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“A New, Perfect Musical Instrument”

The Trautonium and Electric Music in the 1930s

This machine was so modern, so frightfully new,
no one knew quite exactly just what it would do.¹

—Dr. Seuss

In 1933, the last year of the Weimar Republic, the German engineer and erstwhile instrument builder Peter Lertes published a book called *Elektrische Musik*. Bearing the elaborate subtitle “An accessible survey of its foundations, the present state of technology, and its possibilities for future development,” Lertes’s study was the first of its kind: a systematic overview of the new field of electric musical instruments, covering everything from the technical fundamentals of electroacoustics to a survey of the most important inventions of the time. Although the book was written for the most part in the sober and scientific tone of an engineering manual, Lertes allowed himself a brief commentary on the wider significance of his subject. In his foreword, he noted that “electric music” signified for most practicing musicians an “intrusion into a domain of culture and intellect in which there seems to be no place for technology.” His book was meant to serve notice to those still living in denial of the new age of music to come:

The time of music making on instruments that have been played by man for centuries must therefore necessarily be followed by an era of music that accommodates the present-day technical mindset of mankind, an era of music in which the most powerful force of nature, *electricity*—which has above all others contributed to the reshaping of our existence—imprints instrument

building with its own particular character, an era of music that is characterized by the shaping and capturing of the abundance of tone that virtually flows from nature itself. [. . .] Electric instruments would to a large extent fail to realize their purpose if they served merely to imitate mechanical instruments, or if they are employed only in the performance of traditional music. Thus there is a call for creative artists to conceive a new idiomatic compositional style for electric instruments, so that these instruments can become what they ultimately strive to be: instruments for *a new music of a new age*.²

The early 1930s were heady times for the burgeoning field of what was increasingly called, in a familiar abbreviated form, "electro-music." New instruments sprouted up like mushrooms on both sides of the Atlantic. Léon Theremin had settled in New York in late 1927 and continued to develop his eponymous device. In 1929, the Radio Corporation of America (RCA) unveiled a mass-produced model of the Theremin, the first such effort to make electric instruments available to consumers.³ Theremin also devised new inventions such as the motion-controlled Terpsiton and, at the behest of the American composer Henry Cowell, a protosequencer known as the Rhythmicon, which allowed complex polyrhythms to be played via a photo-acoustic apparatus triggered by a conventional musical keyboard. Theremin's relocation to the United States did nothing to slow down the development of new instruments in the Soviet Union, where devices such as Sergei Rzhevkin's Cathodic Harmonium and Nikolai Ananiev's Sonar closely paralleled inventions in Western Europe.⁴ In France, Maurice Martenot's Ondes Martenot made use of various speaker membranes reminiscent of Mager's instruments, and Armand Givelet and Edouard Coupleux built their Radiophonic Organ, a massive instrument with three keyboard manuals and over four hundred vacuum tubes.⁵ But the center of the electro-music universe, at least in terms of sheer quantity of inventions, was Germany. By the time that Jörg Mager, widely recognized as the founder of the movement, unveiled his newest instrument, the Partiturophon, in 1930, the field was buzzing with activity, from the electromagnetic tone wheels of the Magnetophone (a predecessor of the Hammond organ) to Emmerich Spielmann's photoelectric proto-sampler, the Superpiano.

In addition to "pure" electric devices, inventors also developed a wide range of so-called electro-mechanical instruments, in which "acoustic" musical tones were electrically amplified and modified. Mager's former assistant Oskar Vierling designed an amplified piano called the

Elektrochord, whose tone could be treated by various electric filters, and also built a number of electrified string instruments along similar lines. Walther Nernst, working at Humboldt University in Berlin, led a design team that built the Neo-Bechstein grand piano, an innovation intended to revitalize the floundering German piano industry. Lacking a sounding board, it used thin strings and tiny hammers to generate barely audible tones that were amplified and modified by electromagnetic pickups. It also featured a built-in radio and gramophone player, making it an all-in-one musical solution that combined passive listening and active music making in a single device. A 1931 article in the *Journal of Instrument Building* captured the mood of the times: "There is currently a boom in the field of electroacoustic (ether-wave) music. More and more inventors are at work developing this new branch and opening new paths for music. [. . .] All these efforts have a single purpose: to conquer a new world of tones. Who can say if we already stand before this goal?"⁶

Among this swarm of new inventions, the most successful new instrument in Germany was the Trautonium, named after its creator, Friedrich Trautwein (1888–1956).⁷ It came closer than any other invention of its kind to realizing the twin goals of electro-music: establishing an original, idiomatic repertoire and furnishing a universally accessible domestic instrument for the radio age. As this chapter chronicles, Trautwein's rise to prominence coincided broadly with Jörg Mager's decline: while Mager's career represented the early, idealist phase of electric music, Trautwein's ascent signaled the movement's attainment of a new degree of professionalization and public stature. Trautwein succeeded in part by co-opting his rival's rhetoric: like Mager, he portrayed electric music as a creative alternative to the dominance of reproductive sound technologies and gave voice to the hope of bringing artists and engineers together in common cause. In a 1930 interview coinciding with the unveiling of the Trautonium, Trautwein declared:

While electroacoustics has occupied itself in the last few years primarily with the problems of reproduction, I would like to provide new expressive possibilities for the creative musician. Mechanical music has not enriched art as such, but only, for the most part, disseminated it. Above all, I hope through my work to serve creative art and thus to contribute to the reconciliation of the two falsely opposed branches of the human spirit: art and technology.⁸

Though both men's instruments would ultimately fall short of the lofty visions of the electro-music movement, this was as much due to

political and economic circumstances as to the instruments' aesthetic and technical failings. Electric instruments, alone among the technological innovations of the 1920s, flourished in Germany during the following decade, even as many kindred artistic experiments were stamped out.

THE TRAUTONIUM

Like Mager and most other electro-music inventors of the time, Trautwein had a background in radio, and for him too the development of electric instruments stemmed directly from experiences with radio technology.⁹ Although he had played organ as a child and studied music at the Heidelberg Conservatory, his later education focused on electrical engineering and acoustics. His first patents for electric tone generation were filed soon after he received his doctorate from Karlsruhe Technical University in 1921. He filed a number of patents during the 1920s, but—unlike Mager—he was cautious as an inventor and wary of unveiling his creations while they were still works in progress.¹⁰

In contrast to Mager's instruments, which underwent radical changes from year to year, the outward design of the Trautonium never significantly deviated from its first prototype. The playing interface was breathtakingly elegant, consisting of a single wire stretched over a parallel metal plate. When the player pressed down with his finger, the wire and plate made contact and an electrical circuit was closed. The point of contact on the left-right axis of the plate determined the circuit's resistance and thus the pitch of the generated tone.¹¹ A knob on the console allowed the player to adjust the pitch span of the manual in a fashion similar to Mager's "musical pantograph." In addition, there was a set of movable keys over the wire that the player could configure to create a scale of fixed pitch positions: instead of touching the wire directly, the player could press the key, which put the wire and the plate into contact at a determined point. Trautwein had bypassed the problem of tuning by allowing the player to choose between continuous and fixed division of the pitch spectrum.

The playing interface of the Trautonium thus represented a cunning solution to the question of continuous versus discrete pitch control: one observer described the interface as a hybrid between a violin string and a piano keyboard.¹² Trautwein highlighted this aspect of his instrument as an advantage over the Spherophone: while Mager merely "sought to expand the chromatic tuning by the insertion of quarter tones,"



FIGURE 18. Friedrich Trautwein with the first model of the Trautonium, circa 1930.
Source: Leo Kestenberg, ed., *Kunst und Technik* (Berlin: Wegweiser-Verlag, 1930), 452.

Trautwein's instrument captured "continuous tonal space" and put it at the player's disposal.¹³ (In practice, however, the Trautonium's fingerboard was most often used only for string-style vibrato and not for microtonal inflections.) Like Theremin and Mager, Trautwein wanted to simplify the process of learning and playing a musical instrument: "The player should be spared all unnecessary mechanical exertion; he does not need to generate the tone with his bodily energy [. . .] but rather he should create and form the tone in a purely artistic way."¹⁴ The ideal was a "three-dimensional performance" that would give the player fluid and intuitive control over pitch, volume, and timbre.¹⁵

Instead of the vacuum tubes found in other electric instruments, the Trautonium's sound generating circuitry used tiny bulbs filled with neon gas. The bulb functioned as a relaxation oscillator, which gradually built up a charge and then suddenly released it, generating tones that resembled what would later be called sawtooth waves. In acoustic terms, these sounds have a spectrum of harmonic overtones gradually decreasing in amplitude as their frequency increases; their timbre is roughly akin to that of the violin or other bowed string instruments. But Trautwein found the unprocessed tone generated by the neon bulb

to be somewhat raw and abrasive. Attempting to shape electric tones into musically viable timbres, he experimented with both additive and subtractive techniques, but ultimately found both unsatisfying. The superposition of overtones on a fundamental pitch led to the sensation of increased volume but not to a significant change in timbre. Trautwein found the technique of filtering harmonically rich waves more promising but judged the effect too far removed from the richness of "acoustic" instruments.¹⁶ Seeking a new approach to the problem of electrically generated timbres, he developed a model based on the phenomenon of what he called *Hallformanten*—roughly, "formants generated by excitation."¹⁷

