6 Even in the Quietest Moments: Amplifying the Electric Guitar

KYLE DEVINE

Introduction

The electric guitar is often presented as a novel but straightforward solution to a particular problem: amplification. It is remarkable, then, that histories of the instrument focus mainly on the iconic six-string itself. No electric guitar is complete without an amplifier, and no companion to the electric guitar is complete without a corresponding history of electronic amplification.[1]

Amplification has always been a defining characteristic of the guitar. In fact, for most of its history, the instrument was itself nothing if not a resonant body, a self-amplifying acoustic system. After a period when luthiers were supposed to have been making guitars louder by making them larger, amplification began to take on new meaning in the late nineteenth and early twentieth centuries. It was during this time that metallic cone-shaped resonators were developed and the virtues of metal versus gut strings, as well as fingerpicking versus plectrum strumming, were debated. The early twentieth century then witnessed not just a set of crucial technological developments (vacuum tubes, electromagnetic pickups, cone loudspeakers) but a paradigm shift in how engineers, musicians, and the public related to the acoustic world. Sounds were reconceived as signals. Amplification lost its body. A generalized speaker culture took shape.[2]

The usual story, in terms of the electric guitar, has a certain predestined, crescendoing ring to it. This can give the impression that the instrument was simply requested and accepted by musicians and audiences, developed and delivered by technicians and companies. But that is not the whole story. In fact, it conceals a more complex history.

That history could fill volumes. Its value, for the purposes of this chapter, would not be found in establishing a series of amplifier firsts. Of course, there is no end of debate about what constitutes the first true electric guitar transducer (electrostatic microphones or electromagnetic pickups?), the first proper electric guitar amplification system (adapted radios and PAs or dedicated instrument "combos"?), the first real performances and recordings of distortion ("Hawaiian" lap steel players in the early

1930s or the sabotaged amps of early 1950s rock 'n' roll?), and so on. These debates are easy enough to consult in the numerous popular accounts, magazine articles, authorized corporate histories, and coffee table books that serve the market of amplifier aficionados and collectors. Such publications tend to be organized around a few main features: chronology and progress, great men and their businesses, objects and their impacts—not to mention a loud–louder–loudest narrative engine. The limitations of those forms of technological history are known, and will here be treated only in passing, as sources of empirical evidence in a social investigation. The concern of this chapter is to understand the situation of amplification in history and culture, to understand its development and effects as matters of social construction. In other words, the guiding curiosity here is: if electronic amplification is the answer, what was the question?

Thinking in these terms encourages researchers to confront a series of counterintuitive realities. For example, it is not clear that the development of electric guitar amplification, especially during its early phase in the 1920s and 1930s, was really about higher sound levels—or loudness, as Matthew Hill suggests in Chapter 2. In fact, the first amps were not necessarily louder than some acoustic options that were available at the time, meaning that the adoption of electronic amplification must be otherwise explained. This illustrates a familiar theme in the history of technology, where "inferior" devices and systems become widely used, not because of their obvious initial superiority but due to a complex of other factors, including cultural imaginaries and capital backing. Well-known examples include the triumph of disc recordings over cylinders, of VHS videocassettes over the Betamax format—even the shift from water-borne stream power to coal-based steam power.[3] Indeed, from the 1920s to the 1940s and beyond, electronic amplification was at least as much about timbral characteristics and tonal volume (apparent or actual extensity) as it was about loudness (apparent or actual intensity).[4] What is more, all of this was wrapped up in the marketable novelty of an instrument that looked and sounded like the awesome modernity of electrification during the early twentieth century. In these ways, electronic amplification is part of a cultural history that is more helpfully measured in discourse than decibels—and, as I will emphasize, in ways that are inseparable from the boundaries of capital, class, and race.

Neither is the history of the guitar amplifier strictly a story of bigger and bigger being better and better. Those tendencies certainly exist, both materially and discursively, perhaps most noticeably emerging in the 1970s with regard to the noise of punk and the power of arena rock.[5] But the history of guitar amplification is equally a history of miniaturization and personalization. Like the wider electronics industry of which it is

a branch, the guitar amplifier's history shrinks from tubes to transistors to chips and, eventually, digital modeling amps and the microscopic operations of software applications. Similarly, the electronic PA's political rhetoric initially imagined larger loudspeakers allowing larger in-person audiences and creating an essentially limitless acoustic public sphere. But this idea was ultimately more successful with the rise of radio broadcasting, with the market penetration of radios into most private homes, and the aesthetic of intimacy defined by the radio voice (e.g. Franklin Roosevelt's fireside chats). Guitar amps, by comparison, did get larger and louder for rock, yet they were simultaneously getting smaller for studios, bedrooms, desktops—even belt loops.[6] Electric guitar amplification thus parallels the history of microphone singing, which was only ever partly about filling larger spaces with louder voices. That history was equally about making quiet vocal sounds and styles unnaturally loud as well as, especially in studio recording, making loud voices unnaturally quiet.[7]

These seemingly incongruous tendencies do not so much replace one another as their various possibilities become layered, complementary, and interdependent, and as different amp technologies serve different markets. This is perhaps most obvious with the continued production of technically obsolete but nonetheless desirable tube amplifiers, as well as the large trade in vintage amplifiers—a topic that would open up a discussion of masculinity in music equipment that is beyond the scope of this chapter.[8] Also beyond our scope is the extent to which guitar amplification should be understood in relation to a range of competing precepts and practices that structured the history of sound reproduction, especially those surrounding so-called fidelity.[9] A fuller account of guitar amplification would also have to understand its topic in relation to rituals of actual and aspirational loudness in a variety of musical settings.[10] And finally, a more extensive treatment would need to go well beyond this chapter's strategic focus on the United States in the early twentieth century—the place and the moment when the old technology of amplification was new.

