From Enthusiasm to Practice: Users, Systems, and Technology in High-End Audio

by

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Abstract

This is a story about technology, users, and music. It is about an approach to the design, manipulation, and arrangement of technologies in small-scale systems to achieve particular aesthetic goals – goals that are at once subjective and contingent. These goals emerge from enthusiasm for technology, for system-building, and for music among members of a community of users, and the promise of the emotional rewards derived from these elements in combination. It is a story about how enthusiasm and passion become practice, and how particular technologies, system-building activities, listening, debating, innovating, and interacting form that practice.

Using both historical and ethnographic research methods, including fieldwork and oral history interviews, this dissertation is focused on how and why user communities mobilize around particular technologies and socio-technical systems. In particular, it concerns how users' aesthetic sensibilities and enthusiasm for technology can shape both technologies themselves and the processes of technological innovation. These issues are explored through a study of the small but enthusiastic high-end audio community in the United States. These users express needs, desires, and aesthetic motivations towards technology that set them apart from mainstream consumers, but also reveal important and under-recognized aspects of human relationships with technology more broadly. Covering the emergence and growth of high-end audio from the early 1970s to 2000, I trace some of the major technology transitions during this period and their associated social elements, including the shift from vacuum tube to solid-state electronics in the 1970s, and from analog vinyl records to digital compact discs in the 1980s. I show how this community came to understand technology, science, and their own social behavior through powerful emotional and aesthetic responses to music and the technologies used to reproduce music in the home. I further show how focusing on technology's users can recast assumptions about the ingredients and conditions necessary to foster technological innovation.

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Preface & Acknowledgments

Growing up, my brother and I spent many evenings listening to music together long after our parents had gone to bed. Ours was a fairly musical household, and although neither of my parents played instruments, my brother, sister, and I had all taken either piano or guitar lessons (or both). They also had what I later realized was a phenomenal record collection, including work by musicians who became lifelong favorites of mine like George Shearing, Vince Guaraldi, and Dave Brubeck. My brother's musical tastes ran towards Jimi Hendrix, Elvis Costello, Miles Davis, and several Pacific Northwest staples of the so-called "grunge" era, like Soundgarden and Skin Yard. His own record and CD collection was massive, and he'd always somehow managed to have what I'd always assumed was top-notch stereo gear. But when I first visited him after his move to Brooklyn, New York in the mid-1990s, I found that he'd swapped out his huge speakers and complicated-looking receiver for much smaller speakers and an essentially featureless amplifier and preamplifier that produced a sound qualitatively different from anything I'd heard before. That was my introduction to high-end audio.

Several years later, as a graduate student in a research seminar taught by Merritt Roe Smith and David Kaiser, I thought back to my brother's strange stereo. After my first visit to Brooklyn, he had since upgraded to stereo equipment that featured vacuum tubes. While I'd been aware that guitar players often favored vacuum tubes over transistors in amplifiers because of their unique sonic and distortion characteristics, I had no idea that tubes were still being used in home audio equipment. Why would anyone use vacuum tubes – an antiquated and inefficient technology – in a modern stereo system? I began looking for more information about vacuum

tubes in high-end audio equipment for my research seminar, and eventually produced a paper that would later become the foundation for what is now Chapter 5 of this dissertation. High-end audio, it turned out, was fertile territory for scholarly exploration.

Since writing that first paper about vacuum tubes, I have attended several high-end audio expositions, met and interviewed many members of this enthusiast community, listened to hundreds of different products, and read reviews and articles about hundreds more. While my original intent had been to tell a history of high-end audio technology based primarily on textual materials, it became clear that this would mean missing an important part of the story. As my research progressed, other aspects of this community's behavior were revealed that didn't fall quite squarely into historical categories, but were fundamental to any discussion of the how's and why's of the high-end approach to the technologies of home music reproduction. The natural solution seemed to be combining qualitative social research through interviews with members of the high-end audio community and participant observation at high-end audio shows with a historical analysis of high-end audio enthusiast publications. While mixed-methodology studies introduce additional challenges and questions, I felt using both ethnographic and historical methods could increase the probability of producing a well-rounded result. Despite the nearly 400 pages of material following this preface, I've only begun to scratch the surface of this community's history, its technology, and its approach to music. Readers will note in the introduction that certain areas are acknowledged as underdeveloped, both from the standpoint of what matters to this community, and what matters to academic scholarship. Future research will, with hope, serve to fill in these gaps.

Thirty-three members of the high-end audio community were interviewed for this project, each of whom spent hours sharing with me their insights, their stories, and their points-of-view.[1] Many of these people are the sole proprietors of their businesses and do not have ample free time. Their choice to spend some of that free time answering my questions, and helping me make connections with other community members for interviews, played a substantial role in enabling this project to happen. In addition to participating in interviews, several also invited me to visit their factories and shops, spend time listening to their equipment, and one even gave me an enormous collection of *Stereophile* back issues that were a tremendous help in rounding out my historical research. Without their participation, this project would not have been possible. Special thanks goes to Wes Phillips of *Stereophile* for the back issues, and Jeff Dorgay of *TONE Audio* for providing a forum for my early articles and ongoing and enthusiastic support of my work.

On the academic side, I consider myself extraordinarily lucky to have had such a phenomenal committee. David Kaiser, Stefan Helmreich, Susan Silbey and Merritt Roe Smith have been incredibly generous in their support and guidance from the beginning of this project, and indeed from the beginning of my graduate career. Although each of them has had a unique approach to responding to my various drafts, questions, and crises, they have all somehow found ways of offering just the right balance of critique and commendation. I can only hope that the resultant work reflects the positive influences each of them has had on it and on me.

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[1] While some interviewees agreed to have their names and positions included in this research and any publications that resulted from it, many preferred to remain anonymous. To maintain a balance in the narrative, I have anonymized all of the participants in direct quotations from the interviews. Unfortunately, this complicates thanking many of them directly for their support.

A variety of other colleagues played a part in the completion of this work: my fellow HASTS students; Paree Pinkney, Karen Gardner, and Debbie Meinbresse in the STS program; the MIT/Princeton/Harvard "Physics Phunday" crew; Amberly Steward in Anthropology; and Ellen Finnie Duranceau at the MIT Libraries. I also wish to thank Kenneth Oye, Frank Field, Dava Newman, and Daniel Hastings of the PoET program, and my fellow PoET students, for supporting my work and bringing more engineering and political science into my world. Three anonymous reviewers at *Technology & Culture*, along with editor Suzanne Moon, provided thorough, actionable, and generous feedback on two drafts of a forthcoming article that served as the basis of Chapter 6. Their comments, suggestions, and questions have been extremely helpful not only in improving that article and chapter, but this dissertation as a whole. Friends and family too numerous to list here are owed a lifetime of thanks, especially my mother, Melinda, and sister, Hilary. I must also reserve special thanks for my father, Gile, and brother, Gile Jr., for cultivating in me both a love of music and a fondness for audio gear.

Last, but certainly not least, I will never be able to repay the debt owed to my wife, Laura. It is something of a cliché to acknowledge that the author's spouse has been living with a project for as long as the author has, but that is nonetheless true in this case. Somehow, Laura's patience, first with my preparation for general exams during our first year together, followed by the various trials and tribulations of research and writing, has yet to be exhausted. Not only has her expertise as an electrical engineer been vital to expanding my rudimentary understanding of the technologies of audio reproduction, but she has read and re-read virtually every single word of this document, providing superb and thorough editorial guidance. I have no idea how I'll ever make this up to her, but I consider her ongoing willingness to put with me to be a positive sign

for the future. She has made this project both possible and worth completing. Despite her stellar editing abilities, any lingering mistakes in this document, grammatical and otherwise, are mine and mine alone.

Chapter 1 – Introduction:

From Enthusiasm to Practice

> A system is constituted of related parts or components. These components are connected by a network, or structure, which for the student of systems may be of more interest than the components. The interconnected components of technical systems are often centrally controlled, and usually the limits of the system are established by the extent of this control. Controls are exercised in order to optimize the system's performance and to direct the system toward the achievement of goals.
>
> - Thomas Hughes, *Networks of Power*[1]

> The central nervous system no longer appears as a self-contained organ, receiving inputs from the senses and discharging into the muscles. On the contrary, some of its most characteristic activities are explicable only as circular processes, emerging from the nervous system into the muscles, and re-entering the nervous system through the sense organs...
>
> - Norbert Wiener, *Cybernetics*[2]

> A good audio system should be a means to an end, and that is experiencing a [musical] performance... trying to capture what the performers are trying to communicate to you.
>
> - Joseph, an audiophile[3]

This is a story about technology, users, and music. It is about an approach to the design, manipulation, and arrangement of technologies in small-scale systems to achieve particular aesthetic goals – goals that are at once subjective and contingent. These goals emerge from enthusiasm for technology, for system-building, and for music among members of a community of users, and the promise of the emotional rewards derived from these elements in combination. It is a story about how enthusiasm and passion become practice, and how particular technologies, system-building activities, listening, debating, innovating, and interacting form that practice.

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[1] Thomas Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983), 5.

[2] Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge, MIT Press: 1948, 1961), 8.

[3] Interview with author, 04/24/07.

The focus of this dissertation is the "high-end audio" hobby, industry, and, more broadly, community. The primary aim of high-end audio is the reproduction of music in the home with the best possible quality and highest "fidelity," or trueness to the source. As a community of users, high-end audio involves a variety of technologies, as well as social and business practices that distinguish it from the mainstream consumer electronics industry. Its approach to technology shows the importance of users and aesthetic desires in technological innovation beyond the boundaries of this particular pastime. At the same time, this community is not monolithic. How to achieve high fidelity, and which technologies and systems make high fidelity possible, are matters of significant debate both inside and outside the community. Exactly where and how to draw boundaries around what constitutes high-end audio is a further source of disagreement. In his writing about the community, ethnomusicologist Marc Perlman notes that some audiophiles focus on the cost of equipment – in the case of one of his interviewees, high-end audio means $5,000 per component and up.[4] Others, such as the editor-in-chief of the enthusiast magazine *The Absolute Sound,* Robert Harley, claim that high-end audio is about "passion for music, and for how well it is reproduced." "High-end audio is the quest to re-create in the listener's home the musical message of the composer or performer with the maximum realism, emotion, and intensity," Harley writes. "Because music is important, re-creating it with the highest possible fidelity is important."[5] This dedication to high fidelity music

[4] Perlman acknowledges that other audiophiles "would no doubt draw the line elsewhere." Perlman himself bounds high-end audio based on what he calls a quest for "epistemic authority" among enthusiasts and those in the audio engineering community. Some details of his work can be found later in this dissertation. Marc Perlman, "Consuming Audio: An Introduction to Tweak Theory," in Rene T.A. Lysloff and Leslie Gay, eds., *Music and Technoculture* (New York: Routledge, 2003): 346-357, on 347.

[5] Robert Harley, *The Complete Guide to High-End Audio, 3rd Edition*, Acapella Publishing, Tijeras, 2004, 1.

reproduction, and the significance of aesthetics in the process of system-building, makes high-end audio an *ethos* as much if not more than a collection of particular technologies.

High-end audio emerged in the early 1970s out of the "hi-fi craze" of the 1950s and 1960s in the United States. Many hi-fi enthusiasts built their own equipment from kits, and a variety of companies, large and small, sought to capitalize on consumers' interest by introducing numerous new music delivery systems and technologies for the home. Local audio clubs provided opportunities to form social bonds and share ideas, while specialty publications such as *Stereo Review* and *High Fidelity*, along with more popular publications such as *Saturday Review*, published reviews of new equipment and tips for maximizing the quality of home audio systems. Hi-fi hobbyists exhibited what Susan Douglas has described as "oppositional, anti-establishment uses" of home audio technologies, and enthusiasm-driven appropriation of these technologies for uses the originators of the technologies never intended.[6] This appropriation within the high-end audio community has frequently disrupted categories of "old" and "new," "antiquated" and "cutting-edge" by preserving artifacts and media such as analog vinyl records and vacuum tube electronics long after they had disappeared from the popular consumer marketplace. These enthusiasts became known as "audiophiles."[7]

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[6] Susan Douglas, "Audio Outlaws: Radio and Phonograph Enthusiasts," in *Possible Dreams: Enthusiasm for Technology in America*, ed. John L. Wright (Dearborn: Henry Ford Museum Press, 1992): 44-59, on 46. Douglas situates her argument within gender roles as well, suggesting that early wireless communication in the first decades of the 20th century, hi-fi in the 1940s and 50s, and FM radio in the 60s and 70s were almost exclusively the pastimes of white, middle-class boys and men. Although the high-end audio community is arguably more diverse today in terms of both the gender and ethnicity of its members, the white male demographic remains the largest segment of the community.

[7] The term "audiophile" appears to have come into common usage in the early 1950s in the United States, particularly through publications such as *High Fidelity*. The Oxford English Dictionary lists "audio-phile" as first appearing in *High Fidelity* in 1951 and in *Electronic Engineering* in 1953 (as "audiophile"). See http://dictionary.oed.com/cgi/entry/50014698/50014698se13?single=1&query_type=word&queryword=audiophile&first=1&max_to_show=10&hilite=50014698se13, accessed 03/26/09).

The increasing popularity of the hi-fi hobby brought frustration for some enthusiasts. Many audiophiles became disenchanted with what they saw as a largely marketing-driven hi-fi equipment industry that, by emphasizing technical specifications and "bells & whistles," alienated users from the core of their interest in the hobby: listening to music. As David Wilson of Wilson Audio Specialties, a loudspeaker manufacturer, recalled in a 2006 address to the London Hi-Fi Show, "[Hi-fi] consumer products were as much as possible... reduced to cheap content commodities, whose desirability in the customer's eyes was increasingly founded on what the marketers called 'perceived value.' The 'perceived' part of that phrase is the troubling part to me."[8] It was troubling to others as well, including J. Gordon Holt, a technical editor at *High Fidelity* magazine, who founded his own publication called *The Stereophile* in 1962. Holt's enthusiasm for hi-fi was rooted, as he frequently reminded readers, in his love and passion for music, and *The Stereophile* was focused on the abilities of any given piece of equipment to reproduce a pleasing and "accurate" reproduction of music.

From Holt's point of view, accuracy meant two things: first, that the equipment should do as little as possible to alter the sound from the source – a record or tape – and that the sound of live music should serve as the "reference standard" for judging a component's performance.[9] An accurate reproduction was, to Holt, a musically and emotionally satisfying reproduction. Perlman has observed that this combination of accuracy, which had the potential to be measured, and musicality, which did not, introduced a paradox when coupled with the insistence among

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[8] David Wilson, Keynote Address, London Hi-Fi Show 2006, available at http://www.wilsonaudio.com/culture/podcasts.php (accessed 08/27/08).

[9] Holt's arguments regarding fidelity shifted somewhat in the first two decades of *Stereophile* – in the early years of the magazine he maintained that fidelity could be judged against recordings of performances, but he focused more on the live music experience in the latter half of the 1970s through the 1980s. Details can be found in Chapter 4.

audiophiles that certain technologies were better at communicating the emotional impact of music than others.[10] Nevertheless, Holt developed a unique approach to reviewing that shifted the focus away from bench-test results and technical measurements toward what he referred to as the "subjective" qualities of audio equipment, emphasizing emotional responses and aesthetic attributes based on extended listening in a home environment.

Subjective testing also emphasized another attribute Holt believed had been lost from other hi-fi publications under pressure from advertisers and manufacturers: the importance of the user. In the very first issue of *The Stereophile*, Holt argued that subjective testing was important because "components that measure identically do not necessarily sound similar, and because audio equipment is, after all, designed to be used and listened to."[11] This emphasis on the importance of the user's subjective judgment was echoed by Harry Pearson, who founded his own magazine, *The Absolute Sound*, in 1973. Pearson claimed in the first issue that "we have no brief against measurements and numbers. They are sometimes revealing, but, just as often, they are confusing. The ear is an infinitely more subtle and sophisticated measuring device than the entire battery of modern test equipment."[12] To communicate the subjective qualities of equipment under review, Pearson and Holt each developed an extensive lexicon for describing the sonic qualities of particular parts of a home audio system. This subjective approach and its

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[10] Referring to the concept of "the absolute sound" popularized by Harry Pearson, publisher of the enthusiast magazine also called *The Absolute Sound*, Perlman writes, "Assuming that nothing can be more musical than music, if the absolute sound is the sound of music itself, and if accuracy is fidelity to the absolute sound, then mustn't musicality be the same thing as accuracy? Or is musicality a certain way of falling short of accuracy, a fortunate sonic adulteration? The former alternative renders the 'musical'/'revealing' distinction otiose; the latter pits two types of audio excellence against each other." Marc Perlman, "Golden Ears and Meter Readers: The Contest for Epistemic Authority in Audiophilia," *Social Studies of Science* **34**, no. 5 (October 2004), on 791.

[11] J. Gordon Holt, "*Stereophile* Reports on Equipment," *The Stereophile* **1**, no. 1 (September-October 1962): 12.

[12] Harry Pearson, "Viewpoints," *The Absolute Sound* **17**, no. 86 (March/April 1993): 90-91, on 90. A reprint of Pearson's original editorial appeared in this issue marking the magazine's 20th anniversary.

specialized language, along with a variety of technology changes and the founding of a variety of small audio equipment manufacturing firms, marked the emergence of high-end audio.

But, not surprisingly, the growth of this community and industry was hardly linear or without complication. Using "fidelity" as a benchmark for performance is complicated by the necessarily subjective experience of listening to music, and by differing interpretations of what does and does not constitute high fidelity. The subjective and observationally-oriented processes of evaluating fidelity have also brought this community into conflict with those audiophiles and audio engineers who rely on quantification and measurement for assessments of quality. High-end audio enthusiasts, and publications like *Stereophile* and *The Absolute Sound*, are frequent targets of criticism by these more numerate enthusiasts both for their descriptive language (often called "flowery" or "poetic"), and their claims to hear subtle differences between products that have no immediately obvious measurable differences. Further, the high cost of some high-end equipment raises the suspicion among high-end audio enthusiasts and mainstream consumers alike that some community members are engaging in consumption more conspicuous than principled. But despite these conflicts, as well shall see, high-end audio enthusiasts' relationships with the technologies of home music reproduction, and their methods for assessing quality and fidelity, show that the process of small-scale system building, and its basis in aesthetic ideas about how music in the home should sound, are of paramount importance in this community, shaping social interactions and technological innovations.

Today, the high-end audio community remains a small but dedicated segment of the consumer electronics marketplace. As a niche community, precise demographics of the community and industry are difficult to come by, and numbers regarding the make-up of the

high-end audio manufacturing sector in the United States – or, as the Consumer Electronics Association (CEA) describes it, "specialty audio" – have never been especially reliable. One manufacturer told me that coming up with hard-and-fast numbers regarding the size of the industry has been an ongoing challenge for the CEA. Recent estimates put the component audio industry at about $1 billion per year. The CEA as a whole has approximately 2000 members across all areas of consumer electronics, and of that number, approximately 80% have annual revenues of less than $30 million.[13] While not all high-end audio companies display their products at the annual Consumer Electronics Show (CES) run by the CEA, the directory for the 2008 Show listed nearly 300 high-end audio companies from around the world.[14] The editor of a high-end audio review publication estimated the size of the entire high-end audio community world-wide to be around 1 million people.[15] According to their media kit, *Stereophile* magazine has a subscriber base of 74,000, 99% of which is male, with an average age of 49 and average annual household income of $129,000, although my own observations at high-end audio expositions and interviews with audiophiles suggest the community is more economically and socially diverse than these numbers reveal.[16]

The purpose of this dissertation is to paint a portrait of the high-end audio community, the conflicts and disagreements that have shaped it, and the technologies that have arisen from this community's commitments to aesthetically satisfying reproductions of music in the home from

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[13] Interview, 01/24/08.

[14] This includes electronics, loudspeaker, and turntable manufacturers, along with importers and high-end marketing firms. CES is billed as an international electronics show, and this number includes American, European, and Asian firms.

[15] Interview, 03/21/07.

[16] *Stereophile* Media Kit, available from http://www.stereophile.com (accessed 03/11/09). See Chapters 3 and 4 for details on the make-up of the high-end audio community.

the community's emergence in the early 1970s to the end of the 1990s in the United States. Although high-end audio thrives in other countries, and many manufacturers are based (or manufacture their products) outside of the United States, this is largely a U.S.-focused study for reasons I will describe shortly. I intend to show how aesthetically-motivated, small-scale systems-building practices have led to a variety of technological and social outcomes for this community. I will argue that technological innovation in this community is not only shaped by, but dependent upon, the enthusiasm of these users, and that this model of innovation is potentially applicable to other technologies beyond those of high-end audio. I will further argue that becoming an audiophile, as much as it has a particularly visible technological component, is at its core a social process. In so doing, my hope is that this dissertation will contribute to the sociology and history of technology, and, given the emphasis on sound, music, and audio technology, to the emerging subfield of "Sound Studies."

According to Trevor Pinch and Karin Bijsterveld, Sound Studies is focused on "the material product and consumption of music, sound, noise, and silence, and how these have changed throughout history and within different societies" from the broader perspective of Science and Technology Studies (STS).[17] An STS approach to sound, they argue, can "contribute... a focus on the materiality of sound, its embeddedness not only in history, society, and culture, but also in science and technology and its machines and ways of knowing and interacting."[18] Media studies scholar Michael Bull and sociologist Les Back observe that these "ways of knowing" are often expressed with visual metaphors, "yet the experience of everyday

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[17] Trevor Pinch and Karin Bijsterveld, "Sound Studies: New Technologies and Music," *Social Studies of Science* **34**, no. 5 (October 2004), 635-648, on 636.

[18] Ibid.

life is increasingly mediated by a multitude of mechanically reproduced sounds."[19] Bull and Back suggest that focusing on sound and hearing can "broaden the senses of sense," where "thinking with our ears offers an opportunity to augment our critical imaginations, to comprehend our world and our encounters with it according to multiple registers of feeling."[20]

This "broadening of the senses of sense," however, comes with an especially difficult challenge. Bull and Back state that "a visually based epistemology is both insufficient and often erroneous in its description, analysis and thus understanding of the social world."[21] But as Pinch and Bijsterveld observe, "escaping from the visual" and the dominance of visual metaphors in both academic and everyday language is "nearly impossible."[22] While the visual is what is "known," and much of our ways of knowing and talking about what we know revolve around what we observe visually, "the auditory is the unknown, the unfamiliar, the new." Pinch and Bijsterveld note that they "*see* the new *vista* of sound studies but don't hear it!"[23] Indeed, ways of describing the sound of high-end audio systems, and certain components within systems, have been among the greatest challenges faced by this community since its early years. Much of the language of high-end audio reviewing, as will be clear throughout this text, has relied and continues to rely on visual metaphors, and sometimes metaphors associated with taste and touch. Neither Bull and Back nor Pinch and Bijsterveld offer a new vocabulary of sound that escapes from this dependence on the visual, but rather suggest that Sound Studies is well-positioned to

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[19] Michael Bull and Les Back, "Introduction: Into Sound," in Michael Bull and Les Back, eds, *The Auditory Culture Reader* (New York: Berg Publishers, 2003): 1-18, on 1.

[20] Ibid., 2.

[21] Ibid., 3.

[22] Pinch and Bijsterveld, "Sound Studies," 637.

[23] Ibid., emphasis in original.

begin the challenge of formulating both a new epistomology, as well as a new language, of sound.

This dissertation pursues both of these goals. While not free of visual metaphors, I propose that language of systems can provide us with a means to address the soundness of sound. I will argue that high-end audiophiles are best understood as participants in a system in which the user is a central component. As such, we need to understand the materiality of the system, and the aesthetics of the user as a component of the system. In making these arguments, I will examine how individuals become audiophiles, how they become a part of the high-end audio community, and how that community organizes itself around shared and conflicting ideas about fidelity, aesthetics, and system building. I will also explore the process of evaluating home audio equipment in this community, and show how "subjective" approaches foment conflicts with the measurement-oriented and "objective" side of the home audio world – conflicts that mirror, in many ways, the social constructivist critiques of science and technology that were a part of STS scholarship during the same period as this study. I will also focus on particular home audio technologies, and provide context for their development within the social, aesthetic, and economic framework of this community. Embedded in these audio artifacts are both material and aesthetic imprints of the high-end audio ethos that resonate in harmony with this community's love of both music and technology.

In the following sections, I will first provide a brief overview of some of the key home audio technologies that preceded the emergence of high-end audio, and how users interacted with them. In these technologies – the radio and the phonograph, in particular – we can begin to see both user manipulation of home audio technologies in the service of aesthetic goals, and the

emergence of concern for sound quality that provides a backdrop for aesthetic critiques of future home audio technologies. I will then offer an overview of the key literature from the history and sociology of technology that informs the arguments made in this dissertation, focusing on issues related to users, aesthetics, technological enthusiasm, and systems building. Finally, I will explain my methodological approach, and provide brief descriptions of each of the chapters to follow.

Precursors of Hi-Fi: The Radio & the Phonograph

While not all scholars agree on the connection between current and past hobbyist enterprises in the audio world, the roots of high-end audio in the United States are visible in developments with amateur radio and phonograph records during the early decades of the 20th century.[24] The story of early wireless communication, as told by historians such as Hugh Aitken, Susan Douglas, and Susan Smulyan, shows both "inventor entrepreneurs" and passionate hobbyists inventing, tinkering, and innovating with both reception and broadcasting technology.[25] Early hobbyists often built their own radio sets with improvised (or stolen) parts

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[24] Jeffery Tang argues that, while some hi-fi enthusiasts in the 1950s made this connection themselves, the question of whether early radio hobbyists' efforts represent a "precursor" of hi-fi remains "debatable." He does not, however, fully engage with the arguments of Douglas and Smulyan in this regard, particularly Smulyan's suggestion that both hobbyists and corporations alike engaged in efforts to improve both distance reception and sound quality, or Douglas's suggestion of a common "anti-establishment" motivation among both early amateur radio hobbyists and audiophiles during the hi-fi era. Douglas makes a compelling argument for the continuum of radio hobbyism and hi-fi hobbyism that will be adopted here. Jeffery Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975," Ph.D Thesis, University of Pennsylvania, 2004, 115; Susan Smulyan, *Selling Radio: The Commercialization of American Broadcasting, 1920-1934* (Washington: Smithsonian Institution Press, 1994); Douglas, "Audio Outlaws," 46.

[25] Aitken, *The Continuous Wave*; Susan Douglas, *Inventing American Broadcasting, 1899-1922* (Baltimore: Johns Hopkins University Press, 1987); Smulyan, *Selling Radio*, 1994. "Inventor entrepreneurs" are the main focus of much of the work of scholars such as Thomas Hughes. See Thomas Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970* (Chicago: University of Chicago Press, 1989).

and components.[26] As radio became increasingly popular in the first decades of the 20th century, amateurs and corporations alike sought to improve the appearance and functionality of radio sets. Hobbyists in particular were also focused on improving the receiving distances of those sets, and, as Smulyan argues, when receiving beyond a certain distance became technically insurmountable, designers then turned their attention to improving the quality of the signals they were able to receive.[27] While these connections should not be overstated, the focus on improving sound quality laid the groundwork for the efforts of hi-fi and high-end audio enthusiasts years later.

While a sizable portion of radio innovation in the first decades of the 20th century centered around ship-to-shore transmission and wireless telegraphy, early radio engineers and broadcasters were also interested in broadcasting voice communication and music.[28] Prior to World War I, music in the home was heard primarily through record albums and live performance.[29] Records and live performance helped to make music in the home an important part of social and family life for many Americans. As radio spread, music became a staple of both amateur and commercial broadcasting. Prior to Navy-led government regulation of the airwaves following World War I and the subsequent sale of bandwidth to commercial

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[26] See Douglas, "Audio Outlaws".

[27] Smulyan, *Selling Radio*, 1994, 13-20; See also Chen Pang Yeang, "Characterizing Radio Channels: The Science and Technology of Propagation and Interference, 1900-1935," Ph.D. Thesis, MIT, 2005; Kirsten Haring, *Ham Radio's Technical Culture* (Cambridge: MIT Press, 2006).

[28] Douglas, "Audio Outlaws," 1992.

[29] See Mark Katz, *Capturing Sound: How Technology has Changed Music*, (Berkeley: University of California Press, 2004); Colin Symes, *Setting the Record Straight: A Material History of Classical Recording* (Middletown: Wesleyan University Press, 2004); Robert Philip, *Performing Music in the Age of Recording*, (New Haven: Yale University Press, 2004). Philip has a particularly useful discussion of live performance, both professional and amateur, on pages 4-9.

broadcasters, amateurs working out of basements or sheds could broadcast their own radio programs. Lee De Forest, the troubled inventor of the triode vacuum tube, began broadcasting music from his laboratory north of New York City in 1914.[30] In 1920, several stations around the country made music the focus of their programs, sometimes by placing a microphone in front of the horn loudspeaker of a Victrola record player.[31]

During the 1920s, the popularity of radio beyond the domain of hobbyists and amateur engineers helped to form a broad, popular culture in the United States.[32] Radio sets and broadcasting stations proliferated widely during this period. Between 1922 and 1924 alone, sales of radio receivers increased from $60 million to $358 million annually (approximately $675 million to $4 billion in 2008 dollars, respectively).[33] By 1927, there were 732 radio stations broadcasting programs all across the country.[34] By 1940, there were nearly 50 million radio receivers in use in the United States.[35]

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[30] Susan Douglas, *Listening In: Radio and the Imagination, from Amos 'n' Andy and Edward R. Murrow to Wolfman Jack and Howard Stern* (New York: Times Books, 1999), 51. For details on De Forest, see Hugh Aitken, *The Continuous Wave: Technology and American Radio 1900-1932* (Princeton: Princeton University Press, 1985).

[31] Douglas, *Listening In*, 64.

[32] For the influence of radio on American culture, particularly in the form of advertising, see Roland Marchand, *Advertising the American Dream: Making Way for Modernity, 1920-1940* (Berkeley: University of California Press, 1986); Lynn Dumenil, *Modern Temper: American Culture and Society in the 1920s* (New York: Hill and Wang, 1995); Douglas, *Listening In*, esp. Chapter 3: "Exploratory Listening in the 1920s."

[33] Douglas, *Listening In*, 52.

[34] Erik Barnouw, *A Tower in Babel: The History of Broadcasting in the United States, vol. 1 – to 1933* (New York: Oxford University Press, 1966), 209.

[35] Barry Sherman, *Telecommunications Management: Broadcasting/Cable and the New Technologies* (New York: McGraw Hill, 1995), 83. The population of the country in 1940 was approximately 132 million. See http://www.census.gov/popest/archives/1990s/popclockest.txt (accessed 03/26/09).

As radio spread, efforts to improve the quality of phonograph playback were also under way, with significant implications for the future of hi-fi.[36] Prior to World War II, phonograph records were pressed into shellac, the raw form of which came primarily from India. Although sales declined during the Great Depression, the record business in the United States boomed during the immediate pre-war years, with 127 million records sold in 1941. Following the entry of the United States into World War II, however, imports of shellac for non-military use dropped by 70%, and record production all but ceased as factories shifted to manufacturing for the war effort.[37] Nevertheless, during and after the war, innovations in recording and playback technology continued in the United States and elsewhere, in some cases directly related to the war itself. In his history of the phonograph, Roland Gelatt observes that the British Decca Record Company was asked by the British Royal Air Force to develop better techniques for detecting the aural signatures of British and German submarines. Their efforts led to a new recording technique subsequently branded in their post-war record releases as "ffrr" – "full frequency range reproduction." Gelatt describes the resulting sound on music recordings as "brilliant and incisive in the treble, full and resonant bass, with a heightened sense of presence and room tone never before encountered on a phonograph record to such stunning effect." Thanks in part to such innovations, by 1947, the number of records sold per year in the US had risen to 400 million.[38]

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[36] For a thorough discussion of phonograph developments from the late 19th century through the early years of hi-fi, see Roland Gelatt, *The Fabulous Phonograph: 1877-1977* (New York: Collier Books, 1977); Alexander Magoun, "Shaping the Sound of Music: The Evolution of the Phonograph Record, 1877-1950," Ph.D thesis, University of Maryland, 2000.

[37] Gelatt, *The Fabulous Phonograph*, 276-277.

[38] Decca's "ffrr" records arrived in the US in 1946. Ibid., 282-283. See also Magoun, "Shaping the Sound of Music," 449-451.

But it was the introduction of the long-playing or "LP" microgroove record in 1948 by Columbia Records – an event J. Gordon Holt would later describe as the "second coming" for audiophiles – that set the stage for the hi-fi craze in the following decades.[39] Prior to the LP, phonograph records were limited to approximately four minutes per side of playing time. Previous attempts to create longer-playing phonograph records had been both commercially and aesthetically unsuccessful, including a high-profile failure by the RCA Victor company in 1931. Victor's format rotated at 33 1/3 RPMs, which greatly increased the playing time over 78 RPM records that were then the standard. But the different speed necessitated a special turntable system that ranged in price from $247.50 to $995 (between $3500 and $14,000 in 2008 dollars), far beyond the means of most music lovers, particularly in the midst of the Depression.[40] Victor had also transferred mostly older recordings to their new format, and the resulting sound was poor.[41]

When Columbia Records set out to develop their own long-playing format in the 1940s, they avoided the pitfalls that had plagued RCA Victor by, among other things, offering new, higher-quality recordings in the new format upon its release, and supplying cheap upgrade kits for existing turntables. Columbia further made use of vinyl rather than shellac for the record material, which offered reduced noise and increased durability. Although sales declined towards the close of the 1940s, and RCA Victor pursued a competing 45 RPM format, by 1950

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[39] J. Gordon Holt, "Where We Are and How We Got Here," *Stereophile* **5**, no. 3, 1982, 2-3, 18-19, on 2.

[40] Gelatt, *The Fabulous Phonograph*, 253-254. See also Magoun, "Shaping the Sound of Music," Chapter 5.

[41] Gelatt quotes an unnamed reviewer of Victor's new format who wrote that "The recording is conspicuously lacking in color, brilliancy, and character; it is thin, flabby, faded, and lusterless; the music is all there, but it is pale and weak and lacks the life of the original. There is always an unmistakable feeling of emptiness, dullness, and artificiality." Gelatt, *The Fabulous Phonograph*, 253.