The acoustic phenomena known as formants were discovered by the German physiologist Ludimar Hermann (1838–1914), who coined the term to describe the frequency range emphasized by the oral cavity in the production of vowel sounds. They represented a crucial addendum to the overtone theory of timbre developed by Helmholtz.¹⁸ While the harmonic spectrum of a given instrument is projected *relatively* to a fundamental pitch, formants are fixed, absolute zones of resonance shaping the timbre of an instrument over its entire range. To use an anachronistic comparison, formants resemble the bands of a stereo equalizer, which cut or boost certain frequencies across the spectrum. They are in large part responsible for the fact that instruments (including the human voice) have noticeably different registers—that is, various distinct tone colors particular to the low, medium, and high areas of their overall range. On the early models of the Trautonium, the frequency range of the formants could be adjusted continuously by means of rotary capacitors on the instrument's front panel. By moving the formants higher or lower, the player was able to shape the timbre of the electrically generated tone.¹⁹ Trautwein's experiments showed that a low formant creates a dull tone resembling that of a bassoon; a mid-range formant results in a mellow, clarinet-like sound; and a high formant yields a sharp timbre similar to that of a trumpet.²⁰ One critic estimated that the adjustment of a single formant on the Trautonium could produce about fifty distinguishable timbres. As even the earliest models possessed several tunable formants, the number of potential tone colors reached into the thousands.²¹ But according to Peter Lertes, just one formant allowed sufficient timbral variation for most musical needs. He judged the Trautonium's method of tone generation superior to that of all other electric instruments.²²

In addition to stable timbres in which the formant remains in a single position, Trautwein described some more experimental effects attained by adjusting the formant while playing. If the player holds a tone while altering the formant's frequency range, the upper partials can be heard to shimmer, creating a kind of timbral glissando. If a tone is held while the formant is moved in a sudden, discontinuous way, the effect is of a rapid succession of discrete timbres. Finally, if a melody is played while the formant is modified, a unique phenomenon emerges: confronted with the simultaneous motion of both the fundamental tone and its overtone spectrum, the ear is "confused" and cannot decide which to follow. By the same means, human and animal vocal sounds could be imitated by moving both fundamental and formant continuously within a narrow range.²³ Trautwein suggested that such techniques may find use in the "music of the future."²⁴

As this comment implies, Trautwein's relation to electro-music's futurist rhetoric was highly nuanced. In his writings and public remarks about his instrument, he often parroted the language that Mager had helped popularize, even as he subtly played up the contrast between his own professionalism and Mager's image as a quixotic amateur. In response to an interviewer's question whether the practicing musician might be overwhelmed by the unlimited supply of new timbres, Trautwein assented, drawing a distinction between the "infinite-beautiful" and the "limitless-banal." This was likely a jab at Mager and his effusive visions of Klangfarbenmusik. Likewise, even Trautwein's tribute to Mager as the "German pioneer of the idea of electric music" may have contained a backhanded attack: Mager had the dream, Trautwein suggested, while he himself delivered the reality.²⁵

FROM LABORATORY TO CONCERT HALL

The late 1920s marked the arrival of what might be called an institutional approach to electric music, with large research teams, interdisciplinary collaboration, and substantial government funding replacing the more informal and ad hoc approach of earlier years. In May 1928, six months before the launch of the Society for Electroacoustic Music in Darmstadt, the Radio Research Section (Rundfunkversuchsstelle) was established at the Berlin Academy of Music with a broad mandate to research topics relating to the new acoustic technologies.²⁶ It was overseen by Georg Schünemann, the associate director of the Academy, a musicologist and administrator who sought to bring the utopian visions

of Busoni's *Sketch of a New Aesthetic of Music* up to date with the technical possibilities of the 1920s. The goal was to elevate radio to a vehicle of culture (*Kulturträger*) and forge new channels of artistic experience fit for a mass society. Expressing the quasi-political hopes attached to the new medium, the scholar Arno Schirokauer declared in 1929 that with the advent of radio, "art has been socialized. From private ownership it has become everyone's possession."²⁷ Such claims mixed genuine sentiments of cultural populism with ignorance of the obstacles, from commercialization to government censorship, that stood in the way of a truly democratic mode of cultural production.²⁸

Because it was housed in a major conservatory, the Radio Research Section could take advantage of the musical resources at its disposal: various choral, orchestral, and chamber music groups; a massive collection of musical instruments; and an archive of over ten thousand ethnomusicological recordings.²⁹ Its curriculum featured courses in *funkisches Sprechen* (speaking on radio) for would-be broadcasters, speech and gesture for film actors in training, sound-film recording techniques, and composition seminars geared toward writing for radio and motion pictures. The group's activities also touched on new pedagogical uses of radio technology: in 1932 it began broadcasting some of its classes via shortwave radio—a brief but prophetic experiment in "wireless education."³⁰

Also in 1928, the Heinrich Hertz Institute for Oscillation Research was founded at the Berlin Institute of Technology (Technische Hochschule). Its director was Karl Willy Wagner, the engineer and acoustician whose research on electroacoustic filters had influenced both Mager and Trautwein. The broad remit of the HHI encompassed all vibratory phenomena, from acoustics to radio and telephony. Although it was more technically oriented than its counterpart at the Academy of Music, the two institutions were closely linked, and both were involved in the research and development of electric instruments. Fundamental to both was the goal of collapsing the distance between productive and reproductive technologies—instruments and media—through the close collaboration of artists and technologists.

Trautwein was appointed as a lecturer in acoustics at the Academy of Music in 1930 and immediately began working in the studio of the Radio Research Section.³¹ There he found a valuable collaborator in Paul Hindemith, who had taught composition and film music at the Academy since 1927.³² Hindemith, who had previously extolled Jörg Mager's instruments, was quickly won over to Trautwein's cause, and

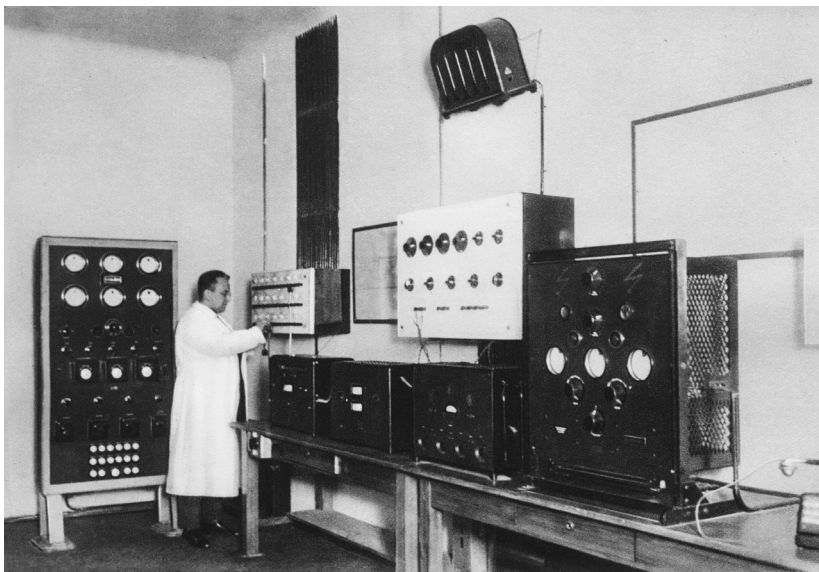


FIGURE 19. The electroacoustic laboratories of the Radio Research Section (Rundfunkversuchsstelle), founded in Berlin in 1928. Source: Leo Kestenberg, ed., *Kunst und Technik* (Berlin: Wegweiser-Verlag, 1930), 449.

even had a hand in the Trautonium's design. Trautwein had originally intended to build a kind of electric organ, similar to Mager's Keyboard Spherophone. The instrument's string manual was seen as a provisional solution because it was cheaper than a full keyboard, but Trautwein eventually decided to keep the more unconventional interface, thanks in part to the encouragement of Hindemith, who, as a violist, found the metal wire appealingly familiar.³³ It was Hindemith, too, who introduced a third important player to the project. Shortly after Trautwein's arrival, Hindemith brought some of his students into the basement studio of the Radio Research Section to hear the experimental model of the Trautonium. Among the visitors was the nineteen-year-old Oskar Sala, a composition pupil of Hindemith's. With his dual interests in music and the natural sciences (he would later study physics at Humboldt University in Berlin), Sala was quick to perceive the instrument's potential, and he soon became involved in its development, serving as an intermediary between Trautwein's technical perspectives and Hindemith's musical concerns.³⁴

Trautwein's first presentable prototype was a small, unimposing device comprising three elements: a manual consisting of a wire

suspended over a metal track, a compartment containing the sound-generating circuitry, and a pedal used to control volume. This instrument was introduced to the public on June 20, 1930, as part of New Music Berlin, a relocated version of the Donaueschingen summer music festival that had presented original compositions for the Welte-Mignon reproducing piano, Jörg Mager's Spherophone, and various experiments with recording media such as sound film and gramophone. Just two days before his debut of the Trautonium, Hindemith and Ernst Toch had presented their original music for gramophone records (discussed in chapter 4). For the instrument's debut, Trautwein had pulled off nothing short of a publicity coup: a newly written work by one of Germany's most prominent composers. Paul Hindemith wrote a set of seven short pieces for three Trautoniums called *Des kleinen Elektromusikers Lieblinge* (The little electro-musician's favorites), which were performed by Hindemith, Sala, and the pianist Rudolf Schmidt. At first blush, these pieces were not particularly noteworthy. Featuring the mildly dissonant contrapuntal textures typical of Hindemith's compositions of the late 1920s, the music ranges from the lugubrious tone of the first movement, which includes a prominent quotation of the *Tristan* theme, to the spry rhythmic playfulness of the sixth movement, which ends with acrobatic cadenzas for each of the instruments in turn.