Insofar as this chapter cannot present anything like a complete history of amplification, neither does it present a single argument about amplification. The goal is instead to cover a range of tendencies and possibilities that have existed in and around guitar amplification, in the interest of illuminating certain aspects of the amplifier's historical emergence. A parallel aim is to suggest some ways that a study of amplification can speak back to certain prominent themes in contemporary music scholarship, which will become more apparent in what follows. To this end, the chapter concludes with a discussion of electric guitar amplification and the problem of electricity—suggesting that the power of the amplifier has never been found in loudness alone.

Loud and Clear: The Social Construction of Electric Amplification

The earliest attempts to electrically amplify the guitar involved attaching telephone receivers and carbon-button microphones to regular acoustic and resonator instruments, and playing those mishmashes through PA systems (which had been introduced for the purpose of speaking to large crowds around 1915). George Beauchamp, who was centrally involved in the early 1930s introduction of the electromagnetic pickup as well as the frying-pan style electric guitar that became associated with Rickenbacker, was apparently experimenting with microphones and PAs around 1925. Eddie Durham commented that one of his band leaders, Jimmy Lunceford, "used to bring the microphone right up to the F hole of the guitar, so that between that and the resonator it was almost like having an electric instrument." Guitar Slim, too, amplified his guitar using microphones and PA systems—and he continued to do so long after dedicated amps were viable.[11]

Although the microphone and PA combination addressed the amplification issue to some extent, and in ways that clearly worked well enough for some musicians, it also resulted in a lot of unwanted sound. Not only were feedback loops an issue, but microphones heard too much: from coughs and sneezes to moving chairs and private conversations. Moreover, as an early essay on electrical instrument amplification explains, "a microphone of the broadcasting type picks up the whole orchestra, when it is only the strings that are weak and that do not balance the brass, so the result is as unbalanced as the original."[12]

Attempting to eliminate such noises and imbalances sparked an encounter between two broad frameworks of understanding (and then, a third). One came from the world of communications engineering, especially telephony and radio. The other came from the world of music, especially luthiers and performers. These ways of understanding the guitar are not defined by the mental life of any particular individual. Rather, they consist in an intersubjective scaffolding for problem-solving known as a technological frame. In this sense, we can speak of the technological frame of communications and the technological frame of the traditional guitar, or the communications frame and what Steve Waksman calls the amplified acoustic frame. As we will see, the differences between these frames were resolved into a new synthetic understanding of the electric guitar—a synthesis that contributed an emphasis on signals more than the resonating body of the instrument, and that imported a specific and idealized approach to signals from telephony and radio. The goal here was that a signal should come through loud and clear.[13]

At the same time, the new hybrid technological frame was further compounded by the flexible interpretation of early amplification among its most relevant social group: guitarists. Encountering electronic amplification, these guitarists—many of whom inhabited those places where low social class relations intersected with racialized lives and histories—brought with them a "heterogeneous sound ideal" that has been understood as a "distinct approach to sound in African and African-American musical traditions."[14] That sound ideal is said to prioritize flexible, non-tempered approaches to characteristics such as timbre and pitch—and I will refer to it as a musical structure of feeling, in the sense of those forms of thought and action that were not necessarily congruent with the dominant or hegemonic common sense of a period, and which were inherently at odds with the "loud and clear" sound ideal imported into the new technological frame of guitar amplification. In other words, electrically amplifying the guitar required a new framework for problem-solving in the world of music—but certain guitarists did not always use the new instrument in the way its designers intended. This eventually led to new technological collaborations and new musical possibilities. In these ways, the invention of electrical guitar amplification represents a classic case in the social construction of technology.[15]

From the 1920s, a variety of electric guitar experimenters, drawing on ideas from telephony and radio (the communications frame), began to realize that the acoustics of the conventional guitar interfered with the electrical signal. Microphones and telephone receivers were therefore disassembled while phonograph pickups were stripped of their needles, mounted directly inside the guitar, and amplified using modified radio receivers.[16] Trial and error led these tinkerers to focus on transmitting and amplifying the electromagnetic vibrations of the strings themselves rather than the tone of the entire guitar. Indeed, as Lewis Williams, an employee of Lloyd Loar's Vivi-Tone company, wrote in 1933: "The subtle etheric flux of a magnet takes a 100% vibration impression and delivers as much to the aggrandizer for pure tone of any volume."[17] And although Loar was working with general principles similar to those of Rickenbacker's George Beauchamp, it was Beauchamp who became most recognized for following this line of thinking through to what, in retrospect, is its logical endpoint: a guitar without an acoustic resonating chamber.

Some of the earliest electric guitar designers worked within the amplified acoustic frame, meaning that "builders and manufacturers involved in making electric guitars held to the notion that amplified sound was still largely reliant upon the acoustic qualities of the instrument."[18] By contrast, other designers incorporated aspects of the communications frame, which contributed an emphasis on electrical signals themselves more than

conventional acoustics. The translation of this signal thinking into the guitar world thus involved a set of compromises surrounding the subordination of the priorities of the acoustic frame (i.e. the faithful amplification of a traditional guitar tone) to those of the communications frame (i.e. the creation of a new type of guitar tone based on the priorities of electronic signals). This was the context in which amplification lost its body. Or, as Emily Thompson has written, "the desire for clear, controlled, signal-like sound became pervasive, and anything that interfered with this goal was now engineered out of existence."[19] At least, that was the ideal.