Columbia's LP format had been adopted by all the major record companies (including RCA Victor).[42] A variety of scholars have noted the concomitant birth of the hi-fi hobby and the commercial release and popularization of the LP.[43] The phrase "high-fidelity" had been in use in advertisements since the 1930s, frequently in reference to radio sets and broadcasting, although Alexander Magoun notes that RCA Victor first displayed a "high-fidelity system" that included a phonograph in 1931, and endeavored to educate the public about sound quality through its advertisements and other activities.[44] Many hi-fi enthusiasts trace the origins of efforts to achieve better sound to this period as well, citing user modifications of mass-manufactured equipment, and instances of users building their own equipment and systems from scratch that took place before the broad popularization of the hobby.[45]

Interests in sound quality that were piqued in the early days of radio blossomed after World War II. The popularization of hi-fi began in earnest in the early 1950's when hi-fi became a label applied not only to music recordings, but to the equipment used to reproduce it, and indeed to people.[46] This phenomenon was characterized, according to some, by an affliction that *TIME* magazine described in 1957 as "audiophilia, or the excessive passion for hi-fi sound and equipment."[47] Hobbyists often built amplifiers, receivers and record players from kits advertised

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[42] RCA Victor nonetheless continued to market the 45 RPM record to audiences interested in non-classical recordings. Ibid,, 290-296; Magoun, "Shaping the Sound of Music," Chapter 6.

[43] Gelatt, *The Fabulous Phonograph*, 297; Keir Keightley, "'Turn it down!' she shrieked: gender, domestic space, and high fidelity, 1948-59," *Popular Music* **15**, no. 2, 149-177.

[44] Magoun, "Shaping the Sound of Music," 366; Keightley, "'Turn it down!' she shrieked," 152-153.

[45] Keightley, "'Turn it down!' she shrieked," 151.

[46] Ibid.

[47] Douglas, "Audio Outlaws," 52.

in the pages of *Popular Mechanics* and *The Saturday Review*. Some scholars attribute this interest in kit-building and the skill it required to the electronics training many servicemen received during the war, now put to a peaceful (if all-consuming) purpose in the home.[48] Susan Douglas has observed that servicemen stationed in the European theater had been exposed to "the superiority of sound engineering abroad," particularly in the United Kingdom, and thus brought back to the United States both the skills necessary to build and modify the electronics, and a desire for quality sound.[49] "High fidelity" also became a more widely-used advertising slogan during this period. Capitol Records began releasing LPs with the phrase imprinted on the record sleeves in 1949, but it was also later applied to a variety of products, regardless of whether or not they had anything to do with home music reproduction.[50]

The post-war period also saw the formation of audio-centered social and professional organizations, such as the Audio Engineering Society and various hi-fi clubs, along with speciality magazines such as *High Fidelity*. These magazines analyzed emerging trends in equipment, offered buying and systems-building recommendations, and became platforms for manufacturers to reach hi-fi consumers through advertisements. Audio and hi-fi terminology, such as "woofers" and "tweeters," and technical terms, such as "distortion" and "feedback,"

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[48] Douglas, "Audio Outlaws," 1992; Joseph O'Connell, "The Fine-Tuning of a Golden Ear: High-End Audio and the Evolutionary Model of Technology," *Technology and Culture* **33** (January, 1992): 1-37. On kit building and post-war technical skill sets, see also Haring, *Ham Radio's Technical Culture*.

[49] Douglas, "Audio Outlaws," 53.

[50] Keightley, "'Turn it down!' she shrieked," 151. Tang observes that some hi-fi enthusiasts complained that "high fidelity" was being used to sell lipstick, wine, and other non-audio products. Tang, "Sound Decisions," 286.

began to enter the common parlance as hi-fi's popularity grew.[51] Popular magazines such as *Saturday Review* ran articles about hi-fi, and specialist magazines saw staggering increases in circulation – in the case of *High Fidelity* magazine, 20,000 subscribers signed up during its first year of publication in 1951.[52] Sales of hi-fi equipment in the United States increased dramatically, with factory sales to distributors rising from $1.9 million in 1950 to nearly $38 million by 1959 ($17 million to nearly $250 million in 2008 dollars, respectively).[53] By the early 1960s, hi-fi had become what Douglas has described as both a "technical quest" aimed at improvements in hi-fi equipment, as well as a "cultural and political quest for an alternative medium marked by fidelity to musical creativity and cultural authenticity."[54] Concerns about the preservation of fidelity, particularly in the face of what was perceived as dishonest or misleading advertisements and specifications from manufacturers and popular hi-fi magazines, led some hi-fi enthusiasts like J. Gordon Holt to try and push the hobby in a different direction, covered in detail in Chapter 4. These efforts. starting in the mid-1960s and gaining momentum in the 1970s, set the stage for the emergence of high-end audio.

We might ask why this community coalesced in the United States in the late 1960s and early 1970s? What about this place and this time contributed to or enabled high-end audio's formation as a community? These questions represent a significant part of the next stage of research for this project, but for the time being, it is worth considering several broad themes

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[51] Woofers and tweeters a types of dynamic loudspeakers; woofers are for low frequencies and tweeters for high frequencies. A discussion of the vocabulary of hi-fi enthusiasts and nature of the hi-fi community in the post-war period appears in Tang, *Sound Decisions*, Chapter 3: Audiophiles: A Community of Expert Consumers, 160-242.

[52] Douglas, "Audio Outlaws" 53.

[53] Tang, "Sound Decisions," 162-163.

[54] Douglas, "Audio Outlaws," 54.

about the United States during the period that Bruce Schulman has dubbed "the long 1970s."[55] Schulman has argued that from roughly 1969 to 1984, Americans "constructed, and relied on, alternatives to the public sphere and the national community," seeking more individualized, personal fulfillment in smaller communities based on religious, spiritual, ethnic, neighborhood, and other associations.[56] After the political upheavals of the 1960s, the ravages of the Vietnam War, and general malaise and loss of faith in large institutions, what came to be known as the "Me Decade" found Americans more inwardly-focused, seeking new connections and undertaking journeys of self-discovery.[57] Technology, particularly the large-scale technological systems of the Cold-War period, were increasingly viewed as oppressive and dangerous. As Thomas Hughes has observed, the systems-building approach of the 1950s that had produced such technologies as the SAGE Air Defense system had "lost credibility" in the wake of the "messy problems that arose in the housing, transportation, health, and poverty programs" that characterized the American political and technological atmosphere of the 1960s.[58] During the 1970s, "counterculture" approaches to and appropriations of technology began to take shape, particularly in small-scale computing and emergent computer networking technologies. As historian of technology Timothy Moy puts it, the attitudes of these new communities were "antiestablishment but not antitechnology." Their focus was, instead, "a vision that appealed to

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[55] Bruce Schulman, *The Seventies: The Great Shift in American Culture, Society, and Politics* (New York: Free Press, 2001), xvi.

[56] Ibid.

[57] The term "Me Decade" was coined by Tom Wolfe in a feature article for *New York Magazine* on August 23, 1976. Ibid., 79.

[58] Hughes, *Rescuing Prometheus*, 304.

technology, precisely and cleverly applied, to put power (literally) back into the hands of the people."[59]

High-end audio enthusiasts during this period looked to the technologies of home music reproduction for aesthetic satisfaction. They sought to build a small community that offered an alternative to the larger-scale and marketing-driven hi-fi hobby. Their approach to technology, while not quite the same as, for example, members of the Whole Earth 'Lectronic Link or WELL, had a similar antiestablishment quality, visible in (among other places) their focus on small, specialty manufacturers and so-called "underground" enthusiast publications.[60] System building for this community took on many of the characteristics that Hughes has labeled as "postmodern," including continuous change and feedback, but with the added emphasis on aesthetics and subjectivity that helped to shape both the technologies themselves and the social interactions among community members. At the same time, they did not reject consumerism outright by any means, and in fact elevated consumption to new levels couched in aesthetic terms but suspected, in some quarters, of being differently but equally conspicuous. While there is a great deal more to be said about these connections than will be in this text, it is clear that during this period, high-end audio enthusiasts were, quite literally, "plugging in."

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[59] Timothy Moy, "Culture, Technology, and the cult of Tech in the 1970s," in Beth Bailey and David Farber, eds., *America in the Seventies* (Lawrence: University Press of Kansas, 2004): 208-227, on 210. See also Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: University of Chicago Press, 2008).

[60] Fred Turner argues that the WELL, a text-only bulletin-board system (BBS), served as a precursor and, indeed, a catalyst for digitally-mediated virtual communities that would become commonplace with the spread of the Internet. "The virtual community that emerged on the WELL," he wrote in a 2005 article for *Technology and Culture*, "not only modeled the interactive possibilities of computer-mediated communication but also translated a countercultural vision of the proper relationship between technology and sociability into a resource for imaging and managing life in the network economy." Fred Turner, "Where the Counterculture Met the Net Economy: The WELL and the Origins of Virtual Community," *Technology and Culture* **46**, no. 3 (July 2005): 485-512, on 491.

Users, Aesthetics, and "Habitus"

The stories associated with the high-end audio community touch upon a variety of themes within the history and sociology of technology, particularly those concerning users, the role of aesthetics and enthusiasm in innovation, and the design of small-scale socio-technical systems. In their 2003 edited volume, *How Users Matter*, Nelly Oudshoorn and Trevor Pinch show that technological innovation often takes place within a "culturally contested zone" where users, firms, and other stakeholders challenge and redefine the uses and meanings of technologies, at times through deliberate *non*-use.[61] They further show that separating users from designers becomes difficult as identities are blurred inside this contested space. Audiophiles, as a particular kind of user, have occupied this space since the early days of hi-fi.

Research on audiophiles has often focused on their behaviors as consumers, with some scholars emphasizing a desire among community members to build and retain social exclusivity, and others emphasizing "non-technical interventions" or "tweaks" that help users "personalize" the technologies of their hobby.[62] Other researchers have concentrated more specifically on the presence of hi-fi equipment in domestic spaces, and its influences, often gendered, on family interactions.[63] But behind both patterns of consumption and uses of technology in the audiophile community are particular aesthetic motivations that also warrant attention. The phenomenon of "technological enthusiasm," as well as aesthetic considerations, have been shown to influence

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[61] Nelly Oudshoorn & Trevor Pinch (Eds.), *How Users Matter: The Co-construction of Users and Technology*, (Cambridge: MIT Press, 2003), 24; see also Ruth Schwartz Cowan, "The 'Industrial Revolution' in the Home: Household Technology and Social Change in the 20th Century," *Technology and Culture* **17** (1976): 1-23; Trevor Pinch and Frank Trocco, *Analog Days: The Invention and Impact of the Moog Synthesizer*, (Cambridge: Harvard University Press, 2002).

[62] O'Connell, "The Fine-Tuning of a Golden Ear"; Perlman, "Consuming Audio," 347; Gelatt, *The Fabulous Phonograph*; Magoun, "Shaping the Sound of Music"; Tang, "Sound Decisions".

[63] Douglas, "Audio Outlaws"; Keightley, "'Turn it down!' she shrieked".

both the development of particular technologies as well as the shape of technological innovation within user communities.

"I am prepared to argue that enthusiastic technologists not only have built the world we live in," wrote historian of technology Eugene Ferguson in 1974, "but that, by and large, they themselves have hustled the support required to be able to do so."[64] Several scholars (although none quite as directly or adamantly as Ferguson) began to explore the emotional aspects of human relationships with technology during the 1970s as part of broader intellectual trends towards emphasizing science and technology's social components, and have since addressed questions of enthusiasm with regard to a wide array of different technologies and technological systems. For Ferguson, emphasizing the influences of enthusiasm on technology's producers and users could correct the tendencies among contemporary scholars to measure technologies and technological change with economic tools. "To plumb the murky depths of human motivation with measuring rods precisely calibrated in economic terms," he wrote, "is to miss the strong romantic and emotional strain in the narrative of American involvement with its technology."[65] Although enthusiasm as an analytical concept presents particular challenges for historians given its emotional and subjective character, Ferguson nonetheless went on to argue that "if we fail to note the importance of enthusiasm that is evoked by technology, we will have missed a central motivating influence in technological development."[66]

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[64] Eugene Ferguson, "Towards a Discipline of the History of Technology," *Technology and Culture* **15**, no. 1 (1974): 13-30, on 21.

[65] Eugene Ferguson, "The American-ness of American Technology," *Technology and Culture* **20**, no. 1, (1979): 3-24, on 3.

[66] Ibid.

Some scholars have approached questions of enthusiasm from high-level, institutional, and broadly social points of view. Historian Joseph Corn, for example, has shown that fascination with early aviation technologies involved ideas of progress and spiritual salvation that inspired tremendous public enthusiasm for this new mode of transportation and exploration.[67] Hughes has labeled the period between 1870 and 1970 in the United States the "age of enthusiasm" given the sheer volume of significant inventions and large-scale system building enterprises that unfolded during this century.[68] Others have shown how enthusiasm for automotive technologies can spur the development of everything from drag racers and hotrods to the fuel-efficient vehicles required by environmental regulation.[69] Users of automobiles have from the early days of this now ubiquitous technology demonstrated an enormous capacity for modification to suit their particular needs and desires, endowing vehicles such as the Model T Ford with what Trevor Pinch and Ronald Kline have described as "interpretative flexibility," or the capacity of a technological artifact to have different meanings and uses for different user communities.[70] Analogous points of convergence between users and technological enthusiasm are evident in the high-end audio community as well. The influences of enthusiasm in shaping high-end audio technology and systems-building practices is particularly evident in audiophiles' approaches to technologies such as vacuum tubes (the subject of Chapter 5) and compact discs (the subject of Chapter 6).

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[67] Joseph Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950*, (New York: Oxford University Press, 1983).

[68] Hughes, *American Genesis*.

[69] See Robert Post, *High Performance: The Culture and Technology of Drag Racing, 1950-2000*, (Baltimore: Johns Hopkins University Press, 2001); David Lucsko, *The Business of Speed: The Hot Rod Industry in America, 1915-1990* (Baltimore: Johns Hopkins University Press, 2008).

[70] Trevor Pinch and Ronald Kline, "Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States," *Technology and Culture* **37** (1996): 763-795.

Issues related to aesthetics and technology have also informed historical and sociological scholarship.[71] The high-end audio community developed in part pursuing the ultimate goal of "fidelity," or "trueness to the source," in home audio reproduction. In this way, audiophiles, described by one scholar as the "self-appointed guardians of fidelity," appear to follow a model of aesthetics associated with 18th century philosopher Immanuel Kant. In particular, audiophiles perform the role of sophisticated but "disinterested" individuals evaluating the performance of audio equipment against a set of standardized and universal aesthetic criteria.[72] But, as 20th century scholars such as sociologists Herbert Gans and Pierre Bourdieu have shown, the notion of a universal aesthetic belies the political and economic forces at work in forming the aesthetic sensibilities of different "taste publics."[73] Gans defined taste publics as "users who make similar choices of values and taste culture content," where "taste cultures" include the various cultural artifacts that can express values, such as music, art, design, and literature, in addition to the books, magazines, films, and other media used to express these aesthetic values.[74] Taste cultures also include social scientific and political values that are often "implicitly" expressed.[75] Gans argued that much of what determined a user's association with a taste public was defined by

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[71] See John Kasson, *Civilizing the Machine: Technology and Republican Values in America, 1776-1900*, (New York: Penguin Books, 1976).

[72] Immanuel Kant, *Critique of Judgment* (translated by Werner Pluhar) (Indianapolis: Hackett Publishing Co., 1987); quotation from Aden Evens, *Sound Ideas: Music, Machines, and Experience* (Minneapolis: University of Minnesota Press, 2005), 7. Evens is particularly offended by Harry Pearson's use of the phrase "the absolute sound" as both the title of his magazine and the central idea behind his reviewing philosophy, the details of which are discussed in Chapter 4.

[73] See Herbert Gans, *Popular Culture and High Culture* (New York: Basic Books Inc., 1974); Pierre Bourdieu, *Distinction: A Social Critique of the Judgment of Taste* (translated by Richard Nice) (Cambridge: Harvard University Press, 1984).

[74] Gans, *Popular Culture and High Culture*, 10.

[75] Ibid., 11. The process of becoming an audiophile hinges on the "educational" process of learning about high-end equipment and technology, and how to perceive certain qualities in the sound produced by different audio systems while retaining a passion for the emotional qualities of music. These issues are covered in depth in Chapter 3.

socioeconomic class, with "education" as the most important factor for two reasons: first, "every item of cultural content carries with it a built-in educational requirement, low for the comic strip, high for the poetry of T.S. Eliot," and second, "aesthetic standards and taste are taught in our society both by the home and the school."[76]

Bourdieu took a similar position, citing the class-specific aspects of aesthetic sensibilities as evidence of flaws in Kant's argument for the disinterestedness and universality of aesthetic values.[77] Bourdieu saw the field of art in which aesthetic values are defined as including not only the artist/producer, but critics, collectors, and other "agents" who "confront each other in struggles where the imposition of not only a world view but also a vision of the artworld is at stake, and who, through these struggles, participate in the production of the value of the artist and the art."[78] "If there is a truth," he wrote,

> it is that truth is a stake in the struggle. And although the divergent or antagonistic classifications or judgments made by the agents engaged in the artistic field are certainly determined or directed by specific dispositions and interests linked to a given position in the field, they nevertheless are formulated in the name of a claim to universality – to absolute judgement – which is the very negation of the relativity of points of view.[79]

For the high-end audio community, if there is fidelity, it is fidelity that is at stake in the struggle. Indeed, despite general agreement regarding its importance, the details of what constitutes fidelity is the source of significant disagreement. As Douglas has suggested about hi-fi culture, these disagreements are not only about sound, but also about culture, and what

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[76] Ibid., 70-71.

[77] Bourdieu, *Distinction*, 41-42.

[78] Pierre Bourdieu, "The Historical Genesis of a Pure Aesthetic," in Pierre Bourdieu and Randal Johnson, ed., *The Field of Cultural Production: Essays on Art and Literature* (New York: Columbia University Press: 1993): 254-266, 261.

[79] Ibid., 263.

particular devices or systems signify within the ethos of high-end audio and the various identities of its members. Responses to the compact disc, for example, were governed by what it represented both sonically as well as culturally – an issue explored in depth in Chapter 6. The aesthetics developed among audiophiles within the high-end audio community is not so much an aesthetics of music, despite the focus on music and emotional connections with music, as it is an aesthetics of *sound*: sound as a means through which to reach a state of aesthetic and emotional pleasure created by music, and high-end audio systems as the means through which to achieve that sound. While this dissertation is not meant to be a treatise on the philosophy of aesthetics, the aesthetic sensibilities of high-end audio enthusiasts and the effects of those sensibilities on their technologies are among the most significant ways in which, to borrow further from Oudshoorn and Pinch, these users "matter."

Bourdieu can also shed light upon the "subjective vs. objective" debates in the home audio world through his concept of "habitus." Habitus emerged as a central concept from Bourdieu's efforts to move beyond the "false dichotomy" of subjectivism and objectivism, and the failures of both to capture the balance of social influences on individual behavior, and vice versa.[80] He defined habitus as abstracted

> principles of... the generation and structure of practices and representations which can be objectively "regulated" and "regular" without in any way being the product of obedience to rules, objectively adapted to their goals without presupposing a conscious aiming at ends of an express mastery of the operations necessary to attain them and, being all this, collectively orchestrated without being the product of the orchestrating action of a conductor.[81]

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[80] Randal Johnson, "Editor's Introduction: Pierre Bourdieu on Art, Literature, and Culture," in Bourdieu and Johnson, ed., *The Field of Cultural Production*: 1-25, on 4.

[81] Pierre Bourdieu, *Outline of a Theory of Practice* (translated by Richard Nice), (New York: Cambridge University Press, 1977), 72.

Habitus, according to Randal Johnson, is a "practical sense" that "inclines agents to act and react in specific situations" without calculation according to consciously-understood rules. It is instead a "set of dispositions" which informs how individuals perceive and interact with the world around them. These dispositions become an ingrained part of an individual's personality with both "durability" and "transposability" to a variety of different areas of an individual's life.[82] Bourdieu referred to these different areas as "fields," or structured spaces of interaction that have their own social hierarchies independent of other fields. Within fields, individuals compete for positions within the hierarchy through the accumulation of what Bourdieu calls "capital." Although Bourdieu imagined economic fields where material capital played an obviously important role, he envisioned capital more broadly as either "symbolic" or "cultural." Symbolic capital represented the "degree of accumulated prestige, celebrity, consecration or honour" that emerges through what Johnson describes as a "dialectic of knowledge... and recognition."[83] Cultural capital represents an "internalized code" that enables an individual to process the artifacts and relationships that are part of a particular field. Here, Bourdieu makes one of his most significant claims as it relates to this dissertation: the meaning and value of art and aesthetic objects comes not from an inherent and "disinterested" quality of those objects, but from the *impressions of those objects generated in an individual via their cultural capital.*[84] In other words, from this point of view, the "absolute sound" is not absolute in the sense of being universal (a la Kant), but is rather a value formed through the process of acquiring cultural

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[82] Johnson, "Editor's Introduction," 5-6.

[83] Ibid., 7.

[84] Ibid.

capital – a process that, for audiophiles, develops through exposure to music and to the technologies of music reproduction in the home.

Bourdieu's concepts of habitus, fields, and symbolic and cultural capital are useful in understanding how individuals become audiophiles (the subject of Chapter 3), and how community members develop relationships with particular technologies for music reproduction. High-end audio enthusiasts generate symbolic capital within the community through their system building activities and their social interactions with other enthusiasts. For some, such as reviewers, symbolic capital is represented in their reputations as individuals familiar with a wide array of different components and systems, and displayed through their abilities to translate their impressions of a system's sonic qualities into words that resonate with other audiophiles. Individuals with significant amounts of symbolic and cultural capital, such as J. Gordon Holt and Harry Pearson, were able to use that capital to shape the field of high-end audio. The exchange of capital is also visible in the reviews themselves, where both negative and positive reviews have reverberant effects on users, manufacturers, and business owners elsewhere in the community. Further, certain devices, such as the vacuum tube and the compact disc, are endowed by community members with a kind of symbolic or "technological" capital that transcends the specific components that are built around them.

Bourdieu's notion of habitus embodies a tension: he rejected models of social practice that reduced individuals to "mechanical functioning" within established roles, but similarly rejected models that bestowed upon individuals the conscious execution of "free will" in any given social situation.[85] Habitus falls somewhere in between, suggesting, as sociologist Ervin

[85] Bourdieu, *Outline of a Theory of Practice*, 73.

Goffman has argued, that individuals tend to live their lives in the "cracks" of an over-arching social structure, inhabiting different roles in different situations and being fundamentally irreducible to a series of abstract categories.[86] Further tension is raised by scholars specifically focusing on 'fans', enthusiastic appreciators of particular popular cultural genres. Henry Jenkins, for instance, characterized fandom, or active enthusiasm, as an act of resistance against mainstream cultural forces. In their consumption and appropriation of various media, Jenkins argues that fans use their "interpretive conventions [to] provide the basis for activism against the producer's actions."[87] As cultural groups on the "borderlands between mass culture and everyday life," fan communities "struggle to define [their] own culture and to construct [their] own community," making meaning from "materials others have characterized as trivial and worthless."[88] Others turn to Bourdieu, suggesting that the choices of "fan objects and practices of fan consumption are structured through our habitus as a reflection and further manifestation of our social, cultural, and economic capital."[89] This point of view challenged the assumption that fandom could be resistive or emancipatory by suggesting that fan cultures, while still separable from mass culture, nonetheless relied on the "existing economic, social, and cultural status quo."[90]

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[86] Erving Goffman, *Asylums: Essays on the Social Situation of Mental Patients and Other Inmates* (New York: Anchor Books, 1961).

[87] Henry Jenkins, *Textual Poachers : Television Fans & Participatory Culture*, Studies in Culture and Communication (New York: Routledge, 1992), 2.

[88] Ibid. , 3.

[89] Jonathan Gray, Cornel Sandvoss, and C. Lee Harrington, *Fandom : Identities and Communities in a Mediated World* (New York: New York University Press, 2007), 6.

[90] Ibid.

More recently, some scholars appropriate aspects of each of these earlier approaches, while acknowledging that "being a fan has become an evermore common mode of cultural consumption," and that approaches that plot the trajectories of fan communities in terms of cultural hierarchies and "discrimination through distinction" are incommensurate with the experiences of fans themselves.[91] Gray, Sandvoss and Harrington argue that issues of broader social concern such as political elections, environmental issues, and health concerns are not "solely dependent on rational discourses but on the ability to present a cause or public figure in which we, as readers, can find ourselves and to which we emotionally relate." Studying fans, they suggest, can reveal some of the "key mechanisms through which we interact with the mediated world at the heart of our social, political, and cultural realities and identities."[92]

Throughout this dissertation, I will demonstrate how audiophile behaviors, preferences, and system-building efforts can show us both the structure of the high-end audio community, and how individual audiophiles forge identities within the cracks of that structure. In so doing, I will show the relationships between audiophiles' habitus, their technological and aesthetic preferences, and their system building efforts. Reflecting the efforts of the recent incarnation of fan studies, I will show that the forming of "emotional bonds" can also take place between members of an enthusiast community and technologies.

Systems-Building and Cybernetics

Within the history and sociology of technology, one cannot utter the word "systems" without invoking the work of Thomas Hughes, whose influence in these areas is difficult to

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[91] Ibid., 7.

[92] Ibid., 10.

overstate. In his 1983 book *Networks of Power*, Hughes sought to unpack the interconnected entities, both technological and social, responsible for the large-scale electric power distribution systems of the late 19th and early 20th centuries, and in 1998's *Rescuing Promethus* expanded this work to systems ranging from the ATLAS missile project to Boston's infamous "Big Dig" to the Internet.[93] Hughes's model of technological systems was, like Bourdieu's concept of habitus, in part a response to the prevalence of deterministic views of technological and social change that had dominated both academic and popular discourse about technology up to the 1960s and 1970s. During this period, scholars from a broad range of disciplines began shifting their attention to the role of social forces in shaping technology. In *Networks of Power* and in his later work, Hughes sought to contextualize technological change within a framework of social, economic, political, and cultural influences while maintaining a focus on the technological aspects of large-scale systems. His work became a part of broader efforts at contextualization that brought consumers and users of technology to the foreground, frequently showing where systems-building and enthusiasm for technology overlapped.[94]

Hughes labeled the people involved in building, promoting, and regulating these large socio-technical systems "system builders," a group that spanned the "inventor entrepreneurs" such as Thomas Edison, who conceived of both the early artifacts and their potential for deployment on a large scale, to the workers who raised power poles, machined parts, and dug tunnels. According to Hughes, these system builders exhibited several key behaviors and attitudes that aided the development of systems, as well as their maintenance and growth.

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[93] See Hughes, *Networks of Power*; Thomas Hughes, *Rescuing Prometheus: Four Monumental Projects that Changed the Modern World* (New York: Vantage Books, 1998).

[94] See Wiebe Bijker, Thomas Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge: MIT Press, 1987).

Among them was "technological enthusiasm," or the belief among system builders that they were "participating in a second creation of the world" that would be subject to rational organization, helping to supply the energy for innovation.[95] As these systems grew, system builders focused their engineering efforts on confronting "reverse salients" in the systems, or areas that lagged behind others and hindered overall growth. These efforts eventually resulted in the system attaining "technological momentum," or self-sustaining energy to operate in a particular direction that, even if that direction became undesirable, was very difficult to change.[96] While Hughes helped to shift scholarly focus to the people and social entities involved in technological change, those people often remained subsumed under the system itself, their actions constrained and their motives governed by large institutional forces. The systems that received his attention were exclusively large-scale, massively complex, and phenomenally expensive. This concentration on large-scale systems and emphasis on technological momentum led to an overall vision, expressed most directly in *American Genesis*, that the "age of enthusiasm" that had given rise to these systems was, by the 1980s, "passing into history."[97]

But user-oriented research within the history and sociology of technology in the 1980s and 1990s raised questions about Hughes's angle of analysis. As described in the preceding section, research on users and enthusiasm shows that users can influence not only the technological artifacts and modify them to suit their own needs, but also innovate in ways unforeseen by the large-scale system builders, changing the direction of the technology and the

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[95] Hughes, *American Genesis*, 3.

[96] Hughes, *Networks of Power*, 14.

[97] Hughes, *American Genesis*, 1.

system.[98] Thus, it is worthwhile to revisit Hughes's arguments for clues as to how we might understand smaller-scale socio-technical systems, and how users affects the development of those systems. What happens to our understanding of socio-technical systems when we shift our frame of reference to technology's users? What do technological enthusiasm and system building look like when a user community is the focal point?

One useful way of conceptualizing small-scale systems comes from aspects of cybernetic theory. The concepts behind cybernetics were first developed by, among others, mathematician Norbert Wiener, who described the fundamentals of cybernetics in his 1948 book, *Cybernetics: or Control and Communication in the Animal and the Machine*. As described by historian of technology David Mindell in his history of control and communications systems prior to cybernetics, Wiener and his colleagues argued that

> "the problems of control engineering and of communications engineering were inseparable," that they were united by the fundamental notion of the message, and that feedback loops, both within machines in between machines and people, must be understood in such terms. Wiener also argued that human behavior and dynamic mechanisms operated according to similar principles, and he posited the analogy between the digital computer (then in its infancy) and the human nervous system. He famously called for a new science of feedback, human behavior, and information for which he coined the term cybernetics, from the greek word *kubernetes*, for 'steers-man'.[99]

In audio amplifiers, feedback provided a way of reducing unwanted spurious artifacts in an electrical signal, enabling clearer transmission of messages. But Wiener's idea of feedback as part of a closed-loop communication and control system extended to other areas, including fire control systems, ship navigation, railroad switching, and neurological function, as well as social behavior and language. In each example, the importance of transmitting a message and getting

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[98] Pinch and Kline show, among other things, that Ford began building tractors, plows, pick-ups, and other vehicles based on a Model T chassis after rural users had both proven it could be done and demonstrated that a market existed for these products. Pinch and Kline, "Users as Agents of Technological Change."

[99] David A. Mindell, *Between Human and Machine : Feedback, Control, and Computing before Cybernetics*, Johns Hopkins Studies in the History of Technology (Baltimore: Johns Hopkins University Press, 2002), 4.

information about its reception back with the greatest possible accuracy was at the core of how feedback could be useful. Cybernetics thus found a variety of adherents from a wide range of disciplines who used these principles as theoretical tools for analyzing both machine and human interaction.

As illustrated by the interview quotation that opens this chapter, audiophiles often describe their systems-building efforts as attempts to get closer to the message composers and performers are trying to communicate with their music. It would be a mistake, however, to conflate musical messages with the messages of "fundamental importance" to cyberneticists like Wiener. A meaningful musical message is clearly different from a meaningful signal in a fire control system. Historians Peter Galison and David Mindell have also demonstrated that the concept of feedback and its use in mechanical devices predates cybernetics by many years.[100] Where cybernetics can be useful for the present study, however, is in Wiener's conception of feedback as part of a system, which Galison and others identify as a key difference with earlier understandings and uses of feedback. Further, despite its origins in military research during World War II, Wiener ultimately came to see cybernetics as a broad "philosophy of nature," that reached into many areas of human experience.[101] While further research can elaborate the relevant philosophical and historical roots of cybernetics, suffice to mention here that the notion

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[100] Galison refers primarily to the work of Otto Mayr, who showed feedback incorporated into various mechanisms as far back as the "golden age" of Islam and the Middle Ages in Europe. Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* **21**, no. 1 (Autumn 1994): 261-262; Mindell, *Between Human and Machine : Feedback, Control, and Computing before Cybernetics*, .

[101] That said, some scholars have used information theory to explore human emotional responses to music, and one could argue that audiophile efforts to reduce noise and distortion in their audio systems follows a similar model as Shannon's 1948 "Mathematical Theory of Communication." See Annabel Cohen, "Music Cognition: Defining Constraints on Musical Communication," in *Musical Communication*, ed. Dorothy Miell, Raymond A. R. MacDonald, and David J. Hargreaves (Oxford ; New York: Oxford University Press, 2005). Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," , 233.

of feedback in systems alone without deeper analysis can serve as a useful concept when undertaking an analysis of small-scale systems in the high-end audio community.

Audiophiles have used the word "systems" to describe their approach to music reproduction in the home for many years. Historian Jeffrey Tang has observed that the ability to combine different components into a system, and the importance of "matching" system components to achieve the highest quality reproduction, were key parts of the audiophile hobby in the 1950s and 1960s.[102] Indeed, the notion of separating various components in an audio system to enable deliberate combining and matching was critical to audiophile definitions of "high fidelity." "High fidelity components differ from regular packaged goods in one basic respect," wrote one enthusiast in the November 1956 issue of *High Fidelity* magazine. "The hi-fi component is an integral part of a music reproduction system that is connected by a strand of wire to the rest of the system. The consumer is allowed complete freedom of choice in selecting the particular unit or units he desires to assemble."[103] The importance of interconnection and "freedom" to mix and match informs Tang's overall argument regarding the critical importance of compatibility and standards in the hi-fi hobby, in terms of both recorded media and how various components could or could not be connected to one another to build an audio system. For Tang, hi-fi enthusiasts are a special type of consumer, and standards enable both system assembly and consumer choice.[104]

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[102] Jeffery Tang, "The Endless Quest for Fidelity: A portrait of the early audiophile community," presented at the 4S-EASST conference, Paris, August 25-28, 2004, available from http://, www.csi.ensmp.fr/WebCSI/4Sx/download_paper/download_paper.php?paper=tang.pdf accessed Feb 8, 2007, page 4.

[103] Ed Altshuler, "Noted with Interest," *High Fidelity*, 6, Nov. 1956, 9, 12, quoted in Tang, *Sound Decisions*, 263.

[104] The issue of standards in concert with aesthetic desires is addressed in the discussion of the compact disc in Chapter 6.