In spite of its generally light, innocuous character, Hindemith's music gave hints of what the new instrument was capable of. In the second piece, the score requires that the instrument's tones be projected from a distant speaker (*Fernwerk*). In addition, Hindemith calls for two distinct tone colors, designated simply as I ("dull") and II ("sharp"). These are first juxtaposed in three separate phrases (I-II-I), the brusque changes of tone color suggesting contrasting stops on a pipe organ. In the final four measures, the two timbres are presented in gradual transition (again I-II-I) in conjunction with a dynamic swell from pianissimo to fortissimo and back again. The seventh and final movement likewise calls for both discrete and continuous contrasts between the two timbres and adds to the mix several alternations—including one mid-phrase—between the main and distant speakers. With these touches, Hindemith provided a modest but promising demonstration of the Trautonium's potential for new musical effects.³⁵

Coinciding with the appearance of the Trautonium, Trautwein published a small book entitled *Elektrische Musik*, which doubled as a technical introduction to his instrument and an attempt to seize the reins of the young electro-music movement. The book was the first in



FIGURE 20. Paul Hindemith's sketch for the first movement of *Des kleinen Elektromusikers Lieblinge*. The handwriting at the bottom of the page reads: "Attempt at a composition for Dr. Trautwein's electric musical instrument." Source: Friedrich Trautwein, *Elektrische Musik* (Berlin: Weidmannsche Buchhandlung, 1930), 38.

a projected series of publications to appear under the imprimatur of the Radio Research Section. In his foreword, Schünemann trumpeted: "We are witnessing the realization of a dream long held by all musi-

cians: we have an instrument that fulfills every musical wish, that can be used and altered in various ways, that combines the advantages of many musical instruments, that can be readily grasped and whose manner of playing is truly artistically executed."³⁶ The period of anticipation was over, Schünemann suggested; a new age of music had finally arrived.

ELECTRO-MUSIC FOR THE PEOPLE: THE VOLKSTRAUTONIUM

In the wake of its Berlin debut, the Trautonium quickly began to make the rounds of the emerging electro-music publicity circuit. In July 1931, Hindemith conducted his new *Concertino for Trautonium and String Orchestra*, with Sala as soloist, at the second Radio Music Convention in Munich. Trautwein's instrument also appeared at the 1932 Radio Exhibition (Funkaufstellung) in Berlin, where it was featured onstage as part of an "electric orchestra" that included Oskar Vierling's electric cello and violin, the Neo-Bechstein piano, and the Theremin. Notably, Jörg Mager's instruments were not represented. A few years into the new decade, it was clear that Trautwein had eclipsed Mager as the face of the electro-music movement. Georg Schünemann of the Radio Research Section, though hardly impartial, declared in 1931 that the Trautonium was "the only really musical instrument" among the new electrophones.³⁷

Trautwein's instrument had an additional point of appeal beyond its sound: it was remarkably easy to produce. Using readily available electrical components, amateur do-it-yourselfers could build workable models at home. Indeed, just a year after the premiere in Berlin, an introduction to the Trautonium was published complete with a fold-out blueprint to guide radio enthusiasts through the construction of their own copy of the instrument.³⁸ The idea of a homemade electric instrument was seized upon by the American publisher Hugo Gernsback, whose *Radio-Craft* magazine featured a cover story on how to build the Trautonium in March 1933. In a breathless editorial entitled simply "Electronic Music," Gernsback hailed the arrival of electric instruments, which, he declared, "will revolutionize the entire musical art [. . .] during the next decade."³⁹ More important for his readership of radio amateurs, though, was the fact that the construction of these instruments was, in Gernsback's words, "ridiculously simple." The feature article provided complete instructions and schematics for the construction of the original 1930 model of the Trautonium, slightly adjusted



FIGURE 21. "The Orchestra of the Future??" This photograph from the 1932 German Radio Exhibition shows a veritable who's who of the electro-music scene, with the exception of Jörg Mager. The sentence across the bottom of the photo reads: "And all these instruments produce their tones over loudspeakers, of which a great number are visible in the background." Source: *Funkschau* 52 [1932], frontispiece.

to account for the different components available to American radio enthusiasts. It described the Trautonium as "a simple musical instrument easily built at home by anyone [. . .] nothing elaborate, nothing expensive." What's more, in an echo of the dubious promises that accompanied earlier electric instruments such as the Theremin, the author assured readers that "one may learn to play it in a short time, even though one is not a musician."⁴⁰

Hoping to seize on the simplicity of the instrument's design and the potential market for a mass-produced model, in 1931 Trautwein and Sala began to develop a new version with support from the radio and electronics firm Telefunken. Envisioned as an electric instrument perfectly suited for domestic music making (*Hausmusik*) and originally called the Telefunken-Trautonium, the instrument would soon become known as the Volkstrautionium. (Though later exploited by the Nazis, the *Volks*-prefix predated them and expressed a populist enthusiasm for affordable, mass-produced consumer goods.)⁴¹ The manual and circuitry were consolidated into a single boxlike enclosure complete with a lid to protect the circuits from dust. Under the hood, the neon bulbs of the earlier model were replaced with a new kind of gas-filled tube called a thyatron, which helped to stabilize the instrument's pitch.⁴² The Volkstrautionium also had several interface improvements to aid performers: an array of



FIGURE 22. The Trautonium in the USA. Source: Cover of *Radio-Craft* magazine, March 1933.

knobs and switches above the manual allowed for quick octave transpositions and timbral adjustments, while carbon resistors under the fingerboard enabled players to regulate dynamics by adjusting the weight of their touch. Finally, the instrument could be plugged directly into a radio receiver for amplification, meaning that it could be marketed as an add-on to that increasingly widespread domestic amenity.



FIGURE 23. The Telefunken-Trautonium, also known as the Volkstrautionium.
Source: Peter Lertes, *Elektrische Musik* (Dresden: Theodor Steinkopff, 1933), 184.

Though motivated in part by sheer marketing savvy, the Volkstrautionium—and the broader goal of a mass-produced electric instrument—also reflected a widespread reexamination of the role of music in modern mass society. Many composers of the time decried the distance between artist and audience as a symptom of social alienation; they called for new forms of music that emphasized participation and engagement, rather than passive reception. This tendency found expression in the idea of *Gebrauchsmusik*, or “everyday music,” one of the key concepts of Weimar Culture musical culture. Popularized by the musicologist Heinrich Bessler in the early 1920s and later associated above all with the music of Paul Hindemith, the notion of *Gebrauchsmusik* inspired a variety of efforts to establish new forms of contact between music and social life. Many composers abjured the pathos and complexity of late-romantic and expressionist music in exchange for a simpler and more direct idiom, often alluding to popular styles. Others turned their attention to “occasional” works meant to accompany social functions or wrote music intended for amateur performance. One of the most famous examples of these efforts to reconceive music’s place in society was a 1929 collaboration between Hindemith and the playwright

Bertolt Brecht entitled *Lehrstück* (Didactic piece), in which the form of the music was freely adapted to the abilities and interests of the performers. The motto of the piece proclaimed: "Musik machen ist besser als Musik hören" ("It's better to make music than to listen to it").⁴³

For some partisans of the movement, the Volkstrautionium appeared as the technological embodiment of the Gebrauchsmusik ideal. The instrument made possible the most radical interpretation of the concept yet: instead of writing music for amateurs, simply give them the means to make their own. In a provocative essay published in 1932, the composer and former Schoenberg pupil Walter Gronostay criticized the electro-music movement's disregard for the social ramifications of modern sound technology. The new instruments were not merely sources of novel timbres, he argued, but rather "presentiments of a new form of community." Gronostay, who taught a course on Gebrauchsmusik at the Radio Research Section, suggested that the true significance of electric instruments was not in "music for listening" but in "music for playing." In the midst of Germany's seemingly never-ending economic crisis, when learning an orchestral instrument had become a luxury for most citizens, electrophones offered a lifeline to the endangered practice of Hausmusik: "Electric musical instruments—and the Trautionium, in particular," wrote Gronostay, "offer the renewed opportunity for making one's own music. Virtually every home has a radio in it. The same source from which one receives music is equally capable of generating sounds itself."⁴⁴ From this vantage point, the Trautionium's viability as a concert instrument was a secondary matter; its true place was in the hands of nonprofessional musicians. Though hardly capable of standing alongside orchestral instruments, as an add-on to the home radio it could perform the more valuable function of "prompting the listener to noodle around, and thus drawing him out of his passivity."⁴⁵ With its affordability, ease of playing, and musical flexibility, the Trautionium could be to the twentieth century what the piano was to the nineteenth: the instrumental foundation of a culture of amateur musicianship.

The Volkstrautionium was presented to the public at the 1933 Radio Exhibition and appeared on the market in August of that year. A press report published in advance of the instrument's unveiling declared that the Volkstrautionium was ideal for domestic music making, where it promised to "replace virtually all other instruments."⁴⁶ Telefunken's marketing likewise pitched the device as a musical jack-of-all-trades: "There is no instrument better suited to making music in the home than the Trautionium. Its owner is no longer compelled to play only those

pieces that are specially written for the instrument, and that he has mastered. Whoever plays the Trautonium can play any piece of music, no matter the instrument for which it was written, in a timbre appropriate to the original setting."⁴⁷ The marketing of the Volkstrautionium (like that of the RCA Theremin in the United States) was rooted in equal parts opportunistic hucksterism and the sincere belief in culture made universally accessible by modern technology.