The virtues of loud and clear sound are stressed from the first promotions of electrically amplified guitars. Appearing in the Chicago Musical Instrument catalog of 1929, an advertisement for Stromberg Electro Instruments declares:

> The tone in these instruments is amplified many times, through a magnetic pickup built into the instrument which takes the vibrations direct from the sounding board, and passes it through a two-stage amplifier. Every tone is brought out distinctly and evenly, with a volume that will fill even a large hall.[20]

Further underlining the emphasis on loud, clear tone outlined in the Stromberg advertisement, Vivi-Tone's spokesman Lewis Williams states: "Because of the inertia and resistance of sounding-board type of instrument [*sic*], the player must use a severe attack that pulls the string widely off its axis in order to get a loud tone." He continues:

> This makes an imperfect string pattern so that the harder the string is pulled the more distorted the tone . . . But in the electrically energized string instruments the perfect pattern of the string is readily retained for no severity of attack to gain loudness is necessary. The electrical energy affords the power . . . To have the tone pure whether soft or loud was the aim of Professor Loar who stoutly maintains: "Nothing is so impressive as a loud tone that is sweet."[21]

An early Rickenbacker catalog, ca. 1931, similarly registers how, having been "touched with the magic wand of electrical genius," the "fairy-voiced Hawaiian guitar, the tinkling mandolin, the ethereal Spanish guitar—all have been liberated, dignified, and given their rightful place among the orchestral instruments." The emphasis is on "VOLUME! CONTROLLED VOLUME." A Rickenbacker amplifier advertisement from 1933 puts it succinctly: "power without distortion."[22] This same communications-derived preference influenced work on (and marketing of) electric guitar amplifiers until well into the 1960s. However, it did not always reflect the use of electric guitars.

It was perhaps Leo Fender who most famously held on to the notion that an amplified guitar, like a communications signal, should come

through loud and clear.[23] Indeed, Fender "kept a close eye" on developments in the hi-fi home stereo market, and in 1961 Fender advertisements still opened by assuring that they were "capable of producing tremendous power, free from distortion, with reserve power available when needed."[24] Yet tremendous power and distortion-free reproduction were not always seen by guitarists as positively correlated qualities. There are innumerable accounts of guitarists who played loudly enough to "be heard above the blare of the neighbor's radio" and to "rattle the window panes, at that dance next month," plenty of assertions "that nobody could out*blast* [Guitar] Slim when it came to volume," and a certain amount of shock that Memphis Minnie played her guitar "amplified to machine proportions—a musical version of electric welders plus a rolling mill."[25] But there are fewer examples of players (as opposed to manufacturers) bragging about how pristine their guitar sounded, despite its high amplitude.[26]

While it is apparent that the "loudness" of the electric guitar was appreciated by many players, they did not necessarily share the manufacturers' desire to maintain "tremendous power, free from distortion." In other words, while the translation of the communications frame into the invention and engineering of electric guitars and amplifiers was relatively smooth, these imperatives were modified in their relationship with a particular structure of feeling in the musical world. The practical thrust of intelligibility taken from telephony and radio (loudness *and* clarity for the sake of comprehension) took on an unexpected aesthetic dimension in the hands of musicians (loudness *over* clarity for the sake of expression). André Millard offers the following summary:

> While the makers of amplifiers and the designers of pickups treated distortion as a major technical problem, many guitar players welcomed it as they sought new and more expressive sounds . . . The people who bought guitars and amplifiers did not always follow the manufacturers' recommendations, nor did they act like *rational* buyers. The strategy of technological innovation did not always work, nor did the *modernity* implied in equipment design.[27]

Of course, cooperation between manufacturers and users did eventually exist in the development of high-powered and deliberately distorted amplifiers—witness Marshall and The Who in Britain, Garnet and The Guess Who in Canada—to say nothing of the effects units that have been designed specifically for distortion since the 1960s.[28] While these amp makers, like earlier ones, were also schooled in the communications frame (via connections to electronics engineering and radio), their collaborations with musicians led to a higher degree of synthetic congruence between the communications frame and the musical world—much like the

relationship between technological innovation and musicianship cultivated by Robert Moog and his synthesizer company.[29]

But it is worth dwelling on Millard's words, for they open onto a history of amplification that is more than just technical or musical. The history of amplification—of sound and electricity—is political. When Millard describes the "modernity" of engineers and equipment, as well as the "rational" customers they imagined, he implies something about the nonmodernity and irrationality of certain guitar players. Millard thus participates in a longstanding and ongoing political discourse whereby certain musical and cultural proclivities and practices are mapped onto certain social designations—especially class and race (as well as gender, which is pursued more in Chapters 12 and 13, by Sue Foley and Mashadi Matabane, respectively). These ostensible nonmodernities and irrationalities constitute the "heterogeneous sound ideal"—the musical structure of feeling—mentioned above, the guitar-related social history of which Rebecca McSwain describes:

> Acceptance of electric guitar feedback (and other noises) as music seems to have begun on the periphery of mainstream American culture. That is, the penchant for ever-increasing volume, which carried musicians into an exploration of such noises, seems to have arisen in black nightclubs and white country music dance halls. While the white and black bourgeoisie argued about the relative merits of electricity in music . . . African-American and hillbilly musicians embraced the power that electricity gave them.[30]

McSwain thus emphasizes a historical intersection in the history of amplification, one where the physical meets the metaphorical—where the power and pleasure of amplification, which is not necessarily found in a literal loudness (or at least not in a sense that would be recognized today), are means by which exploited and oppressed groups make themselves symbolically and materially heard. Amplification becomes defiance, resistance. Yet there is another side to this story. From this perspective, amplification became attached to longstanding biases of deviance, newly expressed in a moment of material and symbolic interchange between loudness and electricity at a particular moment in history—the early-to-mid twentieth-century United States.

