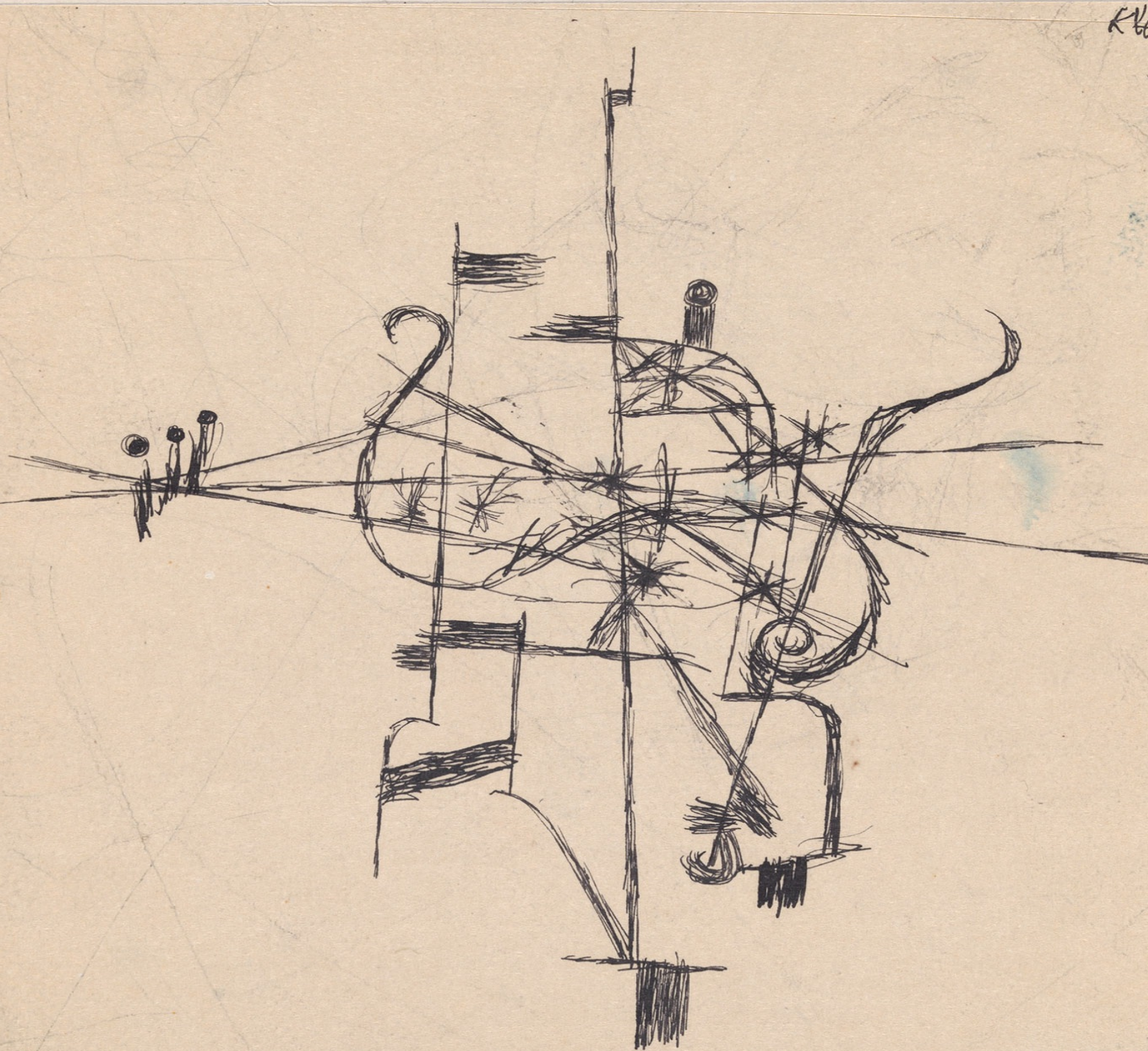


INSTRUMENTS FOR NEW MUSIC

SOUND, TECHNOLOGY, AND MODERNISM



1914. 10.

THOMAS PATTESON

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*Thomas Patterson
Philadelphia, May 2011*

Listening to Instruments

Music is of the imagination,
but the imagination is of the sound
and the sound is of the instruments.¹

—Robert Donington

The demand for new instruments resounded at the dawn of the twentieth century. “Suddenly, Ferruccio Busoni declared in his 1907 *Sketch of a New Aesthetic of Music*, “one day it became clear to me: the development of music is impeded by our instruments. [...] In their scope, the sound, and their performative possibilities, our instruments are constrained, and their hundred chains shackle the would-be creator as well.”² In his *Art of Noises* manifesto of 1913, Luigi Russolo denounced the symphony orchestra as a “hospital for anemic sounds” and called for new ways of exploring the unlimited domain of acoustic phenomena. Edgard Varèse declared in 1916, “We have a great need for new instruments. [...] I refuse to submit to sounds that have already been heard. I seek new technical means which can allow and sustain any kind of expression of thought.”³ Two years later, the Russian composer Joseph Schillinger foresaw the perfection of instruments through the “electrification of music” and asserted that from then on, “the development of music will go hand in hand with science.”⁴ Summing up the sentiments, the American physicist John Redfield wrote in 1926 that “the music of any age depends upon the kind of musical instruments which that age possesses. *Composers can go no further than the possibilities of the instruments for which they write.*”⁵ Among the many messianic visions of artistic renewal in the early twentieth century, these proclamations were distinguished by their technological emphasis. While others sought rejuvenation in folk traditions, popular music and American jazz, classical and baroque genres, or constructivist approaches to composition such as the twelve-tone technique, for these musicians the only solution was “a fundamental change of the sonic apparatus itself”—a new instrumentarium.⁶