In spite of the anticipation surrounding its appearance, the Volkstrautionium was, in Sala's memorable phrase, a "flop." The timing of the release could not have been worse. With unemployment hovering around 30 percent, the instrument's price of 400 reichsmark—equivalent to about two and a half months' wages for an average worker—was out of reach for most Germans.⁴⁸ Although it was intended to piggy-back onto the increasingly ubiquitous radio receiver, the Volkstrautionium may in fact have been edged out of the market by the cheaper device. At the same 1933 Radio Exhibition where the new instrument was unveiled, the new People's Radio (Volksempfänger) was also introduced to the public. Priced at just 76 reichsmark, or about a fifth the cost of the Volkstrautionium, it sold some one hundred thousand units during the exhibition alone. Further dampening the Volkstrautionium's rollout were Telefunken's half-hearted marketing efforts: the company barely advertised it at all. (Even had the product sold well, Telefunken would not have turned a profit. They apparently saw electro-music as a growth industry in which it was worth a short-term financial sacrifice to establish an early foothold.) Of the two hundred units that were manufactured, only a handful were sold. Production was halted in 1937, and the remaining units were returned to Trautwein. Telefunken forwarded all future inquiries about the instrument directly to the inventor and forbade him from using the company's name in connection with the Trautonium.⁴⁹

The Trautonium's troubled public reception stemmed in part from an instrumental identity crisis. Was its place in the home or on the stage? Not surprisingly, the instrument's marketers sought to have it both ways. A brochure entitled "A New, Perfect Musical Instrument" assured the reader that the Trautonium could produce both the new and the old—the ranges and timbres of all known instruments *and* "an overpowering abundance of new, dramatic timbres that are unique to the instrument."⁵⁰ The two prospects were almost always mentioned in tandem: on the one hand, any familiar timbre available at the turn of a dial; on the other, new tones never heard before. Although these two

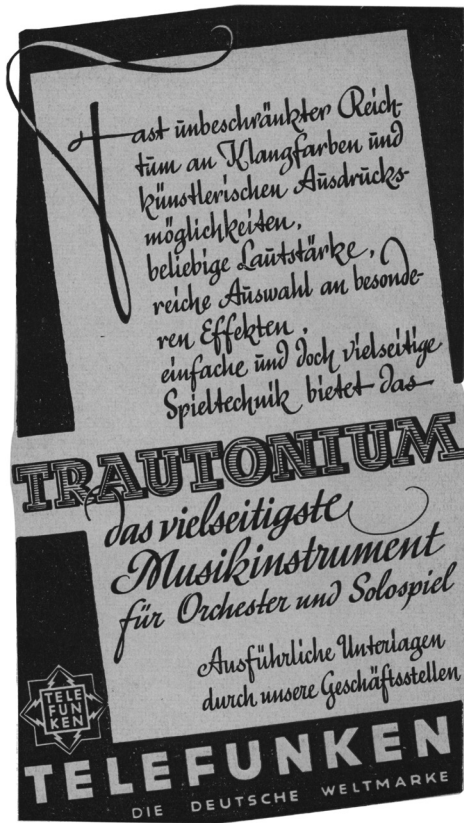


FIGURE 24. One of the few known advertisements for the Volks-trautonium. The text reads: "Nearly unlimited richness of tone colors and potential for artistic expression, volume adjustable at will, a wide variety of special effects, simple and yet versatile playing technique—all this is offered by the Trautonium, the most versatile musical instrument for orchestras or solo playing." Source: Peter Lertes, *Elektrische Musik* (Dresden: Theodor Steinkopff, 1933), back matter.

uses of the instrument were by no means mutually exclusive, in reality there was a tension between the ideals of amateur music making, on the one hand, and modernist experimentation, on the other. If the sheer novelty of the technology had monopolized public and critical attention for the first few years of the electro-music phenomenon, by the early 1930s supporters of the movement were growing restless. As one observer noted in 1932, "The compositions for electric musical instruments have so far conveyed only the technical charm of the new and unfamiliar—not, however, new expressive possibilities for the stirring of emotions!"⁵¹

As long as the Trautonium was envisioned primarily as an instrument for domestic music making, the matter of original music could be set aside. But with the failure to conquer the mass market, the question of

repertoire became suddenly acute. If it was to be a truly artistic instrument, its supporters reasoned, the Trautonium must have its own unique body of music. Even before the release of the Volkstrautonium, electro-music enthusiasts had sounded the warning bell. "We desperately need *new* music for electric instruments," declared Georg Schünemann of the Radio Research Section in an article published in January 1932. "There is certainly no shortage of technical solutions. [. . .] But the musicians, both composers and performers, follow too slowly. There are only a few who help tackle the technical challenges, but the technicians can make progress only by working hand in hand with musicians."⁵² Schünemann voiced an idea that would be heard often in the new decade: no longer was technology the limiting reagent in the progress of music. The new instruments were there, but the artistic will to exploit them was lacking.

Over the course of the 1930s, the Trautonium became increasingly associated not with its namesake inventor but with its virtuoso performer, Oskar Sala. Lacking original compositions beyond Hindemith's few contributions, Sala was forced to rely on familiar showpieces of baroque, classical, and romantic music to demonstrate the Trautonium's musical capabilities. Reinforcing this gesture toward high-culture respectability, the prominent music publisher Schott published a book called *Trautonium School* in 1933, coinciding with the release of the Volkstrautonium. Edited by Trautwein, the book contained an overview of playing technique by Sala and compositional examples by Hindemith, including arrangements of Corelli and Mozart for two Trautoniums and piano.⁵³ But such uses of the instrument sometimes ran afoul of modernist partisans, who expected a new, idiomatic style of electro-music composition. "It bears repeating that the purpose of such a device is not to counterfeit existing instruments," wrote one critic. "Of course, with the Trautonium it is possible to create a violin or trumpet sound, or even to imitate the human voice. [. . .] But the goal of such a device can ultimately only be to create new sounds of great fullness and beauty, and in this way to enrich the music of our time."⁵⁴ Ironically, even Sala's grudging attempts to popularize the Trautonium by playing familiar tunes from the repertoire could backfire: traditionalists sometimes chafed against what they perceived as "experimenting with the classics."⁵⁵ In short, Trautwein and Sala caught flak from both sides: they were attacked for squandering the Trautonium's potential for genuinely new music and at the same time accused of irreverence toward canonic works and the instruments for which they were originally intended. "Thank you, Holy Cecilia, for giving us the violin, the clarinet,

the cello, and the many other lovely instruments," jibed one critic. "For the Trautonium, you are not to blame."⁵⁶

Two years after the release of the Volkstrautionium, yet another incarnation of the instrument appeared when the Reich Radio Society (Reichsrundfunkgesellschaft) commissioned Sala to build a new model that incorporated the many improvements he had made over the past couple years. The so-called Radio-Trautonium had a second fingerboard (allowing the performer to play two-part polyphony) and two pedals capable of modifying both volume and pitch. Its tone-generation circuitry was expanded to create "subharmonics" by means of a technique patented by Trautwein in 1934. In addition to a series of whole number multiples ($2/1$, $3/1$, $4/1$, etc.) above the fundamental tone, it could generate a chain of divisors ($1/2$, $1/3$, $1/4$, etc.) below the played note, and thus provide a new and distinctive timbral coloration. Hindemith noted the "strange possibilities" arising from the instrument's sonic wiring: each of the two voices could be doubled with an additional tone drawn from the subharmonic series, allowing for unexpected combinations.⁵⁷ He dutifully baptized the model with a new composition called "Langsames Stück und Rondo für Trautonium." It would be his last contribution to the instrument's repertoire.⁵⁸ Hindemith, like so many others, would soon become ensnared in the political webs of the Third Reich.

"THE INSTRUMENT OF STEEL ROMANTICISM": THE TRAUTONIUM IN THE THIRD REICH

While the protagonists of electric music enjoyed their fleeting heyday, the Weimar Republic was disintegrating around them. Beginning in 1930, parliamentary democracy was suspended and government conducted by means of constitutionally dubious emergency decrees. Unemployment soared as the aftermath of the U.S. stock market crash wracked the German economy, which was still recovering from the extreme instability of the early 1920s. The National Socialist Party, whose popular support peaked at 37 percent of the electorate in 1932, maneuvered its way into government alongside the traditional center-right parties, while on the left the Socialists and Communists were crippled by vicious internecine battles. Soon after Hitler was named chancellor in January 1933, the Nazis began their ruthless consolidation of power, and within months the already tottering government of the Weimar Republic lay in shambles.

The reprisals came quickly. Georg Schünemann, who had taken over from the composer Franz Schreker as director of the Berlin Academy of Music in 1932, was denounced as a Marxist and stripped of his office in April 1933. By order of Minister of Propaganda Joseph Goebbels, the Radio Research Section's budget was promptly cut; two years later the institution was shuttered.⁵⁹ The Heinrich Hertz Institute was targeted as well. Its director, Karl Willy Wagner, was ousted in 1936 after a lengthy persecution. Wagner's crime: he had resisted orders to dismiss Jewish members of the institute's staff. With typical thoroughness, the Nazis even removed Hertz's name from the institute's title on account of his Jewish ancestry.⁶⁰ In 1938, with the departure of Jörg Mager's erstwhile assistant Oskar Vierling, the institute's "electric music" research group was dissolved.⁶¹ Another crucial site of artistic and technological experimentation, the Donaueschingen Festival, which had migrated from its original locale to Baden-Baden and thence to Berlin, also fell victim to the Nazis' cultural crusade. After 1930 it had been temporarily cancelled on account of the country's dire economic situation.⁶² When it was resumed in 1934, the festival was a ghastly shadow of its former self. Once a cosmopolitan meeting place for contemporary musical currents from all over Europe, it now featured a purified cast of all-German composers. A typical program included marching music for the Hitler Youth and patriotic pabulum with titles such as "Heimat, dir zu Ruhm und Ehr" (Glory and honor to thee, O homeland).⁶³

Amid the shifts of power, electro-music inventors grappled desperately for political favor. In 1933, Mager, likely bitter about Hindemith having favoring the Trautonium over his own instruments, denounced the composer in a letter to Fritz Stein, the party loyalist who had replaced Schünemann as director of the Academy of Music.⁶⁴ Shortly after the closing of the Radio Research Section in 1935, Trautwein discovered a few scores of Communist fight songs composed by Mager among the archived documents. Apparently fearful of being implicated by association, he sent the scores to Stein along with an explanatory letter.⁶⁵ Two years later, Trautwein, who had joined the Nazi Party in 1933, was awarded a promotion to a professorship in acoustics at the academy.⁶⁶ His good standing also ensured that the apolitical Sala would be not only unmolested but substantially supported during the Nazis' twelve-year reign.