Not all scholars writing about hi-fi and high-end audio have focused on systems, however. In one of the earliest pieces about high-end audio specifically, Joseph O'Connell based his analysis on what he calls the "evolutionary model of technology," where high-end audio is equated with the "drosophila," or fruit fly, in biological research. O'Connell argues that high-end audio "is characterized by flexible manufacturing, low start-up costs, short product life, rapid advances, and little resistance to innovation – all of which give it the short generation time sought in the biological realm by genetics researchers."[105] High-end audio represents, in O'Connell's model, "technological evolution in a pure form, very much like the drosophila," although this purity is coupled with what he describes as "reactionary" and "whimsical" nostalgia associated with the use of vacuum tubes, and the somewhat unusual consumption behaviors of audiophiles that do not, at first glance, appear economically rational.[106]

More recently, Marc Perlman has suggested that equipment purchasing and manipulation among audiophiles in the present day can be understood as attempts to "personalize" audio equipment, as that equipment has become less subject to the direct technical interventions practiced by hi-fi enthusiasts during the 1950s and 1960s. He calls this "tweak theory," or the work performed by consumers of audio equipment to turn that equipment from a "commodity into a possession" by means of "any small, fussy thing that improves the sound of an audio system."[107] This process, he argues, brings the "tweaky" audiophiles into "conflict with the technology's chief source of epistemic authority: audio engineering," and as a result has been a long-standing source of contention between the "subjective" audiophiles and "objective" audio

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[105] O'Connell, "The Fine Tuning of a Golden Ear," 5.

[106] Ibid., 2.

[107] Perlman, "Consuming Audio," 352.

engineers.[108] Perlman's model of epistemic conflict can be seen as critical to the building symbolic capital within the high-end audio community, where tweaking becomes a part of what Bourdieu might call the "structured and structuring" behavior within the field of audio systems building. But while tweak theory adds a critical dimension to understanding audiophile system-building practices, my research shows tweaking to be an important, but not a wholly-defining, part of the high-end audio practice. Even the word "tweak" causes some audiophiles to cringe, given the negative association with obsessive behavior and pseudo-scientific product claims from certain manufacturers. One audiophile interviewed for this dissertation explicitly said that the high-end community needs to work harder to represent itself as something other than a "tweaky cult" to the rest of the music-loving public.[109] But Perlman's notion of tweaking as part of a broader conflict for epistemic authority is critically enlightening. These conflicts, although labeled somewhat differently, will be visible in this dissertation.

It should be noted that other scholars studying hi-fi and high-end audio have focused on issues of gender and home audio as it relates to domestic life.[110] With the exception of some discussion of gender and women in high-end audio in Chapter 3, this dissertation will neither pursue the topic of gender nor challenge the existing analyses.

Methodology & Periodization

Although high-end audio is international in terms of community connections, sales, and businesses, its emergence was largely an American phenomenon. Many interviewees, the

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[108] Ibid., 346.

[109] Interview, 03/11/07.

[110] See Douglas, "Audio Outlaws," Keightley,"'Turn it down! she shrieked," O'Connell, "The fine-tuning of a golden ear."

majority of whom were American, cited the importance of audio equipment from small American manufacturers in their processes of becoming audiophiles during this period, as well as the influences of *Stereophile* and *The Absolute Sound*, both American publications. While future research will expand beyond temporal and national boundaries, the present study is focused on the high-end audio community in the United States from the early 1970s to the mid-1990s.

Bounding my study in this way necessarily creates significant gaps. One concerns the rise of home theater, and its effects on high-end audio from the early 1990s to the present. Many interviewees cited home theater as a major challenge to both the aims of high-end audio and the business operations of retailers, as the focus of retail businesses shifted to multi-channel audio and home theater during this period to the detriment of 2-channel, stereo audio that had defined the industry in previous decades. The relative absence of home theater from the present discussion should not be interpreted as suggesting that I believe these changes to be unimportant or not worthy of further study. It is, for the most part, a function of the periodization, which is predominantly focused on the time before home theater's rise, and, sadly, a lack of sufficient time and resources to give this topic the treatment it deserves.

Readers will also notice greater concentration on certain components, namely preamplifiers, power amplifiers, and CD players, with less discussion of turntables, loudspeakers, and accessories. Again, these items are hardly insignificant, and arouse much attention and debate within the community. But the components covered in this study were, in many ways, at the center of the debates that helped form the community during this period. Pre- and power amplifiers, for example, were critical objects of debate regarding the merits and drawbacks of vacuum tubes and solid-state transistors in the 1970s and 1980s, and the

performance of early CD players raised questions that cut to the core of the high-end audio ethos from the early 1980s through the 1990s. They are, therefore, among the best technological representations of audiophile conflicts over questions of fidelity, accuracy, aesthetics, and system building that inform the primary arguments of this dissertation. However, conflicts and innovation with turntables and loudspeakers also merit serious attention. Loudspeakers in particular are, in many ways, the most complex of all home audio components, with electrical, acoustic, mechanical, magnetic, and physical properties that make them the focus of debate and compromise within audiophile households. The complexities of loudspeaker functionality require more attention than time and resources allowed, and, as with home theater, I would prefer to expand upon these issues later than fail to do them justice now.

From a methodological standpoint, I have chosen a mixture of historical and ethnographic techniques to describe and explain the high-end audio community and its technologies. The ethnographic component consisted of oral history interviews with diverse members of the high-end audio community. A total of 33 people were interviewed, ranging in age from early 20s to early 70s, and representing a variety of family and class backgrounds. Twenty-nine interviewees (88%) were in some way involved professionally with the high-end audio industry as reviewers for magazines, salespeople, engineers and designers, shop owners, or manufacturers. I contacted prospective interviewees via "cold" emails or phone calls when contact information was available, by introducing myself at high-end audio expositions, or through referrals from other interviewees. The majority of the interviewees were white males living in the United States, although of this group, eight were born in other countries (25%). Three of the 33 interviewees live outside of the United States full-time (10%).

The interviews lasted between two and three hours. Questions were formulated on the basis of available information about the interviewees available prior to the conversation (which in many cases was fairly limited). Most questions were deliberately "open-ended" to allow the interviews to be dynamic, following the contours of interviewees' responses and stories. Most interviews were conducted via telephone, and all were digitally recorded. I transcribed each interview using voice recognition software and a word processor (all interviewees were offered copies of the transcripts, although only a few requested them). Following the basic guidelines of "grounded theory," transcribed interviews were then coded using both inductive codes from topics respondents mentioned and deductive codes developed from themes and concepts in the literature. Data was stored and managed with the aid of qualitative research software.[111] The fruits of this approach are most evident in Chapter 3, where I describe the process of becoming an audiophile largely with examples from interviews.

Content analysis of historical materials focused primarily on back issues of the high-end audio enthusiast magazines *Stereophile* and *The Absolute Sound*, the hi-fi publication *Stereo Review*, and, to a lesser extent, the classical music magazines *Gramophone* and *Fanfare*.[112] Data gathering from these publications included equipment reviews, editorials, and feature articles. Equipment reviews covered a variety of high-end audio system components, including loudspeakers, pre- and power amplifiers, integrated amplifiers, CD players, turntable systems

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[111] The voice recognition software used was Dragon Naturally Speaking 9 by Nuance Software; qualitative research software was ATLAS.ti by Scientific Software Development, Gmbh. For a description of grounded theory and the processes involved in formulating grounded theory (including coding), see Kathy Charmaz, *Constructing Grounded Theory* (Thousand Oaks: Sage Publications, 2006).

[112] Readers will note that months of publication are not always included in citations – *Stereophile* in particular did not always print the month of publication in early issues, and the magazine was not published on a regular schedule. *The Absolute Sound* also stopped printing volume numbers in the 1990s and instead printed only issue numbers. Citations for these two magazines in particular are therefore not entirely consistent from year to year.

(including cartridges, tonearms, and phono preamplifiers), digital-to-analog converters, and loudspeaker and interconnect cables. For each review, I entered in a database that was fully searchable and sortable the publication details (including the author), the manufacturer name and location, the price of the product, and specific passages quoted from the reviews describing functional as well as sonic characteristics. Data from editorials and feature articles were input in a separate database with similar searching capabilities. Each entry was tagged according to particular topics covered, such as digital audio, reviewing processes, and commentary on the state of the high-end audio industry. Additional tags were added as the research progressed to aid in searching on emergent themes and topics. Both databases also included commentary fields I used to begin exploring ideas and questions as I was analyzing the content of the reviews and articles.

I did not analyze the entire corpus of reviews, editorials and articles, but a sample of 547 feature articles and editorials, 631 separate product reviews covering approximately 1000 different products. My approach to selecting reviews and articles for analysis was dictated in part by time constraints, and by efforts to obtain as wide a representation of different reviews as possible. In general, my strategy was to analyze reviews from even-numbered issues for one year of publication, and odd-numbered issues the following year, depending on the publication frequency.[113] For certain key manufacturers identified in articles and by interviewees as having made an especially important contribution to high-end audio, such as Audio Research, I analyzed reviews regardless of whether they appeared in even or odd numbered issues. Editorials from all issues were included in my analysis. Feature articles were selected primarily from issues I had

[113] In the case of *Stereophile*, the frequency of publication changed significantly from the 1970s, when it was infrequent and somewhat random, to the 1980s, when it became more frequent and eventually went to monthly publication. During periods of infrequent publication, all available issues were analyzed.

selected for equipment review analysis. But, as important themes such as the advent of digital audio technologies emerged during my research, feature articles were also selected for analysis based on their coverage of these themes. Future research will revisit and code articles and reviews in issues that received less attention during this dissertation.

The decision to approach this study with a mixed methodology was motivated by several factors. First, as the period covered is relatively recent, those involved in the hobby, both historically and at present, were accessible in ways that historical actors in other domains frequently are not. Given that accessibility, I saw no reason *not* to pursue interviews with as many people as I could. Naturally, oral history raises questions about the reliability of recollection.[114] Given the significance of subjectivity, aesthetic sensibilities, and music in this community, however, oral histories struck me as vital source of useful information. While oral histories may not provide the most robust representations of what happened when, those issues can be dealt with by placing interview data in context with historical materials of other kinds, while providing details that would be otherwise unavailable. As we shall see, they add an important dimension to our understanding of the high-end audio community and its motivations. Historical materials, primarily from enthusiast magazines published during the period of this study, serve to fill another kind of gap. In his discussions of high-end audio enthusiasts, Marc Perlman relies primarily on ethnographic observation, and offers useful arguments about the motivations behind the behaviors he observes. The historical analysis in this dissertation in many ways supports Perlman's arguments while expanding and complicating those arguments, adding new dimensions that, taken together, paint a more detailed portrait of this community.

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[114] In his study of hi-fi in the 1950s and 1960s, Jeffery Tang notes that he chose not to use oral histories because of their "limited utility" and problems associated with "skewed recollections" and sampling bias. Tang, "Sound Decisions," 34-35.

Readers will notice, however, that some chapters rely on some kinds of data more than others – Chapter 3, for example, is based mostly on interview data, while Chapter 4 relies heavily on textual sources. Ultimately, the goal is that together these different methods will produce a more robust overall representation of this community, its technologies, and its practice.

Regarding the content of specific chapters to follow, Chapter 2 offers a primer on high-end audio systems, and how the components that comprise these systems work and work together. Although many within the high-end audio community believe that subjective impressions formed in home settings to be the most critical in evaluating a particular product's ability to reproduce sound with high fidelity, the technical aspects of a component's design are also considered critical, particularly the ways those components interact with one another in a system. In this chapter I show how users and technologies interact in high-end audio systems, where the feedback points are, and how the characteristics of system components can change the aesthetic qualities of the sound they are used to reproduce. Understanding certain basics of component functionality, and how design choices affect the sound of a system, will be useful for situating the arguments and impressions that appear later in the dissertation. Although it is hardly exhaustive, Chapter 2 will provide readers with a foundational understanding of audio systems from a user's perspective.

In Chapter 3, I describe the process of becoming an audiophile. Despite the emphasis on technology among community members and in popular and academic representations of high-end audio, becoming an audiophile is a process that unfolds in stages. I offer a model of this process that consists of four stages: demonstration, realization, acquisition, and mentorship. These four stages bring new audiophiles into the hobby, and also unfold cyclically for existing

audiophiles, keeping them involved and active. It is a process that both sustains and grows the community, but in some cases can also present roadblocks or challenges for would-be audiophiles that complicate their entrance into and participation in the community. By unpacking the process of becoming an audiophile, I show how aesthetic considerations, attitudes about technology, and a love of music come together to shape the audiophile experience.

Following this description of becoming an audiophile, Chapter 4 turns to the community's formation more broadly. Here, I trace the emergence of high-end audio from the high-fidelity hobby in the 1960s and 1970s through the founding of the two primary high-end audio review publications: *Stereophile* and *The Absolute Sound.* Following the origins of these magazines and the visions of their publishers, I describe how the high-end audio community coalesced around ideas of subjectivity, technology, and aesthetics. The focus on the subjective qualities of audio equipment brought the magazines, along with their subscribers and a variety of manufacturers, into conflict with the more measurement-oriented side of the home audio community, giving rise to a series of arguments over the proper testing and evaluating of home audio equipment that came to be known as the "Great Debate." I argue that this debate, although it involved technology, was primarily focused on methodology and questions about the powers and limitations of "science" in the context of the subjective experience of listening to music. In this way, I show that the arguments unfolding within this user community had a broader relevance to issues concerning science and technology during this same period.

In Chapters 5 and 6, I show how the conflicts, processes, and practices described in the previous chapters came to be represented in technological devices for home audio reproduction. Chapter 5 concerns the shift from vacuum tubes to transistors, the subsequent "tube renaissance,"

and eventual "convergence" of tube and transistor products that has resulted in both remaining prominent in users' systems. In this chapter I show how, in the context of small-scale system building, users can and do re-categorize and appropriate technologies otherwise dismissed or discarded by the broader society, and in so doing they can challenge traditional notions of the sources and shape of technological innovation. Chapter 6 traces the commercialization and reception of the compact disc, and how audiophiles approached this new medium vis-a-vis their particular aesthetic desires for home music reproduction, and their common modes of interaction with their audio systems based on prior experiences with vinyl record turntables. I will show that audiophile penchant for system building was upended by the seemingly closed technology of the CD, and that this technology was largely rejected on aesthetic grounds until it became more open to user manipulation. In both cases, audiophile's aesthetic preferences and ideas about how music should sound in the home helped to shape the technologies of reproduction, and the social environment in which innovation and manipulation of components and systems took place.

But, as high-end audio enthusiasts might say regarding their approach to system building, context is key. Before we can understand the "how's" and the "why's" of high-end audio, we need to know more about the "what's": the various components, the design characteristics, and how they work together in a system. This is the focus of the next chapter.

Chapter 2:
A High-End Audio Systems Primer

In the previous chapter, I described large-scale systems building familiar in the history and sociology of technology through the work of scholars such as Thomas Hughes, and presented a small-scale, user-oriented model practiced by audiophiles. This chapter offers a primer on the technologies of high-end audio systems, exploring each component, how they work together, and how users approach their use in home audio systems. This chapter will illustrate how the particular characteristics of the technologies and their assembly in audio systems relate to the aesthetic experience of listening to music, and demonstrate the importance of the systems approach adopted by audiophiles.

I will first provide a brief overview of the audio system as a whole, and how its various parts are connected. Following the path of the audio signal through the system, I will then describe four categories of high-end audio components: source components, preamplifiers, power amplifiers, and loudspeakers. Although high-end audio systems involve other components that fall outside these categories, components in these four groups are directly involved in the conversion of audio information stored on recorded media into sound, and have been the primary focus of high-end audio engineering and innovation. In these sections, I will include examples of particular design choices and controversies that have characterized the high-end approach to audio systems building. Finally, I will discuss the role of the listening environment. Rooms have been described by some audiophiles as the most important component in the system given their inherent acoustic complexities. Since rooms often serve multiple purposes for families, they also become loci for conflict and compromise.

The technical details highlighted in this chapter are merely an overview of the complex devices and engineering philosophies that go into building high-end audio components. Any one particular component, such as a turntable, is itself a system, worthy of an entire chapter (or book) all its own. Further detail can be found throughout the thesis, particularly Chapters 5 and 6.

The Audio System

High-end audio systems consist of four main component types, plus cables to connect the components together, and accessories to enhance various aspects of their performance (see Figure 2.1). Following the direction of the signal path, an audio system begins with source components, which include devices such as vinyl LP turntables, CD players, radio tuners, and tape decks. Next in the chain is the preamplifier, which acts as a distribution center, receiving the output of the source components, enabling source selection, volume, and balance adjustment by the user and, in some cases, the equalization of the sound via tone controls. The signal then goes to the power amplifier, where it is boosted to a power level that can drive the final components: the loudspeakers. Loudspeakers take the electrical signal from the power amplifier and convert it to mechanical motion, creating the fluctuations in air pressure that we hear as sound.

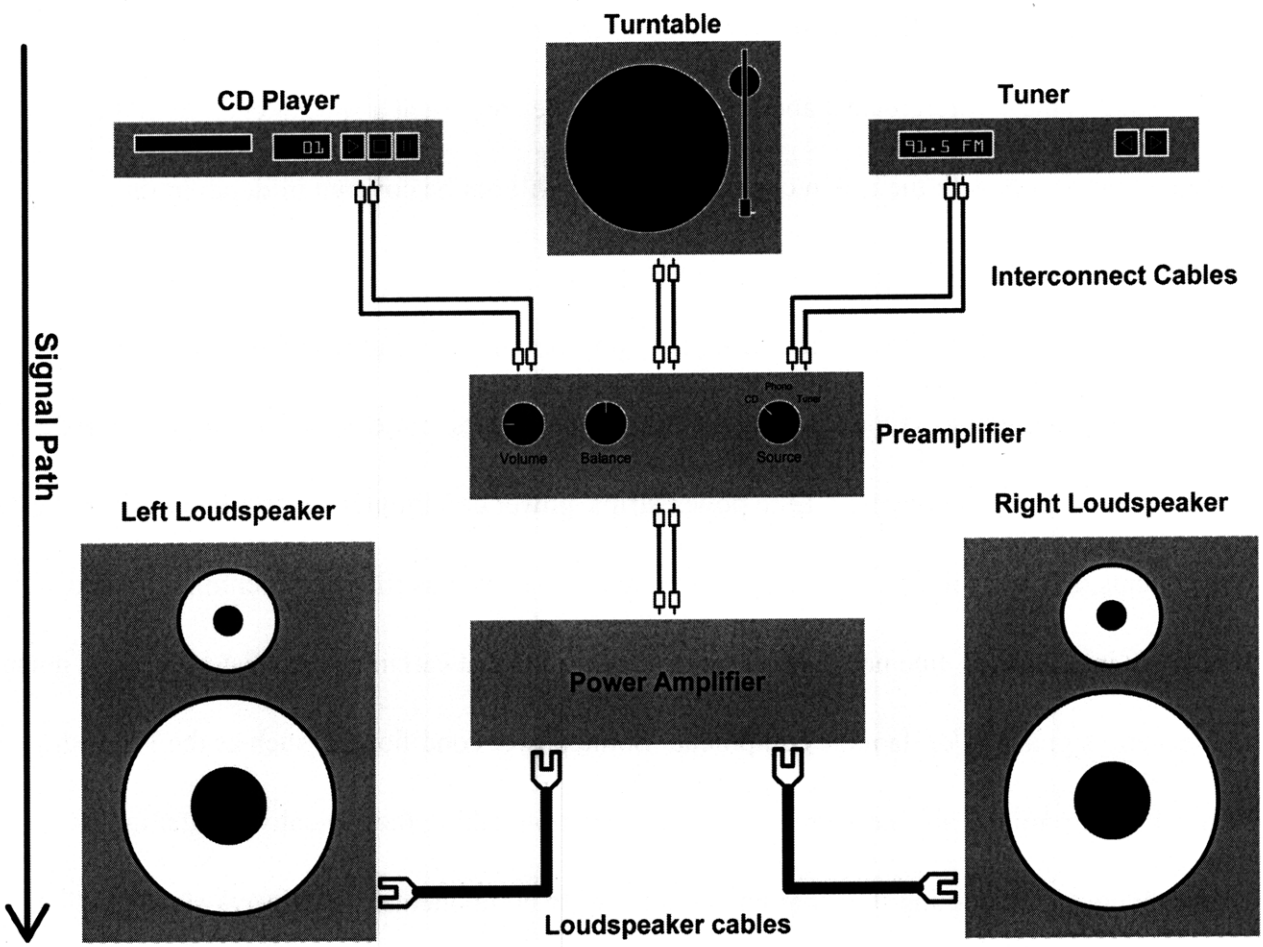

Figure 2.1 - A typical 2-channel (stereo) audio system (adapted from Harley, *The Complete Guide to High-End Audio*, 8).

Components are connected to one another via interconnect cables. As represented in Figure 2.1, each source component requires two interconnect cables in order to transmit both the left and right channel signals in a stereo configuration from the source components to the preamplifier. Interconnect cables come in a variety of plug types, the most common being the barrel connector or "RCA"- style plug.[1] The preamplifier is then connected via interconnect

[1] Jeffery Tang has observed that standardizing on the RCA barrel-type connector between audio components was a major factor in enabling the hi-fi hobby to expand and giving users more freedom to assemble systems of components from different manufacturers. See Jeffery Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975" (Ph.D. Thesis: University of Pennsylvania, 2004).

cables to the power amplifier.[2] The power amplifier connects to each of the loudspeakers via loudspeaker cables. Interconnect and loudspeaker cables represent a special class of audio system components with their own controversies, but will not be covered in-depth in this chapter.[3]

Several additional component categories not shown in the figure are also considered important by audiophiles. One category is power conditioners, or devices that supply filtered AC power to the audio components.[4] Like power strips, power conditioners distribute power to the components, but add robust surge and spike protection, as well as filtering to eliminate radio frequency interference, line noise, and power fluctuations that can introduce distortions and noise to the audio signal and/or damage equipment. Some power conditioners, such as the PS Audio Power Plant Premiere, also perform AC line regeneration, taking the typically fluctuating AC wall voltage and smoothing it so that power delivery to components is an always-steady 120 volts.[5] Other accessories include vibration damping platforms, particularly for source

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[2] As shown in Figure 2.1, the preamplifier has multiple stereo inputs, and a single stereo output. In a multi-channel system, such as a 5.1 surround system for home theater, a multi-channel preamplifier could have many connections to a multi-channel power amplifier or to multiple monaural power amplifiers. Multi-channel sources, such as DVD players, can output all the audio channels along with the video information via a single digital cable to a multi-channel preamplifier, whose circuitry then divides up the digital signal into discrete audio channels that are sent to the power amplifier(s). These cables use the High-Definition Multimedia Interface (HDMI) to transmit all the audio and video information digitally between components.

[3] For details on loudspeaker cable controversies and double-blind versus observational listening tests, see chapter 4.

[4] In general, electronic audio components require AC power, except for some preamplifiers that rely on passive circuit networks for volume control and source switching, and preamplifiers that rely on separate battery power supplies. Loudspeakers in general do not require AC power and are instead powered solely by the power amplifier. However, some loudspeaker designs, such as planar magnetic and electrostatic, require additional power from an AC outlet. Details on preamplifier and loudspeaker designs will follow.

[5] The standard for AC power delivery in the United States is nominally 120 volts at 60Hz. In reality, voltage from AC wall outlets fluctuates throughout a typical day, dropping to under 120 volts during peak power usage, and rising above 120 volts during low power usage. In my own home, the volt meter on a power conditioner used for my small music studio regularly reads as low as 115 volts at peak periods, and 125 volts or greater during low-usage periods, and is designed to shut down if voltage exceeds 130 volts. For details about the Power Plant Premiere, see http://www.psaudio.com/ps/products/description/power-plant-premier?cat=power.

components prone to vibration-induced distortion such as turntables, and acoustic treatments for rooms that absorb or scatter sound waves to eliminate acoustic distortions.

In many cases, audiophiles approach each component as a system, swapping out different parts, such as phono cartridges in a turntable system, to improve or change the sound from the entire system. The arrangement of the components in the room, particularly the loudspeakers, is also considered especially important to achieving the best sound. In this way, high-end audio is not just the components themselves, but their thoughtful combination and arrangement within a listening space.

Source Components

Source, or "front-end," components are the parts of an audio system that interface directly with the medium of the recording or broadcast. This includes LP turntables, CD players, tape decks, and radio tuners (and, increasingly, computer-based hard drive storage systems or "music servers," and portable devices such as iPods). Most source components are complex systems in and of themselves, with both mechanical and electronic parts. For example, a typical vinyl LP turntable consists of a base, a platter, a bearing assembly, a motor, a tonearm and cartridge, and a stylus attached to the cartridge. Each of these parts has received considerable attention from designers, and is assembled into LP playback systems with considerable care by vinyl-oriented audiophiles. The impetus behind efforts to maximize the quality of LP playback comes from the belief among some audiophiles, promoted during the 1970s by the British turntable manufacturer Linn, among others, that the front-end of an audio system is the most critical part. "The Linn philosophy is an analogue of the computer dictum: garbage in, garbage out," wrote *Stereophile* reviewer Alan Edelstein in a 1982 review of the Linn Basik turntable. "Whatever is lost in the

front end of the system is gone forever."[6] While not all audiophiles place as much emphasis on source components, there is general agreement that they are critically important to achieving good sound. Although tape recorders and radios are part of some audiophiles' systems, the most common source components are vinyl LP turntables and CD players, which will be the focus of the following sections.

LP Turntables

Although the CD became the dominant home music format by the 1990s, many audiophiles continue to swear by the sonic superiority – or, at least, the uniquely beautiful qualities – of vinyl LP playback. Despite a variety of inconveniences and distortions inherent to LPs, they remain quite popular with high-end audio enthusiasts, and many companies around the world continue to manufacture and develop new turntable, tonearm, and cartridge systems. Despite the influences of digital downloading of music and the popularity of MP3s, interest in LPs has been on the rise in the last several years. In 2007, Forbes magazine reported that VPI, an American turntable manufacturer, projected doing $7 million in business that year, up from $3 million five years earlier.[7]

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[6] Alan Edelstein, "Linn Basik," *Stereophile* **5**, no. 3 (1982): 9-11, on 9.

[7] Daniel Lyons, "Still Spinning," *Forbes* **179**, no. 12 (June 4, 2007): 64-68, on 64.

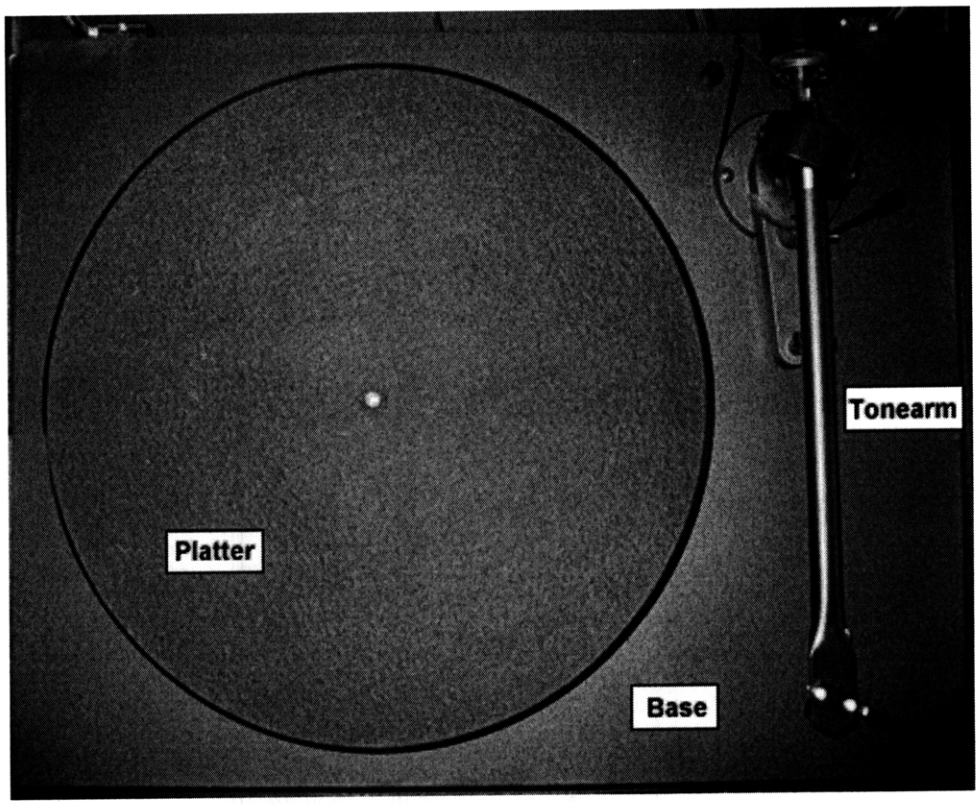

Figure 2.2 - A simple turntable (a Czech-made Pro-Ject Debut III w/dust cover removed) – drive motor is under platter.

Vinyl LP turntable systems convert the mechanically encoded information on a record to an electrical signal that is sent to the preamplifier. This information is stored in grooves cut by a record lathe in a lacquer master disk during the record mastering process.[8] As shown in Figures 2.3 and 2.4, in a stereo LP, sound is stored in microscopic V-shaped grooves where the walls of the groove are at a 90 degree angle relative to each other, and 45 degree angles relative to the record's surface. Ridges in the groove walls correspond with the left- and right-channels of the recording. The side of the groove wall closest to the center of the record contains the left channel information, and the opposite side contains the right channel information. With some

[8] For more detail on analog and digital recording, see Chapter 6.

variation based on program material, a typical LP can store 22 minutes of stereo sound per side in about 1400 feet of groove.[9]

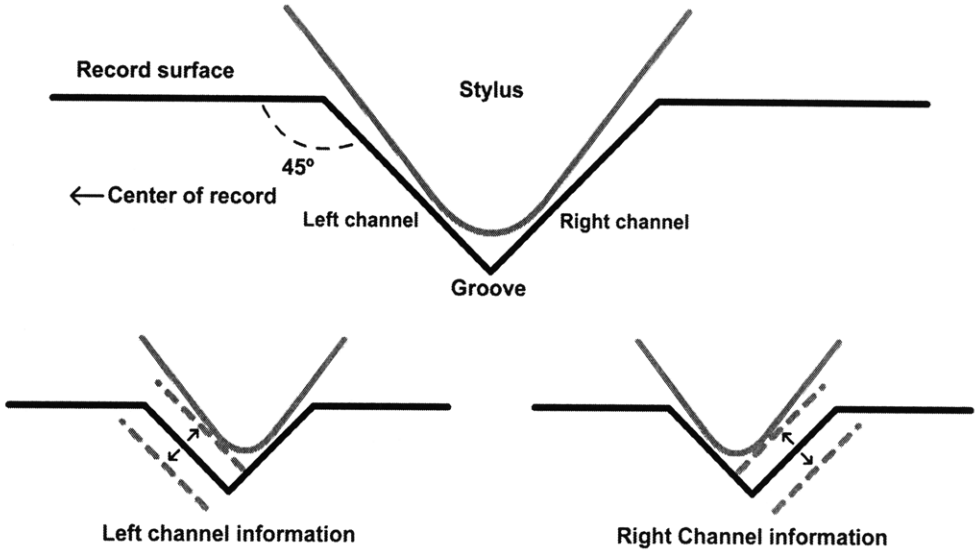

Figure 2.3 - Stereo LP and stylus movement.

During playback, a stylus is used to "read" the information in the grooves, shown in Figure 2.4, and convert it into an electrical signal. Styli are available in different tip shapes, but the most common is a conical or spherical tip that, in order to sit inside of a record grooves, can only be about 15 micrometers wide.[10] The stylus is attached to the body of a phono cartridge by a cantilever. At the other end of the cantilever are magnets that move as the stylus traces the grooves of the record. The magnets are mounted in close proximity to a series of wire coils

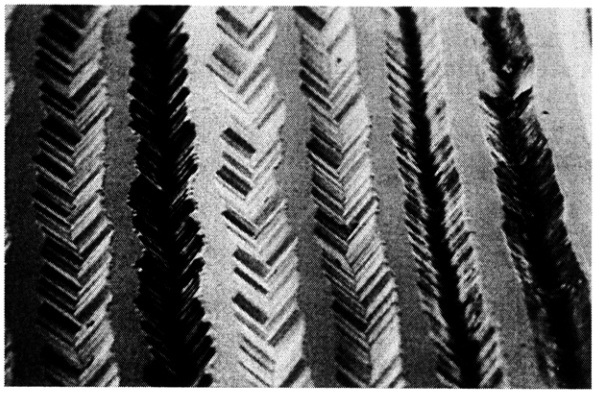

Figure 2.4 - The surface of an LP record at 200 times magnification (from Gilmore, *The Unseen Universe*, 57).

[9] Robert Harley, "An LP Primer," *The Absolute Sound* 172 (June/July 2007): 35-39, on 36.

[10] Robert Harley, *The Complete Guide to High-End Audio* (Tijeras: Acapella Publishing, 2004), 336.

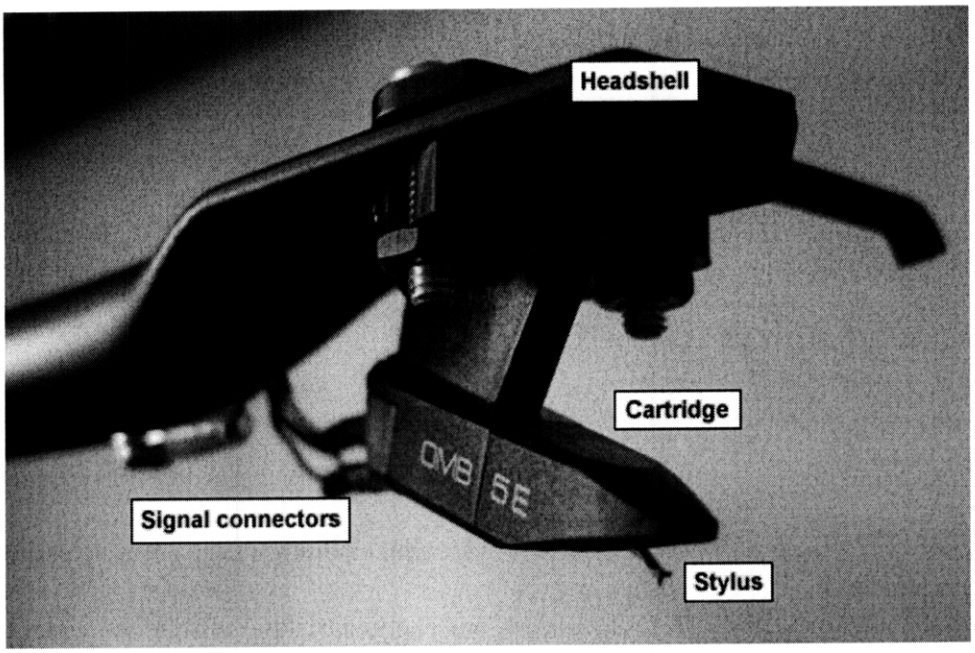

Figure 2.5 - Close-up of an Ortofon OMB 5E moving magnet phono cartridge.