When Virginian country musicians Joe Maphis and Rose Lee Maphis entered a California saloon in 1952, they found themselves a world away from the barn dances they knew. The drinking, the smoking, the dancing, the fighting, the lewd talk, the "airborne din"—they had never experienced anything like it. The atmosphere stunned them into song:

> Dim lights, thick smoke, and loud, loud music
> Is the only kind of life you'll ever understand

Dim lights, thick smoke, and loud, loud music
You'll never make a wife to a home-loving man

A home and little children mean nothing to you
A house filled with love and a husband so true
You'd rather have a drink with the first guy you meet
In the only home you know, the club down the street

A-drinkin' and a-dancin' to a honky tonk band
Is the only kind of life you'll ever understand
Go on and have your fun, you think you've played it smart
I feel sorry for you and your honky tonk heart

High-amplitude music is here associated with indecency, even sin. In his history of the electric guitar, Ian Port summarizes the episode this way: "Thus was the penetrating sound of the Fender guitar first linked to behavior deemed unfit for polite society. Barely a year after it hit the market . . . the Telecaster was . . . carving a gap between those who would give themselves over to the new electric music, and those who heard in it a serious moral danger."[31]

Port may be right that this was the first time Fender was linked to forms of class- and race-based moralism and discrimination. But this particular moment actually tapped into a longer history of loudness that was compounded by the meaning of electricity—a metaphor for power and progress, an object of wonder and admiration, and a symbol of danger.[32] Electric guitar amplification took shape in a world undergoing a long "civilizing process"—in Europe, in its colonial encounters, as well as the Americas—whereby ruling classes fabricated their subjectivities by means of the acoustic construction and subjection of various "others" (rich versus poor, colonist versus colonized, settler versus indigenous, white versus nonwhite, human versus inhuman).[33] Such associations between loudness, class, and race took on new meanings not only during the electrification of the United States from about 1880 to 1940. These associations continued their sedimentation through the electric guitar, perhaps most noticeably with regard to Jimi Hendrix in the 1960s, but also well beyond the guitar—in, for example, hip hop-associated technologies such as car stereos and boomboxes in racialized urban and suburban settings through the 1970s and 1980s, not to mention innumerable contemporary situations in which loudness is constructed as the sound of stigmatization and exclusion.[34] Whatever meaning we may find in the guitar amplifier, then, its social and musical significance extends beyond the object's immediate "materiality." Indeed, the amplifier is not a thing. It is a relationship.

Signal Chains, Supply Chains, Fetish Claims

One point brought out clearly in the historical development of the guitar amplifier is that it has always been about tonal qualities as much as loudness. In fact, early amplifiers were not capable of very high output and at first were probably pursued for certain sonic characteristics and the novelty of electric modernity as much as anything else. The history of amplification may thus be described as a "relentless pursuit of tone."

The editors of a book by that title—Robert Fink, Melinda Latour, and Zachary Wallmark—suggest that electric guitar tone should be understood as a "quasi-object." They borrow this concept from actor-network theory, which is a tradition of science and technology studies related to the one discussed in the previous section, and they define the concept as "a heterogeneous network of causal forces encompassing aspects of both nature (acoustical facts, modes of perception, properties of electronic systems) and culture (aesthetic dicta, genre standards, individual expressive goals)." To illustrate guitar tone as a quasi-object, they suggest, it is both typical and helpful to take an "imaginative trip" along "the 'signal chain' that runs from the player's fingers to the listener's ears."[35]

Strings, pickups, wires, potentiometers, cables, tubes, transistors, resistors, speakers, the fretwork, and the hands—all, we are told, matter in the construction and maintenance of this quasi-object called tone. In such scholarship, the methodological mantra is to follow the "actors," that is, anyone or anything that is a source of processual agency. Of course, this is also the modus operandi of guitarists themselves, as they pursue particular sounds by endlessly updating their techniques and technologies at various points in the signal chain. Scholarly approaches to the electric guitar are thus mirrored in certain popular practices of the electric guitar. Taken to the amplifier, this work would quickly become a history of different tubes, capacitors, speaker configurations, debates about modern versus vintage equipment, and so on. Such histories, in other words, would orbit closely around fetishism, in both the everyday Freud sense and the everyday Marx sense.

In the Freud sense, guitar amplifiers are fetishes as objects of intense (if displaced) desire. In the Marx sense, they are fetishes in being prized for themselves—inasmuch as their powers and values are attributed to their objecthood in ways that distract from the peopled processes through which amps are made. One response to this situation, of course, as the editors of the tone book demonstrate, would be to treat such displacements and distractions as social facts and to examine their effects in musical culture.[36] Another response would take inspiration from recent musicological and organological studies of instrumentality and "materiality."

Such work would be less about the actions or affordances in the "heterogeneous network" of the tonal "quasi-object." Rather, it would take a different "imaginative trip" through another "network"—spiraling outward from the performer–instrument–listener encounter that constitutes the signal chain, toward the anonymous frictions of the global supply chains that make such an encounter possible in the first place.

One of the analytical and political motors of such work is toward the restoration of an object to its social and historical circumstances, a mode of analysis sometimes called demystification. This type of analysis is present in contemporary guitar scholarship, in studies of tonewoods such as Fijian mahogany, as well as other efforts in tracing guitars back to their trees, as we see in Chapter 14 by Chris Gibson and Andrew Warren.[37] It is also increasingly present in music scholarship writ large—including other instruments such as violins, pianos, and drums, as well as various recording formats and the "resource ecologies" that define musical electronics of all sorts.[38] The possibilities of this perspective in relation to amplification are apparent.