The call for new instruments did not long go unanswered. During the fifteen-year span of the Weimar Republic (1918–1933), which held sway between the end of the First World War and the Nazi seizure of power, Germany and its neighbors buzzed with technological experiments in music. Mechanical instruments such as the player piano, originally intended to reproduce the popular hits of the day and immortalize the interpretations of great performers, were refashioned as superhuman machines capable of realizing musical designs unplayable by ten fingers. Electric instruments offered performing musicians new interfaces and sound-generating circuitry, opening up unexplored worlds of timbre and tone. Finally, recording media such as gramophone records and optical sound film were used not to capture but to *produce* sound according to the composer’s wishes, generating musical possibilities beyond the bounds of familiar instruments. From the mid-1920s until the fall of the Republic—and even, to a lesser extent, during the Nazi period—these new instruments stood at the center of the

furious artistic debates of the day. Concerts and festivals provided public forums for the technologies and their enthusiasts, music journals published dispatches on the latest developments and dedicated special issues to the topic, inventors demonstrated their creations throughout Europe, and composers both obscure and established set out to create music for these devices. The instrumental innovations of the early twentieth century were not merely isolated experiments but rather part of a systematic, wide-ranging investigation into the technological foundations of sound and its implications for the art of music.⁷

A hundred years later, musicians take for granted what for Busoni and his ilk was a daring proposition. From a purely quantitative standpoint, the ways of producing, manipulating, and disseminating sound have grown exponentially in the last century. Out of a potentially infinite catalog of possibilities, consider just a few examples: ubiquitous university courses and curricula in “electronic music” and “music and technology,” the massive consumer market for synthesizers and other electronic instruments, and the proliferation of computer-based interfaces of all kinds, from highly abstract computer music languages to the plethora of apps for cell phones and tablets. But it is not only the sheer number of instruments now available that is significant; it is how these devices—digital, analog, and “acoustic”—reshape the fundamental parameters of the art. Instruments make music in a double sense: they create the sounds, but they also forge connections to the aesthetic, social, and metaphysical realities that give these sounds meaning, charging them with the current of human significance. What music is depends, to a large degree, on what instruments can do. The realization of this fundamental interdependence between music and technology is a legacy of the inventions, debates, and performances whose story I tell in this book.

Some of these things will be familiar from the history of what, since about 1950, has been known as “electronic music,” which has been explored at great length in both general and specialist sources. Indeed, this history is by now so well-trodden that it has almost attained the status of a myth. By this I don’t mean simply something that is not true; I mean a sort of history by osmosis, a common or vernacular understanding that seeps into public consciousness from various sources of information. (Most historical knowledge is, in this sense, mythic.) *Instruments for New Music* is a product of both my fascination with electronic music and my discontent with its conventional history—my sense that the very concept of electronic music is too limiting and actually forecloses new perspectives on the relationship between sound, art, and technology in twentieth-century culture.

Perhaps the most basic characteristic of the myth of electronic music is the way it maps onto the chronology of the twentieth century. The exhaustion of the orchestra, the visionary artist stifled by the lack of appropriate tools, the appeal to a distant future in which composers’ dreams could at last be realized—these tropes form the pillars of this historic narrative. The career of Varèse, in particular, is the touchstone here: after composing a number of groundbreaking works that stretched the limits of the orchestra, his frustration with existing instruments led him to abandon composition in the late 1930s. Only after World War II, with the availability of magnetic tape and the founding of the first studios for electronic music, was he finally able to attain his ideal of absolute artistic control.⁸ This story as told and retold by music historians, neatly bisects the twentieth century into an early period of prophetic speculation and a later phase of genuine artistic accomplishment. Consequently everything that came before the emergence of electronic music around 1950 is consigned to “pre-history” of dubious value: if these earlier events are considered at all, they are often

relegated to the role of anticipating or foreshadowing later developments. In this book, I try to understand the technological endeavors of the early twentieth century in their own terms. Only then, I believe, can we begin to figure out how these activities relate to the bigger historical picture, not as predecessors or preludes, but as integral elements of modern culture.

There is another problem. The very concept of electronic music too often implies that in the twentieth century music somehow *became technological*, and it highlights modern sound apparatus at the cost of obscuring the material foundations of music throughout history.⁹ (In an odd way, in many contexts “electronic music” has become vaguely synonymous with “music and technology.”) Further, the myth of electronic music conflates the technological changes undergone in the twentieth century with a particular, admittedly hugely important branch of technology: namely, electronics. Consequently, phenomena such as the unique inventions of Russolo and Harry Partch or the refunctioning of traditional instruments through unconventional playing techniques are typically explained as appendages to electronic music rather than being seen as manifestations of an overarching category of activity. Electronic music, in short, offers too narrow a conceptual framework to encompass the far-flung technological extensions of twentieth-century music. What is needed, and what I hope this book will provide, is a greater sense of continuity both between musical instruments new and old and between technology and the human conditions within which it exists.