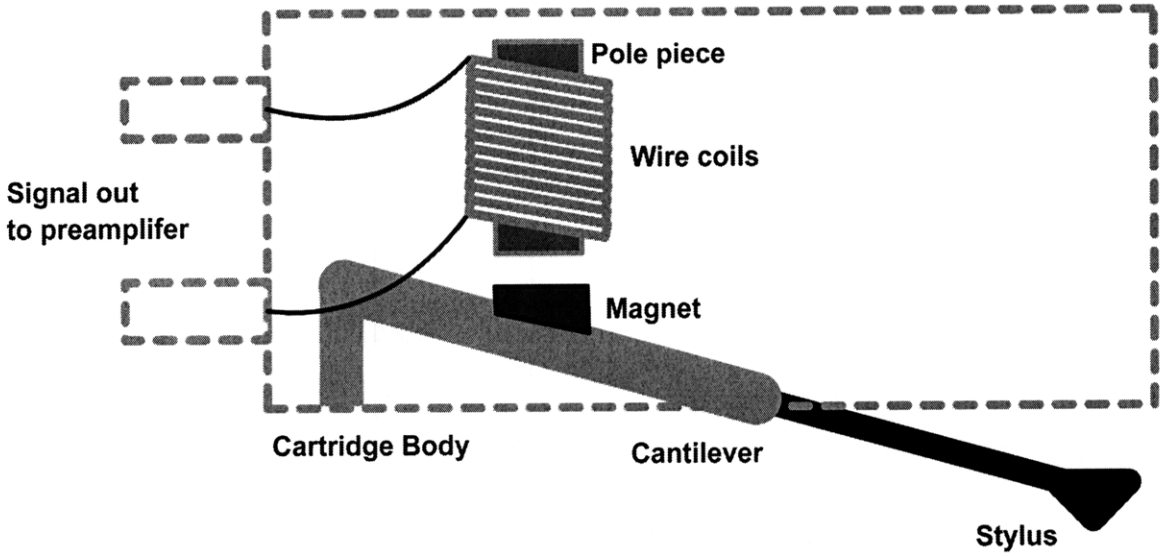

Figure 2.6 - Phono cartridge cross section – dotted line represents cartridge body (stereo phono cartridges have multiple magnet and coil assemblies).

wrapped around metal pole pieces inside the cartridge body, shown in Figure 2.6. As the magnets move along with the stylus, a fluctuating electrical voltage is induced within the coils in a process known as electromagnetic induction. This fluctuating voltage signal flows from the cartridge via wires attached to the tonearm.

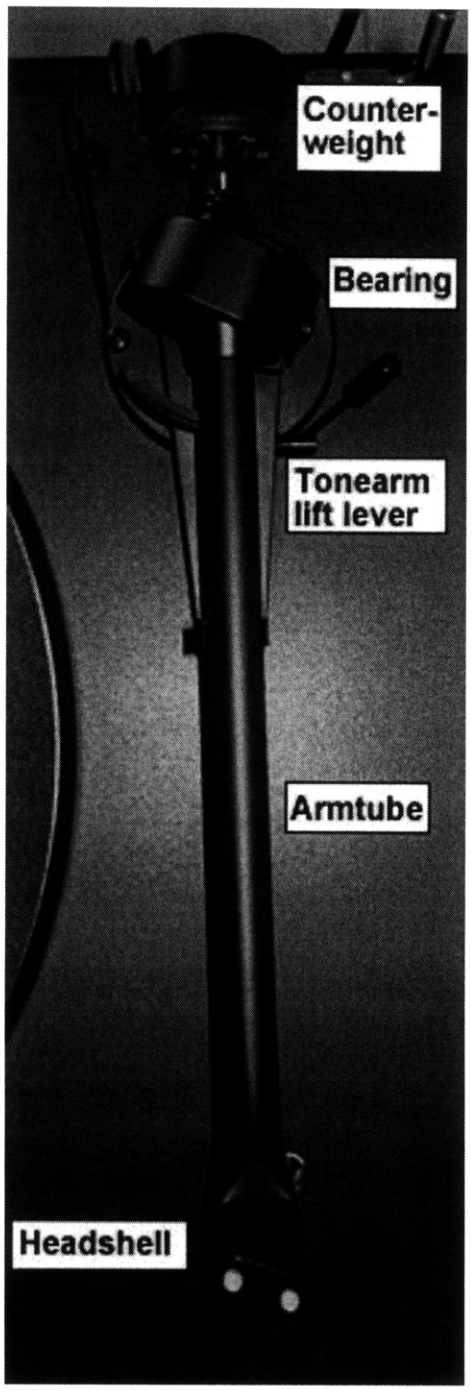

Figure 2.7 - The Debut III Tonearm.

The phono cartridge is allowed to follow the groove of a spinning record by the tonearm assembly, shown in Figure 2.7. There are two types of tonearms: the pivoted type is the most common, where the tonearm pivots both horizontally and vertically at the point of attachment to the base of the turntable. As Figure 2.8 illustrates, a pivoted tonearm includes a counterweight on the end opposite the cartridge for balance and tracking force adjustment, a headshell where the cartridge is attached, and frequently an anti-skating mechanism that helps keep the cartridge in the groove as the record is played. The other type is known as a tangential or linear tracking tonearm, where the cartridge and arm assembly move in relation to the record. Tangential tonearms are designed to more closely mimic the position of a record cutting stylus and thus provide a more accurate reproduction from LPs, but they are less common (and often quite expensive).

The tonearm is connected to the turntable base by an armboard. The armboard is sometimes simply a part of the base, and other times is part of a sub-chassis assembly that isolates the both the platter and tonearm from the base by means of a damping mechanism, such as a series of springs.[11]

[11] Some turntable systems include multiple armboards so that different tonearms and cartridges can be used with the same platter and base.

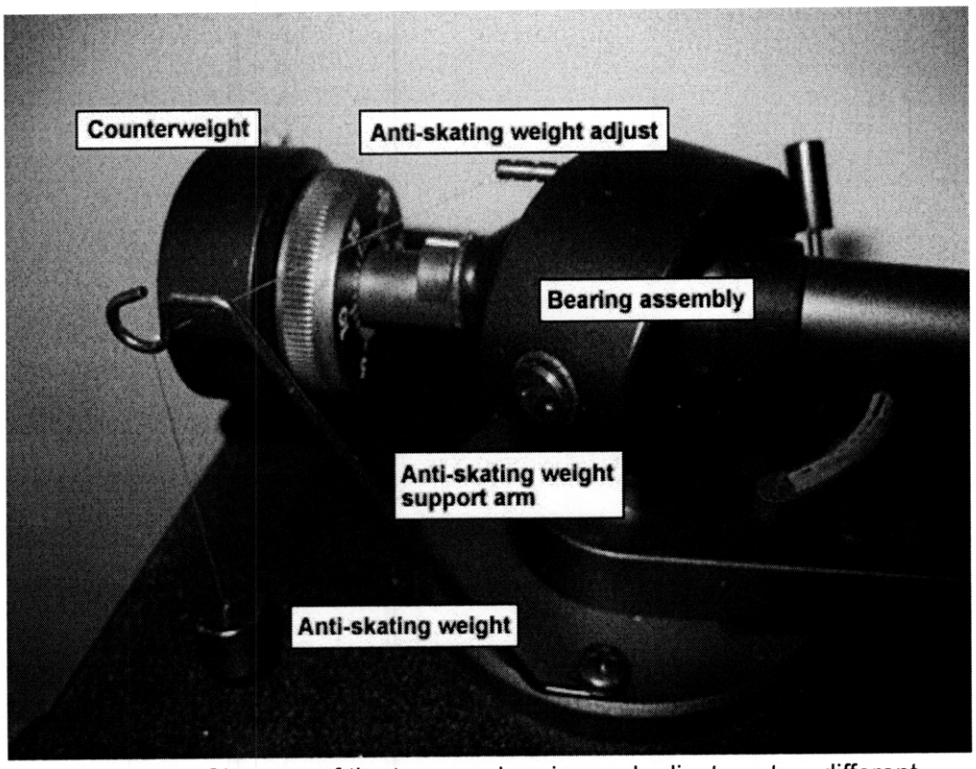

Figure 2.8 - Close-up of the tonearm bearing and adjustments – different tonearms have different adjustment mechanisms that perform the same functions (this anti-skating mechanism is, for example, particular to the Pro-Ject Debut III.

Isolation of the platter and tonearm from the base is intended to reduce distortions associated with external vibrations. In other cases, turntable bases are made with vibration-controlling materials but do not include separate suspension systems. Designers have also sought to reduce vibration from the turntable's motor, which spins the platter. Among the various innovations for isolating the motor from the platter was developed in the 1960s by the Acoustic Research company of Massachusetts, a variation of which is shown in Figure 2.9. Rather than connecting the motor directly to the platter, AR's XA turntable spun the platter with a rubber drive belt attached to a spindle on the motor.[12] Vibrations from the motor were absorbed and dissipated by the drive belt. Many modern turntables use this same method.

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[12] A brief but detailed description of the XA's features can be found in Michael Fremer's review of the Merrill-Scillia Research MS21 turntable system. George Merrill of Merrill-Scillia first made a name for himself building modifications for AR's turntables. Michael Fremer, "The Merrill-Scillia Research MS21 Turntable," *Stereophile* **30**, no. 11 (November 2007): 33-39, on 33.

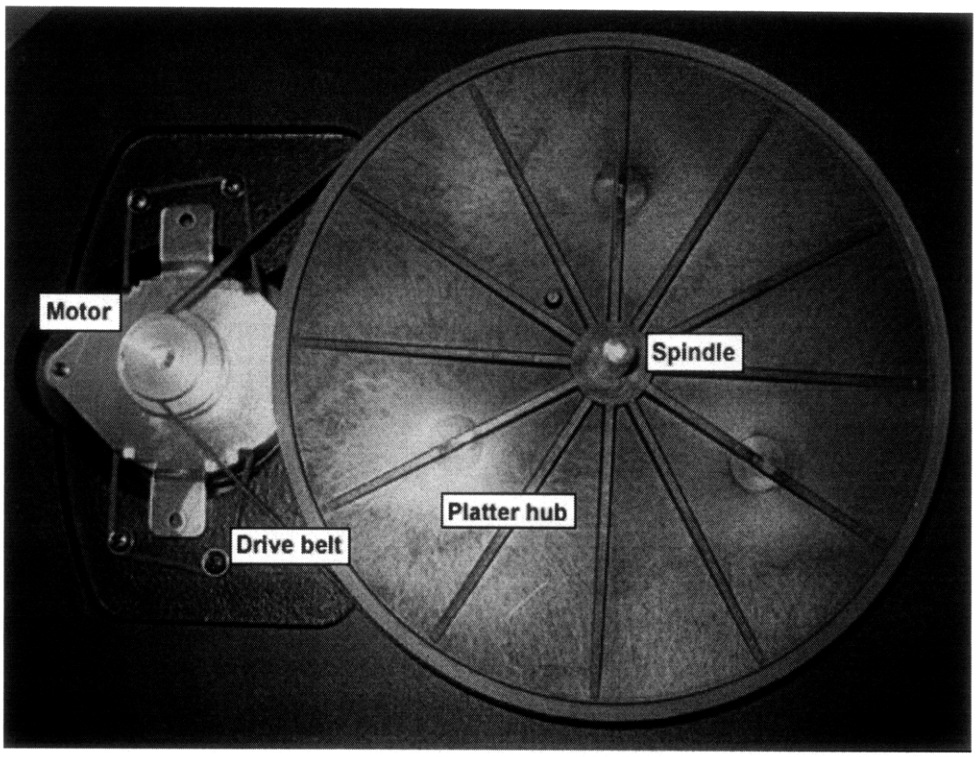

Figure 2.9 - The motor and drive assembly of the Debut III, with platter removed – the motor is suspended and isolated from the base by a rubber band held to the base with screws above and below the motor. The motor spindle has two positions for the rubber band for both 33 and 45 RPM playback.

The signal from the phono cartridge is sent to the phono preamplifier. Phono preamplifiers perform two functions. First, they boost the very low voltage signal from the phono cartridge (often on the order of thousandths of a volt). Second, they equalize the incoming signal according to how the LP was mastered. Modern LPs are mastered using what is known as the "RIAA curve," developed by the Recording Industry Association of America, which calls for rolling-off the low frequency information and boosting the high frequency information during cutting.[13] Low-frequency information takes up more groove space than high-frequency information, and by attenuating the low frequencies, mastering engineers are able to make the grooves closer together on the record, increasing the playing time. Processing the

[13] For an explanation of the RIAA curve, its history and changes to its specifications, see Keith Howard, "Cut and Thrust: Keith Howard examines the theory and practice of RIAA LP Equalization" *Stereophile* **32**, no. 3, (March 2009): 53-62.

signal coming off a record through an RIAA equalization curve restores the attenuated bass information.[14]

LP playback involves user manipulation, to varying degrees, of each of these different parts of a turntable system. The geometry of the tonearm and cartridge assembly, and the weights and pressures exerted at different ends of the tonearm, are central sites of user adjustment. Adjustments of these mechanisms can change the vertical tracking force, vertical tracking angle, and azimuth of the cartridge and tonearm. Vertical tracking force is the amount of pressure applied by the stylus to the record groove, and is adjustable via the counterweight at the back end of most tonearms.[15] Vertical tracking angle is the angle of the cantilever relative to the record surface – ideally this should be as close as possible to the angle at which records are cut. Azimuth corresponds to the position of the cartridge perpendicular to the record surface, and affects right and left channel balance. Some tonearms include azimuth adjustments, and for those that don't, users can add shims in between the cartridge and headshell to adjust azimuth.

For some audiophiles, part of their introduction to the hobby came from learning about turntable systems and figuring out how to make adjustments that improved the sound. "When I discovered vinyl, I couldn't turn back," Luke, a manufacturer's representative in his 30s, told me.

> And I started off with a little Dual plastic turntable. I learned the mechanics of what makes a turntable tick: there's belt drive, there's direct drive, and then the arm is what fascinated me the most. The quality of the bearings, the geometry, in terms of aligning the cartridge, you've got vertical tracking angle, you have azimuth, you have horizontal tracking, you have the rake angle, you have anti-skating, you have the arm height that adjusts another type of angle... I really got into that.[16]

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[14] Some preamplifiers have built-in phono preamplification, often called a "phono stage," or offer upgrades that can add a phono stage. Separate phono preamplifiers are also available and allow for greater customization of the audio system for LP playback.

[15] Robert Harley has observed that even one gram of tracking force applied to a cartridge results in a stylus pressure of about four tons per square inch because of the very small area of the stylus that comes into contact with the record groove. Harley, "An LP Primer," 36.

[16] Interview, 06/22/07.

Set-up of turntable systems, and manipulation of the various parameters and possible combinations, is also critical to the high-end audio retail practice. "I used to have Linn turntables in different permutations," Bruce, a retailer, told me. "I might have eight or nine in a room, in each of two or three rooms, all set up, and they were set up with the same arm, with different cartridges, and then different arms with the same cartridge, some with the external power supply, and some not. And people could hear the differences."[17] Tony, an equipment reviewer, observed that the various adjustments that could be made to turntable systems, and the attention high-end audio companies gave to these systems, played a significant role in getting new audiophiles interested in the hobby and keeping existing audiophiles enthusiastic.

> What had driven a lot of the growth of high-end audio in the LP era was people discovering what I discovered, which was that there was music on their discs that they weren't hearing. I mean, when you had the Beatles and the Rolling Stones and, you know, even bands like Jefferson Airplane working for an entire year on a recording, layering in things, experimenting with new sounds, you had, on the LP, stuff that ordinary systems weren't revealing. So as you got your system to be more and more resolving of detail and more and more musically integrated, you'd get more and more out of those recordings.[18]

The ability to adjust turntable systems with audible improvements in music playback, is a significant part of the attraction of vinyl LPs for many audiophiles. Jim, a former reviewer, also noted that the visual aspects of vinyl LP playback are important: "I much prefer watching a turntable revolve and a tonearm perfectly set up to watching this static piece of… this CD player, and the drawer goes back in and a few digital numbers, you know?" But he cited some of the behaviors of high-end audio enthusiasts with respect to vinyl as "obsessive," particularly with regard to the care and maintenance of vinyl LPs:

> I think there's something, a component in high-end audio that certainly appealed to me, and that was an anal part… just an anal, obsessive part to setting up your tonearm

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[17] Interview, 08/21/07.

[18] Interview, 05/22/07.

> perfectly, and getting the absolute best cartridge, and you'd endlessly repeat various test recordings that have higher and higher recorded levels of either test signals or piano recordings or some difficult-to-track instruments, like a triangle, to see whether the pickup would lose track with the groove, and you'd hear the distortion, the mistracking. And it's a horrendous, gross distortion that you get at the inner grooves of lots of recordings. But you get really obsessive about it, and... coupled with all that are the cleaning rituals, because you have to keep this vinyl clean... the ritualization of record cleaning almost approaches a kind of fetishism for many vinyl addicts. And it's certainly almost approached that with me. I still can't play a vinyl album without religiously cleaning and destatisizing it.[19]

Several audiophiles noted the "religious rituals" surrounding vinyl playback, particular efforts to keep records clean and free from the dust and static responsible for the characteristic pops and ticks of vinyl LP playback.[20] Tony also cited some of the inconveniences of vinyl as compared to new music server systems:

> I think that being liberated from the rituals of having to clean the LP and turn the LP over after 20 minutes and having to file stuff, you know, alphabetically and categorically along the walls of your house is immensely liberating. It allows you to open up an awful lot of time to actually listen to music and have this relationship with these pieces that ostensibly have meaning to you ... I had 6000 records, and there was always something I wanted to hear that I couldn't find, because I couldn't remember whether I called Joe Healy country or rock, or if I, you know, where I'd actually filed the disk.[21]

The care users take in adjusting and assembling turntable systems reinforces the importance of feedback in achieving the desired aesthetic experience. This experience incorporates the pleasures derived from the sound of vinyl-based music recordings, the visual qualities of the turntables themselves, and, for some, the joy of understanding and tinkering with the complex geometry of vinyl LP playback. Other audiophiles find that the distortions in vinyl LPs, the inconveniences, and "work" associated with using them impinge upon their enjoyment of music and of their audio systems.[22] Users rely on a variety of feedback, sonic and non-sonic,

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[19] Interview, 05/07/07.

[20] See Chapter 3 for more detail.

[21] Interview, 05/22/07.

[22] The distortions of vinyl and of analog recordings generally are explored in greater detail in Chapter 6.

to direct their approach to the system as a whole, and determine if a turntable has a place in their system.

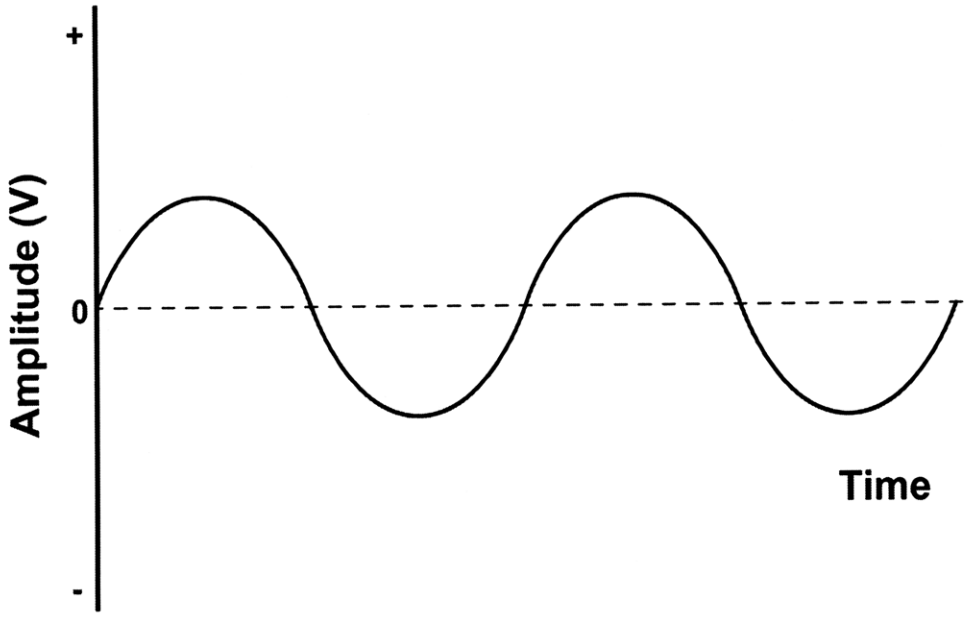
CD Players

The other primary source component in modern high-end audio systems is the compact disc player. CDs differ from vinyl LPs in a variety of ways, perhaps the most important being that CDs store sound digitally rather than in analog form. The reception of the compact disc medium in the high-end audio community when it first became available in the United States in the early 1980s is the subject of Chapter 6. In this section, I will focus on how compact disc players work, and how they are integrated into audiophiles' systems.

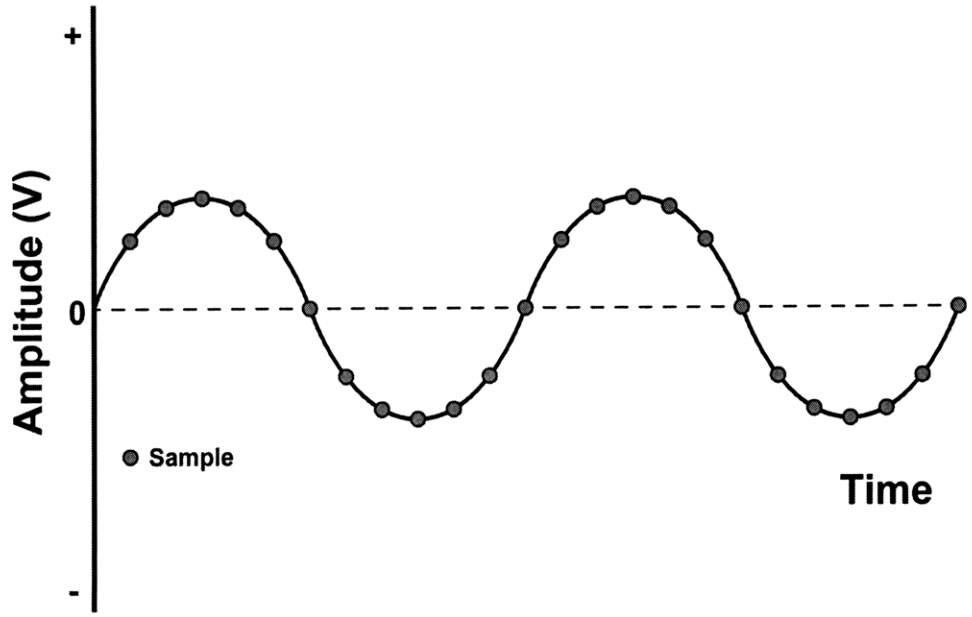
The compact disc system is based on the "Red Book" standard devised by the Japanese electronics firm Sony and the Dutch electronics firm Philips in the late 1970s and early 1980s. The standard defined a variety CD specifications, including physical dimensions, and details of how information is stored on and retrieved from the discs. The CD system uses a digital audio conversion scheme known as "pulse code modulation" or PCM. At its most basic, PCM involves taking periodic measurements of a continuous analog waveform's amplitude in volts, then storing those measurements as discrete, binary numbers. The binary numbers can be written to a variety of different media, extracted, and converted back into voltages that, when strung together, create a replica of the original analog waveform. The images below illustrate the basic functioning of PCM analog-to-digital and digital-to-analog conversion:

Figure 2.10 - A Naim Audio CD 3.5 CD player.

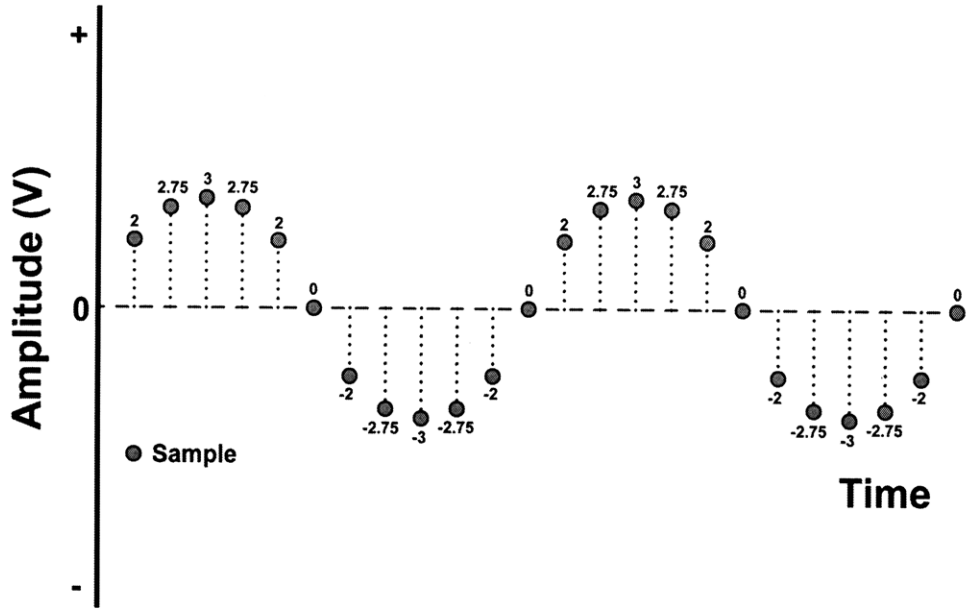
An analog waveform…



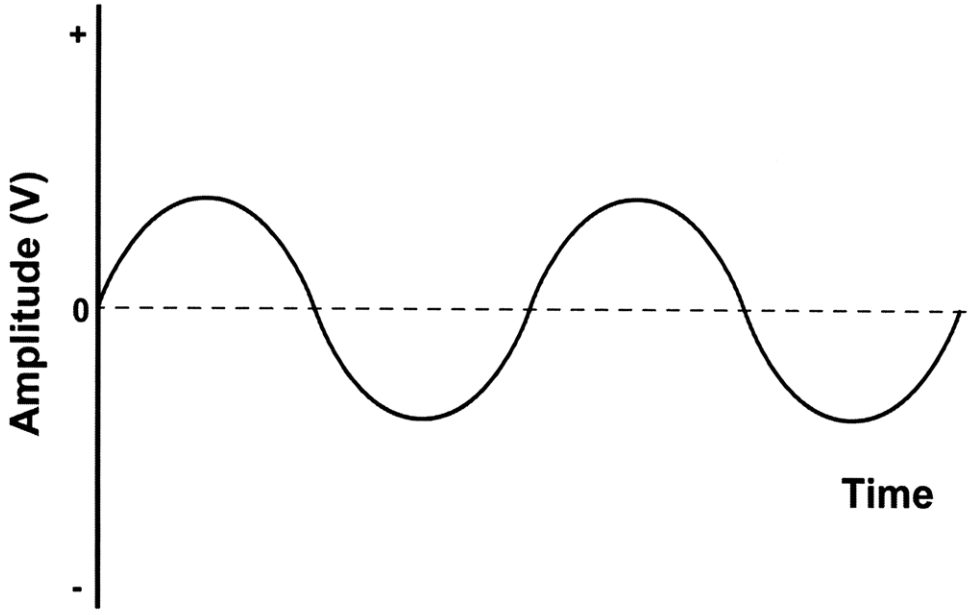
… is periodically "sampled" by an analog-to-digital converter…



…and each sample is assigned a numeric value according to its amplitude, which is converted to and stored as a binary number…



… that can then be used to reconstruct the analog waveform.[23]



In order to ensure that compact discs and players would be compatible, and to enable other firms to license the technology to build their own players (and, eventually, to manufacture

[23] Adapted from Ken Pohlmann, *The Compact Disc Handbook* (Madison: A-R Editions, 1992), 17.

CDs) Sony and Philips had to define two critical attributes for their implementation of PCM: the sampling rate, or the number of samples that would be taken of the analog waveform in a given period of time, and the bit depth, or the range of possible values for the amplitude of each sample. Sony and Philips decided on 44.1 kHz for the sampling rate, and 16 bits for the bit depth.[24]

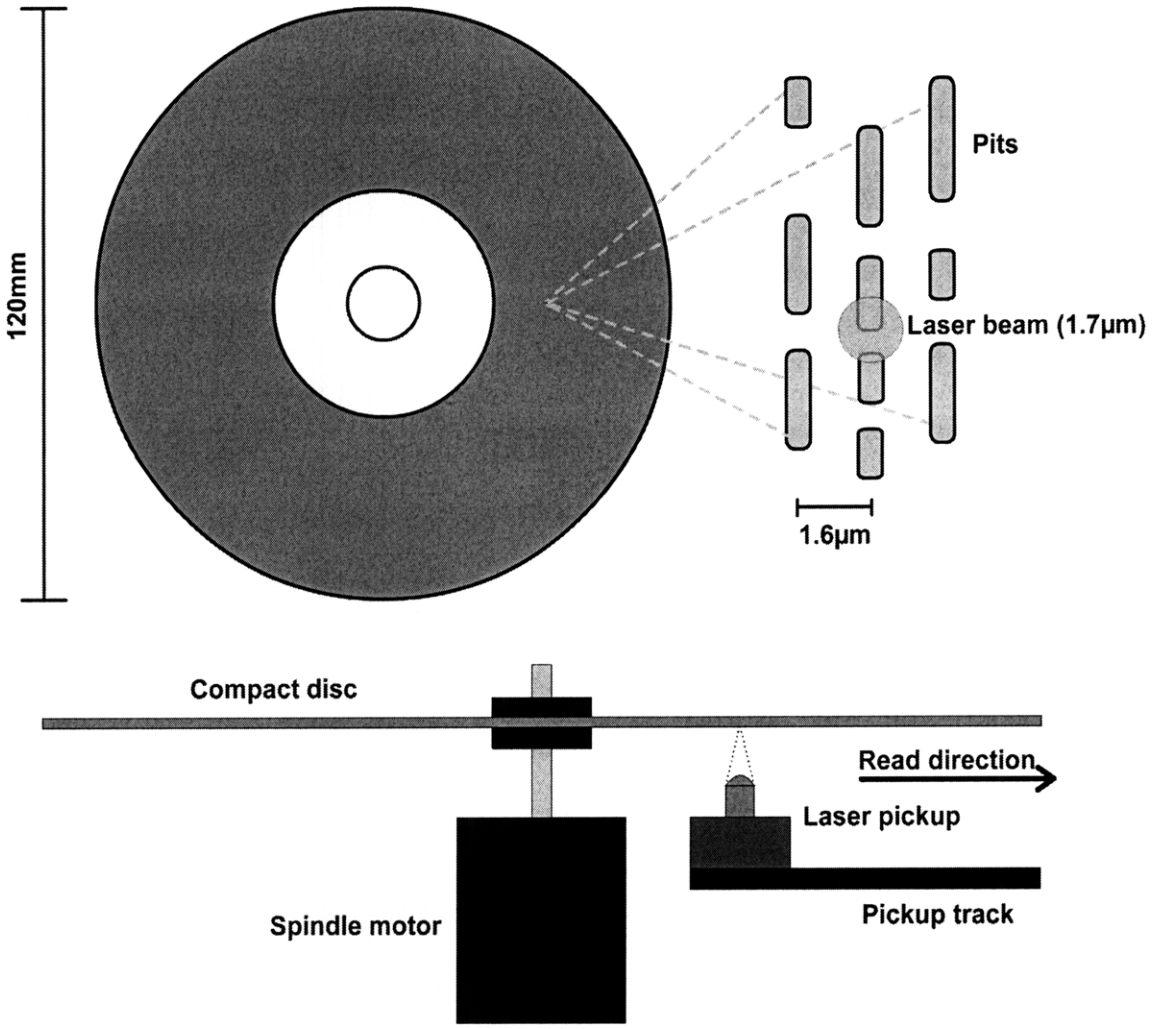


Figure 2.11 - The compact disc surface and playback mechanism.

[24] The Red Book standard's sampling rate was based on the Nyquist-Shannon sampling theorem, which posits that in order to reconstitute a continuous, analog signal from a discrete, digital signal, the sampling rate of the digital signal must be at least twice the frequency bandwidth of the original source. 44.1kHz was selected because it was just over twice the audible frequency range of human hearing, which extends roughly from 20 Hz to 20 kHz, and because of compatibility requirements with U-Matic tape machines used for CD mastering. 16 bits was chosen because it was felt to provide sufficient dynamic range, and because of constraints in the processing power of available digital-to-analog converters. See Chapter 6 for more information.

Digital audio data is stored on compact discs in a spiral arrangement of tiny pits that are read with a laser and converted back into an analog electrical signal by a CD player. The pits, shown in Figure 2.12, are half a micrometer wide and vary in length from about 8/100ths of a micrometer to about 3.5 micrometers, depending on the speed of playback.[25] The small size of these pits results in a long playing time for CDs as compared with vinyl LPs – up to 74 minutes and 33 seconds on a single disc.[26] CDs can rotate at two different speeds: 1.2 meters per second, or 1.4 meters per second, a value known as "constant linear velocity," or CLV. If a CD's total playing time is under 60 minutes, discs are usually mastered at 1.4 meters per second, with longer programs mastered at 1.2 meters per second. A CD player's processing circuitry determines the rotational speed of the spindle motor in order to maintain CLV. The rotational speed varies based on what part of the disc is being read by the laser, as the outer tracks contain a greater number of pits per disc revolution than the inner tracks.[27] A complete 74 minute program results in over 22,000 disc revolutions, and can contain up to 3 billion pits which, if unspiraled in tracks, would be about three and a half miles long.[28]

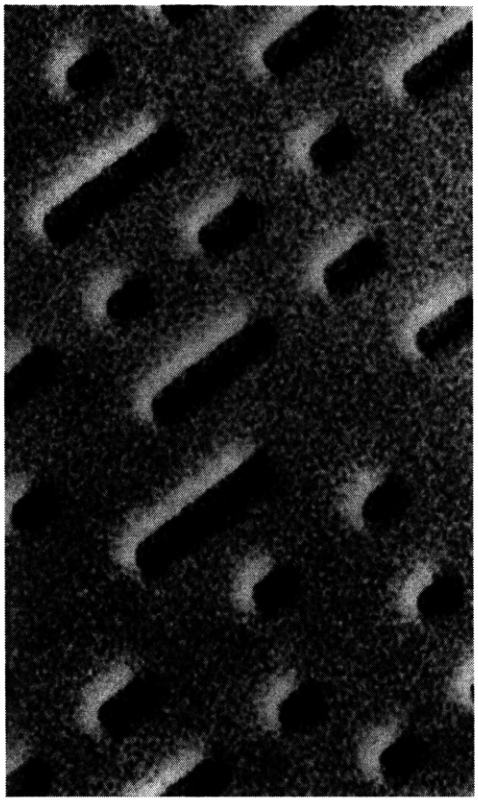


Figure 2.12 - an electron microscope scan of CD pits (from *Stereophile* **13**, no. 5, May 1990, pg 75).