Trautwein's protection could not shield the Trautonium's foremost composer, however. Although Hindemith had moderated his bad-boy image since the 1920s, his indelible associations with the musical culture

of the Weimar Republic made him an easy target for the Nazi culture police. Rumors of his emigration circulated as early as 1933.⁶⁷ The famed conductor Wilhelm Furtwängler publically intervened with a newspaper article defending the composer in November 1934, but when Goebbels denounced Hindemith as an "atonal noisemaker" in a speech to the Reich Chamber of Culture the following month, the writing was on the wall.⁶⁸ Hindemith resigned his post at the Academy of Music in 1937, and in the following year, he was pilloried alongside Mahler, Schoenberg, Webern, Krenek, and Weill as a "standard-bearer of musical decay" at the Degenerate Music (*Entartete Musik*) exhibit in Düsseldorf. He fled to Switzerland, and then, in 1940, to the United States.

In late 1933, a dispatch from Germany appeared in the American journal *Modern Music*. Bearing the title "Under the Swastika," it was from the pen of Hans Heinz Stuckenschmidt, who detailed the situation of contemporary music in the wake of Hitler's rise to power. While many Germans were convinced that the Nazis would be too busy managing the economic crisis to concern themselves with cultural matters, Stuckenschmidt astutely noted "the important part [that] art and culture play in the program of German fascism." With regard to the Nazis' attitude toward music, he distinguished between two camps: those who attacked "dissonant music" outright and those who had a more nuanced view that allowed for incorporating certain "modernist" elements into the artistic apparatus of the Third Reich.⁶⁹ It was the latter group that would hold more sway in shaping the Nazis' cultural policy. This flexibility was consistent with their broader tactic of *Gleichschaltung*, or forcible coordination, through which the Nazis insinuated themselves into all virtually aspects of German society by absorbing preexisting political, social, and cultural organizations and reconstituting them as compliant cogs in the totalitarian machine.

Even as they persecuted many of the movement's leading figures, the Nazis' policy toward electric music, like their reaction to Weimar culture in general, was characterized less by ideological consistency than by sheer opportunism.⁷⁰ In spite of their "blood and soil" rhetoric and their contempt for the rootless cosmopolitanism of modern life, the Nazis were no fusty reactionaries. They carefully positioned themselves between the irretrievable past of prewar Germany, on the one hand, and the despised "system" of the Weimar Republic, on the other. Their aesthetic ideology promised nothing less than an alternate modernity, one with all of the intoxicating energies but none of the troubling ambiguities. In his first public statement on the arts after being named chancellor in 1933, Adolf

Hitler condemned both modernism and traditionalism as equally foreign to the spirit of National Socialism.⁷¹ In a similar vein, Goebbels pleaded, "We National Socialists are not unmodern; we are the carriers of a new modernity, not only in politics and in social matters, but also in art and intellectual matters. To be modern means to stand near the spirit of the present."⁷² It was Goebbels who popularized the motto of Nazi aesthetics: "steel romanticism" (*stählerne Romantik*), a concept that fused the soulful depths of the German artistic tradition with the tough and unsentimental attitude demanded by the challenges of modernity. Steel romanticism, explained Goebbels, was "harder and crueler" than earlier forms; it was "a romanticism that has the courage to confront problems and stare into their pitiless eyes without flinching."⁷³

The Nazis' willingness to appropriate progressive tendencies in art was matched by their enthusiastic embrace of technology. The ground for this rapprochement had been prepared by the work of protofascist philosophers such as Paul Krannhals, whose writings attempted to reconcile the ostensibly opposed forces of *Technik* and *Kultur*. No different from liberal champions of modernity such as Ernst Cassirer or inventors such as Jörg Mager, Krannhals distinguished between wholesome, "organic" technologies that serve mankind's purposes and harmful, "mechanical" ones that subordinate ends to means. His magnum opus was tellingly titled *The Organic Worldview*.⁷⁴

Electro-music thus fit perfectly into the Nazis' ideological program. Provided it was safely distanced from its unfavorable associations with the Weimar Republic and shown to benefit the new regime, the movement was allowed to live on in the Third Reich. The sincerity of the Nazis' interest in electric instruments was demonstrated by a remarkable meeting that took place in April 1935. At the Ministry of Propaganda, Trautwein and Sala presented the Trautonium to Goebbels and a specially invited audience of musicians, composers, and scholars. Accompanied by piano and cello, Sala demonstrated his mastery of the instrument by playing a Bach sonata, a Beethoven trio, and a sonata movement by Max Reger. Goebbels and Trautwein conversed at length about the Trautonium's prospects for composers and performers, but the minister made no secret of the fact that his primary concern was the instrument's ability to provide music for mass gatherings.⁷⁵

While party officials such as Goebbels probed electro-music's propaganda value, the instruments' inventors rushed to make themselves useful to the new regime. They argued that their instruments were not mere

technical novelties but sonic expressions of the emerging National Socialist Zeitgeist. Bruno Helberger, the coinventor of the electric instrument known as the Hellertion, argued that electric music was uniquely attuned to the world-historical destiny of the German nation. He appealed to the party faithful in an article published in the *Frankfurter Zeitung* in December 1936:

It could well be claimed that our present worldview, with its commitment to the community of blood and labor, finds its commensurate instrumental expression neither in the dogmatically static sound-world of the organ nor in the military instruments such as drums and horns, nor again in the virtuosic instruments of our traditional art music. Instead we seek, in the organic connection of all things, a sound material that has grown out of the new practical possibilities of our technology and social organization and that is, so to speak, biologically connected to the present state of our culture and our worldview.⁷⁶

If the country's leaders sought a musical form of expression that captured the energies of the historical moment, Helberger suggested, what better way than a new genre that combined the cultural prestige of "the most German of the arts" with the transfiguring power of modern technology?

Trautwein also took pains to justify electric music's existence in the new Germany. Here he battled on two rhetorical fronts: first, defending the artistic value of electric instruments to skeptical musicians, and second, framing the larger project of electro-music as a service to the German nation. Trautwein lamented that electric instruments still faced much of the same stubborn opposition that they had at the time of Mager's debut in the mid-1920s. "In many cases, the efforts of electro-music have been hindered not only by indifference but by open, sometimes acrimonious "resistance," he wrote. "The few pioneers of electro-music have found no sympathy for their ideas; unfortunately, then as now they were for the most part viewed as dreamers."⁷⁷ He insisted that electric instruments answered the profound necessity of artistic progress, which had been felt by great German musicians such as Bach, Mozart, Beethoven, Wagner, and—somewhat surprisingly, given his questionable Teutonic pedigree—Busoni. (Indeed, Trautwein's claim that "instrumental music is significantly constrained by the quality of musical instruments" was a paraphrase of Busoni's declaration that "the development of music is impeded by our instruments."⁷⁸) Echoing sentiments expressed earlier by Mager and Theremin, Trautwein also

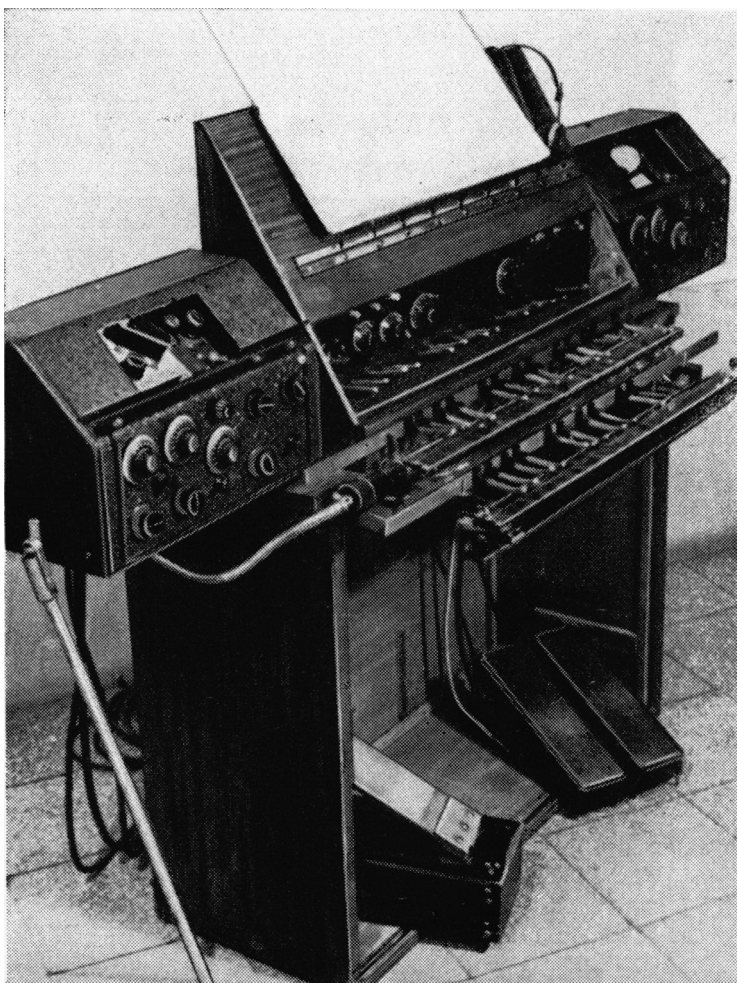


FIGURE 25. The three-voice Trautonium, circa 1936. To the original monophonic sound module (center), two additional modules have been added. Three playing manuals are located below the center module. The pedals on the right control volume; the one on the left allows for continuous modification of tone color. Source: Friedrich Trautwein, "Wesen und Ziele der Elektromusik," *Zeitschrift für Musik* 103, no. 6 (1936), unpaginated photo insert.

challenged the idea that electricity was incompatible with the direct, sensitive touch of true musical artistry and that the "mechanical," or technologically mediated, electric tone could not compare to the "organic" response of traditional instruments. Trautwein argued that it is not the source of the tone but its *shape* that determines artistic quality.