Indeed, the biggest problem with the story of electronic music is the way it tends to be told in isolation from the larger history of twentieth-century culture. The progression from the first electronic instruments to tape machines to synthesizers and computers is depicted as a natural unfolding of technological forms; history becomes a timeline of inventions and innovations laid out with all the taxonomical neatness of a scientific exhibit. But the history of instruments, when properly told, concerns not just the objects themselves but also what they promise, portend, and make possible. The controversies surrounding the movement for new instruments in the early twentieth century both echoed and influenced the broader debate about the role of technology in modern society: musicians’ deepening engagement with technology, far from being merely a search for “new sounds,” constitutes one of the primary vectors through which music in the twentieth century opens out into other fields of thought and action, from aesthetics to politics, science, and philosophy.

My purpose in this book is not to champion a kind of technological reductionism—throwing back the curtain to reveal the machines behind the music. The technical and aesthetic threads of music are intertwined through and through: instruments are “technologies of enchantment.”¹⁰ Like all artifacts, they are products of human brains and bodies, shot through with imagination, will, and desire. The study of instruments need not represent a challenge to traditional humanistic concerns; on the contrary, it could help resuscitate aesthetics in its radical, original sense: the science of perception and feeling.¹¹ This means, on the one hand, that technologies cannot be fully comprehended apart from the human contexts in which they emerge. On the other hand, the study of art must encompass the material means of cultural production. Tracing the contours of what has been called the *instrumentality* of music is not a question of exposing aesthetic experience as the subjective by-product of an underlying material reality, but rather of grasping how the spell of art is technologically cast.¹²

There was no common musical aesthetic uniting the various figures brought together in the book. While they shared a vision of the radical reform of music through modern technology, they were motivated by distinct and sometimes mutually antagonistic objectives.¹³ They disagreed about the kind of instruments worth pursuing, about the musical potential even of given devices, about how the new instruments fit into existing habits of music making, and about the role of technology in culture at large. In short, the movement for new instruments was not a monolithic project but rather an arena in which different worldviews collided. The underlying motivation for the disparate undertakings recounted in the following pages was the search for new musical possibilities, new foundations of creative work. The technological enthusiasm of the age was driven by a kind of musical fundamentalism, a desire to bypass worn-out means of expression and get one's hands on sound itself. New instruments allowed the artists of the time to explore the outer limits of artistic possibility. As one observer noted in 1927, "The boldest artists are groping in the dark of an unexplored space. What they discover there is difficult to measure with the old yardsticks; it is absolutely otherwise. Whether it is a dead end or the path to a new century, a narrow, arduous borderland or a vast fertile country, no one can say." Significantly, the examples given of these "threshold" phenomena were all technological experiments: the investigation of the continuum between tone and noise, the division of the semitone into quarter tone and smaller values, and the mechanical reproduction of music.¹⁴

Technology in twentieth century music is typically associated with modernism in its antiromantic, scientific, and "objective" tendencies. Likewise, the technological enthusiasm of the Weimar period was understood at the time as a manifestation of the "New Sobriety" (*neue Sachlichkeit*), which stood for a down-to-earth, unsentimental attitude toward art and society. Many of the figures in this book—among them Hans Heinz Stuckenschmidt, László Moholy-Nagy, and Rudolf Pfenninger—saw the new instruments as embodiments of modern values such as clarity, order, and control. They embraced a rigorous, quasi-scientific ideal of music in opposition to the image of the inspired artist inherited from the nineteenth century. But this matter-of-fact mindset was by no means universal among advocates of the new instruments. Others, such as Jörg Mager, Oskar Schlemmer, and Oskar Fischinger, wove modern technology into a poetic and visionary worldview. In the language of expressionist aesthetics, they sought to "project themselves into the cosmos" and extend the scope of their experience to a superhuman scale.¹⁵ Embracing the machine as a means of spiritual transport, they gave themselves over to "technological sublime," in which the artifacts built to control natural forces become objects of the fascination and awe that those forces once evoked.¹⁶ Such unlikely alliances between mysticism and modernity were probably what the philosopher Ernst Cassirer had in mind when he bemoaned the "romantics of technology" who exalted inventions that they did not understand.¹⁷ Cassirer and other critics feared that the newest technologies offered an up-to-date guise for dangerous antimodern attitudes.

The split between what might be called "machine modernism" and "machine romanticism" reflected a broader duality in the early twentieth century between an infatuation with modern life and an idealistic quest for alternatives to a disenchanting reality. This opposition was illustrated in Oskar Schlemmer's colorful characterization of the bifurcated artistic culture of the Bauhaus in the early 1920s: "On the one hand, the influence of oriental culture, the cult of India, also a return to nature... communes, vegetarianism, Tolstoyism, reaction against the war; and on the other hand, the American spirit [*Amerikanismus*], progress, the marvels of

technology and invention, the urban environment.”¹⁸ In short, there were two broad strains of technological enthusiasm: one embraced technology as the embodiment of the modern *Zeitgeist*, while the other saw it as a way to transcend profane reality and reach a state of timelessness or ecstasy.