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[25] Pohlmann, *The Compact Disc Handbook*, 49.

[26] Some CDs can play as long as 79 minutes.

[27] Ibid., 54, 53.

[28] Ibid., 51.

The discs are made of layers of polycarbonate plastic, lacquer, and a thin coating of metal, most often aluminum, as a reflective surface. This reflective metal surface is laid on top of the pitted surface of a CD, making the pits "readable" by a CD player's laser. During playback, the laser light is reflected from the metal-coated pits to a photo detector. The reflected laser hits the photo detector at full intensity if the reflection is coming *either* from the bottom of a pit or from the "land" between pits. The transition from pit to land and vice versa, however, results in a phase shift in the laser that reduces the intensity of the light hitting the photo detector. These full-intensity and reduced-intensity reflections modulate the photo detector such that a full-intensity reflection from either a pit or the land between pits is interpreted as a binary "0," and a reduced-intensity reflection from the transitions between land and pit is interpreted as a binary "1." These binary numbers are strung together and processed by the CD player's circuitry to convert the digital information back into an analog signal.[29] Conversion of the digital information stored on the surface of a CD back into an analog waveform is handled by the CD player's digital to analog converter, or DAC. The DAC takes the binary numbers and converts them back into electrical voltages, then strings those voltages together to reconstitute a continuous analog signal. A DAC consists of both digital and analog processing circuitry, and can be extremely complex.

CD player controls vary from product to product, but virtually all players include a drawer or tray to hold the discs, transport controls (play, pause, stop, skip, etc), and a digital display to indicate the track number, the time index of the track as it plays, and other information. While all CD players have analog audio outputs, some players additionally have

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[29] Robert Harley, "You've Come a Long Way, Baby: the Compact Disc Turns 25," *The Absolute Sound* 174 (September 2007): 42-56, on 52.

digital outputs that allow the player to be used with a separate, outboard DAC. These outputs bypass the CD player's internal DAC circuitry and send the digital signal extracted from the surface of a CD to the outboard DAC via a digital interface. A CD player that has all the basic transport functions and a digital output, but no internal DAC or analog outputs, is referred to as a CD *transport*. Although there are a variety of digital interfaces, each transmits the digital signal according to the Sony/Philips Digital Interchange Format (S/PDIF). Many CD players with digital outputs will include an RCA-style interface as well as an optical interface (often using the Toshiba-designed "TosLink" connector). Outboard DACs are made by a variety of high-end firms and offer features and components designed to output a higher-quality, lower-distortion analog signal from the digital information retrieved from the CD player or transport. Many modern outboard DACs will convert digital information encoded at higher bit depths and sampling rates, and include Ethernet or USB inputs as well as RCA or TosLink inputs for use with computer-based high-resolution digital files.

Among the many points of contention within the high-end audio community when the CD was introduced was what appeared to be fewer obvious opportunities for users to tinker or intervene. This did not, however, stop them from trying, as we shall see in Chapter 6. The separation of the CD transport from the DAC was one of the key developments in CD technology that helped the medium become accepted in the high-end audio community. It changed the CD player from a "black box" into something that could be more easily integrated into the audiophile model for small-scale system building.

Preamplifiers

Figure 2.13 - An Audio Research Reference 3 preamplifier (from *Stereophile* **29**, no. 12, December 2006, pg. 109). Used with permission.

As *The Absolute Sound* editor Robert Harley has described, the preamplifier is the "Grand Central Station" of a high-end audio system.[30] The preamplifier receives signals from source components, allows the user to adjust the volume and balance of those signals, and feeds them to the power amplifier. Preamplifiers vary significantly in terms of their functional complexity and circuit design, but for the most part, high-end preamplifiers are designed to do as little to the source signal as possible. In the early days of *Stereophile* magazine, J. Gordon Holt often described the ideal preamplifier as a "straight wire with gain" – a piece of wire that connects the source component to the power amplifier with a slight boost to the signal, but nothing more.[31] This idea continues to be important to audiophiles, and preamplifiers are often praised for what they do *not* do to the source signal.

Ironically, this emphasis on non-intervention with the source signal sometimes results in devices with very complex circuitry. But it also means the elimination of features commonly found on mass market audio equipment, such as tone controls for bass, treble and midrange, "loudness" controls, or digital processing that adds reverberation effects to mimic various

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[30] Robert Harley, *Introductory Guide to High-Performance Audio Systems* (Tijeras: Acapella Press, 2007), 79.

[31] Chapter 4 describes the importance of this idea in detail with regard to early preamplifier comparisons done in the magazine, particularly with the Dyanco PAT-4. See J. Gordon Holt, "Dynaco PAT-4 Stereo Preamp," *The Stereophile* **2**, no. 8 (Spring 1968): 13-19;

acoustic environments.[32] These features, referred to disparagingly in the high-end audio press as "bells and whistles," are considered detrimental not only to the quality of the source signal, but "antithetical to the values of high-end audio," particularly the aim of connecting more deeply and closely with the artists who made the original recording.[33] This post-recording user-controlled equalization of music is seen as a departure from the original vision of the artist who made the recording, and is one of the few areas where user manipulation of the audio system is discouraged.

Preamplifiers come in a variety of configurations and available options. As noted in the discussion of turntables, some preamplifiers include a phono preamplifier for use with a turntable, or phono preamplifiers can be added through expansion cards. Preamplifiers that do not include phono preamplification are often referred to as "line level" preamplifiers or "line stages." A line stage accepts only high-voltage signals from sources such as CD players.[34] Preamplifiers also vary in terms of the number of inputs. Most preamplifiers have at least three inputs for source components, and some also include tape monitors for use with tape decks (although as cassette tape decks disappear, this is becoming less common). While most preamplifiers are "active," using either vacuum tubes or solid-state devices to add voltage gain to the incoming signal from the source components, some preamplifiers are "passive," meaning they contain only volume controls with no vacuum tubes, transistors, or other devices that are

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[32] "Loudness" controls found on some audio components are actually equalizing circuits that boost bass and treble frequencies at low volumes. Harley, *The Complete Guide to High-End Audio*, 237-238.

[33] Ibid., 133.

[34] High-voltage output levels are known as "line levels." Some CD players have output signals high enough to drive power amplifiers directly without the need for a preamplifier. Most CD players, however, do not have output volume controls and lack the source selection options provided by preamplifiers. LP turntables always require some form of preamplification.

part of a gain stage, such as capacitors. Since passive preamplifiers can only attenuate an incoming signal, they are generally limited to use with high-output source components, such as CD players. But their simpler design (and correspondingly smaller number of electronic devices the signal must pass through on its way to the power amplifier) is felt by some audiophiles to be better at preserving the integrity of the signal from the source components.[35]

Prior to the advent of the CD player, preamplifiers were the components in an audio system where a signal from a source component would first encounter amplification devices such as vacuum tubes or transistors. Since these devices are viewed as the most common source of distortion, the preamplifier is considered especially important to maintaining an unadulterated and "uncolored" signal path in an audio system. As Aaron, a representative for an equipment manufacturer that builds both tube and solid-state electronics, told me,

> I always have said to people, what should we get first? My view is, get the preamplifier okay. And then you can improve the source, you can get an amplifier with more power later, or you can get also bigger speakers. But the preamp is very, very important. To have a bad preamplifier and put a thousand dollars into an amplifier and new speakers doesn't do you any good. Everything goes through the preamplifier.[36]

Beyond issues related to the use of vacuum tubes versus solid-state transistors in both preamplifier and power amplifier design (the subject of Chapter 5), circuit design and parts selection in preamplifiers is approached quite differently by different firms and engineers. One issue in particular is focused on "single-ended" versus "balanced" operation. Single-ended circuits were the dominant topology available in hi-fi and high-end equipment through the 1980s, using the RCA-style connectors that, by the 1960s, had become the de facto standard for home

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[35] Harley, *The Complete Guide to High-End Audio*, 149-150; Anthony Cordesman, "The Adcom GFP-555 and PS Audio 4.5 preamplifiers," *Stereophile*, **9**, no. 7 (November 1986): 135-142; Wes Phillips, "Adcom GFP-750 preamplifier," *Stereophile* **22**, no. 3 (March 1999): 86-89.

[36] Interview, 09/07/07.

hi-fi equipment.[37] Single-ended circuits with RCA-style jacks, shown in Figure 2.14, use one wire connected with the center pin of the plug to carry the audio signal, and the other wire, connected to the outer sleeve of the plug, as the common ground among all the components in the system.[38] But single-ended cables are prone to interference from magnetic fields and other sources, which can add hum and noise to the signal; 60 Hz hums generated by the magnetic fields surrounding power lines are a particularly common issue.

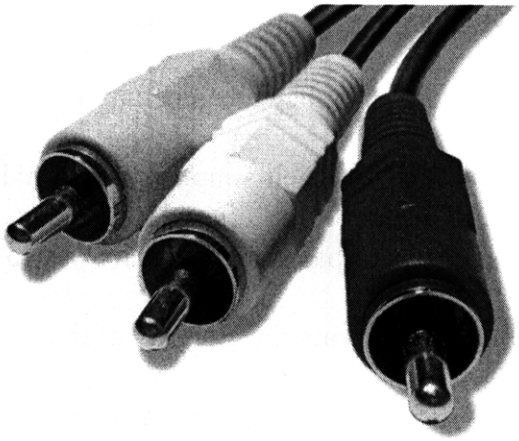

Figure 2.14 - RCA-style jacks (from http://en.wikipedia.org/wiki/File:RCA_Connector_(photo).jpg, accessed 01/19/2009).

In professional audio applications, where the elimination of hum and noise is a higher priority than in home applications, balanced operation was used as a way of eliminating this type of interference.[39] In a balanced circuit, both the left and right channels of the audio signal are each conducted over two wires, with a third wire for the ground (hence the use of three-prong XLR plugs, shown in Figure 2.15, for balanced equipment). The two wires for each channel both carry the same signal, but one is a mirror image

Figure 2.15 - XLR-style jacks (from http://en.wikipedia.org/wiki/File:Xlr-connectors.jpg, accessed 01/19/2009).

[37] For a discussion of connection standards in hi-fi during the post-war period, see Tang, *Sound Decisions*.

[38] The term "single-ended" is also used to refer to a particular topology in vacuum-tube amplifier designs that is not related to the present discussion. In a stereo configuration, two RCA cables (one for the right channel and one for the left) are used.

[39] Balanced operation was not developed exclusively for audio applications – any circumstance in which a signal is amplified may use single-ended or balanced operation.

of the other; in audio engineering parlance, they are referred to as "180° out of phase" with one another. Because of this mirroring, the two signals are referred to as "balanced." These balanced signals are fed into what is known as a "differential amplifier," which amplifies only the *difference* between the two out-of-phase signals. The advantage of this design is that if noise is introduced in the cable between one component and another, it will be common to both the in-phase and out-of-phase signals, and be rejected by the differential amplifier; a phenomenon known as "common mode rejection."[40]

While noise rejection might, on the surface, seem wholly positive, some in the high-end audio community argue that balanced operatio introduces greater complexity in the circuit and, as a result, increases cost. In addition, the advantages of balanced operation are only realized when more than one component in the system is balanced, such as both the preamplifier and power amplifier, and sometimes CD players as well, so that the signal does not have to be converted multiple times from single-ended to balanced or vice versa. The complexity, cost, and potential incompatibility with existing single-ended components is frequently the focus of anti-balanced commentary among audiophiles. "As [my boss] said to me several years back," Aaron told me, "it is very hard, very difficult to make a bad sounding tube amplifier. But it is much more difficult to make a top-sounding preamplifier, because you can't do shortcuts. You need to... have the best possible parts, and simpler circuitry. And that's why we have never offered balanced technology."

> The bad part with [balanced] is you have to double up the circuit. So that means you either... the costs will go up tremendously, almost double, or you can use less-costly parts

[40] The ability of differential amplifiers to reject noise is referred to as "common mode rejection ratio" or CMRR. The process of amplifying only the difference between the two audio signals also results in a 6dB increase in gain in balanced circuits over single-ended circuits. Harley, *The Complete Guide to High-End Audio*, 363-366; Glenn White, *The Audio Dictionary* (Seattle: University of Washington Press, 1991), 28-29; Martin Colloms, "Balance: Benefit or Bluff?" *Stereophile* **17**, 11 (November 1994): 77-81.

> and stay the same. And when do you need balanced? If you have more than 30 feet of interconnect, if you live under a TV tower, or RF tower, you can pick it up. But, for the common customer in his environment in the house, it means nothing. You double up the circuit, you double up the volume controls. Instead of having two volume controls, you have to have four. And if you take [our] preamplifier that is so filled inside with these big [capacitors], if we should do that balanced, you would have to have two chassis, and that would double the price.[41]

As Aaron suggested, because the audio signal is carried over two wires and phase inverted on one side, the signal must pass through separate, identical circuits to reach the output. This "doubling up" of the circuitry is viewed by some audiophiles as inconsistent with a high-end audio engineering ethos that values simplicity in circuit design. "If you take a company," Aaron said, "and you say to [the engineers], 'Build me a tube preamplifier balanced, and build me one single-ended, with exactly the same parts quality,' I bet you can't hear any difference. The single-ended may sound better because it has fewer parts."[42] Balanced operation also became a marketing buzzword when more balanced equipment began to appear in the 1990s, sparking further suspicion. "Market pressures are so great," wrote *Stereophile* reviewer Martin Colloms in 1994, "that, much against their better judgment, a number of designers are succumbing to the demand for balanced equipment, passing the extra cost on to their customers."

> For example, I know of a fine D/A processor that delivers superb sound quality in its normal form. One of its primary virtues is its very short signal path following the DAC chip, which the designer refused to sully with the usual, compromised, tacked-on balanced output amplifier. To maintain sound quality in the market-mandated balanced form, the designer was driven to replicate the entire DAC chain, driving the second DAC with a non-invasive, inverted digital data signal in order to achieve the pair of audio outputs for balanced working. It almost doubles the cost of the decoder, with no perceptible audible benefit.

"There's no reliable proof," he wrote, "that an audio system with balanced connections sounds any better than a well-designed normal system."[43] He further criticized the use of balanced

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[41] Interview, 09/07/07. Aaron's reference to two volume controls in a single-ended preamplifier refers to the fact that the volume of the right and left channel signals in a stereo preamplifier are handled by separate circuits controlled by a single volume knob.

[42] Ibid.

[43] Colloms, "Balanced: Benefit or Bluff?" 78, 77.

circuits for making systems building more difficult for audiophiles who already had single-ended components in their audio systems.

The popularity of balanced operation in the 1990s also led to suspicion of products that were labeled as balanced, but were not in fact "truly" balanced. Aaron described these products as "BS balanced," meaning that instead of being balanced from input to output, they were single-ended products that used a phase splitting device on the input to convert an unbalanced signal to a balanced signal, then performed the reverse operation on the output. Performing the splitting and summing operations on single-ended circuits adds what Colloms referred to as "messy, potentially sound-corrupting conversion buffer/amplifiers at the inputs and outputs," and as such components with these configurations are generally felt to be poor substitutes for either truly balanced or high-quality single-ended designs.[44]

But balanced operation also has many adherents, and the mid-to-late 1990s proved to be a fruitful period for components with this design. Companies such as Audio Research, Krell, Rowland Research, and others offered balanced preamplifiers and power amplifiers that could be used with either balanced or single-ended source components. One company that started operations during this period based its entire design philosophy – and its name – on the superiority of balanced operation in preamplifiers and power amplifiers. Balanced Audio Technology was founded by Victor Khomenko and Steve Bednarski in 1994. In an interview with Khomenko and Bednarski in 1995 with *Stereophile* reviewer Robert Deutsch, Khomenko, an engineer with expertise in instrumentation design, recalled some early discussions with Bednarski when they both worked for Hewlett-Packard: "One day, Steve came to me and told me

[44] Ibid., 78.

he'd bought a preamplifier that sounded really good, and featured something very unusual: a balanced circuit. My immediate response was, 'But that's the only right way to build a circuit.'"[45] Intrigued, Khomenko set about designing and building his own balanced preamplifier. When it was complete, he invited Bednarski over to compare Bednarski's preamplifier with his home-grown design. "I've never been so embarrassed by the performance of something that I had been quite proud of as when I compared my preamp with Victor's," Bednarski recalled. "And that, for both of us, was the starting point of conceiving this as a business."[46]

Although Khomenko's prototype design was impractical from a cost standpoint, he was undeterred by the cost issues associated with producing balanced equipment cited in the high-end audio press. In response to a question from Deutsch regarding cost, Khomenko rejected the idea that balanced equipment always had to cost double that of single-ended designs.

> If you look at the parts cost of the Khomenko-5 [preamplifier], a fully balanced differential design, it's not substantially higher than many single-ended designs. There are many different ways of building balanced circuits... You can make a very simple and elegant design in balanced. The design philosophies [of balanced and single-ended] overlap tremendously. Balanced differential stages are commonly used in single-ended components as well. Our approach has always been of utmost simplicity. I was taught very early in my career that a good engineer is a lazy engineer—you can't be a good engineer if you make something very complicated; it probably won't work very well or be very reliable.[47]

Bednarski and Khomenko also took the somewhat unusual step of issuing a series of white papers about their preamplifier and power amplifier designs, explaining their design philosophy. The white paper for the VK-5 preamplifier addressed the question of balanced versus single-ended topologies directly. "Attempts have been made in various publications at explaining the sonic superiority of balanced topology," they wrote.

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[45] Robert Deutsch, "BAT men: Victor Khomenko & Steve Bednarski," *Stereophile* **18**, 12 (December 1995), available from http://www.stereophile.com//interviews/767/ (Accessed 06/12/07).

[46] Ibid.

[47] Ibid.

> For lack of a better handle, authors concentrated on the enhanced noise immunity and high common mode rejection ratio (CMRR) of such circuits. All our experience indicates that this is a great oversimplification. Such explanations do not even begin to clarify why the overall sound quality improves from switching to balanced, not just the noise aspects. There is still no reliable evidence that the CMRR is the reason for the balanced topology's virtues in audio systems... Then, how do we know that balanced is superior? We listen. We believe it is better to admit that we don't understand something than to provide a pseudo-scientific explanation. We build better and better balanced circuits and hear the music. We rejoice.[48]

Since the late 1980s and early 1990s, an increasing number of electronics manufacturers have offered balanced operation for their preamplifiers, power amplifiers, and CD players. Given the association between balanced operation and the "professional" domain of audio, and the association between single-ended and "consumer" audio, it could be argued that the appeal of balanced equipment for high-end audio enthusiasts comes at least in part from a desire for exclusivity and connection with a more technically-sophisticated and engineering-oriented side of the audio world.[49] But as Bednarski, Khomenko, and other designers argue, there are indeed benefits from the use of balanced circuits that result in noticeable sonic improvements for home audio systems, as well as aspects of balanced versus single-ended operation that cannot be readily explained in engineering terms. This combination of measurable technical performance and subjective aesthetic performance is a significant part of what keeps the high-end audio hobby interesting for enthusiasts.

Power Amplifiers

Following the preamplifier in the signal chain, and frequently also designed to operate with balanced connections, is the power amplifier. The power amplifier can be thought of as the engine of the audio system, supplying the necessary energy to the audio signal coming from the

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[48] Balanced Audio Technology, VK-5 White Paper, 4

[49] Harley notes that balanced connections are often referred to as "professional" connections to "differentiate them from 'consumer' unbalanced jacks." Harley, *The Complete Guide to High-End Audio*, 363.

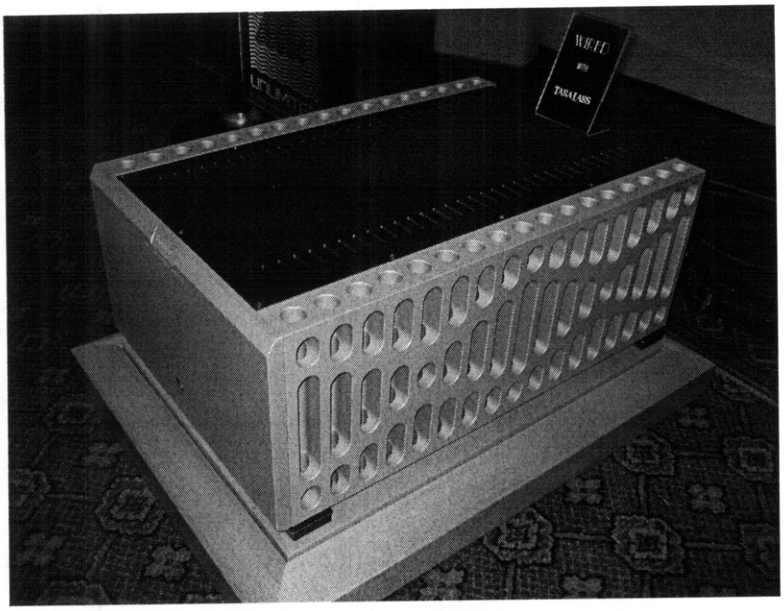

Figure 2.16 - A solid-state mono power amplifier from Boulder Amplifiers (Rocky Mountain AudioFest, 2007).

preamplifier to drive the loudspeakers. Like other components in an audio system, power amplifiers come in many configurations based on a variety of different devices and circuit designs. These configurations bear on the overall performance of the audio system in several ways, including output power and distortion. Power amplifiers have also been at the center of debates not only about the virtues and vices of vacuum tubes and solid-state transistors, but more broadly about measured specifications versus subjective evaluation. As a device that performs only one basic function – boosting the incoming signal – one might assume it would be the least complex or controversial of all the components in an audio system. But power amplifiers are more complicated than their often featureless front panels might suggest, and have been the subject of significant debate (see chapters 4 and 5).

Power amplifiers have a variety of measurable attributes that correspond with their electrical and sonic performance. Among them are bandwidth, linearity, efficiency, and dynamic range. Bandwidth refers to the frequency range at which the amplifier can output a signal without significant (and audible) loss of power. Many power amplifiers have bandwidth

capabilities which exceed the range of human hearing.[50] Linearity refers to the relationship between the input signal and the output signal. An ideal power amplifier would be perfectly linear, in that the ratio between input and output would always be the same. In reality no power amplifier is perfectly linear, and deviations from linearity are heard and measured as distortion in the output signal. Additionally, if the input signal is increased beyond the power amplifier's output abilities, the waveform of the signal is clipped, which also creates distortion. Efficiency corresponds to how well a power amplifier converts AC power from a wall socket into power output to the loudspeakers. Some power amplifier are inefficient, but produce excellent, low distortion sound (discussed in detail below). Dynamic range is the difference between the smallest and the largest output a power amplifier is capable of without signal loss to either noise or clipping distortion.[51] There are a

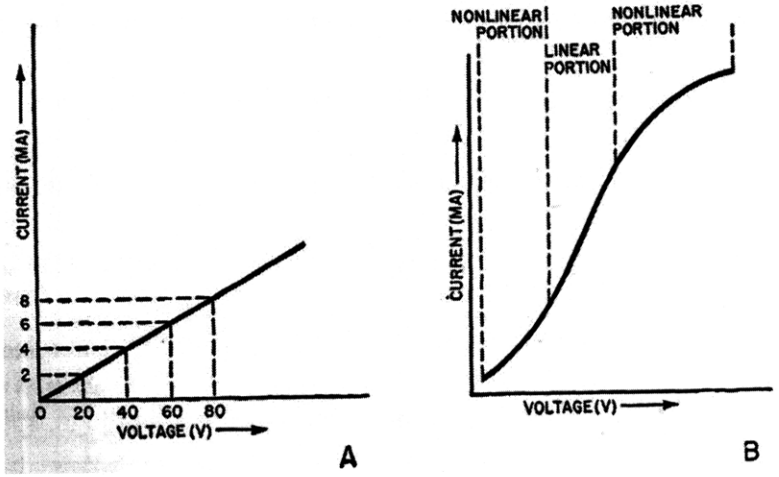

Figure 2.x - Graph A represents a perfect "linear" amplifier voltage-to-current relationship, while Graph B shows a more typical voltage-to-current relationship, in this case for a vacuum tube. Engineers design power amplifiers to operate within an amplification device's linear region, a process known as "biasing" (from Department of the Army and the Air Force, *Basic Theory and Application of Electron Tubes*, pg. 26).

[50] For example, the Hyperion HT-88 monoblock vacuum tube amplifiers reviewed in the January 2009 issue of Stereophile have a measured bandwidth of 20 Hz to 43 kHz. Art Dudley, "Hyperion HT-88 Monoblock Amplifier," *Stereophile* **32**, no. 1 (January 2009): 117-129, on 117.

[51] Useful definitions and additional detail of each of these terms can be found in White, *The Audio Dictionary*, 30-31, 184-185, 113-114, 110, and the discussion of power amplifiers on 256-259.

variety of other attributes that affect the sound from a power amplifier, particularly those having to do with its response to the loads presented by loudspeakers.[52]

Power amplifiers include input jacks for the audio signals from the preamplifier, plus positive and negative terminals for loudspeaker cables. Loudspeaker terminals on a power amplifier are referred to as "binding posts," and most binding posts can accommodate a variety of loudspeaker cable jack types, including banana plugs, spade lugs, or (less common in high-end audio) bare wire. Some power amplifiers allow users to change operational parameters, such as the amplification characteristics or "bias" of the output stage, or the amount of negative feedback used in the circuit. Negative feedback refers to the addition of a small amount of the output signal, in a mirror-image or "phase inverted" state, back into the input stage. This can reduce distortion and improve the linearity of the amplifier, but also flattens the overall frequency response, which can be detrimental to a music signal.[53] Vacuum tube-driven power amplifiers also often feature adjustments to ensure optimal performance and life-span of the tubes, although many modern tube-driven amplifiers perform these functions automatically.[54] Most power amplifiers, however, do not have many, if any, user-controlled features.

Beyond these common characteristics, high-end power amplifiers come in three primary varieties: stereo amplifiers, integrated amplifiers, and monoblock amplifiers.[55] Stereo amplifiers

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[52] Loudspeakers generally present power amplifiers with loads that change based on the frequency of the incoming signal. In some loudspeakers, these changes are dramatic enough to make it difficult for some power amplifiers, particularly those with low output power, to keep up. Additional detail regarding debates about measured versus observed performance of power amplifiers can be found in Chapter 4.

[53] White, *The Audio Dictionary*, 218-219. Some audiophiles attribute the poor sound quality but excellent distortion measurements of early solid-state amplifiers to the use of substantial amounts of negative feedback.

[54] Adjustment of vacuum tube behavior is also referred to as "bias."

[55] These are the common types for two-channel (stereo) audio systems. Home theater systems often use "multichannel" power amplifiers for Dolby 5.1 or 7.1 soundtracks that include surround sound channels.

include the electronics necessary to amplify and output both the left and right channels of the audio signal from the preamplifier in a single chassis. Some stereo amplifiers are designed so both the left and right channels share the same circuit and power supply, while other designs have separate power supplies and circuits for each channel, known as "dual mono" designs. Integrated amplifiers are the most compact of the three varieties, and include not only a stereo power amplifier but also the preamplifier circuitry and associated volume and source selection controls in a single chassis, obviating the need for a separate preamplifier. Until fairly recently, integrated amplifiers were considered the least desirable of the three types, but several high-end audio firms design integrated amplifiers that have received very positive reviews from the enthusiast press, including Pass Labs, Naim, and NAD. Monoblock designs amplify and output only one incoming audio signal, and must be used in pairs in stereo audio systems. The advantages of monoblock designs include greater power supplied to each loudspeaker than is often possible with a single-chassis stereo amplifier, and reduced inter-channel interference. The drawbacks include the increased expense associated with an additional chassis, circuit, and power supply, and the need for more space to accommodate both amplifiers. Some stereo amplifiers can be converted to mono operation and used with a twin amplifier in a monoblock configuration.

Power amplifiers generally consist of four main parts: the input stage, the driver stage, the power supply, and the output stage. The input stage supplies the initial voltage increase to the signal received from the preamplifier, and the driver stage supplies the amplified voltage signal to the devices in the output stage. But in most power amplifier designs, the most crucial aspects, and those which receive the most attention from engineers and reviewers, are the power

supply and output stage. Although power supplies are found in all components that require external power for operation, they are considered especially vital in power amplifiers. Power supplies have two separate but related jobs in an audio component: to convert the high-voltage power from a household supply circuit to the low voltages required by vacuum tubes or transistors, and also to convert the alternating current (AC) from household jacks to the direct current (DC) needed for the component's electronics – a process known as rectification.[56] Power supplies also contain capacitors that act as a reservoir of energy for moments when the power amplifier must output power beyond its normal capacity, such as with musical transients like bass drum hits, cymbal crashes, or high dynamic peaks in orchestral performances. The ability of a power amplifier to supply current to loudspeakers for normal-level musical passages as well as sudden changes in dynamics is directly related to the power amplifier's power supply.[57]

The output stage of a power amplifier is the most often discussed and debated within the high-end audio community by engineers and non-engineers alike.[58] The output stage of the power amplifier is the final stage, converting the fluctuating voltage of the audio signal to a fluctuating current signal that can drive the loudspeakers. Output stages can be designed with a

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[56] An important distinction concerns the difference in signal type between power used to run the amplifier's circuitry, and the form of the signal being amplified. While DC is what allows an amplifier to operate, the audio signal itself is an alternating current signal, although it is not alternating at a constant or near-constant rate as does the alternating current used for household power from wall sockets. Rectification, particularly related to vacuum tube circuits, is described in Chapter 5.

[57] Harley, *The Complete Guide to High-End Audio*, 182.

[58] One of the concerns often expressed about power amplifier design concerns the use of capacitors between different stages of an amplifier to block unwanted direct current from reaching the loudspeakers, which can cause damage. Such capacitors, however, are thought to degrade the quality of the audio signal, particularly in the high frequencies (as Stereophile reviewer Dick Olsher noted in a review of the Airtight ATM-2 power amplifier in 1990, "we all know that the best capacitor is no capacitor.") Engineers have experimented with a variety of different circuit designs to minimize or eliminate the detrimental effects of capacitors in these parts of an amplifier, including the use of metal foil capacitors that can discharge more quickly than electrolytic capacitors, or designing without capacitors between the stages (known as 'direct coupled' designs) that then require additional circuitry in the output stage to prevent DC from reaching the loudspeakers. Dick Olsher, "Airtight ATM-2 power amplifier," *Stereophile* **13**, no. 5, (May 1990): 111-115, on 111. See also Harley, *The Complete Guide to High-End Audio*, 184.

variety of output devices, including vacuum tubes, bipolar transistors, other types of transistors such as MOSFETs, or some combination.[59] The greater the number of output devices, the greater the amount of current that can be supplied to the loudspeakers, but also the greater amount of power necessary from the power supply. The efficiency of this stage of a power amplifier – how much of the supplied power is actually delivered to the loudspeakers versus how much is converted to heat – depends on how the devices in the output stage have been configured to operate. Output stages of power amplifiers are often designated by "classes."[60] The most commonly used classes for audio amplifiers are Class A, Class AB, and Class D.[61]

Class D circuits are a relatively new type of circuit in high-end audio. Class D amplifiers are the most efficient of all the different classes and produce very little heat, and therefore are

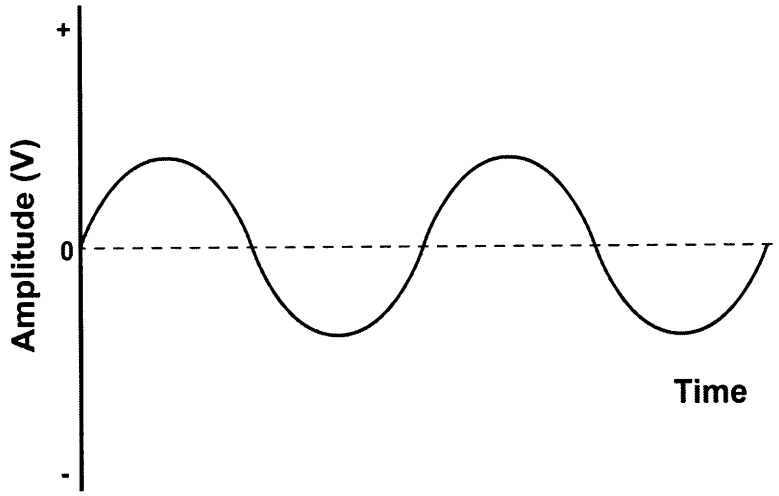

Figure 2.17 - A sine wave.

[59] "MOSFET" stands for "metal-oxide-semiconductor field-effect transistor." Field-effect transistors use electric fields to control conductivity. They are different in operation than bipolar transistors, and within the high-end audio community, MOSFETs are considered superior in sound to bipolar transistors.

[60] White, *The Audio Dictionary*, 256-259.

[61] Some Class A amplifiers are also commonly referred to as "single-ended," and amplifiers with more than one output device operating in Class A are called "push-pull". To avoid confusion with the previous discussion of single-ended versus balanced circuit topology, these designations are not used here, and these amplifiers are simply referred to as Class A.

used in devices like laptop computers. To illustrate the operation of a Class D amplifier, it is helpful to look at it in terms of Class A operation. In a Class A amplifier, the entire audio signal (shown in Figure 2.17 as a simple sine wave) is amplified by each device in the output stage, as illustrated in Figure 2.18.

