, Yasser, Partch, Schillinger,” PhD diss., University of Texas, 1979.

Austern, Linda. “‘Tis Nature’s Voice’: Music, Natural Philosophy, and the Hidden World in Seventeenth-Century Science.” In *Music Theory and Natural Order from the Renaissance to the Early-Twentieth Century*. Cambridge: Cambridge University Press, 2001.

Barthes, Roland. “The Brain of Einstein.” In *Mythologies*. Translated by Annette Lavers. New York: Hill and Wang, 1972.

Bell, Ian F. *Critic as Scientist: The Modernist Poetics of Ezra Pound*. New York: Methuen, 1981.

Bensaude-Vincent, B. “When a Physicist Turns on Philosophy: Paul Langevin (1911–39).” *Journal of the History of Ideas* 49 (1988): 319–338.

Biezunski, Michel. *Einstein à Paris: Le temps n’est plus…*. Saint-Denis, France: Presses Universitaires de Vincennes, 1991.

Bonds, Mark Evan. “The Spatial Representation of Musical Form.” *Journal of Musicology* 27/3 (2010): 265–303.

Botstein, Leon. “Einstein and Music.” In *Einstein for the 21st Century: His Legacy in Science, Art, and Modern Culture*, edited by Peter Galison, Gerald Holton, Silvan S. Schweber. Princeton: Princeton University Press, 2008.

Brodsky, Warren. “Joseph Schillinger (1895–1943) : Music Science Promethean.” *American Music* 21/1 (2003), 45–73.

Burkholder, J. Peter. “Ives and the Four Musical Traditions.” In *Charles Ives and His World*, edited by J. Peter Burkholder. Princeton: Princeton University Press, 1996.

Carpenter, Patricia and Severine Neff, Eds. *Arnold Schoenberg: The Musical Idea and the Logic, Technique, and Art of Its Presentation*. Bloomington, IN: Indiana University Press, 2006.

Carter, Tim. “Schoenberg, Weill, and the Federal Arts Project in Los Angeles, Spring 1937.” Forthcoming, 2011.

Case, Sue-Ellen. *Performing Science and the Virtual*. New York: Routledge, 2003.

Chase, Gilbert. *America's Music: From the Pilgrims to the Present.* New York: McGraw-Hill Book Company, 1966.

Clark, Ronald W. *Einstein: The Life and Times*. New York: Harper, 1973.

Clarke, Bruce. "Dark Star Crashes: Classical Thermodynamics and the Allegory of Cosmic Catastrophe." In *From Energy to Information: Representation in Science and Technology, Art, and Literature*, edited by Bruce Clarke and Linda Dalrymple Henderson. Stanford, CA: Stanford University Press, 2002.

Clarke, Bruce. *Energy Forms: Allegory and Science in the Era of Classical Thermodynamics*. Ann Arbor: University of Michigan Press, 2001.

Clarke, Bruce and Linda Dalrymple Henderson, eds. *From Energy to Information: Representation in Science and Technology, Art, and Literature*. Stanford, CA: Stanford University Press, 2002.

Crawford, Dorothy Lamb. "Arnold Schoenberg in Los Angeles." *The Musical Quarterly* 86/1 (2002), 6–48.

Crawford, Richard. "American Musicology Comes of Age: The Founding of the AMS." In *The American Musicological Society, 1934-1984: An Anniversary Essay by Richard Crawford*. Philadelphia: The American Musicological Society, 1984.

Crist, Elizabeth. *Music for the Common Man: Aaron Copland During the Depression and War*. New York: Oxford University Press, 2005.

Cunningham, David. "Einstein on the Beach." In *Writings on Glass: Essays Interviews, Criticism*, edited by Richard Kostelanetz and Robert Flemming. Berkeley: University of California Press, 1997.

Cusick, Suzanne G. "Gender, Musicology, and Feminism." In *Rethinking Music,* edited by Nicholas Cook and Mark Everist. Oxford: Oxford University Press, 1999.

Delaere, Mark and P. H. Daly. "Mutations in Systems in the Natural Sciences and Music in the First Half of the Twentieth Century." *International Review of the Aesthetics and Sociology of Music* 21/2 (1990): 3–28.

Eamon, William. "Inventing the World: Einstein and the Generation of 1905." *Antioch Review* 43/3 (1985): 340–351.

Elton, Lewis. "Einstein, General Relativity, and the German Press, 1919–1920." *Isis* 77/1 (1986): 95–103.

Ertan, Deniz. *Dane Rudhyar: His Music, Thought, and Art*. Rochester: Rochester University Press, 2009.