Just as the new sound technologies brought together artists of opposing aesthetic positions, so too did they throw open the gates separating the various forms of art. One of the most remarkable effects of the technologization of sound was to draw music into the synesthetic gyre of the early twentieth century. This multi- (or inter-)media impulse, too, belonged to the spirit of the age: the painter Paul Klee spoke for many when he dismissed the hallowed distinctions between the arts laid down in Gottfried Lessing’s classic eighteenth-century aesthetic treatise *Laoköon* as “learned nonsense.”¹⁹ Indeed, one of the primary reasons why music historians have overlooked the technological undertakings of the Weimar period is that very few of the movement’s major figures were professional musicians. Stuckenschmidt, for example, though trained as a composer, made his mark as a critic and impresario. The Hungarian painter and photographer Moholy-Nagy was one of the central theorists of technological experimentation in the arts, and his writings exerted a foundational influence on the search for new instrumental modalities in the 1920s. The choreographer Oskar Schlemmer, who taught alongside Moholy-Nagy at the Bauhaus, developed an abstract, puppetlike form of dance and costume design whose musical equivalent he sought in mechanical instruments. The inventors Jörg Mager and Friedrich Trautwein, though at best amateur musicians, were able to envision new forms of music on the basis of their electroacoustic investigations into sound. Finally, the pioneers of optical sound film after 1930—Walter Ruttmann, Oskar Fischinger, and Rudolf Pfenninger—were all filmmakers by training, and they translated their skills in that medium to a new form of music-making based on cinematic techniques such as splicing and montage.

The intermingling of artistic media points toward another overlooked aspect of Weimar-era experimentation: virtually all the new instruments of the period were based more or less closely on existing forms of media technology. As the mass-media empires of broadcasting and recording rose around them, the musicians and artists of the Weimar Republic sought to seize the industries’ tools and turn them into instruments for new music. Moholy-Nagy provided a catalytic jolt to the movement with his 1922 essay “Production-Reproduction,” published in the Dutch art journal *De Stijl*.²⁰ Here he formulated what would become the credo of like-minded artists: a turn from merely *reproductive* applications (duplication, dissemination) to generative or *productive* uses—that is, the creation of new forms of art that exploited the unique capabilities of modern technologies.

Artists of the period did not universally oppose media as means of communication—indeed, most believed that recording and radio transmission had great potential as instruments of modern enlightenment—but they resisted what they saw as the one-dimensional function of modern technologies in propagating existing forms of art. In some cases, turning media into instruments was simply a question of deliberate artistic “refunctioning”: for example, inscribing directly onto recording formats such as player piano rolls or optical sound film. In the case of early electric instruments, however, the relationship to existing media technologies was more remote, and thus the act of repurposing was more technically involved: radio components, intended to receive signals, could be cobbled together in new configurations to create and control electrically generated tones. One contemporary observer wrote that electric

instruments, “whose technical components are familiar from the domain of radio electronics do not want to be an ear, but rather a voice.”²¹

For many of the protagonists of this book, then, the new instruments became a vehicle for technological critique: they reimagined media not as passive transmitters of preformed content but as tools whose function and meaning were determined by their users.²² From the standpoint of the later technological history of the twentieth century, Moholy-Nagy’s duality of production-reproduction anticipates the emerging categories of *instruments* and *media* as tools of artistic expression, on the one hand, and means of communication, on the other. Media scholar Jonathan Sterne has argued that the conventional distinction between music instruments and reproductive media has long failed to do justice to reality: instead of a hard line between the two, history shows a continuous flow between “productive” and “reproductive” sound technologies.²³ The distinction between media and instrument, in short, is not embedded in the objects themselves but emerges from patterns of use. Technologies do not impose upon their players a uniform technique but rather, at most, inbuilt tendencies or inertial forces—*attractors*, so to speak, in the phase space of creative possibility.

TECHNOLOGY IN THE BALANCE

While the search for new instruments was buoyed by an attitude of what might be called technological euphoria, this optimistic mood was by no means universal in the early twentieth century. The early twentieth century was a time of profound technological anxiety in European culture, and the movement for new instruments both reflected and shaped broader debates about technology writ large. The origins of this debate reach back into the second half of the previous century, as engineers and scientists sought to raise the cultural standing of their professions by showing how material progress benefitted not only the body but also the mind and spirit. One of the foremost protagonists in this project was the German physicist Hermann von Helmholtz (1821–1894). Helmholtz viewed his research as a bridge between the older tradition of the humanities, or *Kulturwissenschaften*, with their qualitative and holistic orientation, and the ascendant natural sciences, which were highly specialized and analytical in orientation.²⁴ Incidentally, Helmholtz was also a pioneering researcher in acoustics whose findings were hugely influential for many early-twentieth-century experiments in sound technology. In his book *On the Sensations of Tone*, first published in 1863, Helmholtz attempted to synthesize the two domains of music and natural science—in his words, to “connect the boundaries of two sciences, which, although drawn toward each other by many natural affinities, have hitherto remained practically distinct—the boundaries of *physical and physiological acoustics* on one side, and of *musical science and aesthetics* on the other.”²⁵

Helmholtz’s work was a touchstone for many of the figures in this book, on account of both its groundbreaking insights and its ambitious project of bridging art and science. But this was just one manifestation of a larger effort by German intellectuals to demonstrate the underlying unity of technological progress and humanistic culture. In his 1877 book *Principles of a Philosophy of Technology*, Ernst Kapp challenged the conventional understanding of technology in terms of mechanisms and depicted tools as “organ projections,” or extensions of the human body: for Kapp, the hammer was a synthetic fist, spectacles were externalized eyes, and the telegraph was an artificial nervous system.²⁶ By envisioning technology as an organic outgrowth of humanity rather than an extrinsic, alien force, Kapp and other scientifically

inclined intellectuals challenged the technophobic bias in German culture and helped foster a sympathetic attitude toward technology by framing it in terms of the natural, the spiritual, and the creative.²⁷