The constant, "automatic" flow of electricity provides merely the raw material to be cultivated into beautiful tones by the performer. Indeed, he suggested, the automation of tone production enables the performer to focus all the more intently on the nuances of technique.

Beyond vindicating his instrument on aesthetic and musical grounds, Trautwein faced the more ambitious task of reconciling his project with the ideological strictures of the Third Reich. He did this by inflecting the familiar tropes of electro-music rhetoric to make them conform to the Nazi worldview. Trautwein's invocation of the ancient unity of art and technology in the Greek concept of *technē* was nothing new, but such proclamations took on darker meanings in the Germany of the late 1930s, where the reconciliation of tensions was often used as a cover for political coercion.⁷⁹ Likewise, his claim that electro-music could rouse instrumental technology from the "hundred-year slumber" in which it had languished since the early nineteenth century has an ominous ring in light of Nazi slogans of national (and racial) awakening—"Deutschland erwache!" Most remarkable, however, was the way that Trautwein linked the travails of electro-music to the "individualistic capitalism" of the liberal bourgeois era.⁸⁰ He suggested that the new instruments had failed to become established in practice due to the shortsighted logic of the previous age, for which profitability was the sole measure of value. But now, in "the age of National Socialism [. . .] the economy is not the master but rather the servant of culture."⁸¹ Technology, long reviled on account of its association with materialism and rootless modern rationalism, could now be embraced in clean conscience by German artists:

Art now has the task of sustaining and deepening the spiritual exaltation of the people. To this end, the artist is dependent on the technological means of the modern age, and he shirks his task if he rejects these means in whole or in part on an unsound basis. Technology is no demon; it too is a product of our responsible countrymen, with whom the artist can and should work together as a comrade for the new Germany.⁸²

Whether such statements expressed sincere ideological fervor or cynically curried favor with the new regime, they helped secure a place for electric instruments in fascist Germany. But electro-music inventors such as Helberger and Trautwein not only gave rhetorical support to the Nazi creed—they also lent their services to Hitler's high-tech propaganda apparatus. This was a mutually beneficial arrangement: the inventors won publicity and prestige for their instruments while the regime showcased the greatness of German technology and culture. The

1936 Olympic Games in Berlin presented the Nazis their first chance to shine on a global stage, and electro-music inventors featured prominently in the public spectacle. Trautwein offered his instrument to test the vast speaker system set up in the newly built Olympic Stadium and developed a variety of means to project sound for large audiences, and in dedicated towers. The Trautonium was also played three times in the official radio programming accompanying the games.⁸³ Bruno Helberger's Hellertion was used in the Nuremberg Rally the following month, where it was hailed in a press report as "the instrument that will bestow upon our age a new experience of music."⁸⁴ And of course, the same technology that emitted electric tones could also project human voices. For a 1938 celebration of the winter solstice in Nuremberg, Oskar Vierling devised an elaborate electroacoustic infrastructure, including a massive tower bedecked with loudspeakers capable of clearly projecting amplified speech some 600 meters.⁸⁵ Photographs from the period reveal a landscape dotted with inconspicuous bell-shaped loudspeakers affixed to poles like streetlights. Such images underline the ominous truth of Hitler's famous comment "Without the loudspeaker, we could not have conquered Germany."⁸⁶

In exchange for their services to the regime, cooperative electro-music inventors enjoyed healthy, if selective, official support. One of the leading patrons was Strength through Joy (*Kraft durch Freude*), the government office tasked with fostering public contentment through administered leisure activities. The organization was a major funder of the KdF-Großtonorgel, an electric organ based on earlier models developed by Vierling. This instrument was used extensively during the 1936 Olympics, and was even played by Goebbels during a public demonstration.⁸⁷ The Trautonium, however, remained the flagship instrument of German electro-music, one that kept a high profile throughout the 1930s even as the inventions of Theremin, Mager, and others faded from public view.⁸⁸ Sala continued to concertize and developed a new, more portable version of the instrument specially suited for his travels: the *Konzerttrautonium*. From January 1938 until the outbreak of World War II in September 1939, Sala's performances were heard across the Reich thanks to a series of broadcasts on Radio Germany (*Deutschlandsender*), the state-run station that fell under the control of Goebbels's Ministry of Public Enlightenment and Propaganda. Called simply "Music on the Trautonium," this was a series of fifty-four broadcasts, each lasting 15–25 minutes.⁸⁹ Sala's performances continued even

as World War II engulfed the European continent: from 1940 to 1944, he gave no fewer than forty-seven concerts and lecture-demonstrations throughout Germany, including performances of Harald Genzmer's Concerto for Trautonium and Orchestra with the Berlin Philharmonic in 1940 and 1942. The programs also featured music by Genzmer and arrangements of classical chestnuts by Paganini, Handel, Liszt, and others.⁹⁰ Many of these appearances were sponsored by Kraft durch Freude.

Genzmer, one of the most prominent younger composers active in Germany during the Third Reich, received numerous commissions and stipends from the National Socialist regime in the late 1930s and was honored with a bronze medal at the 1936 Olympics for his composition *Der Läufer* (The runner). In 1944 he was included on the list of the "God-graced" (*Gottbegnadeten*), a select group of artists and cultural figures who were spared from military service by direct order of Hitler and Goebbels.⁹¹ A former pupil of Hindemith at the Berlin Academy of Music, Genzmer eventually eclipsed his teacher as the foremost composer for the Trautonium. His concerto provided Nazi impresarios with a politically acceptable alternative to Hindemith's earlier works, filling the demand for original music and conferring a certain artistic legitimacy on the instrument by ensconcing it in the symphony orchestra. The style of the music was bracing but accessible. With energetic lines on the Trautonium and broad, dramatic gestures from the orchestra, the concerto conveyed a thrill of novelty while remaining safely within the bounds of late-romantic symphonic rhetoric. More than any other artifact of the time, Genzmer's concerto represented the consummation of the Nazi romance with electric music. Among the work's generally positive press, a 1942 review hailed the Trautonium as nothing less than "the instrument of steel romanticism."⁹²

INTERLUDE: MUSIC FOR THE MASSES

The Nazis' use of electric sound to manipulate and amplify collective emotion was not so distantly related to Weimar-era efforts to bring music into the public sphere. In both cases, technology was thought to be capable of transcending the plane of aesthetics and altering the social dimensions of musical practice, "deprivatizing" musical experience in accordance with the collectivist impulses of political movements on both left and right. This was possible in large part thanks to an aspect

of electrically generated sound that had been hitherto neglected: not pitch, tone, or timbre, but sheer volume.

In an essay addressing the problem of sound projection in outdoor settings, Trautwein lamented that the musical production values of the 1936 Nuremberg Rally had lagged far behind the stunning "cathedral of light" created by choreographed batteries of spotlights. For earlier forms of "open air" music, ensembles such as the brass band sufficed, but for the Nazis' huge gatherings of previously unimaginable size and scale, only electric instruments were up to the task. Trautwein claimed that a new genre of "mass rally music" (*Großkundgebungsmusik*) would be the sonic manifestation of the emerging culture of the "national community" (*Volksgemeinschaft*) equal in historical stature to the religious, courtly, and bourgeois cultures of past ages. (He also took pains to distance this form of musical spectacle from the politically tainted notion of *Gebrauchsmusik*, for which it might easily be mistaken.)⁹³

But, as already suggested, the search for new forms of "music for the masses" was by no means a monopoly of the political right, and the interventions of Helberger and Trautwein had numerous precedents, many of which were of a more experimental character. In the early 1920s, the Russian composer, theorist, and arts administrator Arsenii Avraamov organized a number of massive open-air concerts of what he called the *Symphony of Sirens*.⁹⁴ The largest of these took place in the port city of Baku, Azerbaijan, in 1922, to mark the fifth anniversary of the October Revolution that brought the Soviets to power. In all likelihood the loudest and most ambitious musical event the world had ever seen, each performance of *Symphony of Sirens* marshaled the sonic resources of an elaborately orchestrated array of ships, artillery, infantry regiments, hydroplanes, steam locomotives, and factory sirens. The "Internationale," the de facto national anthem of the young Soviet Union, was played by a specially built ensemble of over twenty sirens. (In an almost Dadaesque touch, the tune of the "Marseillaise" was also sounded to the accompaniment of a "choir of automobiles.") Avraamov conducted this vast military-industrial orchestra by waving various colored flags from the top of a tower overlooking the arrayed participants. The *Symphony of Sirens* was intended to inaugurate a new genre of public, proletarian music, a festival of sound expressing the unified political will of the socialist state. Declared Avraamov, the music of industry will "oust the church bells of the old culture and replace them with the working roar of the sirens, the very timbre of which is so close to the proletarian heart."⁹⁵ (Not one to rest on his laurels, Avraamov later

proposed a project of "topographical acoustics": "And if the sound of sirens is not powerful enough, what could we dream about? Clearly: about the devices of Theremin or Rzhnevkin, installed on aeroplanes, flying above Moscow! An Aerosymphony!")⁹⁶

This enthusiasm for masses—of sound and of people—was shared widely by modernist artists of the time. In his "Musico-Mechanico Manifesto" written in 1922 and published two years later, the American composer George Antheil (of *Ballet mécanique* fame) proclaimed a vision strikingly similar to that of Avraamov's industrial symphony. But while Avraamov's *Symphony of Sirens* was conceived as a spectacle celebrating the power of the state, Antheil imagined a technological transformation of humanity framed in metaphysical rather than political terms: "great music machines in every city, which give the life of the future world a new psychic vibration—a vibration that will have a different grasp of space, which will revolutionize the life of the man of the future."⁹⁷