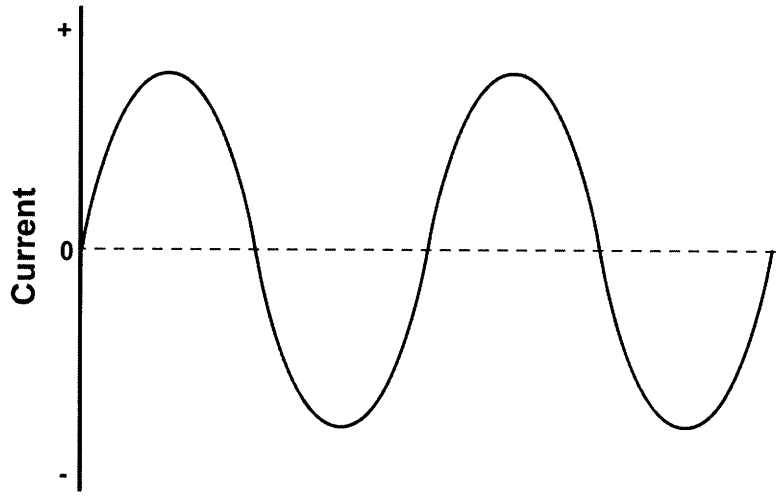

Figure 2.18 - Class A amplification.

In a Class D amplifier, the incoming audio signal modulates the width of full-amplitude pulses that repeat at a frequency much higher than the highest audible frequencies in the audio signal, as shown in Figure 2.19.

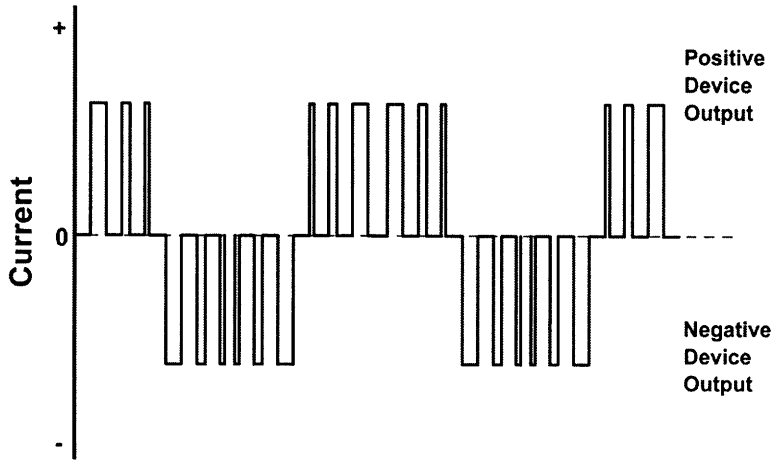

Figure 2.19 - Class D amplification.

The pulses are fed to the output devices which are then switched all the way on or all the way off in accordance with the width of each pulse. The resulting current signal is filtered to produce a smooth signal to the loudspeakers.[62]

Class D amplifiers have presented a new set of questions in recent years due to their distinct sound, and the manner in which they are designed. Unlike other amplifier designs where the engineer designs the input, driver, and output stages, as well as the power supply, the output stages of Class D amplifiers are most often sourced from other companies. The reason for this is that the need to precisely control the rapid on/off switching of the transistors requires extremely high precision and a different method for mounting the various parts to the circuit board; traditional "through-hole" circuit boards introduce tiny amounts of stray capacitance that can prevent a Class D output stage from functioning.[63] At present, a variety of Class D power amplifiers are available from several high-end firms, including long-standing companies such as Audio Research, Cary Audio, and Rowland Research. In a 2006 discussion among amplifier designers, Jeff Rowland of Rowland Research, whose solid-state power amplifier designs received accolades in the high-end audio community in the 1980s, told *The Absolute Sound*'s Robert Harley that he was "quite astounded" by the performance he was able to achieve with Class D designs. He also observed that the high efficiency of Class D made it "green" technology, which appealed to him.[64] But designer Dan D'Agostino of Krell, known for his powerful Class A and Class AB power amplifiers, responded that his experience with Class D

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[62] White, *The Audio Dictionary*, 258.

[63] Robert Harley, " Class D Power Amplifiers: A Technology Primer," *The Absolute Sound*, no. 166 (November 2006): 74-78, on 78.

[64] Robert Harley, Jeff Rowland, Dan D'Agostino, Bruno Putzeys, "Designer's Roundtable," *The Absolute Sound*, no. 166 (November, 2006): 80-84, on 80.

was "significantly different" than what Rowland had observed. "We can't get anything in the switching domain to sound anything like what we build in the linear domain," he said, "nor have the power, the presence, the staging, or any of those things."

> We attribute this to the fact that the technology isn't finished – the devices aren't fast enough and the filter technology is not ideal for every speaker system that's out there. We basically have come to a conclusion that switching technology doesn't even remotely approach what we're doing in the linear domain.[65]

Not unlike early CD players, discussed in Chapter 6, some designers and audiophiles find Class D technology attractive and full of promise, but from a systems standpoint it can be challenging to integrate with their existing components. In a sidebar to a 2006 review of the NuForce Reference 9 Special Edition Class D power amplifier in *The Absolute Sound*, reviewer Wayne Garcia noted that "more than any other amp in this survey the NuForce is going to generate controversy."

> My colleague Chris Martens is crazy about it, our [Editor in Chief] Robert Harley thinks it's pretty good, and I think it's terrible. To my ears – and in my system, which seems to be critical of some of these [Class D amplifiers] – this amplifier is not transparent; it's cold and clinical with that kind of false "clarity" that fools us into thinking it's transparent when it really isn't.[66]

"[My] experience suggests that Class D amplifiers are highly load dependent," Donald, an equipment reviewer, told me.

> Some amplifiers sound fabulous on one speaker and a really bad on another speaker... I think [radio frequency interference], cabling, and the loudspeaker load are the underlying cause for a lot of the disparity in opinion of class D... It's so young that we don't really have a grasp on it. Class D can sound great, or it can sound bad.[67]

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[65] Ibid.

[66] Wayne Garcia (sidebar), "NuForce Reference 9 Special Edition," *The Absolute Sound*, no. 166 (November 2006): 97.

[67] Interview, 03/11/07.

Loudspeakers

At the end of the signal chain in an audio system are the loudspeakers. Loudspeakers vary greatly in terms of size, shape, materials, appearance, and sonic character. As discussed in Chapter 4, loudspeakers are one of the few components in the audio system that all audiophiles, whether subjectively- or objectively-oriented, agree must be heard in a real-world environment in order to be assessed for quality. Measurements of loudspeakers, in other words, rarely provide a sufficient level of detail about how a loudspeaker will sound. Since they are often the largest components in the system, loudspeakers also tend to be the focus of greater concern for integrating audio systems into home environments, and are frequently the subject of disagreements between audiophiles and their spouses (see chapter 3). Marcus, a high-end audio salesman, laughed as he told me, referring to a brand of especially large horn loudspeakers, "it's a divorce that just happened or is waiting. We've told people occasionally, you know, jokingly, 'if you really want to get out of your marriage, we have some stuff.'"[68] Beyond concerns related to physical integration, loudspeakers are also the components in an audio system that interact the most with the listening environment: significant variables include the shape and size of the room, the position of the loudspeakers relative to the walls, and the other objects in the room. Given these variables, loudspeakers can be difficult components to work with. As Paul, a shop owner, told me, "speakers are ugly things."

> They're the least satisfying piece of audio equipment you can buy. And that has to do with a number of things that I've discovered. First, they certainly are the things that have the most distortion. They are the things which actually seem to change over time the most. And I have a theory that you tend to get... most speakers are very colored, and you tend to get used to the sound and want something new. So one of the ways you know whether you bought a speaker that's pretty neutral is that you don't really feel any

[68] Interview, 05/02/07.

> need to change it. You want to change things going to it. That's been very rare in my experience.[69]

Virtually all loudspeakers operate by converting fluctuating current into mechanical motion, which creates disturbances in the air that we perceive as sound. How this is achieved varies significantly among the common loudspeaker designs in the high-end audio industry. There are, however, several commonalities that nearly all loudspeakers share. The first of these concerns how the incoming audio signal from the power amplifier reaches the drivers, or the devices which perform the conversion from electric signal to mechanical motion. In a typical loudspeaker, the signal from the power amplifier first encounters a circuit known as a crossover. The crossover divides the signal according to frequency, and sends the divided signal to the appropriate driver, as shown in Figure 2.20.

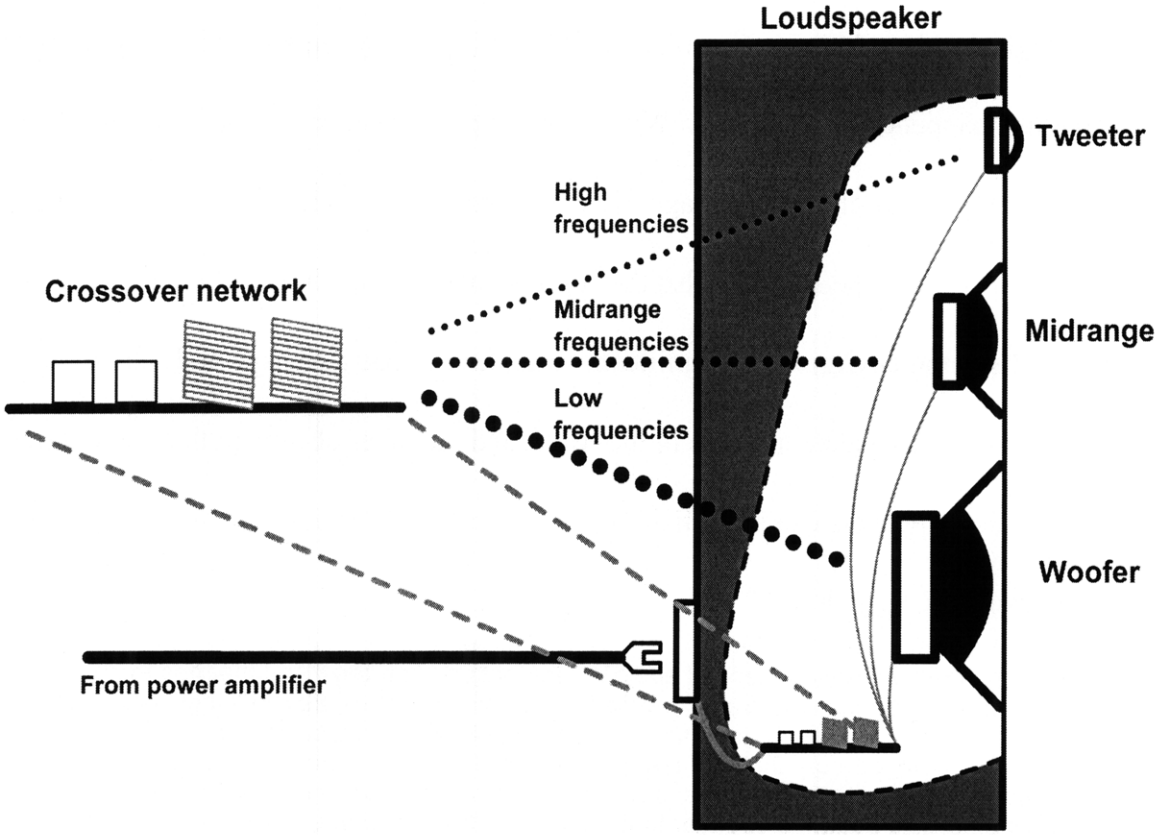

Figure 2.20 – In a typical loudspeaker, the crossover is responsible for splitting and distributing the audio signal to the drivers based on frequency using resistors, inductors, capacitors, and sometimes other electronic components.

[69] Interview, 05/31/07.

In Figure 2.20, the loudspeaker has three drivers: a "tweeter" for high-frequencies, a mid-range driver for mid-range frequencies, and a "woofer" for bass frequencies. Crossovers act as filters that direct the bass frequencies to the woofer, the high-frequencies to the tweeter, and midrange frequencies to the mid-range driver.[70] The design of the crossover is a key element in loudspeaker performance. Each driver has a range of frequencies that can be reproduced with the least distortion, and frequencies falling outside of that range are either very distorted or impossible for the driver to reproduce (for example, a tweeter is physically incapable of producing bass frequencies). Loudspeaker designers must therefore build the crossover to match the driver's frequency response capabilities, while at the same time ensuring a seamless integration between the different drivers. Crossovers are also one source of the loudspeaker's impedance, or resistance to being driven, and the crossover's design and the components used to build it have a significant effect in this regard.

Figure 2.21 - Dynamic loudspeakers from Wilson Audio (Festival Son et Image, Montreal, 2007).

In addition to impedance, another common specification given for loudspeakers is their sensitivity, or how much sound pressure the loudspeaker can produce when supplied with a signal of specific strength. Loudspeaker sensitivity is measured by

[70] This description is of a a "passive" crossover, which acts purely as a filter. Some loudspeaker systems use "active" crossovers, which supply amplification in addition to filtering, although this is rare for most home audio loudspeakers.

supplying the drivers with one watt of power and measuring the resulting sound pressure level at a distance of one meter from the front of the loudspeaker. Sensitivity measurements appear in specifications in decibels, or dB – for example, 86dB sensitivity means that the loudspeaker produced 86 decibels of sound pressure at one meter when supplied with a one watt signal. In general, the more sensitive the loudspeaker, the less power is required from the power amplifier to produce a given level of sound pressure. In other words, loudspeakers with high sensitivity measurements, such as 100dB or greater, can play very loud with low-powered power amplifiers.

High-end loudspeakers primary come in three varieties based on the driver type: dynamic, electrostatic, and planar magnetic.[71] Dynamic loudspeakers are the most typical and generally use the familiar cone-type drivers, as shown in Figure 2.22. These drivers consist of a cone made from semi-rigid material (everything from paper to polypropylene to aluminum)

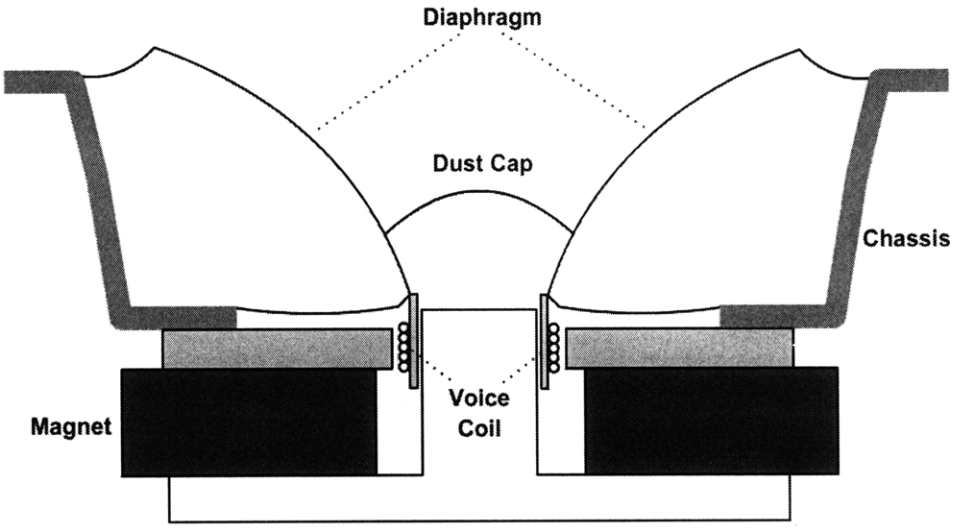

Figure 2.22 - A dynamic driver assembly (adapted from Martin Colloms, *High Performance Loudspeakers*, pg. 210.

[71] Some high-end loudspeakers are based around horn designs. Horn loudspeakers resemble the horns on old Victrola record players, where a flared enclosure is capped on one end with a compression driver and is open to the air on the other end. Horns are sometimes used in conjunction with dynamic drivers to provide treble and mid-range reproduction, but in general are not used for bass frequencies. Although horns have a variety of characteristic distortions, they are extremely efficient. For examples of modern horn loudspeaker designs, see the German firm Avantgarde Acoustics webpage at http://www.avantgarde-acoustic.de/hornlautsprecher.php?lang=en. See also White, *The Audio Dictionary*, 162-163.

attached to a coil of wire, known as the voice coil, that is suspended inside of a permanent magnet. The crossover sends a signal through the voice coil, generating a fluctuating magnetic field that interacts with the field generated by the permanent magnet. This interaction causes the voice coil and cone to move back and forth, creating sound pressure waves in the air. Dynamic loudspeakers are the simplest of the three designs, and have the advantage of being able to play loudly, often with high efficiency. But because dynamic drivers are virtually always mounted inside of cabinets, resonance problems can produce what many audiophiles describe as a "boxy" sound.

Electrostatic designs use a thin, lightweight membrane of resistive material, such as Mylar, suspended between two electrostatically charged surfaces, or stators (shown as a cut-away drawing in Figure 2.23). The membrane itself is charged with extremely high voltages, creating a uniform electrostatic field.[72] The incoming audio signal modulates the electrostatic fields created by the stators on either side of the membrane, causing the membrane to move quickly back and forth, creating sound waves. Although on the surface electrostatic designs appear more technically complex than dynamic designs, small electrostatic loudspeakers appeared in radio

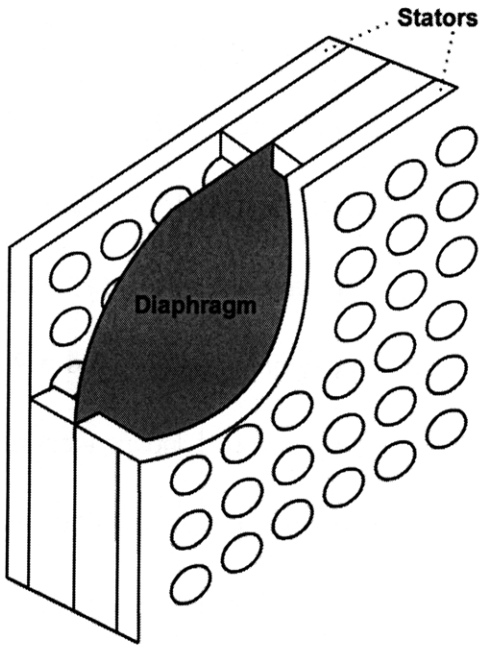

Figure 2.23 - A cut-away diagram of an electrostatic driver, showing the stators and the diaphragm (adapted from Martin Colloms, *High Performance Loudspeakers*, pg. 88).

[72] In one of the most famous electrostatic designs, the British Quad ESL-63, the diaphragm was charged to 5000 volts. For further technical details, see Julian Hirsch, "Quad ESL-63 Speaker System," *Stereo Review* **47**, no. 8 (August 1982): 28-30.

receivers as early as the 1930s. Design of high-fidelity electrostatic loudspeakers was for many years hampered by limitations in diaphragm materials, as few materials offered the light weight and rigidity necessary to create low-distortion sound. But in 1956, Peter Walker of the British hi-fi firm Quad released that company's first electrostatic loudspeaker, the Quad ESL, which had an enormous impact on the hi-fi and eventually the high-end audio communities.[73] Further designs by Quad and by companies such as Janszen, KLH, Stax, Acoustat, Sound Labs, and Martin-Logan maintained electrostatic loudspeaker design as an area of significant experimentation and innovation in the decades following the release of the original Quad ESL.

The high voltages required by the membrane and the stators means an additional supply of AC power is necessary for electrostatic loudspeakers, unlike dynamic designs, which generally do not require external power. The stators are perforated to allow passage of the sound waves generated by the membrane, which results in the radiation of sound waves on both sides of the membrane. This makes electrostatic designs dipolar, as opposed to dynamic loudspeakers, which radiate in only one direction.[74] Given their dipolar characteristics, and the fact that a flat, large membrane generates the sound waves as opposed a smaller, cone-shaped dynamic driver, the sound of electrostatic loudspeakers tends to be quite different from dynamic loudspeakers. In particular, many audiophiles feel that electrostatic designs do a superior job of conveying what Robert Harley describes as the "correct size of instrumental images."[75] Their panel construction also eliminates the "boxy" sound of some dynamic loudspeakers. But electrostatic loudspeakers

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[73] The original Quad electrostatic loudspeaker used a material similar to Mylar. For a retrospective look at (and listen to) the Quad ESL loudspeaker and the history of electrostatic designs, see Dick Olsher, "The Original Quad ESL," *Stereophile* **10**, no. 5 (August 1987): 165-169.

[74] For this reason, dynamic loudspeakers are sometimes referred to as "point source" loudspeakers.

[75] Harley, *The Complete Guide to High-End Audio*, 213.

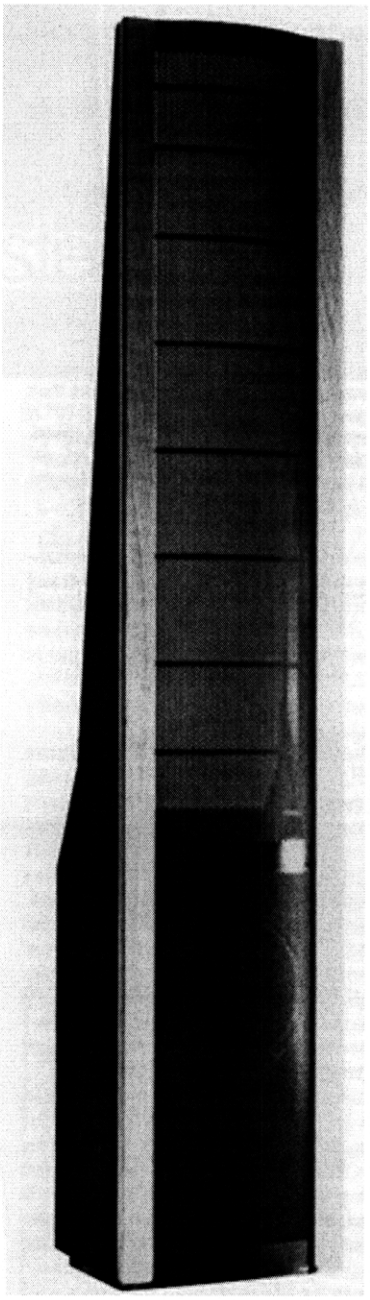

Figure 2.24 - A Martin-Logan Sequel II electrostatic hybrid loudspeaker (from *Stereophile* **12**, no. 8, August 1989, pg. 114). Used with permission.

also tend to be less sensitive than dynamic loudspeakers, requiring more powerful power amplifiers. Dynamic loudspeakers are also better at reproducing bass frequencies than electrostatic designs. Some firms, such as Martin-Logan, compensate for this by building "hybrid" electrostatic loudspeakers (as shown in Figure 2.24) where the mid-range and treble frequencies are handled by electrostatic panels, and the bass frequencies by dynamic woofers, all in the same enclosure.[76]

Planar magnetic loudspeakers are similar to electrostatics in that both involve moving a flat diaphragm to produce sound, and both come in large panel configurations. While they share certain sonic qualities, their operation is quite different. As shown in Figure 2.25, planar magnetic loudspeakers come in two driver varieties: the "ribbon" driver and "quasi-ribbon" driver. Ribbon drivers are strips of metal suspended between two permanent magnets. When an electrical current is fed through the metal strip, it creates an electromagnetic field that interacts with the magnetic field created by the permanent magnets, causing the strip to move back and forth. This back and forth motion, as with electrostatic loudspeakers, generates sound waves. Quasi-ribbon design, found in the products of

[76] This method can create additional problems, however, surrounding the integration of the bass driver and the electrostatic panels. *Stereophile* editor and reviewer John Atkinson noted in his review of the Martin-Logan Sequel II electrostatic hybrid loudspeaker in 1989 that, despite the speaker's many virtues, "I was dissatisfied with the speaker's performance in the crossover region, the transition between the upper bass and the lower midrange." John Atkinson, "Martin-Logan Sequel II Loudspeaker," *Stereophile* **12**, no. 8 (August 1989): 113-123, on 122.

Magnepan, perhaps the most well-known manufacturer of planar magnetic loudspeakers, uses sheets of Mylar as the diaphragm onto which lengths of wire have been fastened. The sheets sit on top of a series of permanent magnets. The audio signal is fed through the wire, creating a fluctuating electromagnetic field that again interacts with the field created by the permanent magnets, creating sound waves.[77]

Like electrostatic loudspeakers, planar magnetic loudspeakers are dipolar, radiating sound from both the front and rear. Also like electrostatic designs, they have a reputation for being difficult to set-up, with dependencies on room interactions and listener position that are different from dynamic loudspeakers. Some designs create such a specific "sweet spot" in the listening room that if the listener moves their head in one direction or another, the sound changes significantly. In his review of the Acoustat X electrostatic loudspeaker system, J. Gordon Holt observed that the loudspeakers were very "beamy," meaning they concentrated their best sound almost like a spotlight at a certain listening position, and that to get the full potential from the loudspeakers, the listener had to remain seated. "If you habitually stand or perambulate when listening," he wrote, "these are not for

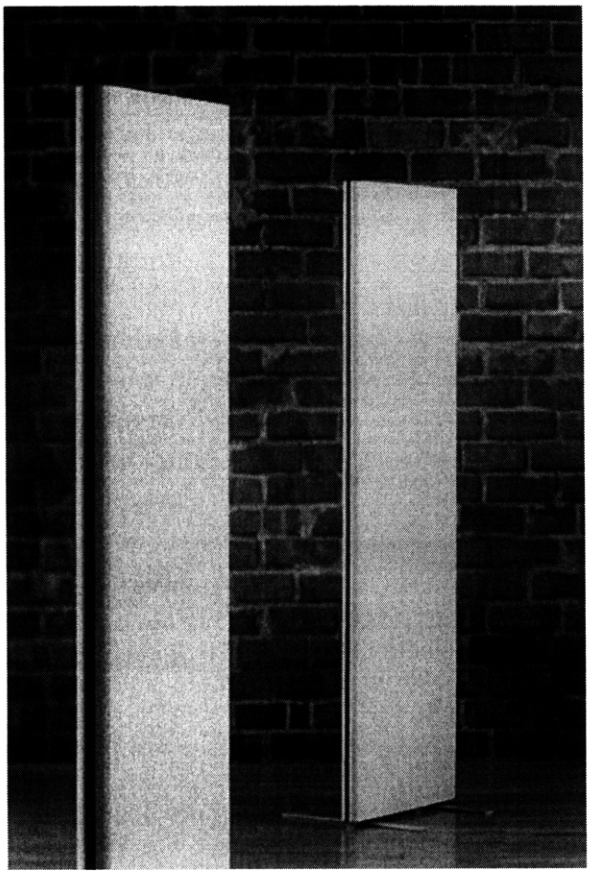

Figure 2.25 - Magnepan MG1.6 planar magnetic loudspeakers (from *Stereophile* **22**, no 1, January 1999, pg. 125). Used with permission.

[77] Harley, *The Complete Guide to High-End Audio*, 205-211,

you!"[78]

Still, electrostatic and planar magnetic loudspeakers elicit a type of excitement from audiophiles that is rarely expressed about dynamic loudspeakers. While many dynamic loudspeakers are acknowledged as excellent, a number of audiophiles described themselves as having especially powerful experiences with panel-type loudspeakers during their early experiences with high-end audio. For example, John, an equipment reviewer, described himself to me as an "electrostatic speaker guy," whereas virtually no one interviewed for this dissertation described themselves as "dynamic speaker guys."[79] Despite their shortcomings, electrostatic and planar magnetic loudspeakers, when properly set-up and integrated into an audio system, appear to have the ability to create powerful emotional experiences for audiophiles. Several interviewees mentioned that their first experiences with panel speakers were characterized by not realizing they were the source of the music they were hearing – in one case, the interviewee had first assumed the sound he heard must have been coming from a live instrument. Details of these experiences can be found in Chapter 3.

Set-up and the listening environment

"Question: What is it that almost every audiophile takes for granted, yet has more effect on the sound of his system than does any single component in that system?" J. Gordon Holt asked in a 1983 editorial entitled, "The Forgotten Factor." "Answer: his listening room." Holt believed, as did many others, that audiophiles' listening rooms and the arrangement of

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[78] J. Gordon Holt, "Acoustat X Speakers," *Stereophile* **4**, no. 3 (1982): 16-24, on 20. Robert Harley notes in his discussion of magnetic planar loudspeakers that this limited range of good sound results from the "very narrow vertical dispersion" of ribbon-type drivers, "meaning they radiate very little sound above and below the ribbon at high frequencies." Harley, *The Complete Guide to High-End Audio*, 209.

[79] Interview, 06/25/07.

components within them, particularly loudspeakers, were often sub-optimal. "It is probably safe to say that 95% of the systems in audiophile homes are being degraded by a bad listening environment," he wrote.

> Sound waves reflect from walls, floors, and ceilings, reaching our ears milliseconds after the direct sounds from the speakers and smearing those sounds. Echoes reverberate back and forth between parallel reflective surfaces, adding more smear and coloring the sound with spurious brightness or resonating bass hangovers. And reflections from side walls are heard as false stereo direction cues, impairing the accuracy with which a system reproduces instrumental locations.[80]

He placed much of the blame on décor, observing that "Danish Modern Sparse" would render a room "a veritable echo chamber," while "Overstuffed Homey" would disrupt the creation of a stereo image. But he recognized that most audiophiles would not be in a position to significantly modify their listening rooms, particularly because those rooms were often also living rooms and had to accommodate the needs of a family in addition to an audio system. He offered several tips for how audiophiles could improve the sound of their systems, and the characteristics of good rooms for audio, such as having a symmetrical shape but non-parallel room-boundaries to decrease problems with spurious sonic reflections.[81] Holt's message was an elaboration on many of the points he'd been making since the early days of *Stereophile* – namely that equipment for home audio reproduction was "designed to be used and listened to" in typical household rooms. Given Holt's preference for reviewing equipment's subjective qualities in a home set-up rather than evaluating specifications and performing bench-test measurements, the listening environment necessarily took on an important role.[82]

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[80] J. Gordon Holt, "The Forgotten Factor," As We See It, *Stereophile* **6**, no. 1 (January 1983): 3-4, on 3.

[81] Ibid., 4. In his book *Sound Reproduction: Loudspeakers and Rooms*, acoustics and loudspeaker design expert Floyd Toole observers that avoiding parallel surfaces in listening rooms does not reduce problems with unwanted resonances created by sound waves reflecting off room boundaries, and that rectangular rooms are ultimately preferable for their simplicity when it comes to proper loudspeaker placement. Floyd Toole, *Sound Reproduction: Loudspeakers and Rooms* (Burlington: Focal Press, 2008) 203-204.

[82] See Chapter 4 for details.

In general, audio systems are set up in a way that maintains consistent and symmetric distances between room boundaries – particularly back and side walls – and loudspeakers. Electronics and other associated equipment can be arranged according to the audiophile's preferences and the lengths of interconnect and loudspeaker cables available (in general, shorter cables are considered best, particularly for loudspeaker cables). Equipment is most often stored in free-standing equipment racks. Some products, such as those from Bright Star Audio, use shelves made from materials of varying density to eliminate vibration, which the company claims will improve component performance.[83] Gingko Audio, makers of vibration-control platforms for electronics and turntables, offers a white paper detailing the design and operation of their products, including measurements showing improved performance from a CD player using their platform compared with the same player on a shelf with no vibration control.[84]

Beyond the utility of various products to house and protect electronic components, loudspeakers are generally felt to require the greatest care in placement because they interact the most with the listening environment. The position of the listener is selected based on the room dimensions and characteristics of the loudspeakers' performance in the room, but in general is at least several feet away from and centered relative to the loudspeakers. As previously discussed, some loudspeakers – particularly panel designs – tend to impose limitations on the number of places in the room where the sound is the best, also known as the "sweet spot." Dynamic loudspeakers tend to be less problematic in this regard.[85]

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[83] See http://www.brightstaraudio.com/vibration_control_products.htm, accessed 01/07/09.

[84] Gingko Audio, "There's no such thing as 'Good Vibrations' when it comes to your high-end audio/video system!" (available from http://www.gingkoaudio.com/manuals/gingkowhitePaper.pdf, accessed 01/01/09).

[85] A detailed description of loudspeaker placement and other aspects of room set-up can be found in Harley, *The Complete Guide to High-End Audio*, 73-130. Floyd Toole's book *Sound Reproduction: Loudspeakers and Rooms* is devoted entirely to the science of loudspeaker/room interaction.

In the 1980s, both *The Absolute Sound* and *Stereophile* published detailed descriptions of the reviewers' listening environments to provide readers with context for reviewers' comments and guides for setting up their own systems. In the March/June 1981 issue of *The Absolute Sound*, each of the reviewers, including founder Harry Pearson (whose listening room is shown

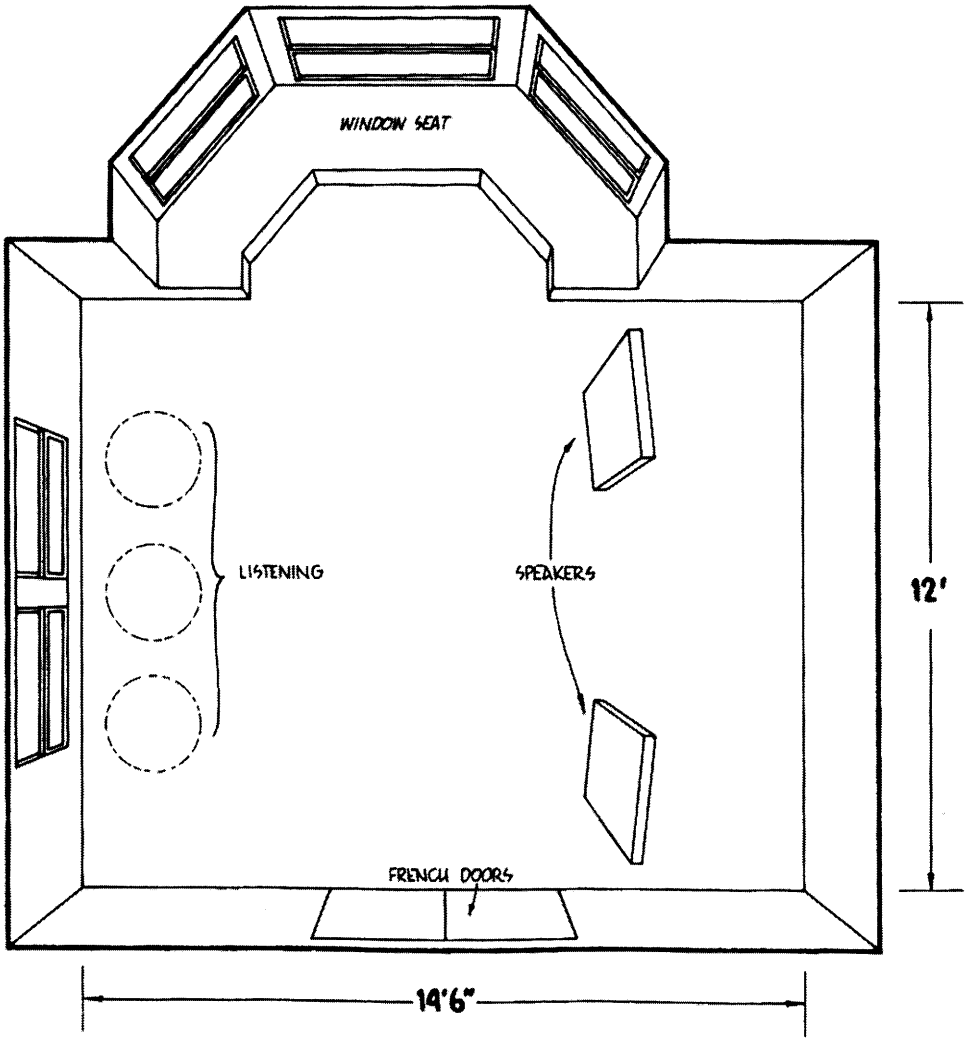

Figure 2.26 - Pearson's "Music Room #1" (from *The Absolute Sound* **6**,nos. 21 & 22, March/June 1981, 66).

in Figure 2.26), provided descriptions of their rooms and "reference systems" along with their "listening biases." "I do have some negative biases that should be disposed of at the beginning," wrote Pearson.