This project gained steam with the advancing industrialization of Germany and the rise of a new, scientifically trained class of professionals around the turn of the century. The engineer Max Eyth asserted that technological objects should be viewed as products of the human spirit, no different from works of art. A device that turns electricity into light, Eyth suggested, is as noble a creation as a novel or a poem. He described the urge to invent in terms typically reserved for the inspiration of the artistic genius:

The cause of all invention [...] is the *creative* impulse in the spirit of man, the *pleasure* of making, the *joy* of producing. It is the same force that drives the artist and the poet to his creation, without want, without necessity, but inexorably; the Promethean spark that lives in man, the divine in us, that makes the animal into a human being and gives the human being an affinity to God.²⁸

Another engineer-philosopher, Eberhard Zschimmer, argued that the cultural value of technological creations was to be found not in the artifacts themselves, but in the expression of human will that they embodied. Through the painstaking labors of his craft, the inventor undertook a quest for freedom through the mastery of the physical world: “Because we are born into chains in nature, thus there awakes with the spark of spirit the idea of freedom over nature: *the idea of technology*. Every new invention is a new stage in the freedom attained by humanity through the progress of technology.”²⁹ Zschimmer and others sought to bridge the apparent chasm between the mechanical and the organic by portraying inventors as creative figures—artists in the medium of technology, so to speak.

But this effort to make a place for inventors and engineers in the cultural pantheon was by no means unopposed. For many, and especially for the cultural elite that had been steeped in the humanist tradition of the nineteenth century, technology symbolized all the ills of the modern age. This techno-skeptical attitude found its most influential voice in Oswald Spengler’s pop-intellectual treatise *Decline of the West* (1918–1922), which presented a gloomy narrative of European civilization sputtering toward its inevitable doom at the hands of its own devices. In Spengler’s pessimistic vision, the technological and materialist obsessions of Western, “Faustian” culture had created a world drained of human meaning and understood solely in terms of scientific manipulation.³⁰ Just as nature had been brought to heel by its human creatures, Spengler suggested, humanity would soon be subjugated by its own mechanical progeny. The sociologist Max Weber sounded a similar note in his lecture “Science as a Vocation,” written, like Spengler’s book, during the final days of the First World War. Weber proclaimed that the techno-scientific mindset of European modernity had led to the “disenchantment of the world.” Humanity’s experience of awe before the unfathomable workings of nature had given way to the blasé arrogance of universal knowledge and mastery.³¹

This simmering discontent with modernity found expression in a diffuse intellectual tendency known as “philosophy of life” (*Lebensphilosophie*). Rooted in the writings of thinkers such as Wilhelm Dilthey, Henri Bergson, and Friedrich Nietzsche, this was an eclectic cocktail of ideas that included disgust with the supposed superficiality of regnant scientific materialism, a concern for unity and synthesis over the analytic mindset of nineteenth-century positivism, and strikingly proto-environmental critiques of industrialization and the

destruction of the natural world.³² Although *Lebensphilosophie*, above all through its associations with philosophers such as Nietzsche and Ludwig Klages, eventually became tainted through piecemeal appropriation by the Nazis, it was no monopoly of the political right. Apprehension about the fragmented, chaotic nature of modern life was felt across the ideological spectrum, and none were immune from what historian Peter Gay called the “hunger for wholeness.”³³

The fear that modernity posed a threat to humanistic culture was especially acute in musical circles. The valorization of technology in the early twentieth century challenged widespread suspicion that the modern, disenchanted world of science was fundamentally incompatible with the expressive domain of art—epitomized, according to aesthetic consensus, by music. Music was the sanctum of an endangered subjective “inwardness,” whether conceived as religious awe, emotional expression, or metaphysical transcendence. Over the course of the nineteenth century, the concert music tradition came to represent a refuge from the noise and chaos of modernity, a safe haven for the spiritual values threatened by industrialization and the emergence of mass society. The technological enthusiasm of the early twentieth century thus signaled an ominous incursion of modernity into one of the last bastions of humanist culture.³⁴

Defenders of musical tradition, though often skeptical of the new technologies, felt compelled to take them seriously. No less an authority than Curt Sachs, a prominent musicologist, historian and one of the founders of the modern discipline of organology, turned his attention to the new instruments and their significance for the music of the modern age:

Today [in 1927] [...] we find ourselves again at a critical, decisive point. Lauded and lamented, young composers are taking up the new expressive means offered by the record industry and its relatives. We ourselves have witnessed the maturation of these technologies: the development of the Edison phonograph to the Gramophone and the little music box to the [Welter] Mignon Organ has played out in our own time, and today we are astounded witnesses to tone production through electrical currents.³⁵

For Sachs, as for many others, the dawning instrumental revolution represented an epochal shift in the relationship between spirit (*Geist*) and technology (*Technik*)—in other words, between musical ideas and their means of realization. Sachs was troubled by the possibility that the “technique of the instrument builder,” not the “mind of the composer,” could gain the upper hand in the unfolding of music history.³⁶ In the new instruments, he perceived the danger of technology run amok, unchecked by a higher principle.