What are amps made of? Where do those materials come from? How do we account for the historical and ongoing production of millions and billions of paper cones, alnico and neodymium magnets, wooden cabinets, glass tubes, metal chassis, silicon semiconductors, and the like? What happens when we think not only about reproduction parts for the vintage market but true vintage parts themselves, which were made to different environmental standards, and which can raise problems such as toxic "capacitor juice" (polychlorinated biphenyl and dioxins)? What are the effects of all this on the planet and its people?

This type of critical supply chain organology represents a form of demystification that is aimed at puncturing the displacements and distractions of fetishism. Such work is crucial in our moment of ecological uncertainty. However, not only do these studies risk quickly reaching a point of diminishing returns (empirical details may change from object to object and component to component, but the general analytical and political points remain the same). They also risk falling into a trap. What does it say that this work of demystification itself strongly resembles a popular form of entertainment in television programs such as *How It's Made* and *Dirty Jobs*, as well as countless YouTube channels—and is therefore entirely amenable to capital? What are the materialist forces that have given rise to (and which nourish) the current wave of scholarship on "materialities" such as signal chains and supply chains? And how does all this obtain in a moment of environmental turmoil, when guitar magazines publish articles on "The Environmentally Conscious Guitarist," pointing out how "old tubes … blown speakers, frayed wires, trashed

amps, unwanted enclosures, and fried electronics" contribute to the fact that "modern music making generates a small mountain of unwanted junk"? The lessons on offer in popular writing but also some scholarship come down to sympathetic, ethical, activist approaches to consumption, which throughout their history have been notoriously ineffective.[39] Here we converge on the observation that it is often the moment where signal chain and supply chain studies believe themselves to be at their most critical that they may, in fact, be most compatible with the interests of capital.

This should give researchers pause. It asks musicologists and organologists of both signal chains and supply chains to consider what is critical about their critiques. It should help us realize that, in a counterintuitive twist, such forms of demystification can function as deeper forms of mystification and fetishism. A parallel example from the sociology of food helps bring the point home. Supply chain showcasing, as is often found with regard to organic food, looks like demystification even and especially as it deposits an additional layer of mystification onto commodity culture. The sheep of fetishism sneaks in wearing the wolf's clothing of critique, creating "a distortion of reality which reifies and reproduces the fundamental process of capitalism by making the commodity form the solution to its own mystifications." In other words, and not to mention many other commodities that are sold in terms of ecological friendliness, organic food can represent the "predicament of a social formation that offers its agents the means to reproduce its own structure while simultaneously feeling as though they are toppling it."[40]

Amplifier companies do not appear to have adopted green marketing techniques. Not yet. Perhaps this is because, unlike wooden guitars, which have long been implicated in sustainability marketing, amps have less about them to suggest an aura of "naturalness." Either way, the situation is a little surprising considering the range of other electronic goods (fridges, dishwashers, smartphones, laptops) that sell themselves in terms of energy ratings, water ratings, fairtrade supply chains, recyclability, and so on. Given the emerging hegemony of green capitalism, it is easy enough to imagine amplifiers also adopting such practices—even if belatedly. It is also straightforward to imagine a branch of guitar scholarship that would, likewise, trace amps back to trees and mines and factories. All of which, to me, raises a crucial question. Why is the practice of supply chain revelation, or the appetite for "materiality," so central to both commodities and entertainment as well as the contemporary inclination of music research, and in what ways might such projects coincide?

Conclusion: The Electric Guitar and the Problem of Electricity

In his cultural history of the electric guitar, Steve Waksman asks: "Can electricity be the basis of difference?" He is wondering about musical difference—electricity as the line in the historical sand between two forms of the blues. Although Waksman thinks the idea is a bit strange, and "too far to the side of technological determinism," he does find in it some explanatory force regarding the development of the electric guitar and musical experience. I see additional potential. It is possible to discuss electricity as a basis of material difference and, in so doing, to suggest the necessity of going even further in the direction of technological determination.[41]

Several authors point to a path forward, even if few of them would associate themselves with determinism. David Hesmondhalgh and Leslie Meier show that music listening was industrialized in its connection to consumer electronics in the first half of the twentieth century. Paul Théberge describes how musicians became consumers in a new way with the proliferation of digital instruments from the 1980s, which bound the musical world up in new ways with the rhythms of the computer industry. Georgina Born, Eric Drott, and Jonathan Sterne, in their different ways, discover the relationships between musicians, listeners, and social reproduction in today's political economy of information capitalism. If all these authors contribute to our understanding of the long development of relations between music, technology, and capital, then the history of the amplifier is illuminating for drawing attention to one such relationship that has been fundamental but largely unexamined since the early 1900s: electricity.[42]

The field of energy humanities is helpful here. Writing about oil, Imre Szeman describes how energy formations shape societies "in every possible way and at every possible level, from the scale of our populations to the nature of our built infrastructure . . . and from the possibility of movement and travel to *expectations* of the capacity to move and interact."[43] Something similar can be said about music with regard to electricity. Electrical energy has not only shaped novel possibilities for making music and listening to it. Electricity has also altered fundamental understandings of what counts as "musical"—of what music is, what we expect of it, and what we might want it to become. If, as John Durham Peters has written, "grids and circuit boards are ontological in their effects," then the electric guitar amplifier was among the earliest and most important electronic instruments to usher in new forms of musical existence and expectation.[44]

Electricity like this does not occur naturally. It has always been bound up with a sociotechnical system that can be described in terms of electricity capital, or "the nexus of state, regulatory, and financial relationships that shape private accumulation through electricity provision."[45] Electrification built itself throughout the United States according to the logics of commodification and profitability, not the logics of social need or value, which meant that "electricity was not merely one more commodity" but "seemed linked to the structure of social reality"—and in a particular way.[46] Electricity capital helped remake forms of citizenship and, in so doing, presented new opportunities, not just for the enrichment of everyday life but for forms of exploitation that reflected and reinforced differential politics of geography, class, race, and gender. If, as Théberge shows, musicians became new kinds of consumers in the 1980s, they had long been essentially customers in relation to electricity capital.