> Aberrations in the upper midrange and the lower highs (say, between 4000 and 8000 Hz) are the most difficult for me to live with for any period of time. Dips in this region (identifiable sonically by the absence of air and a darkening of instrumental harmonic

> structure) are just as oppressive to me as peaks (harshness, brightness, and the like) there. I also find high-frequency brittleness (the kind that comes from a resonance just within or above the audible range) exceedingly fatiguing.[86]

Stereophile followed suit in 1987 with slightly more detailed sketches of listening rooms, and additional discussion of the musical preferences of the magazine's reviewers. Holt provided a long list of symphonic music composers whose work he enjoyed, and noted that he also liked "jazz, most 'soft' rock, and some pop material," but "despise[d] with a passion all 'soul,' modern jazz, punk rock, and gospel hootin' and hollerin'."[87] Reviewer Ken Kessler, on the other hand, wrote that he listened to "everything except classical, opera, New Age, and ethnic music of the Polka/Irish dirge/Hungarian/Chinese/French, etc., variety."[88]

Holt's depiction of his own listening room, shown in Figure 2.27, included acoustic treatments from the firm Acoustic Sciences Corporation, called "Tube Traps." Tube Traps are made of acoustically absorbent material that eliminates unwanted reflections from the room surfaces, and fall into the category of "room treatment" products available from a variety of firms. Floyd Toole, former head of the Canadian National Research Council's acoustic sciences division, describes devices such as ASC Tube Traps as "solid, somewhat flexible, surfaces that remove energy by moving in response to sound pressure, and dissipating the energy mechanically."[89] A variety of firms have developed many different types of acoustic treatments,

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[86] Harry Pearson, "How to Read *The Absolute Sound*: The Reviewers Review Themselves," *The Absolute Sound* **6**, nos. 21 & 22 (March/June 1981): 66-67, on 66.

[87] Editorial staff, "A matter of Taste: *Stereophile*'s review team outline their taste in equipment, listening rooms, and music," *Stereophile* **10**, no. 1 (January 1987): 152-179, on 155.

[88] Ibid,. 163.

[89] Toole, *Sound Reproduction*, 219.

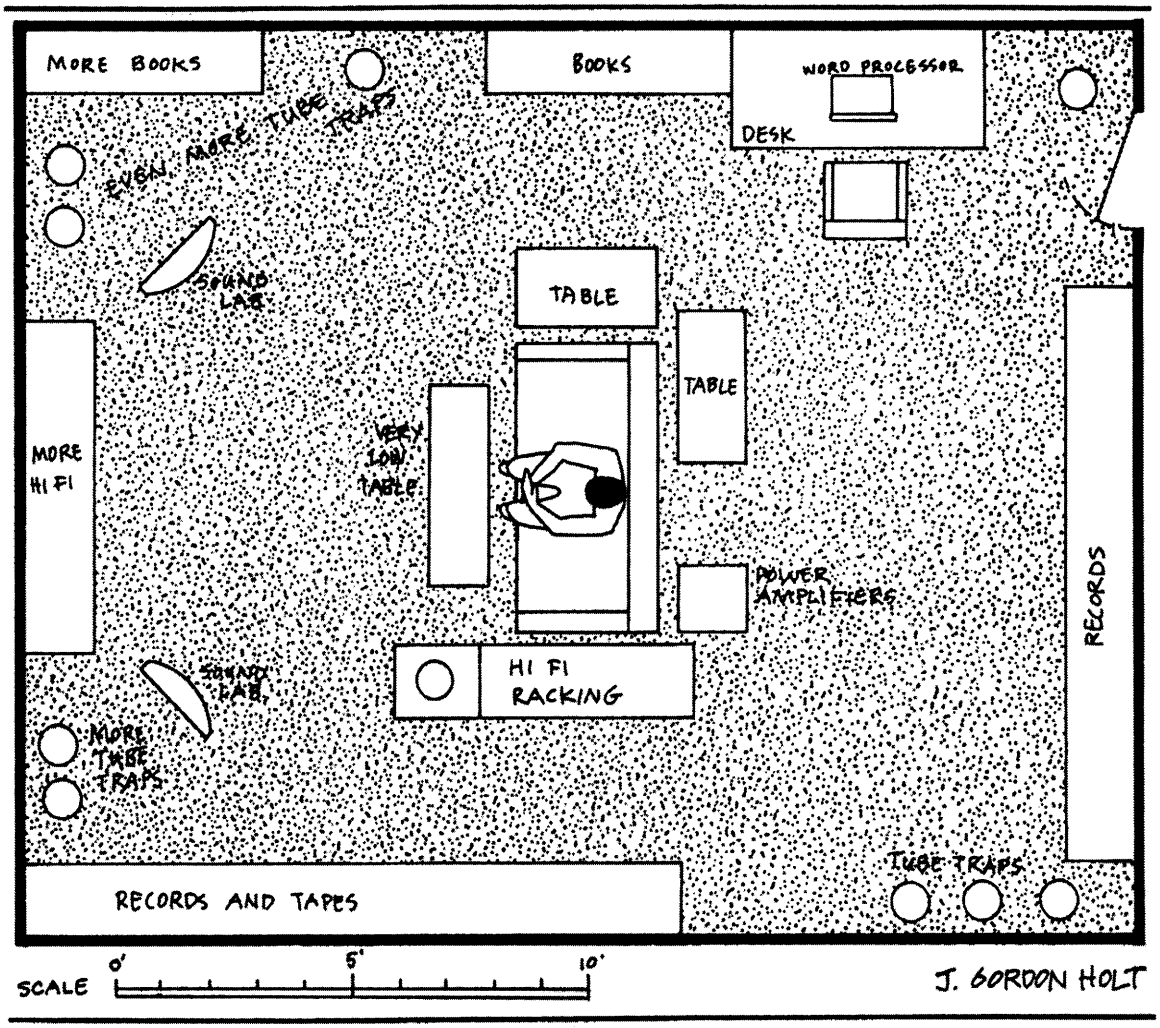

Figure 2.27 - J. Gordon Holt's listening room - note inclusion of "ASC Tube Traps" for acoustic treatment (from *Stereophile* **10**, no. 1, January, 1987, pg. 153.) Used with permission.

including diffusers that scatter sound waves to reduce reflection issues, and design their products to fit in with room décor.[90]

These descriptions of the reviewer's listening environments tended to reinforce the idea that high-end audio was a hobby most accessible to those with, at least, a middle-class lifestyle and the resources to establish a dedicated space in their homes for an audio system. Reviewers often had dedicated rooms or living rooms large enough to accommodate loudspeaker systems

[90] For a variety of acoustic treatment products and styles, see the Acoustic Sciences Corporation website at http://www.asc-hifi.com/ (accessed 01/07/09).

such as the Infinity IRS-Betas, which consisted of four separate towers for a stereo confirmation. Such large rooms were seen as necessary for proper auditioning of the equipment under review, and many reviewers also reviewed components, particularly loudspeakers, designed for smaller rooms and apartments.

Both *Stereophile* and *The Absolute Sound* have, in the last decade, made efforts to review systems designed for audiophiles with smaller living spaces and more restricted budgets. The dedicated room, however, remains elusive for many audiophiles. "[One] constraint on the whole experience of high-end gear [for me] was not ever having a room that was really well-suited to letting a system, you know, setting it up properly and setting the speakers at proper distances from the front walls and side walls and having enough ceiling height to let things open up a little bit," Thad, a non-industry affliated audiophile, told me, describing his small, top-floor apartment in a Brooklyn brownstone. "I never had any of that, and there was stuff everywhere in the room. But my thought was always, 'well, I'm not living here forever, whereas the gear I hope I'll have for a long time, or the system, it'll to be evolving for a long time.'"[91]

Conclusion

Like the high-end audio community broadly, high-end audio systems are not monolithic or totally predictable, but they share certain characteristics that are important to the overall experience of music listening in the home. For each of the different components described in this chapter are a broad array of different design possibilities that have noticeable impacts on both the sound and operational characteristics of the systems of which they are a part. In the following chapters, I will build from this basic description of audio systems to show how high-

[91] Interview, 03/30/07.

end audio enthusiasts approach small-scale system building, and why various design differences matter aesthetically to this community.

Chapter 3:

Demonstration, Realization, Acquisition, Mentorship – Becoming an Audiophile

In 1971, when he was 12 years old, John went to a local stereo shop with his neighbor, who was a few years older, to browse and listen to some music. Although his family wasn't especially musical, John had already developed a powerful love of rock and pop music of the day, much of which he was introduced to by his neighbor. He still vividly remembers the details of his visit to the shop: "it was a Sansui 771 receiver, a pair of JBL L26's, a Dual... 1228 with a Shure M91CD [cartridge], and [the salesman] put on Steely Dan's 'Can't buy a thrill.' And I was like, 'wow, this is really cool, I need to get into this.'"[1] This thought was followed by the deflating realization that the system's $1600 price tag put it far outside of his 12-year-old's budget. But, his interest piqued, he set out to learn everything he could about audio electronics, saved his money for various components, and eventually built himself a vacuum tube-driven amplifier based on schematics in RCA's *Radiotron Designer's Handbook.*

As he got older, John's love of music and interest in audio equipment grew. Eventually, he sought employment at an electronics store in his town ("I felt I knew a lot about the gear," he told me, "and I really wanted to get a deal on gear for myself.") He continued to expand his audio system as a teenager, but an experience with a different type of audio equipment set him on a new path:

> I would say the real profound... the real profound revelation was... there was a store in [my town] that's still there, [and] one of the guys in our shop came in, and he went, "you

[1] Interview, 06/27/2007.

> guys got to see this place. They've got the most amazing stuff." And that was the real first, at about 20, that was the first real high-end audio experience I'd had. You know, they had Magnepan and Mark Levinson and the early B&W 800 series, and Linn and Rega and all of that stuff... that was when the light bulb went off, you know. I got rid of my whole system, bought a pair of Magnepans, bought a Rega Planar 3, bought some Hafler gear that I built from kits, and that's when it really kind of got kicked into high gear at that point... it really became a full-blown obsession at that point in time.[2]

While the details are specific, the broad outlines of John's story are quite common among high-end audio enthusiasts. Early exposure to music, and the power of hearing music through high-end audio systems for the first time, are formative and critical parts of joining this niche enthusiast community. While audiophiles express their interests in music through the technologies of high-end music reproduction, the process of *becoming* an audiophile is as much social as it is technological, if not more so. The relationships audiophiles form with the technologies of home audio reproduction are subject to individual tastes and budgets, but begin with and continue to involve a wide array of social interactions with other enthusiasts that help to generate and sustain the community and its technologies. In this chapter, I offer a model of the social process of becoming an audiophile. I will explore how this process builds the community, how it can be both welcoming and excluding, and how the technologies of high-end audio reproduction figure into the experience. While showing the various attributes that make the high-end audio community unique, examining the process of becoming an audiophile can also shed light upon how communities mobilize around and identify themselves through particular technologies.

Scholars in a variety of fields, including anthropology, sociology, and history, have addressed the formation of subcultures and how people join or become associated with different hobbies, fan cultures, elite organizations, or intellectual endeavors. Historian of science David

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[2] Ibid. Magnepan manufacturers planar magnetic loudspeakers; Mark Levinson Audio Systems builds pre- and power amplifiers; B&W is a British loudspeaker manufacturer, and Linn and Rega manufacture both turntables and electronics.

Kaiser has explored the range of social, political, and economic influences that drew graduate students towards careers in physics during the Cold War, observing that the processes and motivations for becoming a physicist underwent significant changes that affected both the make-up of the physics community, and the types of research and experimentation practiced during this period.[3] In his book *Nuclear Rites*, Hugh Gusterson explores the processes by which people become nuclear weapons scientists, gain access to secret information, and develop both knowledge and status in the weapons design community through participating in nuclear tests.[4] Elsewhere, Gusterson, referring to Pierre Bourdieu's sociological exploration of the relationships between social class and aesthetic sensibilities, has described how scientists' "participation in nuclear tests confers a kind of symbolic capital that can be traded as power or as knowledge."[5] Gusterson argues that working on nuclear tests gives scientists status and power within the weapons design community, in part from the acquisition of what Donald Mackenzie calls "tacit knowledge" of weapons design that is only attainable through testing.[6] Although the world of high-end audio is quite removed from the world of nuclear weapons design, the process of becoming an audiophile imparts upon members of this community a sense of belonging,

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[3] David Kaiser, "The Postwar Suburbanization of American Physics," *American Quarterly* **56** (2004), 851-888; David Kaiser, "Whose Mass is it Anyway? Particle Cosmology and the Objects of Theory," *Social Studies of Science* **36** (August 2006): 533-564.

[4] Hugh Gusterson, *Nuclear Rites: A Weapons Laboratory at the End of the Cold War* (Berkeley: University of California Press, 1996); see chapters 4 ("Secrecy") and 6 ("Testing, Testing, Testing") in particular.

[5] Gusterson references Bordieu's *Distinction: A Social Critique of the Judgment of Taste*. Hugh Gusterson, "Nuclear Weapons Testing: Scientific Experiment as Political Ritual," in Laura Nader, ed., *Naked Science: Anthropological Inquiry into Boundaries, Power, and Knowledge*, (New York: Routledge, 1996).

[6] Donald MacKenzie and Graham Spinardi, "Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons," *American Journal of Sociology* **101** (1995): 44-99.

extensive knowledge of the technologies of high-end audio reproduction and,eventually, the "symbolic capital" that enables experienced members to act as mentors to new members.[7]

Many audiophiles' stories of first getting involved in the hobby echo what sociologist Howard Becker describes as becoming "deviant," or joining a subculture with unique characteristics, behaviors, and artifacts that are not necessarily shared with (or sanctioned by) the general population. Becker's research on marijuana users shows that becoming a marijuana user requires the guidance of an expert user with a willingness to share his or her expertise with a novice. While Becker argues that a novice marijuana user cannot enjoy the experience of being high "unless he goes through a process of learning to conceive of it as an object [for pleasure]" and "to enjoy the sensations he perceives," audiophiles tend to rely on music's power to spark emotional responses as a way to draw others to the hobby.[8] This is not to say that all music is equally accessible to all people, but rather that the power of music to create sensations in a listener obviates the need for the "training" that Becker suggests is necessary for marijuana users.[9] At the same time, audiophiles often have a particular (and, some might argue, peculiar)

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[7] Audiophiles with a great deal of listening experience, such as reviewers and shop owners, inhabit positions of power and respect within the community, although several shop owners and reviewers mentioned during interviews the frequency with which customers, readers, and other non-professionals in the high-end audio community dismiss this expertise in sales encounters or letters to magazines. For more on Bourdieu and notions of symbolic capital, see Chapter 1.

[8] Howard Becker, *Outsiders* (New York: The Free Press, 1963/1997), 53. The power of music to provoke emotional responses is not linear, but has been shown through a variety of different studies by philosophers, psychologists, cognitive scientists, sociologists, and others – both quantitatively and qualitatively. See Dorothy Miell, Raymond MacDonald, David J. Hargreaves, eds., *Musical Communication* (New York: Oxford University Press, 2005); Daniel Levitin, *This Is Your Brain on Music* (New York: Dutton, 2006), Oliver Sacks, *Musicophilia: Tales of Music and the Brain* (New York: Vintage Books, 2008).

[9] Though it is true that musical taste is a marker of class, at least according to Bourdieu. On the question of accessibility, which is a significant issue for audiophiles (but more from a material standpoint), Bourdieu observes that among the variety of things that separate the different classes and their individual "tastes" in France is music. Those from the upper classes tend to prefer more abstract, dissonant music, while those of the lower classes prefer simpler, more accessible music. "Nothing more clearly affirms ones 'class,'" he writes, "nothing more infallibly classifies, than tastes in music." Pierre Bourdieu, *Distinction: A Social Critique of the Judgment of Taste* (Cambridge: Harvard University Press, 2002), 18; see also Chapter 1.

approach to listening that involves learning to perceive certain qualities in the sound, including the ability to distinguish different parts of the frequency spectrum and evaluate components based on this analysis.[10] Learning to listen means developing a sense of the different characteristics of different equipment, and forming what one editor of a high-end magazine called a "database" of knowledge of high-end audio equipment that allows an audiophile to maximize the fidelity, and their enjoyment, of their music system and, for reviewers, enables them to discriminate between different components based on this knowledge.[11] Although audiophiles go through a process of learning how to assess the qualities of sound produced through high-end equipment, this occurs only after their initial experiences of getting involved in the hobby – experiences that tend to be more emotional and music-driven.[12]

Ethnomusicologist Marc Perlman has described the audiophile community as divided into two distinct camps: "golden ears," who believe that they can hear and are affected by often immeasurable subtleties in equipment and music recordings, speaker cables, interconnects, and even AC power cords; and "meter readers," who judge equipment based on measurable performance specifications, and believe that attributes of audio equipment that cannot be

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[10] The purpose of such training is to be able to tell if a particular loudspeaker, amplifier, preamplifier or other component emphasizes or attenuates a specific part of the frequency spectrum. J. Gordon Holt, founder of *Stereophile* magazine, published a chart in the Winter 1971/72 issue that showed which instruments occupied which parts of the frequency spectrum, and the language the magazine used to describe when the sounds of those instruments tended to be over or under emphasized. J Gordon Holt, "Subjective Testing (Part 5): Wherein We Consider More Terminology for Describing Reproduced Sound," *The Stereophile* **4** (Winter 1971/72): 4-5, on 5.

[11] Interview, 03/21/07.

[12] While the label of "deviant" is not entirely fitting for audiophiles, much of Becker's work reflects upon the experiences of audiophiles as it does on the communities of marijuana users and musicians that are the focus of *Outsiders*. Audiophiles are deviant in the sense that the behaviors and artifacts that distinguish them from non-audiophiles are sometimes considered ridiculous and excessive by non-audiophiles, but they are not deviant in the sense that they are not violating any explicit "rules" or laws, as is the case with Becker's marijuana users. They are, however, pursuing a pastime which is not shared by most of the public. Much of the sociological research on deviance is focused on individuals who participate in illegal or unsanctioned activity, though Becker also studies professional jazz musicians whose activities include a wide range of activities, both sanctioned and unsanctioned. I describe "sanctioned" behavior as related to Becker's notion of "conforming" behavior, or "simply that which obeys the rule and which others perceive as obeying the rule." See Becker, *Outsiders*.

measured cannot be heard or otherwise experienced.[13] The "golden ears" rely on their own hearing and sensations when listening to particular equipment, and attempt, sometimes with flowery language, to describe what they hear and feel – characteristics that have earned them the label of "subjectivist" in the high-end audio community. The "meter readers" rely on engineering-oriented design specifications and testing procedures, using measurement tools often found in laboratories and on engineering workbenches such as oscilloscopes, for which they are labeled "objectivist." The conflict between subjectivist and objectivist in the world of high-end audio, Perlman suggests, comes down to a quest for "epistemic authority" – who gets to decide what is and is not considered high-end or high-fidelity, whether one particular group's positions are defensible, what separates people who genuinely love music from "kooks."

But the story of this controversy, and the ways that audiophiles themselves understand subjectivity and objectivity, are more complex than this binary categorization suggests. While the existence of these two camps helps reveal the broad structure of the high-end audio world, and the conflict over epistemic authority is crucial to understanding the formation of the high-end audio community during the 1970s and 1980s (the subject of Chapter 4), an audiophile's individual identity – both as a high-end audio enthusiast and a music lover – exists, following Erving Goffman, in the "cracks" of that structure.[14] While, Perlman acknowledges that the community "cannot be sharply delineated" along subjective and objective lines, this separation

[13] Marc Perlman, "Golden Ears and Meter Readers: The Contest for Epistemic Authority in Audiophilia," *Social Studies of Science* 34 (2004): 783-807.

[14] Erving Goffman, *Asylums: Essays on the Social Situation of Mental Patients and Other Inmates* (New York: Anchor Books, 1961).

nonetheless remains the focus of his work.[15] While debates over expertise in public understandings of science and engineering provide tremendous insight into the high-end audio community, in this chapter I will argue that the process of forming one's identity as an audiophile has less to do with such debates, and more to do with shared experiences, particularly with music, and interaction among enthusiasts.

The process of becoming an audiophile consists of four primary stages that I call *demonstration*, *realization*, *acquisition*, and *mentorship*. Each of these stages, found at the confluence of music, technology, and enthusiasm, involve social interaction with other audiophiles and are critical to the formation and maintenance of the high-end audio community. Although each stage is distinct in audiophiles' descriptions of their experiences, they often overlap or occur simultaneously, and many audiophiles continue to cycle through the process throughout their involvement in the hobby. Demonstration and realization, for example, are often both part of the acquisition of a high-end audio system, although they can also occur independently. What is more, given the variety of experiences associated with acquisition, it frequently involves discovering the positive as well as the frustrating aspects of the high-end audio hobby. The search for a personal high-end audio system thus becomes a key part of the overall process of becoming an audiophile, and helps to shape a new audiophile's approach to and attitude about the community. In many ways, acquisition is the most complex part of the overall process, and influences how audiophiles approach the mentoring stage.

Examining the process of becoming an audiophile raises several other significant questions about the high-end audio community: given the emphasis on technology, what is the

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[15] Marc Perlman, "Consuming Audio: An Introduction to Tweak Theory," in Rene T.A. Lysloff and Leslie Gay, eds., *Music and Technoculture* (New York: Routledge, 2003): 346-357, on 347. A more thorough examination of conflicts within the audio world can be found in Chapter 4.

role of music? How do audiophiles develop relationships with particular technologies? As the high-end audio community is largely male, are there aspects of the process that make it uncomfortable for or unwelcoming to women music lovers? For those audiophiles who eventually join the high-end industry, what part does their early experience with the social and technical aspects of the hobby play in their professionalization?

Within this process, a love of music and fascination with music reproduction technology are tightly coupled and at times difficult to distinguish. But the cyclical nature of some audiophiles' involvement in the hobby, as I will show, suggests that the focus on music remains unchanged while the equipment for reproducing it can vary dramatically in terms of both price and quality. Further, my research suggests that regardless of audiophiles' leaning towards an objective or subjective approach to home audio, the basic process by which they become audiophiles is very similar. That these distinctions become visible later is an interesting question, but by focusing on early processes of socialization into this particular community, we can begin to expose the cracks in the high-end audio community's structure where audiophile identities are formed.

In the following sections, I will describe the prerequisite conditions for becoming an audiophile – characteristics that help to create an atmosphere where a person is open to the process. I will then describe each stage of the process, supported by examples from the lives and experiences of audiophiles. My data consist primarily of oral history interviews with members of the high-end audio community, including engineers, business owners, salespeople, equipment reviewers, and enthusiasts who are not involved professionally with the industry. Using their stories and experiences as the foundation for the model follows the basic principles of building

"grounded theory" for social behavior.[16] Although this approach is associated primarily with ethnographic methods applied to sociology and anthropology, understanding the process of becoming an audiophile also speaks to the history and sociology of technology, particularly those areas focused on technological enthusiasm and users.[17]

Foundations of Audiophilia

Many audiophiles insist that, despite common conceptions that only those with "golden ears" and deep pockets can be a part of the high-end audio hobby, anyone with an interest in music and a willingness to listen can hear the differences in various equipment for music reproduction, and appreciate the quality of sound produced by high-end equipment (a point to which I will return shortly).[18] The extent of that appreciation makes a significant difference in how, and if, a person chooses to pursue the hobby. To enable the process of becoming an audiophile to begin, three conditions are frequently present. These conditions (in no particular order) are:

- *Exposure and access to music from a young age.* This could be live or recorded music, or some combination of the two. Sometimes the future audiophile was the primary motivator for getting music into their home, even as children.

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[16] See Kathy Charmaz, *Constructing Grounded Theory* (Thousand Oaks: Sage Publications, 2006).

[17] See Chapter 1 for a discussions of technological enthusiasm and users in historical and sociological literature.

[18] It must be said, following the observations of Perlman and others, that the perception of differences in the sound produced by different components is highly controversial. The most controversial area has to do with high-end cables for speakers and interconnects between components, where claims to greater performance, often made using scientific and engineering-oriented language, are dismissed by objectivists as largely "smoke and mirrors" if not outright fraud. On questions of general accessibility, however, objectivists and subjectivists tend to agree that anyone with an interest can hear differences in equipment. See Chapter 4 for details.

- *At least a passing interest in the technologies of audio reproduction.* Some audiophiles, such as John, were tinkerers as young people, experimenting with electronics, kit-building, and so on. But this does not appear to be necessary to make them audiophiles later. Merely an awareness of and curiosity about technologies of audio reproduction is sufficient.
- *A passion for music.* This passion is created and reinforced through interactions with family members, friends, and other people who act as "mentors" to young music enthusiasts, introducing them to different types of music, to new music, and generally creating an atmosphere where music is both present and considered important.

When each of these conditions are present, the person can be considered a *music lover*, but not necessarily an audiophile.

Each person interviewed for this project was asked the same question to begin the discussion: "can you describe the first time you recall being especially impressed or moved by something that you heard?"[19] The question was left open for the interviewees themselves to determine what, exactly, this meant: a first encounter with music, or a first encounter with audio electronics? If it was music, was it recorded or live? Interviewees were allowed to decide for themselves how and where to begin. The majority answered the question by first talking about music. Bob, a turntable expert and salesperson:

> From a musical standpoint, it was quite early, and that would be the... I guess the earliest I can remember would be listening to Tennessee Ernie Ford, "16 tons," played by my grandmother on her turntable when I must've been six, and I was struck by the power of that music.[20]

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[19] As of this writing, a total of 33 interviews have been conducted.

[20] Interview, 04/27/07.

Thad, a non-professional high-end enthusiast:

> Music was just always happening in the house, fortunately for all of us, and consequently it just became a natural part of my life... So for us, for me, you know, being raised around [my] Mom and Dad's record collection, and the pop music of the time, gave me lots of opportunity, I guess, to sample musical influences on a family level, as well as just whatever was happening in the pop culture of the time.[21]

Jim, an equipment reviewer:

> My family was very musical. My mother taught violin and piano and she'd briefly concertized before she married my father. And they met because my father played violin as a good amateur, so there was always a lot of music in my home. In fact we had a music room, and there was a grand piano in there, and I'd hear my mother practicing. And I was really thrilled with the sound of the grand piano.[22]

Tom, a salesperson:

> A neighbor decided to emulate Leonard Bernstein and have "symphony for kids," if you will, where truckloads of kids from various school districts... would come in and they would do, you know, a fairly easily accessible classical piece. In our case it was Dvorak's Ninth... a very accessible piece. And I sat there and.... I mean, I grew up listening to big band. My parents were children of the Depression, so big band and some Broadway, you know, "My Fair Lady"... So it was interesting because it was a completely different, whole different world for me, cause at that point I was just starting to deal with the Beatles and all of that and, you know, two-minute songs. And all of a sudden I get exposed to a 45 minute- to an hour-long symphony. And it was really very impressive. Very impressive. I thought I was going to hate it... but the whole presentation of the music was just, like.... wow. I mean, if you know the New World Symphony, it's very big, and very big, broad strokes, and very emotive, and it was really, "holy cow!"[23]

Tony, an equipment reviewer:

> I have a strong memory of watching a 78 rpm, red vinyl recording of the Davy Crockett song playing on a console, a hi-fi radio that we had in our living room. And that was probably, I must've been... probably '55 or '56, which was when the Davy Crockett craze hit, so I was probably three or four years old. And then the whole stereo thing... I grew up in a college town... and the guys across the street from our house had big Klipsch corner horns and a hi-fi that they would play Ray Charles and R&B stuff on. I remember listening to the Bo Diddly song that, you know, had the riddle, like "you should've heard what I saw last night," lyric in it. And I remember sitting there for a long time trying to figure that out.[24]

William, a business owner:

> I can also recall being a very young kid and going to the [local] theater... and watching James Brown in a performance of "Please, Please, Please," where he throws off the

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[21] Interview, 03/30/07

[22] Interview, 05/07/07.

[23] Interview, 4/25/07.

[24] Interview, 05/22/07.

> cape multiple times, devastated by this relationship with the woman that he's imploring to take him back. And I, I mean, my goodness, I must've been, I don't know, seven or eight years old, something of that sort. And it was just astonishing to watch the kind of emotion and performance that he was putting on.[25]

The impressions left by these childhood experiences, vividly recalled as adults, are powerful enough to spark a lifelong passion for music, and illustrate how the process of becoming interested in and passionate about music can occur in a variety of settings. Although memory can be deceptive – as Tony observed just prior to the above passage, "we're probably entering into the area of self-mythologizing here" – they nonetheless have meaning for adult audiophiles reflecting on how they first became interested in music and audio. Responses to this first question were not universally immediate, but in most cases, particular experiences related to early exposure to music were sufficiently top-of-mind that they could be described quickly after the question was posed.

As Tony's recollection demonstrates, some audiophiles also recall the specifics of their family's, friend's, or neighbor's early audio systems, adding details about the equipment to their descriptions of early encounters with music. Ron, an engineer and business owner:

> It was when I was about 7 or 8 years old. There was an old NBC classical radio station... that played wonderful classical music... And... they played a piece of Beethoven as one of the endings to one of their concert programs. And that's with sort of formal music. Now, music was always very prominent in my house. My mother had a lovely soprano voice, and much of my family's time together was spent in song, or... and even as a child, we had a Thorens record player, but it was a music box. You could change the disks in this, and it could play beautiful music. And so part of the ritual of tucking the kids in every night was, you got to listen to a song on this music box.[26]

Bill, a former shop owner and manufacturer's rep:

> Through [a friend] my father managed to acquire a Quad preamp, a Quad valve amplifier, a Thorens turntable, and a single... Tannoy 15-inch Concert Grand driver. It was a dual driver with a tweeter, midrange built-in, and he had a custom cabinet made for it... and I just remember from the time... I guess I was eight... experiencing that system, and I always had an interest in things electronic and, you know, being a bit of a kid geek. And I

[25] Interview, 06/06/07.

[26] Interview, 04/26/07.

> remember listening intently to all kinds of records that were played on that system, and it was simply a joy.[27]

Dan, a salesman:

> Oh, I think all of us, you know, in my strata or whatever, had these almost, you know, what... you'd say almost prehistoric experiences of your father's old tube radio, sitting down in the corner with the tubes glowing away, and the Philharmonic coming out of it. And then later, my brother and I appropriated the radio, and it was, you know, Murray the K. coming out of it.[28]

Recollections of particular brands of audio equipment are common, as illustrated by both Ron and Bill. Others, like Dan, recall different but equally important details of the technology, such as a spinning turntable or glowing vacuum tubes. Engagement with the technologies of home audio reproduction can take a variety of forms for young music lovers. Some recall becoming intrigued by the idea of hi-fi before actually hearing any systems for themselves, such as Bob:

> My friends all had big brothers in my neighborhood. And we looked at them as sort of like, you know, they were like super-people. They were gods, in a way, and one of my friend's big brothers came over to my house and I was listening to something on the record player, like Herb Alpert or something, and he said, "oh, what kind of turntable is that?" And I had never heard the term "turntable"... and I never really thought about identifying what model of turntable it was. And I now remember... I didn't know then, even. I had to look at it, but it was a Sears Silvertone that my grandmother had, that had the fold-out speakers. And I asked, you know, I sort of deigned to speak to this guy... I was curious, so I asked him, why was it important? And he started telling me about this shop in town that sold just hi-fi equipment, and that was the first experience I had recognizing that there were people out there who specifically chose high quality gear, and because one of my friend's big brothers turned me onto the idea, I was, like, totally captivated by the idea. It became... all of a sudden it became the coolest thing.[29]

For some, a developing familiarity with the technologies of home audio reproduction brought an awareness of differences in the sound produced by different equipment. J. Gordon Holt, the founder of *Stereophile* magazine, recalled that during a music appreciation class in school he suddenly felt moved by the music, which led to his discovery of the differences between his home equipment and that of his school:

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[27] Interview, 04/20/07.

[28] Interview, 6/28/07.

[29] Interview, 04/27/07.