In 1926, the critic Adolf Weissmann published a book entitled *Die Entgötterung der Musik* (*Music Come to Earth*), in which he explicitly counterposed the romantic concept of art against the effects of modern technology: “We find ourselves in the midst of radical upheavals in the domain of art, and it is music, perhaps, which plays the greatest part in them. Nothing of the kind has ever happened before. [...] Music’s descent to earth [*Entgötterung*] need not be its ruin; but its conformity to this new world of machinery cannot but change its very core.”³⁷ For Weissmann, modern technology was a declaration of war on the nineteenth-century ideal of art. Automobiles and airplanes collapse distance and endanger the artist’s “splendid isolation,” while economic pressures force him to think of ephemeral successes and scorn the quest for immortality through timeless works. The result is the uprooting of romanticism, a process begun in the nineteenth century and completed by the Great War.³⁸ Weissmann expressed the conflict between technology and human freedom in terms of the struggle between musician

and instrument: “Mind devised the machine; now the machine fetters and drives mind. [...] *A* the piano, man, as a musician, still wrestled with the machine. He could once dominate it by giving it a soul. Now the machine is ready to subdue him.”³⁹ As he recognized, music in the early twentieth century had become the site of a proxy battle over technology and its role in modern society.

INSTRUMENTS AND THE FUTURE

Thinkers such as Sachs and Weissmann, with their skeptical attitudes toward the new technologies, represented the old guard of an increasingly embattled humanistic tradition opposed to the “materialist” values of emerging industrial society. It was the engineers’ gospel of Helmholtz and company—technology as a harbinger of human freedom—that formed the deep cultural substrate of the utopian visions of the early twentieth century and that united the otherwise contentious band of characters featured in this book. In the domain of music, one of the earliest and most influential advocates of this ideal was the Italian-German composer and writer Ferruccio Busoni (1886–1924). Busoni was the primary vector through which the technological enthusiasm of the early twentieth century entered into the bloodstream of European classical music. It was his writings, and above all his widely read 1907 treatise *Sketch of a New Aesthetic of Music* (*Entwurf einer neuen Ästhetik der Tonkunst*), that laid the intellectual foundation for the technological experiments of the 1920s and ’30s. More than any other figure, Busoni was the patron saint of the movement for new instruments.

For the purposes of this book, the critical idea of Busoni’s *Sketch* was that composition as thought had outstripped the potential of available musical technologies: instruments had become the limiting reagents in the chemical reaction that fueled the progress of music. For Busoni, the constraints imposed by traditional instruments were not only technical but also emotional and associative: no amount of skill can allow the composer to escape “the tremulous ardor of the cello, the hesitant entry of the horn, the timid shortness of breath of the oboe, the showy loquaciousness of the clarinet.”⁴⁰ Crucially, however, the exhaustion of the symphonic instrumentarium was at once a crisis and an opportunity for radical renewal. “It may be that all the possibilities of traditional instruments have not yet been exploited,” Busoni wrote. “But we are certainly well along the way of the path toward exhaustion. Where then do we turn our gaze, where does the next step lead? The answer, I believe, is abstract sound, unbounded techniques and technologies [*Technik*], tonal limitlessness. All efforts must push in this direction, in order to bring about a new, virginal beginning.”⁴¹

Remarkably, in light of the scope of his later influence, Busoni said very little about actual technologies in his book. He dilated at some length on technical novelties such as new scales and systems of tuning but mentioned only one new instrument, the Telharmonium of the American inventor Thaddeus Cahill, and described it in rather impressionistic terms. (Busoni’s misunderstanding of Cahill’s instrument had ramifications in the later development early electronic instruments, as shown in chapter 3.) He hailed the Telharmonium’s “scientifically perfect sound” and declared that “only a long and diligent experimentation, an ongoing education of the ears, will render this unfamiliar material pliable for the coming generation and for art.”⁴² It was Busoni’s ability to link the transcendental imagery of musical idealism with the real technological prospects of the age that enabled his writing to cast such a powerful spell on the later course of twentieth-century music.

Even as his book went through two highly successful editions, Busoni's views provoked spirited opposition. The most prominent challenge came from the German composer Hans Pfitzner, whose 1917 pamphlet *The Danger of Futurism (Futuristengefahr)* doubled as a soapbox for his nationalist and antimodernist views on contemporary music.⁴³ "Futurism" for Pfitzner—the term appears nowhere in Busoni's book—signified Busoni's contempt for tradition and reckless enthusiasm for novelty. He accused Busoni of dismissing the entire history of music as a mere prelude that must be "annihilated root and branch" in order for the music of the future to be born. The product of Busoni's vain quest for utopian systems of musical organization was at best idle speculation, and at worst artistic nihilism:

In general [Busoni's] expositions degenerate into dreams and prophecies of as-yet nonexistent developments and the futuristic musical theories that will lead to them, and—of course, not unrelated to this—a more implicit than overt negation of everything that has come before. [...] Strange! Busoni disavows what is right at hand, but he believes in what nonexistent!⁴⁴

For Pfitzner, who saw himself as a defender of the German classical-romantic tradition, Busoni's vision of the music of the future was simply unrecognizable as the art of Bach, Beethoven, and Brahms: "It appears to me that if Busoni's dreams were to be realized, the result would be no new aesthetic of music, but an entirely new art," he wrote, "if indeed there could be an art that has nothing in common with what we now call music, aside from the vibrations of the air."⁴⁵ Pfitzner believed that great art can emerge only from the inextinguishable well of creative inspiration and never from the development of new instruments or techniques.⁴⁶ The origin and essence of music is *Einfall*, or inspiration; instruments are merely the external means of clothing the musical idea in acoustic form. Pfitzner argued that because music, unlike the other arts, lacks a preexistent material with which to work, composition is a purely spiritual act. In his words, "the composer has nothing in the external world as material, but rather only his feelings. He creates *ex nihilo*." The alternative to this belief in inspired creation is "a regression to the workmanlike primitiveness of earlier times, when the concept of the 'composer' had not yet emerged in its pure form." For Pfitzner, the notion that music was somehow dependent on technology was an affront to all practitioners of the art.