In his writings from the early 1920s, Jörg Mager, too, dreamed of his electric instruments taking part in ecstatic musical gatherings. At a time when his invention was hardly more than a laboratory prototype, Mager foresaw the possibility of a "twelve-horsepower fortissimo" that would dwarf the effects of even the most massive Mahlerian orchestra.⁹⁸ He envisioned a new form of open-air public music played by amplified electric instruments—communal concerts that would fuse the audience into a unified expressive organism through the power of sound:

Today, when crowds of humanity are pressed densely together in great cities, *gigantic* constructions alone can meet their needs—also in artistic matters. Previously the *church* was the only organization that conveyed musical culture to the broad masses. Outside of the church, musical enjoyments were virtually unattainable, since the instruments of that time filled only small spaces. Thus the price had to be relatively high, in any event too high for the broad masses of the working population. Here the Spherophone will have revolutionary effects! With its ability to create hurricane-like swellings of tones, it will enable thousands of people at once to share a single musical experience. Thus will entirely new compositions come about by themselves; for whenever masses gather, there stirs a need for the musical expression of a powerful communal feeling, *human sentiment!*⁹⁹

Explicitly posed as a modern alternative to both the superannuated rituals of the church and the elitist offerings of the bourgeois concert hall, Mager's techno-spectacle answered the musical demands of the new social order. Housed in a high tower and operated by trained musical

engineers, the instrument channels into sound the collective passions of the assembled crowds: "Tone-color cascades spray over the thousands of people. [. . .] All the feelings evoked in the human soul by the miracle of spring—cheering and jubilation, tender intimacy, childlike zest—the Spherophone sounds them out into the distance, fuses them together, and raises them to a thundering ecstasy of springtime joy! A utopia—but for how much longer?"¹⁰⁰

JÖRG MAGER'S LAST YEARS

Mager, like many others, rode the brief wave of electro-music euphoria in the early 1930s. This was the high point of his career, and it was not to last long. Following its introduction in 1930, the Trautonium quickly stole the spotlight from Mager and his instruments. With their formidable institutional and artistic alliances, Trautwein and Sala seemed poised to deliver what Mager had long been merely promising. But the Trautonium was just the beginning of Mager's woes—trouble was brewing among his supporters as well. His contract with the Society for Electroacoustic Music, though extremely favorable for the inventor, had come with strings attached. Mager had been promised substantial autonomy, but the society asserted an interest in the goal of "fostering and enabling the economic utilization" of his inventions. Practically speaking, this meant that the society's support ultimately hinged on the prospect of marketing an electric instrument. Prior to his contract with the society in 1929, Mager had developed his instruments without any apparent thought of mass production. Indeed, it seems likely that no one deemed such a thing possible until Theremin signed on with RCA in New York to begin the large-scale production of his instruments.¹⁰¹

The society's desire to get their hands on a saleable version of Mager's instrument became a source of continuous tension between the inventor and his benefactors. Although there was talk of mass-producing the Partiturophon in the wake of its 1930 debut, the instrument was still hampered by major technical shortcomings. The biggest limitation was that each keyboard manual was monophonic, meaning it could play only one tone at a time. Polyphony of more than two voices could be achieved only by playing two adjacent manuals with a single hand. Though the keys of the instrument were shortened somewhat in order to facilitate this technique, the monophonic manuals nonetheless imposed steep limits on the kind of music that could be performed, without—like Theremin's or Trautwein's instruments—introducing a

novel playing technique. Another problem was that, the instrument's bulky loudspeaker membranes hardly lent themselves to domestic use.¹⁰² Because Mager lacked the expertise to address these issues himself, the society brought in a number of technicians to assist him. But the inventor quickly drove them away with his stubbornness and suspicions about the security of his intellectual property.¹⁰³ The Society for Electroacoustic Music even considered the possibility of inviting Trautwein as a collaborator, but the distrustful Mager nixed the idea.¹⁰⁴

Mager soon began to chafe under the society's pressure to adapt his instrument to the exigencies of the musical market. The friction between external demands and Mager's impractical idealism was exacerbated by the inventor's burgeoning friendship with the eccentric Estonian philosopher Count Hermann Keyserling (1880–1946). A Baltic German from an aristocratic family, Keyserling's wealth enabled him to live as an independent intellectual. He penned a number of influential writings that combined philosophical concepts with autobiographical reflections and attempted a synthesis of Eastern and Western intellectual traditions. His most popular book, *Travel Diary of a Philosopher*, written during travels to South and East Asia in 1911–12, sold some fifty thousand copies in the decade after its appearance. In 1920, Keyserling established an intellectual salon known as the School of Wisdom (Schule der Weisheit) in Darmstadt, whose gatherings attracted a number of the prominent intellectuals of the time, including Thomas Mann, Carl Jung, Hermann Hesse, and Rabindranath Tagore. Soon after meeting Mager in the late 1920s, Keyserling became an enthusiastic advocate for the inventor and his project. In an article published in November of 1930, he framed Mager's cause in the now-familiar language of mystical transcendence: "The musical creator of the future will possess a new means of expression that will open new and as yet unknown paths for their invention," Keyserling declared. "That which previously only the esoteric and sacred music of the East could achieve will become 'objectively' possible."¹⁰⁵ Keyserling also lashed out at the Society for Electroacoustic Music, whose members he portrayed as philistines intent on cashing in on Mager's invention by turning it into a cheap substitute for existing instruments. Emil Schenck, the chairman of the society, blamed Keyserling for encouraging Mager's impractical streak and fomenting discord between the inventor and his would-be supporters, but the count was more likely a mouthpiece for Mager's growing discontent with the society and its demands. The conflict between Mager and his backers came to a head in January of 1932, when

the inventor allowed his contract with the Society for Electroacoustic Music to expire.¹⁰⁶ Mager soldiered on, entreating new supporters in an open letter published in the *Journal of Instrument Building*, where he trumpeted the still-untapped economic prospects of "electro-music."¹⁰⁷ But his career would never recover. In his 1933 book *Elektrische Musik*, Peter Lertes noted that "in spite of the years of labor Mager has put into the development of his instruments and the generous support that he has received in both financial and technical respects, [his] organ has not yet found entry into musical practice."¹⁰⁸

The tensions between modernism and marketability that led to Mager's departure from the society also left their traces in his final instrument, the five-voice Partiturophon, developed between 1932 and 1934. Although Mager did not fundamentally deviate from the keyboard-based model after 1928, by the early '30s the Partiturophon had been outfitted with a number of new features. The instrument now had a pressure-sensitive keyboard that allowed players to apply vibrato to a held tone by rapidly altering their fingers' weight on the keys.¹⁰⁹ Even more remarkably, it now included an appendage known as the *Bauchschweller* (belly swell), which enabled the player to increase the volume of the tone by expanding and contracting his abdomen.¹¹⁰ These additions highlight the extent to which Mager's instrument was conceived as an artificial extension of the body, a technological membrane that responded to the player's every nuance of performative gesture. But to Mager's critics, these modifications proved that he was more interested in gimmicks and novelties than in addressing the real shortcomings of his instrument.

Mager had still not solved the problem of the monophonic manuals, which he had acknowledged as his instruments' "Achilles' heel."¹¹¹ By the early 1930s, a number of other electric instruments were capable of polyphonic tone production. But instead of following this trend, Mager attempted to recast the Partiturophon's limitation as an advantage: "Precisely because each manual works only monophonically," he suggested, "one is forced to treat this monophonic line individually, so that—as in the polyphony of Bach, for example—each voice can be brought out as in a three-dimensional relief. In addition, each keyboard, being independent, can maintain its own appropriate timbre, which makes possible mixtures and contrasts of tone color of an almost orchestral quality."¹¹² Thus, Mager suggested, because each manual is timbrally independent, the Partiturophon could create the "illusion of chamber music" or even of a small orchestra. Further, the keyboard manuals could be pulled out

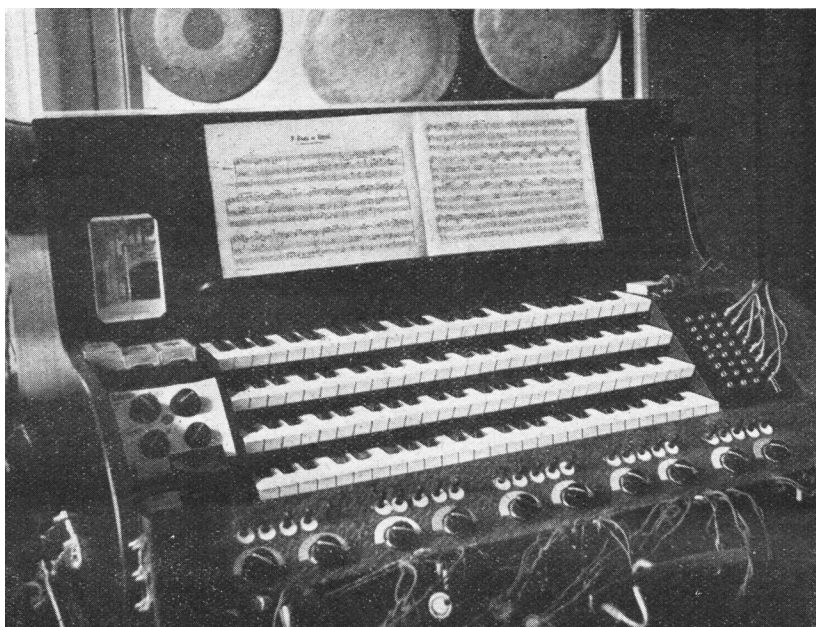


FIGURE 26. The five-voice Partiturophon, circa 1934. Both Mager's and Trautwein's instruments continued to grow during the 1930s, but both achieved polyphony only by multiplying monophonic manuals. Source: "Das 'Partiturophon'—Eine Hausmusik-Lösung," *Zeitschrift für Instrumentenbau* 54, no. 21 (1934): 329.

of the instrument's console like removable drawers, allowing a number of musicians to play a single instrument in consort. But these appeals to a potential market of amateur musicians were far-fetched, since the success of the Partiturophon as a home instrument was at least in part contingent on the existing repertoire of keyboard music being specially arranged for its monophonic manuals.