Fauser, Annegret. "Aaron Copland, Nadia Boulanger, and the Making of an 'American' Composer." *Musical Quarterly* 89/4 (2006): 524–554.

Fauser, Annegret. *Musical Encounters at the 1889 World's Fair*. Rochester, NY: Rochester University Press, 2005.

Feisst, Sabine. "Schoenberg Reception in America, 1933–1951." In *The Cambridge Companion to Schoenberg*, edited by Jennifer Shaw and Joseph Auner. Cambridge: Cambridge University Press, 2010.

Fisher, David J. "Colin McAlpin: His Music to 1903," Non-Doctoral diss., University of Sheffield, 1989.

Galison, Peter. *Einstein's Clocks, Poincare's Maps: Empires of Time*. New York: W. W. Norton & Company, 2003.

Gann, Kyle. "Subversive Prophet: Henry Cowell as Theorist and Critic." In *The Whole World of Music: A Henry Cowell Symposium*, edited by David Nicholls. Amsterdam: Overseas Publishers Association, 1997.

Glass, Philip. "Einstein and Music." In *Einstein: A Hundred Years of Relativity*, edited by Andrew Robinson. New York: Henry N. Abrams, 2005.

Gordon, Tom. "The Cubist Metaphor: Picasso in Stravinsky Criticism." *Current Musicology* 40 (1985): 22–33.

Gouk, Penelope. *Music, Science, and Natural Magic in Seventeenth-Century England*. New Haven, CT: Yale University Press, 1999.

Gouk, Penelope. *Representing Emotions: New Connections in the Histories of Art, Music, and Medicine*. Burlington, VT: Ashgate, 2005.

de Graaf, Melissa. "Documenting Music in the New Deal: The New York Composers' Forum Concert, 1935–1940." PhD diss., Brandeis University, 2006.

Haar, James. *The Science and Art of Renaissance Music*. Princeton, NJ: Princeton University Press, 1998.

Halbreich, Harry. *Bohuslav Martinů: Werkverzeichnis, Dokumentation und Biographie*. Zurich: Atlantis-Verlag, 1968.

Hauptman, Fred. "Review of John Alden Carpenter. Skyscrapers, etc. London Symphony Orchestra; Kenneth Klein, conductor. 1987. Angel DS 49263." *American Music* 7/2 (1989): 229.

Henderson, Linda Dalrymple. "Einstein and 20th-Century Art: A Romance in Many Dimensions." In *Einstein for the 21st Century: His Legacy in Science, Art, and Culture*, edited by Peter Galison, Gerald Holton, and Silvan S. Schweber. Princeton: Princeton University Press, 2008.

Hicks, Michael. "Cowell's Clusters." *Musical Quarterly* 77/3 (1993): 428–58.

Hicks, Michael. *Henry Cowell, Bohemian*. Urbana, IL: University of Illinois Press, 2002.

Hoffa, William Walter. "Ezra Pound and George Antheil: Vorticist Music and the Cantos." *American Literature* 44/1 (1972): 52–73.

Holton, Gerald. "Einstein and the Cultural Roots of Modern Science." *Daedalus* 127/1 (1998): 1–44.

Illy, Jozsef. *Albert Meets America: How Journalists Treated Genius during Einstein's 1921 Travels*. Baltimore: Johns Hopkins University Press, 2006.

Isaacson, Walter. *Einstein: His Life and Universe*. New York: Simon and Schuster Paperbacks, 2007.

Jackson, Myles W. *Harmonious Triads: Physicists, Musicians, and Instrument Makers in Nineteenth-Century Germany*. Cambridge, MA: MIT Press, 2006.

James, Kathleen. "Expressionism, Relativity, and the Einstein Tower." *The Journal of the Society of Architectural Historians* 53/4 (1994): 392–413.

Johnson, Julie M. "The Theory of Relativity in Modern Literature: An Overview and 'The Sound and the Fury'." *Journal of Modern Literature* 10/2 (1983): 217–230.

Jones, Michael Duane. "The Dynamics of Physical Force in the Modeling of Tonal Melodic Motion," PhD diss., University of Iowa, 2009.

Kassler, Jamie C. *Music, Science, Philosophy: Models in the Universe of Thought*. Burlington, VT: Ashgate, 2001.

Katz, Mark. *Capturing Sound: How Technology Has Changed Music*. Berkeley, CA: University of California Press, 2004.

Kern, Stephen. *The Culture of Time and Space, 1880–1918*. Cambridge, MA: Harvard University Press, 2003.