In his response to Pfitzner's attack, an open letter bearing the title "The Future of Music," Busoni offered a defense of his musical aesthetics couched, appropriately enough, in technological metaphor. Just as those who first dreamed of human flight could not envision the machines that finally fulfilled that ancient wish, Busoni could not foresee the course that the new music would take. Instead, he hoped to lay the foundation for future developments whose precise contours were unimaginable from the standpoint of the present. In a final gift to Pfitzner, who had compared his antagonist's speculations to the science fiction novels of Jules Verne, Busoni reminded his adversary "how much technical fantasy in these books has now become fact."⁴⁸

As the confrontation between Busoni and Pfitzner demonstrates, the question of instruments and their role in music was bound up with larger debates over music's place in the trajectory of history and artists' competing loyalties to past and future. While Pfitzner worried that musical tradition would be sacrificed for the sake of a "new music" of questionable value, Busoni believed that the survival of the art could be ensured only by a radical technological intervention. Here, as elsewhere, debates ostensibly about technology turned out to revolve

around other matters, from the possibility of progress in art to the relationship between form of art and the society in which they exist.

Busoni's speculative vision would exert a powerful allure for the composers, inventors, and critics of the Weimar Republic. The dominant mood of the movement was, quite literally "futurist." For the protagonists of the search for new instruments, the success of the endeavor was to be measured not only by its immediate impact on contemporary musical life but also by its distant and unforeseeable ramifications. This attitude resonated with the optimistic progress-thinking typical of the technological discourse of the time. The philosopher Ernst Cassirer, writing in 1930, declared that "technology is ultimately concerned not with what *is*, but with what *could be*."⁴⁹ The journalist Frank Warschauer argued that historicist thinking, which tries to understand the present on the basis of the past, must give way to "science of the future" that understands the present on the basis of its teleological arc: "The path of technology, according to everything we know, is perfectly straight. We need only follow its trajectory in order to see where it leads, and indeed, must lead. To recognize the character of technification, it is necessary to look to the future. Only then can what is happening in the present moment become clear."⁵⁰ This notion of a technological conditioned sense of futurity corresponded to a tendency in the broader pan-European avant-garde toward theoretical speculation, polemics, and imaginative brainstorming. Many modernists seemed to be more concerned with creating systems, techniques, and processes for making art than with producing finished works. Artists saw themselves in relation not to historical lineage from the past but to future developments in which they hoped to play a generative role.⁵¹

For all his invocations of a distant future in which his prophecies would be vindicated, Busoni's musical utopia did not have to wait long. In 1906, a year before *Sketch of a New Aesthetic of Music* was first published, Lee de Forest patented his Audion triode, the invention that would come to symbolize the birth of the electronic age. No longer would giant spinning dynamos be needed to generate sufficient electric charge to create a synthetic tone; now this could be done by the compact, lightweight, and eventually mass-producible vacuum tube. Ironically, while engineers increasingly fancied themselves as inspired visionaries, many artists aspired to the sublime rigor of science: Musicians of the period spoke of their work in terms of "discovery," "investigation," and "research." The musical possibilities they contemplated were no mere thought experiments—they were real potentialities engendered by the shifting technological basis of sound production.

Still, the product of the techno-aesthetic fusion foretold by Busoni was bound to be something new and volatile. Pfitzner's crotchety admonitions about the "dangers of futurism" would eventually gain a certain retrospective validity: the vertiginous effects of the new instruments would indeed change music into "an entirely new art," as he had warned. By introducing the machine into the studio, composers exchanged the limited but stable instrumentarium of the nineteenth century for the bewildering possibilities of modern technology. As we will see in the following chapters, the new instruments offered a devil's bargain: their powers were vast but also unpredictable and uncontrollable. Neither imperiously dictating musical reality nor obediently channeling their masters' wishes, they were "tricksters" whose mercurial nature belied their apparent fixity as material objects. Rather than expanding compositional possibilities in a linear and predictable way, the instrumental innovations of the early twentieth century scrambled conventional aesthetic

categories, destabilized the boundaries between the arts, and reshaped the relationship between past, present, and future in artistic consciousness. As Busoni's progeny would discover, the marriage of music and modern technology would have implications unforeseen even by its most radical advocates. To a greater degree than ever before, music and technology would enter into a mutually catalytic relationship, impelling each other toward exhilarating and unsettling new possibilities.