Although some electrical grids do take the form of public utilities, the ongoing privatization of electricity capital, as well as various uncertainties about generating electric power on a warming planet, raise real questions about the obligations, rights, and struggles of citizenship, subjectivity, and belonging. It also raises real questions about the material conditions of music.[47]

We have evidently traveled far from the "users matter" paradigm of science and technology studies. It is possible to see the synthesis of technological frames and the incongruence between the loud-and-clear imperative of the synthetic electric guitar frame and the classed and racialized musical structure of feeling, not simply as a difference in ideals but, rather, in relation to a material force by which music (via the electric guitar) was made available to capital accumulation in new, lasting, and almost unavoidable ways—regardless of whether or not guitars were played at high volumes or with distortion. Additionally, we have pushed beyond the comforting concrescence of signal chains and supply chains sought in some musicologies and organologies of instruments, beyond a focus on the "materiality" of music that risks reinscribing the commodity fetishism it seeks to dispel, opening a broader and deeper meditation on the material conditions of musical life.

Can electricity, and by extension, the electric guitar amplifier's relationship with electricity capital, really be the source of such difference? I do wonder. In the end, my conclusion is that skepticism on this matter speaks less to the triviality of the perspectives than to forms of encompassing political power and subjection that have, until recently, been largely taken for granted in music and music research. In other words, the importance of electrical energy in music has been hidden by its very success; its normative

ubiquity has "hindered an appreciation of its biopolitical importance."[48] Although the politics of the guitar amplifier may be most obvious in spectacular displays of loudness that rattle windows and embattle neighbors—or, conversely, when the power goes out and the conditions of its possibility are denied and laid bare—the significance of deeper infrastructures of energy production and distribution are no less real for being less apparent in their everyday situations. The electric guitar amplifier is a political technology, even in the quietest moments.

Notes

1. It should be noted that, while there is truth to this opening salvo, I am also consciously representing a rhetorical device that structures the history of the electric guitar—i.e. that players, fans, and historians have paid most attention to the guitar as such, while the amplifier has been an afterthought. In the popular literature, this rhetorical move then opens the way to the narratively effective and satisfying "surprise" that, in fact, amplifiers were invented "before" the electric guitar (e.g. Ritchie Fliegler, *Amps! The Other Half of Rock 'n' Roll* (Hal Leonard, 1993); Tom Wheeler, *The Soul of Tone: Celebrating 60 Years of Fender Amps* (Hal Leonard, 2007)).
2. See Matthew Hill, "George Beauchamp and the Rise of the Electric Guitar up to 1939," unpublished PhD thesis, University of Edinburgh (2014), pp. 25–27, 36; Jeffrey Noonan, *The Guitar in America: Victorian Era to Jazz Age* (University Press of Mississippi, 2008); Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (University of Chicago Press, 1999); Jonathan Sterne, "Space within Space: Artificial Reverb and the Detachable Echo," *Grey Room* 60 (2015): 113–116.
3. The format examples circulate widely in public discourse. On the rise of the fossil fuel economy, see Andreas Malm, *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming* (Verso, 2016).
4. In everyday discussions of high-amplitude sound pressure levels, *loudness* and *volume* are interchangeable. Historically and materially, they are different phenomenon. But this is not the place to get into all the technicalities and histories. For interested readers, strong thinking on loudness, including the apparent paradox that loud sound does not actually have to be loud, see Michael Heller, "Between Silence and Pain: Loudness and the Affective Encounter," *Sound Studies* 1/1 (2015): 40–58; Jonathan Sterne, *Diminished Faculties: A Political Phenomenology of Impairment* (Duke University Press, 2021), pp. 117–156.
5. See Steve Waksman, *This Ain't the Summer of Love: Conflict and Crossover in Heavy Metal and Punk* (University of California Press, 2009).
6. There are numerous consumer guides to these products. For a scholarly discussion, and an example of the beltloop amp, see Steve Waksman, "Make It Loud! Why Amplifiers Matter," Electric Guitar in American Culture Conference (October 8, 2022).
7. Simon Frith, "Art versus Technology: The Strange Case of Popular Music," *Media, Culture and Society* 8 (1986): 263–279; Paula Lockheart, "An History of Early Microphone Singing, 1925–1939: American Mainstream Popular Singing at the Advent of Electronic Microphone Amplification," *Popular Music and Society* 26/3 (2003): 367–385.
8. See Paul Théberge, *Any Sound You Can Imagine: Making Music / Consuming Technology* (Wesleyan University Press, 1997), pp. 93–130; Eliot Bates and Samantha Bennett, "Look at All Those Big Knobs! Online Audio Technology Discourse and Sexy Gear Fetishes," *Convergence* 28/5 (2022): 1241–1259.
9. In addition to the work of Rick Altman, James Lastra, Mara Mills, Emily Thompson, Steve Wurtzler, and many others, see Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Duke University Press, 2003) and Peter Doyle, "Ghosts of Electricity: Amplification," in *The SAGE Handbook of Popular Music*, edited by Andy Bennett and Steve Waksman (SAGE, 2015), pp. 532–548.
10. In addition to the work of Emily Dolan, Benjamin Piekut, Julian Henriques, Paul Jasen, and many others, see Sterne, *Diminished Faculties*, pp. 117–156.