Kimball, Roger. "'The Two Cultures' Today." *New Criterion* 12/6 (1994): 10.

Kleppinger, Stanley V. “On the Influence of Jazz Rhythm in the Music of Aaron Copland.” *American Music* 21/1 (2003): 74–111.

Leppert, Richard D. Introduction to *Essays on Music: Theodor W. Adorno*, by Theodor W. Adorno. Berkeley: University of California Press, 2002, 1–67.

Lerner, Neil. “Aaron Copland, Norman Rockwell, and the ‘Four Freedoms’.” In *Aaron Copland and His World*, edited by Carol J. Oja and Judith Tick. Princeton: Princeton University Press, 2005.

Lerner, Neil, “The Classical Documentary Score in American Films of Persuasion: Contexts and Case Studies, 1936–1945,” PhD diss., Duke University, 1997.

MacDonald, Malcolm. *Schoenberg*. New York: Oxford University Press, 2008.

MacDonald, Malcolm. *Varèse: Astronomer in Sound*. London: Kahn and Averill, 2002.

Mark, Michael L. *A History of American Music Education*. Lanham, MD: Rowman & Littlefield Education, 2007.

Mattis, Olivia. “Varese’s Multimedia Conception of ‘Deserts’.” *Musical Quarterly* 76/4 (1992): 557–583.

Miller, Arthur I. *Einstein, Picasso: Space, Time, and the Beauty that Causes Havoc*. New York: Basic Books, 2001.

Missner, Marshall. “Why Einstein Became Famous in America.” *Social Studies of Science* 15/2 (1985): 267–291.

Morgan, Robert P. “Spatial Forms in Ives.” In *An Ives Celebration: Papers and Panels of the Charles Ives Centennial Festival-Conference*, edited by H. Wiley Hitchcock and Vivian Perlis. Urbana, IL: University of Illinois Press, 1977.

Morrison, Mark. “Why Modernist Studies and Science Studies Need Each Other.” *Modernism/Modernity* 9/4 (2002): 675–682.

Neff, Severine, ed. *Second String Quartet in F-Sharp Minor, Op. 10: Authoritative Score, Background and Analysis, Commentary*. New York: W. W. Norton and Company.

Ouellette, Fernand. *Edgard Varèse*. New York: Orion Press, 1968.

Ouellette, Fernand. *Visages d’Edgard Varèse*. Montreal: Editions de l’Hexagone, 1959.

Oja, Carol. *Making Music Modern*. New York: Oxford University Press, 2006.

Palisca, Claude V. "Moving the Affections through Music: Pre-Cartesian Psycho-Physiological Theories." In *Number to Sound: The Musical Way to the Scientific Revolution*, edited by Paolo Gozza. Boston: Kluwer Academic Publishers, 2000.

Palisca, Claude V. "The Science of Sound and Musical Practice." In *Science and the Arts in the Renaissance*, edited by John W. Shirley and F. David Hoeniger. Washington, DC: Folger Shakespeare Library, 1985.

Palisca, Claude V. "Scientific Empiricism in Musical Thought." In *Seventeenth-Century Science and the Arts*, edited by Hedley Howell Rhys. Ann Arbor, MI: University Microfilms International, 1980.

Palisca, Claude V. "Was Galileo's Father an Experimental Scientist?" In *Number to Sound: The Musical Way to the Scientific Revolution*, edited by Paolo Gozza. Boston: Kluwer Academic Publishers, 2000.

Pape, Gerard. "Varèse the Visionary." *Contemporary Music Review* 23/2 (2004): 24–5.

Pescatello, Ann M. *Charles Seeger: A Life in American Music*. Pittsburgh: University of Pittsburgh Press, 1992.

Pollack, Howard. *Aaron Copland: The Life and Work of an Uncommon Man*. New York: Henry Holt and Company, 2000.

Pollack, Howard. *Skyscraper Lullaby: The Life and Music of John Alden Carpenter*. Washington: Smithsonian Institution Press, 1995.

Rao, Nancy Yunhwa. "American Compositional Theory in the 1930s: Scale and Exoticism in 'The Nature of Melody' by Henry Cowell." *Musical Quarterly* 85/4 (2001): 596–600.

Rao, Nancy Yunhwa. "Partnership in Modern Music: Charles Seeger and Ruth Crawford, 1929-31." *American Music* 15/3 (1997): 352–380.

Rhees, David J. "A New Voice for Science: Science Service under Edwin E. Slosson, 1921–1929," MA thesis, University of North Carolina at Chapel Hill, 1979.