“The Joy of Precision”

Mechanical Instruments and the Aesthetics of Automation

It is not the automaton that plays the flute; it is the mechanic, who measured the wind and set the fingers in motion.¹

—Jean-Jacques Rousseau

On the evening of July 25, 1926, an unusual concert took place in the small Black Forest town of Donaueschingen, Germany. Presented as “original compositions for mechanical instruments,” the event featured three pieces by Ernst Toch, six “Polyphonic Études” by Gerhart Münch, and two works by Paul Hindemith, all written especially for a model of piano called the Welte-Mignon, which played automatically by means of a pneumatic mechanism activated by a spinning paper roll. The finale was an experimental stage performance called the *Triadic Ballet*, with costumes and choreography by the Bauhaus teacher Oskar Schlemmer and accompaniment for mechanical organ by Hindemith. A contemporary account captured the strange scene as the music began:

The hall was illuminated by unseen sources. It was absolutely quiet as Hindemith wound up the device. [...] The piano began to play: music like an étude, toccatas with otherwise unplayable harmonic progressions, with a speed that could never be approached even by the most virtuosic of players, with an exactitude of which a human could never be capable, with a superhuman sonic force, with a geometrical clarity of rhythm, tempo, dynamics, and phrasing, which only a machine could produce. [...] The piano finished the composition and there was an uneasy pause. Should one applaud? There’s no one sitting there. It’s only a machine. Finally a quiet applause, growing louder. Calls of “da capo.” And sure enough, the piano played it again, without hesitation, as precisely as the first time.²

This concert, and its successor the following year, presented a collection of original compositions written not for a human performer to play, but for the mechanical piano itself. These pieces, though written by a handful of different composers, shared certain stylistic traits. They were all miniatures in scale, with the longest piece clocking in at a mere four and a half minutes. A brisk or very fast tempo and a medium-to-loud dynamic level were dominant throughout most of the compositions. In terms of genre, the pieces tended toward either preclassical contrapuntal or ornamental models. This predilection for polyphonic forms, on the one hand, and quasi-improvisatory showpieces, on the other, was typical of the modernist style of the mid-1920s.³

In Hans Haass’s *Capriccio Fugue*, the fugal subject is presented straightaway, the entries of the voices rapidly accumulating to a densely layered polyphonic haze. The audible structure of the piece quickly disappears amid a bewildering sequence of *trompe l’oreille* effects—cloudlike agglomerations of tones, trills, parallel motion in several octaves at once, and cascading scalar passages. Haass exploits the Welte-Mignon’s capacity for breakneck speed not only in the general prestissimo pace of the music but also in particular passages where the succession of

tones surpasses the temporal resolution of the human ear. At these moments the listener can no longer register individual pitches but instead perceives only tonal blurs and smears, effects that are almost entirely dissociated from the conventional timbral palette of the piano.

At the other end of the spectrum is the fourth of Gerhart Münch's *Six Polyphonic Etudes*, a strikingly understated example of the Welte-Mignon's technical capabilities. Entitled "Fugato," the piece presents three distinct registers of activity spanning the entire range of the piano: a sparsely populated bass zone, a somewhat more active middle register, and an upper voice proceeding in shuffling pairs of notes (dotted-eighths followed by sixteenths). Each voice seems to go about its business more or less unaware of the others, with the upper two parts tracing meandering downward paths that reach their nadir and then abruptly "reset" to the top of their range. Because the repeated patterns in the middle and upper voices are slightly out of phase with each other, the musical motion is at once audibly cyclical and subtly disorienting. Just after the midpoint in the brief "Fugato," each of the voices is doubled at a different interval, creating an effect of harmonic blurring that amplifies the piece's ambiguous finish: instead of concluding, it simply cuts off midphrase.

The 1926 concert in Donaueschingen was the first public manifestation of a short-lived but intense engagement with the artistic potential of new instruments. For a brief span in the middle of the decade, the "mechanical music" phenomenon transfixed the German musical intelligentsia. In flurries of articles in musical journals, untold hours of labor in composers' studios, and a handful of concerts, this movement ran its spectacular course, bringing technology and its role in modern music to the forefront of European consciousness. In 1926, as the mechanical vogue had already begun to fade, Hindemith wrote that "no other aspect of musical life has been so hotly disputed in recent times as that of music made by mechanical instruments."⁴ By separating performance from the presence of musicians, the advocates of mechanical music challenged conventional aesthetic assumptions and raised unsettling questions about the technological mediation of musical expression, eliciting debates that would continue to reverberate through the remaining years of the Weimar Republic.

MUSICA EX MACHINA

The machine—as symbol and reality—captivated the imagination of early twentieth-century Germany. Between unification in 1871 and the outbreak of World War I in 1914, the country embarked on a rapid process of industrialization that transformed it into a technological and economic superpower. Modern technology—from airplanes and automobiles to film and photography—came to represent a revolutionary force that promised, for good or ill, to reshape life in all its dimensions.⁵ After the war, Germany, along with the United States and the Soviet Union, was among the countries that most eagerly embraced the new marvels of the machine age: from the Ford-style production line to radio broadcasting, modern technology promised to usher in a new world of prosperity and progress.

Though the arts had shown the influence of modern technologies since even before the turn of the century, beginning around 1920 the "machine aesthetic" began to surface everywhere. The French architect Le Corbusier's manifesto *Vers un'architecture* featured photographs of biplanes, ocean liners, automobiles, and grain silos alongside the examples of modern architecture, while the anthology *Buch neuer Künstler* interleaved reproductions of contemporary abstract art with images of power tools, cogwheels, and ventilators.⁶

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