11. On Beauchamp, see Richard Smith, *The History of Rickenbacker Guitars* (Centerstream, 1987). On Lunceford, see Leonard Feather, *The Book of Jazz: From Then Till Now* (Dell, 1957), p. 129. On Slim, see Earl King in Robert Palmer, "The Church of the Sonic Guitar," *South Atlantic Quarterly* 90 (1991): 655: "Slim never used an amplifier. He always used a P.A. set, never an amplifier."
12. Lewis Williams, "The Theory of Electrically Energized String Instruments," *The Crescendo* 25/4 (1933): 4.
13. For extensive insight into the deeper history here, see Mara Mills, "The Dead Room: Deafness and Communication Engineering," unpublished PhD thesis, Harvard University (2008) and Jonathan Sterne, *MP3: The Meaning of a Format* (Duke University Press, 2012).
14. Steve Waksman, *Instruments of Desire: The Electric Guitar and the Shaping of Musical Experience* (Harvard University Press, 1999), p. 119. Note that Waksman is partly quoting the earlier work of Samuel Floyd and Olly Wilson.
15. Readers unfamiliar with the basic vocabulary of the social construction of technology (SCOT) and science and technology studies (STS), including Madeline Akrich's classic essay on de-scripting technical objects, see Wiebe Bijker, Thomas Hughes, and Trevor Pinch (eds.), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (MIT Press, 1987), and Wiebe Bijker and John Law (eds.), *Shaping Technology / Building Society: Studies in Sociotechnical Change* (MIT Press, 1992).
16. Precedent for such work can be found in relation to the violin; see Hill, "George Beauchamp," pp. 30–35.
17. L. A. Williams, "The Theory of Electrically Energized String Instruments," *The Crescendo* 25/2 (1933): 4.
18. Steve Waksman, "California Noise: Tinkering with Hardcore and Heavy Metal in Southern California," *Social Studies of Science* 34/5 (2004): 679–680. Waksman makes a similar point with regard to later designers such as Leo Fender and Les Paul.
19. Emily Thompson, *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900–1933* (MIT Press, 2002), p. 3.
20. Stromberg advert reprinted in Richard Smith, "Rare Bird: Early Electric Guitars, I," *Guitar Player* 22/3 (1988): 133. Note that Hill distinguishes the Stromberg-Voisinet, saying it "does not meet the definition of an electric guitar in the same way that is usually understood" ("George Beauchamp," p. 35).
21. Williams, "Electrically Energized String Instruments," p. 4.
22. For early Rickenbacker catalogs and ads, see www.rickenbacker.com.
23. My own surveys of music magazines such as *Down Beat* and *Guitar Player* support this claim. See also Wheeler, *Soul of Tone*. Les Paul offers another example of a communications-minded electric guitarist (see Waksman, *Instruments of Desire*).
24. Respectively: André Millard, "Playing with Power: Technology, Modernity, and the Electric Guitar," in *The Electric Guitar: A History of an American Icon*, edited by André Millard (Johns Hopkins University Press, 2004), p. 139; *Down Beat* 27/15 (1961): 40.
25. Respectively, Frank Chambers, "How to Build a 'Junkbox' Electric Guitar," *Radio-Craft* 11/5 (1939): 271; Kendall Ford, "A Home-Made String-Music Pickup," *Radio-Craft* 11/2 (1939): 601; Palmer, "Church of the Sonic Guitar," 664; Gruhn on Minnie quoted in Rebecca McSwain, "The Social Reconstruction of a Reverse Salient in Electrical Guitar Technology: Noise, the Solid Body, and Jimi Hendrix," in *Music and Technology in the Twentieth Century*, edited by Hans-Joachim Braun (Johns Hopkins University Press, 2002), p. 193.
26. Of course, this characterization is genre-dependent. My argument here pertains mostly to blues and rock. Due to different aesthetic imperatives, the positive correlation of loudness and clarity held on longer in genres such as jazz.
27. Millard, "Playing with Power," pp. 136–137, 140; emphasis added.
28. For an account of this later period, see Millard, "Playing with Power." On the collaboration between Jim Marshall, his employees Ken Bran and Dudley Craven, and Pete Townshend of The Who, see Rich Maloof, *Jim Marshall The Father of Loud: The Story of the Man Behind the World's Most Famous Amp* (Backbeat, 2003), pp. 40–74 (see also Waksman, *Instruments of Desire*, pp. 183–184). For some background on Gar Gillies of the Garnet Amplifier Company and Randy Bachman of The Guess Who, see Thomas Garnet Gillies, *The How and Why of Guitar Tube Amps as "Gar" Sees It* (Garnet Amplifier Company, 2005).