Whether oblivious to these difficulties or simply undeterred, Mager was now pitching the Partiturophon as an instrument of reproduction, as opposed to a tool of musical revolution. Instead of microtonality and Klangfarbenmusik, Bach fugues and the *Moonlight Sonata* served as examples of the instrument's capabilities. Nonetheless, Mager dusted off his old futurist proclamations of "radio music without transmission," now reconciled with the requirements of domestic music making:

Electro-music is nothing other than the use of the elements of radio technology in the form of *direct*, not merely *reproductive* generation of oscillations. The Partiturophon Home-Organ is thus nothing other than a *broadcasting station*, which of course transmits not into the cosmos but only into the mu-

sic room. The miracle of electrical musical vibrations, used for *direct* music making without first having to play nonelectric instruments into the microphone, as in radio, [is] thus far more significant than the mere *reproduction of sound* through the radio.¹¹³

As Mager attempted to rebrand his instrument as an all-in-one device for amateur musicians, the press began to assimilate the Partiturophon to familiar organological models, calling it an "electric organ" or an "organ without pipes." The establishment of a stable and familiar design—a keyboard mechanism with multiple manuals, sustained tones whose timbre was controlled by banks of switches and buttons—made such labels intuitive. Not only Mager's Partiturophon, but also instruments such as the Welte Light-Tone Organ, the Magnetton, and the Coupleux-Givelet Radio-Tone Organ fit neatly into this model, although in each case the actual mechanics of tone production were different.¹¹⁴ The shift in Mager's rhetoric thus corresponded to a process of organological consolidation in the development of electric instruments during the 1930s. Increasingly, due to both ease of construction and perceived prospects of mass marketing, electric instruments became synonymous with keyboard-operated "electric organs." Alternative interfaces such as those found on the Theremin and Trautonium were exceptions that proved the rule.

Another problem—and by now, a familiar one—was the lack of an original repertoire. Mager's instruments, to an even greater degree than Trautwein's, were plagued by a shortage of music written expressly for them. In lieu of idiomatic compositions, Mager had to make do with materials at hand: a 1936 account of one of his lecture-demonstrations reported him playing Bach, Beethoven, folk songs, and popular hits.¹¹⁵ Remarkably, the one surviving piece of notated music for his electric instruments, published in 1935, was a composition by Mager himself for four-voice Spherophone entitled "Little Christmas Lullaby" ("Weihnachts-Wiegenliedchen"). Looking at the score of this tuneful piece in D minor, one is struck by the apparent blandness of the music. Was the radical potential of electric tone generation doomed to produce nothing more than exotic new colors with which to gild the late-romantic mausoleum? Despite its outward conventionality, however, the piece is of interest for the designations in italics underneath each of the four staves. The second and fourth staves are labeled with generic terms calling for a gong and sheet iron, respectively. The first and third feature brand names of German loudspeaker manufacturers, Seibt and Grawor.

For these voices, Mager likely used either prebuilt loudspeaker units or cobbled together his own speakers using components from these firms' models. Thus, the markings for each of the four staves specify loudspeaker plates or membranes used to color the tone of each of the four voices in Mager's composition: they are the equivalent of instrumental designations in a typical score. Seen from this perspective, and in light of the descriptions of Mager's experimental techniques in chapter 3, this piece of holiday kitsch becomes quite a bit stranger. With its juxtaposition of a nostalgic compositional language and unearthly metallic timbres, Mager's Christmas lullaby perfectly embodies the conflicts and paradoxes of the electro-music phenomenon.

Following the expiration of his contract with the Society for Electroacoustic Music, Mager was thrown back into economic uncertainty. Although he was politically a leftist and a pacifist, he attempted to ingratiate himself to the new government, going so far as to write a letter to Hitler arguing for the importance of his work to the German nation. (Mager's latent anti-Semitism, expressed in his contempt for Theremin's German representative Georg Julius Goldberg, who was Jewish, no doubt helped ease his approach to the Nazis.)¹¹⁶ Whether his coziness with the regime was ultimately opportunistic or ideological, in the long run it hardly made a difference. Although Mager had powerful allies, including the journalist Fritz Stege, who wrote for the party-line *Zeitschrift für Musik*, and Peter Raabe, president of the State Music Bureau (Reichsmusikkammer), his continuing support was largely contingent on his instruments' dwindling propaganda value for the German government.

In 1935, the Prince Emil Manor in Darmstadt, where Mager had been allowed to stay following the dissolution of the Society for Electro-acoustic Music, was handed over to the Bund Deutscher Mädel, a branch of the Hitler Youth for adolescent girls. Mager left Darmstadt and never returned. For the next several years he led a precarious, semi-nomadic existence. He had long suffered from diabetes, and his poverty and frequent relocation exacerbated his illness. His last years offered some tantalizing glimmers of hope. A 1935 review of Mager's newest instrument spoke of his work in familiar tones of reverence and even featured a photograph of a bust of the inventor made by the sculptor Heinrich Jobst.¹¹⁷ Mager appeared at the yearly gathering of the General German Music Association (Allgemeine Deutsche Musikverein) in Weimar in June 1936 alongside Trautwein, despite the latter's attempt to prevent him from attending.¹¹⁸ (Trautwein by this time viewed Mager as

an erratic amateur whose unprofessionalism harmed the cause of electric music.) The same year, Mager was invited to Berlin to contribute to the sound track for the UFA film *Stärker als Paragrafen*. (The resulting thirty-second clip of the Partiturophon is the only known recording of his instruments.) A press account from this period paints a melancholy picture of the indefatigable "sorcerer of sound" playing his instrument in a near-empty beer hall in Berlin.¹¹⁹ In spite of his waning audiences, though, Mager was still able to cast a powerful spell on those who heard his demonstrations. The inventor's friend, the poet Julius Maria Becker, provided this exemplary effusion from the year 1936:

Mager plays us a short, improvised piece, a truly intoxicating bacchanal of strangely mixed magical sounds, which gave one the impression that the door to another world had been thrown wide open. One doubts no longer the unique and unprecedented meaning of his work. The console, from which the closing of electrical contacts calls forth entire series of unexpected scales, entire floods of astounding harmony as if summoned from nothing, controls the gushing limitlessness of the sounding world. Mager stands on the threshold of something final and absolute, for no vibration, no wisp of tone color, no slightest trace of existing sound could resist the will of this magical organism. Everything must become sound, everything is subjected to the fate of tonal birth and must emerge into reality: from his console, Mager orchestrates the spheres themselves.¹²⁰

Mager's last years paint a picture of seemingly inexorable decline. By the late 1930s, he was impoverished, sick, and desperate. In a letter from this period, the inventor referred to himself as a "music-futuristic Jesus" who had been "driven out of the temple of the holy Lady Musica by courtyard cattle-merchants and moneychangers."¹²¹ A brief article from July 1938 reported that Mager had left the town of Bamberg, where he had set up a makeshift laboratory and enchanted the locals with a Christmas concert the previous year.¹²² A final attempt to escape penury by selling his patents to international investors was nixed by Goebbels, who wanted to prevent Mager's instruments from falling into foreign hands but didn't care to purchase them for the German government either. Mager died the following year in a hospital in his hometown of Aschaffenburg. His obituary notice encapsulated the inventor's fate: "The perfection of his instruments, such as the Spherophone and the Partiturophon, was guided by the goal of creating the entire spectrum of instrumental timbres purely and independently from the ether waves, so to speak. A fitting exploitation of his gifts as an inventor

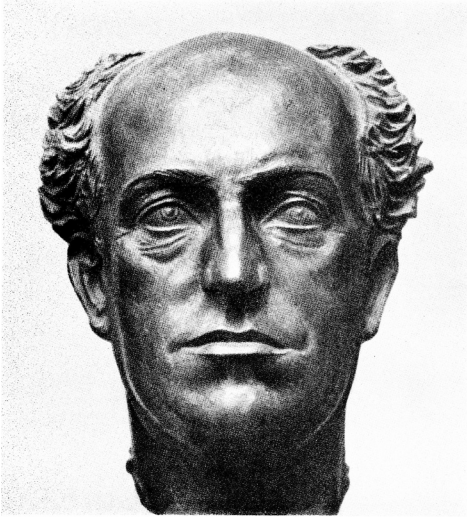


FIGURE 27. The inventor as hero. Bust of Jörg Mager by Heinrich Jobst. Source: Paul Zoll, "Jörg Mager's 'Partiturophon': Eine umwälzende, elektro-akustische Erfindung," *Zeitschrift für Musik* 102, no. 12 (1935): 1332.

was unfortunately hindered by his inability to adjust to the practical demands of life."¹²³

In the year of Mager's death, a brief notice appeared in the *Journal of Instrument Building* bearing the title "369 New Musical Instruments in Ten Years." The article recorded the effort of a Parisian publisher to catalog the hundreds of new devices created in the previous decade. However, the author noted that the majority of these inventions had disappeared almost as suddenly as they had sprung up. Just as few works of art survive the test of time, the author observed, most of the new instruments had failed to establish themselves in musical practice: "Scarcely more than a dozen were viable; the rest are played, if at all, by the inventors themselves."¹²⁴ This postmortem neatly sums up one of the most vexing aspects of the technological modernism of the 1920s and '30s: the discrepancy between the frenzy of inventive activity and the relative dearth of surviving artifacts, be they recordings, scores, or the instruments themselves. Mager's case is exemplary: not only were his inventions all destroyed or lost in the global conflagration that began in the year of his death, but virtually no trace of their music survives.