Richmond, Sheldon. "The Interaction of Art and Science." *Leonardo* 17/2 (1984): 81–86.

Riethmueller, Albrecht. "Schoenberg schreibt an Einstein: Die Briefe im musikalischen Kontext." In *Musizieren, Lieben und Maulhalten! Albert Einsteins Beziehungen zur Musik*. Basel: Schwabe, 2006.

Robinson, Andrew. "The World of Physics Before Einstein." In *A Hundred Years of Relativity*. New York: Harry N Abrams, Incorporated, 2005.

Rorem, Ned. Introduction to *Antheil and the Treatise on Harmony*, by Ezra Pound. New York: Da Capo Press, 1924.

Rosenblatt, Roger. "The Age Of Einstein." *Time* 154/27. 31 December 1999. Accessed on 2 February 2011 http://www.time.com/time/magazine/article/0,9171,993020,00.html

Rosenthal, Harold. "Moody [Manners], Fanny." *Oxford Music Online.* Accessed on 9 January 2011.

Schoenberg, E. Randol. "Arnold Schoenberg and Albert Einstein: Their Relationship and Views of Zionism." *Journal of the Arnold Schoenberg Institute* 10/2 (1987): 134–87.

Seuphor, Michel. *Le Style et le cri*. Paris: Seuil: 1965.

Shlain, Leonard. *Art and Physics: Parallel Visions in Space, Time, and Light*. New York: Harper Perennial, 2007.

Singleton, Charles S., editor., *Art, Science, and History in the Renaissance*. Baltimore: Johns Hopkins Press, 1967.

Spitzer, Michael. *Metaphor and Musical Thought*. Chicago: University of Chicago Press, 2004.

Sponsel, Alistair. "Constructing a 'Revolution in Science': The Campaign to Promote a Favorable Reception for the 1919 Solar Eclipse Experiments." *The British Journal for the History of Science* 35 (2002): 439–467.

Spratt, John F. "Science and Music." *Interdisciplinia* 1/1 (1975): 67–83.

Steege, Benjamin, "Material Ears: Hermann von Helmholtz, Attention, and Modern Aurality," PhD diss., Harvard University, 2007.

Steege, Benjamin. "Varèse in Vitro: On Attention, Aurality, and the Laboratory." *Current Musicology* 76 (2003): 25–51.

Sterken, Sven. "Towards a Space-Time Art: Iannis Xenakis's *Polytopes*." *Perspectives of New Music* 39/2 (2001): 262–273.

Strawn, John. "The *Intégrales* of Edgard Varèse: Space, Mass, Element, and Form." *Perspectives of New Music* 17/1 (1978): 138–160.

Tapscott, Stephen. *American Beauty: William Carlos Williams and the Modernist Whitman*. New York: Columbia University Press, 1984.

Tick, Judith. *Ruth Crawford Seeger: A Composer's Search for American Music*. New York: Oxford University Press, 1997.

Trippett, David. "Composing Time: Zeno's Arrow, Hindemith's 'Erinnerung,' and Satie's 'Instantanéisme'." *Journal of Musicology* 24/4 (2007): 522–580.

Vermeersch, B. C. "Composers' Forum." *Oxford Music Online*. Accessed 10 October 2010.

Walker, D. P. *Studies in Musical Science in the Late Renaissance*. London: Warburg Institute, University of London, 1978.

Watkins, Glenn. *Pyramids at the Louvre: Music, Culture, and Collage from Stravinsky to the Post-Modernists*. Cambridge, MA: Belknap Press of Harvard University Press, 1994.

Whitesitt, Linda. *The Life and Music of George Antheil, 1900–1959*. Ann Arbor, MI: UMI Research Press, 1983.

Whitworth, Michael H. *Einstein's Wake: Relativity, Metaphor, and Modernist Literature*. Oxford: Oxford University Press, 2001.

Yung, Bell. "From Modern Physics to Modern Musicology: Seeger and Beyond." In *Understanding Charles Seeger: Pioneer in American Musicology*, edited by Bell Yung and Helen Rees. Urbana: University of Illinois Press, 1999.

Zbikowski, Lawrence M. "Seeger's Unitary Field Theory Reconsidered." In *Understanding Charles Seeger: Pioneer in American Musicology*, edited by Bell Yung and Helen Rees. Urbana: University of Illinois Press, 1999.

Zon, Bennett. *Music and Metaphor in Nineteenth-Century British Musicology*. Burlington, VT: Ashgate, 2000.