29. See Trevor Pinch and Frank Trocco, *Analog Days: The Invention and Impact of the Moog Synthesizer* (MIT Press, 2002).
30. Rebecca McSwain, "Reverse Salient in Electrical Guitar Technology," 195.
31. "Dim Lights, Thick Smoke (And Loud, Loud Music)" was written by Joe Maphis, Rose Lee Maphis, and Max Fielder. It was released in 1953 on Okey Records. The song lyrics and part of the background story are from Dorothy Horstman, *Sing Your Heart Out, Country Boy: Classic Country Songs and Their Inside Stories by the People Who Wrote Them* (EP Dutton, 1975), pp. 201–202. Additional background and quotation from Ian Port, *The Birth of Loud: Leo Fender, Les Paul, and the Guitar-Pioneering Rivalry that Shaped Rock 'n' Roll* (Scribner, 2019), p. 105.
32. David Nye, *Electrifying America: Social Meanings of a New Technology, 1880–1940* (MIT Press, 1992).
33. Among many examples, not all of which reference Norbert Elias's work on the civilizing process, see Richard Cullen Rath, *How Early America Sounded* (Cornell University Press, 2003), pp. 145–172; Emily Cockayne, *Hubbub: Filth, Noise, and Stench in England* (Yale University Press, 2007), pp. 121–130; Ana María Ochoa Gautier, *Aurality: Listening and Knowledge in Nineteenth-Century Columbia* (Duke University Press, 2011), pp. 31–76; Marek Susdorf, "Musicolonialism in Suriname: Sonic Contributions to the Construction of the Category of the Human and Its Others," unpublished PhD thesis, University of Oslo (2021).
34. Tricia Rose, *Black Noise: Rap Music and Black Culture in Contemporary America* (Wesleyan University Press, 1994), p. 62. For additional perspective on sound and car culture, see David Morris, "Cars with the Boom: Identity and Territory in American Postwar Automobile Sound," *Technology and Culture* 55/2 (2014): 326–353. See also Ori Schwarz, "The Sound of Stigmatization: Sonic Habitus, Sonic Styles, and Boundary Work in an Urban Slum," *American Journal of Sociology* 121/1 (2015): 205–242; Michael Birenbaum Quintero, "Loudness, Excess, Power: A Political Liminology of a Global City of the South," in *Remapping Sound Studies*, edited by Gavin Steingo and Jim Sykes (Duke University Press, 2019), pp. 135–155.
35. Robert Fink, Zachary Wallmark, and Melinda Latour, "Chasing the Dragon: In Search of Tone in Popular Music," in *The Relentless Pursuit of Tone: Timbre in Popular Music*, edited by Robert Fink, Melinda Latour, and Zachary Wallmark (Oxford University Press, 2018), p. 5.
36. Fink, Wallmark, and Latour, "Chasing the Dragon," p. 6. See also Jonathan Sterne, "Spectral Objects: On the Fetish Character of Music Technologies," in *Sound Objects*, edited by James Steintrager and Rey Chow (Duke University Press, 2019), pp. 94–104.
37. José Martínez-Reyes, "Timber to Timbre: Fijian Mahogany Plantations and Gibson Guitars," in *Audible Infrastructures: Music, Sound, Media*, edited by Kyle Devine and Alexandrine Boudreault-Fournier (Oxford University Press, 2021), pp. 93–116; Chris Gibson and Andrew Warren, *The Guitar: Tracing the Grain Back to the Tree* (University of Chicago Press, 2021).
38. In addition to the work of Aaron Allen, Matt Brennan, and many others, see Eliot Bates, "Resource Ecologies, Political Economies, and the Ethics of Audio Technologies in the Anthropocene," *Popular Music* 39/1 (2020): 66–87.
39. Tzvi Gluckin, "The Environmentally Conscious Guitarist," Premier Guitar (5 January 2018), www.premierguitar.com/gear/guitar-recycling (accessed April 26, 2023). On the history here, see Tad Skotnicki, *The Sympathetic Consumer: Moral Critique in Capitalist Culture* (Stanford University Press, 2021).
40. Both quotes from Ryan Gunderson, "Problems with the Defetishization Thesis: Ethical Consumerism, Alternative Food Systems, and Commodity Fetishism," *Agriculture and Human Values* 31 (2014): 116. See also Devine and Boudreault-Fournier, *Audible Infrastructures*.
41. For the Waksman quotes, see *Instruments of Desire*, p. 182. For a subtle discussion of technological determinism, which is lacking from most discussions (usually little more than accusations and dismissals), see John Durham Peters, "You Mean My Whole Fallacy Is Wrong: On Technological Determinism," *Representations* 140 (2017): 10–26.
42. See, respectively, David Hesmondhalgh and Leslie Meier, "What the Digitalisation of Music Tells Us about Capitalism, Culture, and the Power of the Information Technology Sector," *Information, Communication, and Society* 21/11 (2018): 1555–1570; Paul Théberge, *Any Sound You Can Imagine*; Jonathan Sterne, *MP3*; Georgina Born (ed.), *Music and Digital Media: A Planetary Anthropology* (University College London Press, 2022); Eric Drott, *Streaming Music, Streaming Capital* (Duke University Press, 2024).

43. Imre Szeman, "How to Know about Oil: Energy Epistemologies and Political Futures," *Journal of Canadian Studies* 47/3 (2013): 147. Emphasis in original.
44. John Durham Peters, *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (University of Chicago Press, 2015), pp. 27, 38.
45. Nikki Luke and Matthew Huber, "Introduction: Uneven Geographies of Electricity Capital," *Environment and Planning E: Nature and Space* 5/4 (2022): 1700.
46. Nye, *Electrifying America*, p. 156. See also Thomas Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Johns Hopkins University Press, 1983), pp. 461–467; Nikki Luke, "Powering Racial Capitalism: Electricity, Rate-Making, and the Uneven Energy Geographies of Atlanta," *Environment and Planning E: Nature and Space* 5/4 (2022): 1767.
47. Gavin Steingo has written on the conditions of (orchestrated) electrical scarcity in Soweto, South Africa, in an essay that I reference in the subheading for this chapter section. See "Electronic Music and the Problem of Electricity," in *Audible Infrastructures*, pp. 253–273.
48. Akhil Gupta, "An Anthropology of Electricity from the Global South," *Cultural Anthropology* 30/4 (2015): 556.

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