> One time while I was dozing [the teacher] got talking about Wagner, and he pulled out a piece of music – the Prelude to Act III of *Lohengrin*, or something like that. All of a sudden I woke up. It stood my hair on end. I'd never heard anything like this. So I went out the next weekend to the record store and bought that record, brought it home, and listened to it on my parent's phonograph. It was a little wind-up acoustical Victrola, and it didn't sound the same! That was when I first realized that all phonographs were not created equal.[30]

Susan, a business owner, who had grown up listening to her mother's radio and small record player:

> I think the first time I became aware of equipment as being better was when I started baby sitting for one of my neighbors. He was a stockbroker, and he had a really wonderful... you know the all-in-one sets that they had. You open the top... well, this was like a modern piece of furniture, and it had all Fisher equipment in it. And it was better than anything I'd ever heard before. And I thought, "I would really like to get some of this one of these days."[31]

Others recall being brought along for trips to audio shops with their families, and through that experience, becoming aware of the existence of the variety of audio gear available. Thad:

> We went down to [the local hi-fi shop] and [my] Dad bought basically a whole new stereo... it was a Sony receiver, so amp, preamp, tuner, I think, all built into one kit. Sony cassette deck, which at the time I recall being a fairly high quality... although I had noticed when we were there, they had this crazy Nakamichi high-end cassette deck, which at that time seemed like really, seriously cool gear, which now seems really funny to think about. I think it was called a Nakamichi Dragon, and it had this really cool cassette flipping mechanism where the whole front of the thing opened, came out forward, and then this little tray that was holding the cassette would spin it around, and that would close again. So, cooler than auto reverse, even though it was more mechanically cumbersome... I remember being really impressed by it at the time when we were shopping.[32]

Later, Thad described how he participated in the purchase of a pair of loudspeakers when he was around 12, which further demonstrated the differences in equipment:

> [My] Dad had bought his B & W monitors for the family room to run with [our] AV system, and they sounded great, and I actually remember when we bought those. Again I had been with Dad, and we listened, we actually listened to, you know, a handful of different speakers to choose them. And that's one of the first times I can remember... [before] I was too young to remember the whole ritual of testing equipment and listening to pieces of music and all that. But I remember that with those B & W monitors that he bought for the family room, we listened to a few different speakers, and he actually asked me what I

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[30] Steven Stone, "J. Gordon Holt – 35 Years and Just Getting Started," *Stereophile* **20**, 1 (January, 1997): 74-88, on 74.

[31] Interview, 07/19/07.

[32] Interview, 03/30/07.

> thought sounded good, and we ended up agreeing that the B & Ws were the best of the lot that we had sampled.[33]

For many audiophiles, experiencing these differences helped to generate the interest in pursuing the hobby further as young people, and set the stage for future experiences with high-end equipment.

Several audiophiles described having grown up in musical households, and some (eight of the 33 interviewed) described themselves as musicians, and three had pursued music semi-professionally. But having musical training did not appear to significantly affect the process of becoming an audiophile. This is not to suggest that the issue of musical training is irrelevant – only that further study is needed to understand more precisely the relationship between being a musician and developing an interest in high-end audio. Some interviewees speculated that musicians are rarely audiophiles because their exposure to the sound of live music leaves them unsatisfied with the levels of "realism" possible even with high-end home audio systems.[34] But the three audiophiles who had pursued music careers all expressed a belief in the potential for high-end audio to provide an emotionally powerful experience with music in the home, and had themselves had profound realization experiences with high-end audio systems.[35]

Demonstration & Realization

The first two stages of becoming an audiophile, while distinct, are tightly coupled with one another. *Demonstration* refers to the guided experience of hearing a high-end audio system that can occur in a variety of settings, while *realization* describes being moved by the

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[33] Ibid.

[34] Interview, 04/24/07.

[35] Interviews, 05/31/07; 06/18/07; 06/28/07.

demonstration to the point of becoming convinced of a system's ability to reproduce music in a more aesthetically and emotionally powerful way than a music lover has previously experienced.[36] The moment of realization is frequently recalled with great detail, and is virtually always associated with particular high-end components, such as amplifiers and loudspeakers. Demonstration and realization are necessary for a music lover to become an audiophile, but are also experiences audiophiles continue to have throughout their time in the high-end audio community as they are exposed to new and different equipment.

Although first experiences with high-end systems frequently occur in the homes of friends or acquaintances, there are certain formalities, such as the listener being invited to take the "sweet spot," or the seat in the room where the sound is considered the best, and music selected for demonstration that is aligned with the music lover's tastes and interests. The care taken by both shop owners and non-professional audiophiles demonstrating systems to others illustrates the importance of the demonstration for bringing new people into the audiophile hobby. When I asked the editor of a high-end audio magazine if he thought a demonstration was necessary to get people involved, he replied, "Absolutely. It is essential. There's no substitute for it."[37] Frank, a writer and former shop owner, went further, suggesting that "high-end audio doesn't exist without a demonstration that taps into the emotional listening experience."[38]

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[36] "Realization" is not an entirely satisfying description of this experience. Many interviewees used words like "revelation" or "epiphany" – language that has a particularly spiritual tone. This is quite common among audiophiles, exemplified by an attendee at the 2007 Home Entertainment Expo in New York City who responded to a demonstration by the Manhattan high-end audio shop Sound By Singer with the statement, "Now that was a religious experience." However, words such as "revelation" and "epiphany" have very particular meanings in the context of religious studies, which is not a focus of this chapter. Quotations from the interviewees will therefore contain different and more specifically spiritual language frequently used to describe the experience.

[37] Interview, 03/11/07.

[38] For more on the significance of the relationship between music and emotion, see Daniel Levitin, *This Is Your Brain on Music*. Interview, 06/18/07.

Although there was some variation in how high-end or hi-fi was defined by audiophiles, the importance of demonstration and realization in their recollections of first becoming involved in the hobby was consistent. Bill related the story of his first job in the industry at a small high-end shop, where he encountered a Quad electrostatic loudspeaker for the first time:

> In fact I'd say my single biggest musical experience was when I was being interviewed by [the owner of a high-end shop], you know, we were chatting in the front, my wife and I were sitting in the lobby, and in the back room [the other owner] put on one of the Bach suites for unaccompanied cello by Fournier on LP. And [the owner] was asking me questions, and I kept hearing this cello coming from the other room. And I just... finally, rudely, I just got up and bolted to the other room, because I wanted to see who the hell was playing the cello in there. You know, it was one of those experiences, and I saw this funny looking speaker that looked like the back seat of a car, and it of course it was the old Quad. And it was startling. It was like... it was a revelation, and that was when... just that sound made it very clear to me that, whatever was involved here, I wanted to work with these crazy people.[39]

Tony recalled a similarly powerful experience with the same loudspeaker:

> And then one day, a friend played me a pair of Quad electrostats, and he had a tiny little room and these were backed up against the wall. I thought they were not... as many people say, I thought they some type of space heater. And he pulled out a little [chair], and set it in the middle of the room and then moved the speakers to within 3 feet of it... 3 feet away from the wall, that was really all the space the room had. Then he cued up David Bowie's "Heroes," and I thought that I'd never heard anything that incredible in my life. And it was my introduction to electrostatic loudspeakers, it was my introduction to tube electronics, which I thought had sort of gone the way of the dinosaur, and it was my introduction to a really high-end turntable. I was completely transported. But the part that really shocked me was my wife was also. She just turned to me and she said, "one day we're going to own a pair of these speakers, aren't we?" True, I had already begun plotting how I could manage to do that.[40]

Mike, a manufacturer's rep, described an experience with a similar loudspeaker design:

> I was visiting New York City... probably late 70s, early 80s, and I walked into this high-end store and I heard this beautiful music being played. At the time there was a company called Apogee loudspeakers, which made a ribbon loudspeaker... and I'm standing at the front counter and I'm listening to music, and I didn't really know a whole lot about the speakers... but they had them set up kind of in the middle of the room away from any walls. And I didn't realize that the sound was coming from the speakers, and so I actually walked between them and passed them going to the back of the store looking for the speakers that the music was coming from. And as I did it I walked right through the soundstage, through the sound field, and went, "holy shit, music's coming from those? Those big ugly monstrosities there?" They were making such beautiful music, but what

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[39] Interview, 04/20/07.

[40] Interview, 05/22/07. The loudspeakers heard by both Bill and Tony were electrostatic designs made by the British firm Quad, which featured a wide, tall, slightly convex panel only about two inches thick. See Chapter 2 for a description of how electrostatic speakers work.

> struck me... was that I couldn't tell that the music was emanating from a particular source. And that got me interested. That kind of got me hooked.[41]

Stan, a non-professional enthusiast, recalled first hearing a CD player he later bought:

> I do know that the first time I heard a Wadia [CD player] run through, I do not know what the amp was, but run into a pair of [Wilson Audio] WATT/Puppies [loudspeakers], and [my wife] was with me, she would remember this too. It's like, "that's it, sweetheart." We brought a CD, which was recorded in, I don't know, some cathedral in Cologne, and it's the kind of thing where you've potted up the mic, and there's no sound, but suddenly the... you see the recording space, it's just like, you know, eternal sunshine of the spotless mind or whatever that's called... you hear the intake of breath, and it's just like, "Jesus Christ! Yeah, *that's* what it's supposed to sound like!"[42]

In these examples, hearing high-end audio systems for the first time also becomes an occasion for learning about a new technology, such as electrostatic loudspeakers, or learning of a different application of an old technology, such as Tony's experience with his friend's vacuum tube electronics. The appeal of these particular technologies, as in Stan's experience, is often related to a feeling of "rightness" in the presentation of music, or, as in Mike's example, uniquely "beautiful" rendering of a performance.[43] Moments of realization with high-end audio systems are thus frequently associated with particular technological artifacts that serve as guideposts along the path of becoming an audiophile. Demonstrations and realizations that occur in shops, such as those described by Bill and Mike, add to the music lover's exposure by also introducing them to certain aspects of the high-end audio retail experience.[44] Most shops are set up specifically to perform demonstrations: depending on the size of the shop, as many as three or

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[41] Interview, 06/01/07.

[42] Interview, 10/06/07.

[43] Electrostatic or planar magnetic loudspeakers were the focus of many audiophiles' early realizations about high-end audio (including Thad, Bill, Tony, Mike, and John), in part because of their different sonic characteristics from more familiar dynamic loudspeakers. See Chapter 2 for technical details.

[44] Many interviewees reported a decline in the overall number of high-end audio retail establishments since the 1970s and 80s.

four demonstration rooms will be built into the space.[45] Demonstration rooms are frequently acoustically treated with sound-absorbing or deflecting material to eliminate spurious acoustic artifacts that can negatively affect the sound from the system, and are insulated against sound coming from the other rooms. Equipment is frequently displayed in both lobby areas as well as in demo rooms, but many shops try to minimize the amount of equipment in a room that is not part of the system being demonstrated. Comfortable chairs and sofas are situated in the centers of the rooms between the loudspeakers, and some shops sell this type of furniture in addition to the electronic components.[46] The reasons for these specific set-ups are identified by some audiophiles as both technical and psychological. Joseph, a business owner, described the disadvantages of listening in a large showroom:

> The set up in [a] showroom is very suboptimal. I don't know whether you know, but when you play a set of speakers next to a full, a room full of other speakers, you're not listening to just that pair of speakers. You're listening to all of them, right? Because the louder the music you play, the vibrations in the air are moving the cones of the other speakers that are exposed to the air, right? And so if you think about it, everything becomes very garbled, and gets muddy, because, you know, it's not an optimal setup.[47]

Tony, who had worked in high-end audio retail, had a different view:

> [One manufacturer] had a very unique way of selling equipment. People laugh at a couple of these things, but they were quite effective psychologically. One of them is that they believed in single speaker demonstrations, which is that you'd have only one set of speakers in the room. And they would give this convoluted explanation for why they felt that other drivers in the room would resonate in harmony and would blur the sound of the music. But I think that it was on a psychological level, that you saw your salesperson actually moving things in and out of the room, and that it made a difference how the system was set up.[48]

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[45] Donald, a reviewer, told me, "There are a few really outstanding retailers in the United States, but it's not like it used to be in the 1980's, where every major city would have 5 or 6, or 8 or 10 places where you could go in, and go from room to room, and hear really first-rate sound in every room, At every dealer, in every major city in the country. It's just not like that any more." Interview, 03/11/07.

[46] This is particularly true for shops that sell home theater equipment. Companies such as CinemaTech make theater-style seating that can be built into home theater rooms, and are often a part of the demo displays at high-end shops.

[47] Interview, 04/24/07.

[48] Interview, 05/22/07.

Tony's observations reflect a position adopted by many audiophiles towards some manufacturers claims about the performance of their equipment. While the idea of unused loudspeakers compromising the sound in a demonstration room may not be persuasive technically, the act of moving equipment in and out of the room has its own powerful psychological affect on a customer, and further results in more deliberate set-ups of the system being demonstrated, which can tangibly improve the resulting sound.

Demonstrations in shops can also introduce music lovers to some of the more frustrating aspects of high-end audio retail. When I asked Mike about his experience in the shop where he heard the Apogee loudspeakers, he said that he didn't get any more information about them that day because the salesman he encountered was "stuck-up" and "obnoxious."[49] While several audiophiles related stories of bad experiences at high-end audio retail shops, Paul was uniquely proactive about his:

> I went down to [a local shop] with a pocket full of cash, like lots and lots and lots of cash. And all I wanted these guys to do was first, explain to me... what was going on and how the system worked, 'cause... I'd like to know information. And two, to hook up exactly what it is that they were going to recommend that I buy. They refused... they couldn't do the first, and they refused to do the second. I was supposed to take their word for it, because they were the only game in town. And I walked out of there and said, "you know what? If this is all it takes to be a high-end audio dealer, I can do a hell of a lot better than *these* guys." And I have to thank them for getting me in... I went home, and I incorporated my business that day.[50]

While the details of audiophiles' experiences in high-end audio shops can vary significantly, these examples illustrate both the importance of the demonstration and some of the difficulties music lovers sometimes encounter with demonstration and with the next stage of the process: acquisition.

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[49] Interview, 06/01/07.

[50] Interview, 05/31/07.

Acquisition

Following a demonstration and realization, the next step for new audiophiles is the *acquisition* of their own high-end audio system. Acquiring a high-end audio system is often accompanied by learning about equipment through high-end audio magazines, having first retail experiences at high-end audio shops, engaging in equipment exchanges with other audiophiles to build first systems with used components, and discovering the depth and breadth of the community more broadly. Despite the subjective, individualized experience of listening to and enjoying music, acquisition also can become a catalyst for greater social interaction with other enthusiasts.

For many music lovers, the process of acquisition of their own high-end audio systems includes learning more about the technology and community through specialty magazines, particularly *Stereophile* and *The Absolute Sound*.[51] Phillip, an equipment reviewer, described both *Stereophile* founder, J. Gordon Holt, and *The Absolute Sound* founder Harry Pearson as "heroes," but expressed a preference for Pearson's magazine when he was first getting involved in high-end audio: "I thought [*The Absolute Sound*] was a more enjoyable magazine and it was more highly respected, and it was less of a yahoo read. It was more erudite and intellectual."[52] Tony had a similar reaction to *The Absolute Sound* early on:

> [Harry Pearson] wrote about the emotional experience of listening to music, and how improving the resolution of the system improved your relationship to the music itself... he didn't have a sonic checklist that every review would be, "the bass is profound, the midrange is translucent," you know. He had a specific vocabulary, which is startling to encounter for the first time, as had Gordon [Holt]. But Harry managed to make it seem important, but at the same time, very much about becoming a better listener. And I really reacted to that. He had strong writing chops, he connected very much with what I

[51] For a description of the two magazines, their founders, and their reviewing processes, see Chapter 4.

[52] Interview, 05/29/07.

> thought of as the better me, and I sort of wanted to be a part of that community very badly. And I think that most readers of the magazine at that time did.[53]

Along with a demonstration of a friend's high-end system, Phillip credited *The Absolute Sound* with reinvigorating his interest in music reproduction after several years of unsatisfying gear purchases:

> The mainstream magazines like *Stereo Review*, they had lost their focus and so there was no guidance, there was no passion. And that was my guidepost. I had lost interest as well, and I certainly didn't have a lot of money... [*The Absolute Sound*] really rescued me from audio hell when I first heard a good system. That the publisher and the editor, Harry Pearson... he, basically, him and Gordon Holt at *Stereophile* championed, you know, good sound, and "Don't read the measurements. The measurements are taking us down a blind alley. You have to use your ears because your ears are what you're listening on. And the measurements... all these measurements freaks have really taken us down a dark path to bad sound." And they were right.[54]

The more subjective and observational reviewing styles of these magazines did not immediately appeal to all new audiophiles. Carl, who had become interested in home audio reading more specifications- and measurements-oriented stereo magazines such as *Stereo Review*, described his initial response to *Stereophile*:

> I saw an ad in, I think it was *Hi-Fi* or one of those audio magazines way back in the back, and it was talking about *Stereophile*. And this is when they were doing a big push to try and bring on a lot of readers. And it was like, oh, '82, somewhere in there. And I decided to get a sample copy, and kind of read it, and kind of thought, well, you know, this is just completely different than everything I've been reading up to this point. They were talking about tubes, and things I'd never even known about. And I had a lot of doubt, you know.[55]

His attitude about the magazine changed, however, after a demonstration he heard at a high-end shop:

> [The salesman] started asking what I had, and I tell him I had an all Carver system, and he said, "you know, bring it all down. Bring it down some time, and we'll set it up side-by-side [with a Robertson 4010 amplifier] and listen." And so I did. And I was just flabbergasted at how much difference there was between my Carver amplifier, and this Robertson 4010. And it wasn't hard to hear at all. That's what you... you know, by that time, at the age I was at by then and after years of reading the magazines, I was like, you know, everything I'd known was that there were some minor differences, but they're just,

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[53] Interview, 05/22/07.

[54] Interview, 05/29/07.

[55] Interview, 09/24/07.

> you know, you don't hardly hear them, most people can't hear them, they really don't matter. And I was just floored at how much difference there was in the sound. And at that point there was when I realized that, "hey, this *Stereophile* magazine knows what they're talking about," because they had actually rated [the Robertson 4010] quite highly back then. And I could hear it.[56]

Not all audiophiles encounter salespeople as accommodating as Carl did. Visiting high-end audio retail shops for the first time can be intimidating or confusing for new audiophiles. Thad, after hearing his neighbor's system, asked where he could go to check out some equipment for himself:

> So he told me about [a local high-end shop], and I went there, and felt sort of intimidated, as you do when you go into places like this because it's not easy to kind of blend into the background and stare at things without being approached by a sales person. And I just didn't know much about any of this gear or any of the brands or anything at the time. I mean, I obviously knew what I liked sound-wise or music-wise. I didn't... I guess I wasn't really sure of what was possible sonically apart from what I'd heard at [my neighbor's]. But I started sort of shopping around a little bit... [my neighbor], of course, introduced me to the guy he knew there who had sold him his gear, and he was a nice guy, so I sort of stepped into this world.[57]

Intimidation and unfamiliarity with high-end audio stores was expressed by others as well. Phillip noted that, after having his own realization with a friend's system in the early 1970s, he "just didn't go to any of the audio salons because I... was kind of like, you know, post college hippie... I felt intimidated by some of these big audio salons. I didn't even know they existed, really."[58] Feelings of intimidation often stem from the unusual setting and sales process in high-end audio shops, and from the exposure in retail settings to a variety of technical and non-technical debates over sound quality in the high-end audio world. In some cases, customers who visit high-end retail shops are not prepared for the experience, and react negatively. Tony described one particularly memorable encounter with a customer at a high-end shop where he worked:

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[56] Ibid.

[57] Interview, 03/30/07.

[58] Interview, 05/29/07.

> Early on, I bought totally into the [shop's] way of, you know, like, "this is how you listen, this is how you do comparisons, let's do this, now you tell me what you think." And shortly after I'd been working there, I had a guy that was just starting to act very agitated while I was giving him [this] approach. And it finally was something I couldn't help but notice, and I said, "excuse me, are you okay?" And he goes, "no. This is totally freaking me out. Nobody has ever asked me what I thought in a sales encounter before, and I'm just not sure I'm comfortable with this. I have to go." Okay... it doesn't work for everybody.[59]

Although many audiophiles' experiences in retail shops end positively (Thad bought an amplifier and preamplifier from the same salesman who had helped his neighbor), some audiophiles expressed frustration with high-end dealers. "Do you ever watch SpongeBob?" John asked me, "because there's a character on SpongeBob called Squidward, and he's really snotty, and he goes, 'can you be helped?' That's how most of the guys in most of the stereo stores are."[60] Donald, a reviewer, compared high-end audio dealers to other high-end retail segments:

> There's a sense of elitism, or you have to show them your credit record before they'll let you listen to anything. I experienced that myself when I was a high-end audio consumer when I was young and had a very small budget for high-end. I encountered that. I think it's a turnoff to a lot of people to go into high-end dealers. The high-end industry doesn't treat its customers the way other high-end industries do, like watches or cars or boats. I don't know very much about those other industries, but it seems to me like the retailers in those industries have a different attitude toward their customers than do the high end audio retailers... [they are] more respectful towards their customer.

Several audiophiles attributed retail difficulties for new audiophiles not just to high-end dealers, but to so-called "big box" electronics stores and to the influences of the growing computer retail market. John speculated that

> people have had such a bad experience buying computers that they think, "oh my God, this is another thing where I'm going to go in and they're going to be rude to me, and I don't know what I need, and it's just going to be another bad technology experience." I think all the awful computer experiences everyone has had has contributed to some of the fear from wanting to buy high-end audio.[61]

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[59] Interview, 05/22/07.

[60] Interview, 06/27/07.

[61] Interview, 06/27/07.

For Phillip, frustration with the perceived dominance of computer retail extended to the mainstream press and their coverage of audio, making it difficult for new audiophiles who may not know about specialty magazines to obtain information:

> The biggest issue right now is the fact that all of consumer electronics writing in America has been taken over by computer geeks who know nothing about sound, and know nothing about video, either. Or photography. But because the computer is now being used for photography, now all of a sudden they're experts, but they don't know anything. And because computers are used for audio, they're the audio experts, you know? They know nothing... and also because of computer prices, you know, most of these bozos, you know... if something is $200, they think it's expensive. And David Pogue [of the *New York Times*] is the worst example of an idiot. You know, this computer guy. I buy his books... his new instruction manuals, they're great. But his head's up his ass when it comes to audio. He doesn't value a good audio system because he's never heard one.[62]

From the retailer's and salesperson's point of view, dealing with customers can be equally frustrating. Dan suggested that the poor experiences at big-box retailers that John observed should, but often don't, cause customers to appreciate the service they can get at high-end audio establishments. "We get people coming back to us three years later complaining that their remote control doesn't work or that, you know, their kid stepped on it and they want a new one for free or something," he told me. "You come back to Best Buy 10 minutes later, they don't know you."[63] For shop owners, the realities and expenses of running a business, particularly one based on low volume sales like a high-end audio shop, are complicated by customers who use the shop's resources but do not purchase anything. After years of running his own shop, Paul put it this way:

> The problem is that when you open up a business, you open it, unfortunately, not only to people who are serious about the process, you open it up to people who also have nothing better to do but kick your tires. Those people make it impossible to do what I was trying to do on a wholesale basis, which is to set up systems that you can listen to without switchers, any switchers whatsoever, at your leisure, as long as you want, make the comparisons, and then come to a conclusion and buy. That's still a really good thing to do, and it's something we try to do as much as we possibly can, but inevitably, inevitably, what gets in the way of that is... and more so now than ever, what gets in the way of that is a smaller, unfortunate group of people who think that you, since you own a business,

[62] Interview, 05/29/07.

[63] Interview, 06/28/07.

> you owe it to them to take all of your time to let them listen to whatever they feel like listening to whether they plan on buying or not... A place that does that would be called an audio museum, not an audio store. And I think, my philosophy is that I owe it to real customers to give them the very best attention I can, the very best equipment I can and the very best demos I can, and that means that real customers are defined by people who really are interested in buying something. And those people who are honest enough to tell me, "I don't want to buy anything, I just want to hear something," and have a reasonable sense of how long that should be, I have no problem with. I mean, I'm happy to be nice to people... it is a privilege for me to serve customers, and it is a privilege for customers to be able to go into a store like mine, which, frankly, with the kind of rents that I'm paying, you know, needs to turn a profit and needs to make sales.[64]

High-end audio retailers also face difficulties from the rise of online sales and equipment exchange websites, such as Audiogon.[65] Dan described online purchases of high-end audio gear, which do not include the demonstrations many audiophiles consider necessary (and which high-end audio retailers pride themselves on being able to do) as the "zipless blank", referring to Erica Jong's more colorful description of anonymous sexual encounters in her book, *Fear of Flying*. "You will not have to talk to me," he laughed. "If you don't like talking to people who have a point that they want to make with you, and try and, you know, maybe perhaps guide you a certain way or... gee, there's this whole other thing that you can do. You just go 'click'. And you'll see what comes in the mail."[66] Tom, who had worked in high-end audio retail for many years, made observations similar to Paul's:

> [The internet is] just a new form of the complication that's always been there, and that is, you know, you run against people that... don't think they have to buy the stuff that they're hearing in your store. It's just free. And they... even though they themselves often charge for every little thing they do in their business. They don't understand why we want to do the same thing. And, you know, also a lot of people not understanding our retail market. They think we're a part of the food or clothing industry, where profit percentages are measured in three digits. We're happy when we make 50 points. And it's, you know, it's tough. I mean, [my boss] has to pay me a fair amount of money for my expertise, [and] people supposedly come here because they want our expertise. But they're not

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[64] Interview, 05/31/07.

[65] Audiogon.com is a classified ads and auction site, similar to eBay for audiophile equipment. In addition to ads from individuals, dealers also place ads for used or demo gear. Online sales by dealers can complicate relationships between dealers and manufacturers, as most manufacturers have strict rules about how sales are divided between dealers, and punish dealers for selling in another dealer's territory. Other manufacturers are lax about enforcement of these rules, and online sales, since they are not territory-specific, adding another layer of complication.

[66] Interview, 06/28/07.

> willing to pay us for it. They think we... that money grows on trees and that it's okay to come and spend a lot of my time, and then buy it online. It is a problem.[67]

Retail experiences, however – for both the retailers and the customers – are by no means universally negative. For retailers, helping music lovers achieve an emotional connection with music helps to offset some of the frustrations otherwise felt in the retail side of the business. Marcus, a salesman, said,

> One of the most intangible, enjoyable parts of it is the occasional really great client... who is not necessarily at all the one who spends a lot of money. Nothing wrong with the really good client who spends a lot of money. Everybody needs them. But I've had more clients who have said, literally... you'll understand quickly how few, that they've, you know, they've scrimped and they've really agonized over a choice of a very modest system, and they brought it home, and then, incredibly rare occasion, have said that it changed their life. Because it just enabled all sorts of other things to happen... People started to come over to hang out with them. Or it just introduced them to the idea that they could, in fact, just relax. Or whatever it might be. And the occasional person who buys whatever and just loves it... it's a little trite to say it makes it all worthwhile, but I think you understand what I'm saying.[68]

Bob, who had worked in retail for many years and had a variety of other jobs outside of the high-end industry, echoed Marcus's feelings:

> [Working in high-end audio retail] felt like I was contributing to the world because I was helping... I was, like, saving the world from bad hi-fi. Honest. You know, the other jobs I've had, which have included teaching and working on very important high-capacity digital networks, I never really felt like I was contributing as much to the world as I do in getting people fixed up with the best music at home.[69]

Many audiophiles credited their experiences at shops with showing them the landscape of high-end audio equipment. Tony, through his interactions with the friend who first introduced him to high-end audio systems, recalled imagining that a used market for equipment most likely existed, and found a shop in his town that carried used equipment:

> It was unlike any other store that I'd ever been to. It was small, but it was packed with stuff, and it was displayed very respectfully on shelves that went basically up to the ceiling. And, you know, I didn't realize it at the time, but I was seeing the whole panoply of high-end history in there. I saw Marantz 8B monoblocks, 8B stereo amplifiers, Marantz 9 monoblocks, there was Audio Research gear, which at that time was considered to be

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[67] Interview, 04/25/07.

[68] Interview, 05/02/07.

[69] Interview, 04/27/07.

> the cutting edge of the new tube renaissance. There were McIntosh tuners of every variety there, and this was right before this stuff became tooth-achingly expensive because of Asian collectors who were willing to pay any price for these classic names. It was still relatively affordable. There were Quad loudspeakers of course, there were Klipsch La Scalas and Klipschorns. There were very compact LS 35A monitors and stuff from Britain, like Leek tube amplifiers and Esoteric Audio Research gear. It was a real learning experience just to go in the store... sooner or later, you'd see everything, no matter how rare it was.[70]

For Tony, being in the shop (where he later worked for a short time) also enabled him to observe some social aspects of the high-end community that were new to him:

> And the guys that would hang out there were quite interesting. It ranged from people that were captivated by all hi-fi gear to guys that had looked at something when they were kids that they couldn't afford, and said, "I won't be a success until I can own this." And then once they felt they'd arrived, the process of acquiring that became their way of acknowledging that they had arrived. So it was kind of an interesting meeting of cultures, too.[71]

Positive experiences in high-end audio shops, particularly for new audiophiles buying their first systems, could also lead to lasting relationships between retailers and audiophiles. Tony described how, in an idle conversation with the owner of the used high-end equipment shop, he mentioned that a preamplifier he'd sent to the manufacturer for repair was delayed in coming back, and the manufacturer was being unresponsive:

> And [the owner] goes, "oh yeah, he does that all the time. But I know he's good for it eventually. Here's what I'll do. I will give you what I would buy that preamplifier for in credit on anything that I've got in the store, and you can take it home, and then when he gets around and sends it back to, you can just bring it in to the store and trade it in." And I went, "okay, that sounds like a great deal." And I ended up buying a great preamplifier from him, and then when it came time to buy a power amplifier, my wife said, "well, why don't you go talk to that guy that you bought the preamplifier from? He treated you right then."[72]

Dan recalled buying his very first audio system from a local shop he had passed by many times as a child:

> I used to walk by [this dealer's] store on the way to the bus stop every morning as a schoolboy. And I'd see these various things, which I later learned all about what they were, and, you know, kind of dawdle and stuff. And so finally when I had $250 saved up,

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[70] Interview, 05/22/07.

[71] Ibid.

[72] Ibid.

> I walked into his store. I was 14, this is 1966, okay? I walk into his store in cut-offs... and he had his back to me, he was up on a ladder doing his headphone display. And he just... he just kind of turned about 10 degrees, okay? And he goes, "yes, kid?" He's always had a reputation as a real high-end snob... Anyway, so he says to me, "yes, kid?" And I, of course, I am totally in awe, you know, I just looked up at him and I say, "yes, I have $250 and I want to buy a stereo with real bass and treble..." And he kind of waits a second, and he turns to me and he goes, "kid, I don't have anything new for $250." And I just kind of freeze as I feel the egg, you know, wash over my face... And then, about another 30 seconds later, he goes, "but, if you'll wait around, I'll look in the basement for some used gear." And here we are today. He sold me a used set up that, you know, for whatever, my 250 or 300 bucks, totally blew my friends' minds.[73]

Several years later, Dan returned to the same shop to upgrade his audio system:

> ... so I go into the same guy's store, okay, and by now he called me "the kid." He says, "well kid, what is it?" I said, "listen: I want a new system, I want to move up." Now, back then... so this is like 1970, okay? Back then, 50 watts a channel was like a million, you know. People had 3 watt systems, blah blah blah. I went in and bought a 50 watt per channel amplifier, a pair of these big freaking JBL [loudspeakers], and a turntable for a thousand bucks. And he looks at me, and he goes, "now you can go home and blow up your building!"[74]

While the majority of audiophiles interviewed for this dissertation were middle-aged, several were in their 30s or younger. Despite the decline in the number of retail stores where audiophiles could get demonstrations, the younger interviewees nonetheless found them, but also sometimes acquired parts of their audio systems differently. As previously described, Thad, who was in his mid-30s, found his local high-end audio shop through interactions with his neighbor, but he also described how he purchased parts of his audio system through Audiogon.[75] Luke, a manufacturer's representative in his early 30s, described how, when he was a teenager, he and his friends would travel together to local audio shops:

> And I, with a couple of friends of mine that also appreciated audio... we wouldn't have anything to do sometimes on a Friday after school, or on a Saturday, or on a professional day, a day off, school's closed, whatever it may be. So we'd say, "you know, let's hit the audio stores, let's just go, and..." and we'd go to three or four different ones. We didn't have a car, so we'd take the bus. And I would take the literature. And I became a regular

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[73] Interview, 06/28/07.

[74] Ibid.

[75] Interview, 03/30/07.

> at some of those stores. They would recognize me. "Oh, here comes that kid again." I mean, I can see right now, that's probably what they thought.[76]

Tim, an audiophile in his early 20s and the youngest person interviewed for this project, also had his first high-end audio experience at a local shop, and developed a positive relationship with the dealer. "I ended up... going back [to the shop] quite a bit," he told me.

> And working for him [in the] fall after I finished... I was writing up my masters, and I hadn't defended my thesis yet, and I was going to be taking this teaching position at the university for the winter term. But I wasn't, you know, in the meantime I wasn't really doing anything. So I got work at his shop, just trying to make a bit of money on the side to keep myself sane while I was trying to finish up this writing. So I worked there in the fall... yeah, I guess I developed probably, maybe what most likely isn't the normal relationship with your audio dealer. Like, I've actually done landscaping work at his house![77]

Several interviewees also noted that their interests in audio, and acquisition of audio systems, opened doors to other social interactions and helped them make connections with like-minded people. "I always gravitated to music people," John said.

> Most of my friends are either recording engineers or musicians or big, huge music collection people, and I just, you know, I think naturally gravitated to those people. And that was a really exciting part of the high-end audio world back in the late 70s, early 80s, because, you know, we all would get together and share music and hang out. And we didn't have, you know, MTV and jet skis and text messaging, and so we hung out and drank beer and listened to music. I mean, that's what we did.[78]

Many audiophiles, particularly those who had become interested in audio during the 1960s and 1970s, made similar comments, describing spending time with friends listening to music and visiting audio shops. Hi-fi systems were often the center of social activity in college dorms, and a number of audiophiles noted that it was their room or apartment that became a hub in their social networks, which they attributed to their having the best hi-fi of all their friends.[79] Dan, who had taken a year off between high-school and college to travel in the Middle East, said, "it

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[76] Interview, 06/22/07.

[77] Interview, 05/08/07.

[78] Interview, 06/27/07.

[79] For work on social interaction and "male bonding" hobbies mediated by technology, see Kristin Haring, *Ham Radio's Technical Culture* (Cambridge: MIT Press, 2007).

was like I showed up [at school], not only a year older or whatever, but I had a hi-fi, I had a stash… you know, I was, like, ready for fun!"[80] Indeed, many audiophiles connected the experience of getting together to listen to music with other social activities such as eating, drinking, and taking drugs. Phillip joked that "of course, the music enhancement from [smoking pot] is better than any stereo tweaks you could possibly think of."[81] Marcus credited the increasing availability of drugs with helping to expand general interest in audio during the 1960s and 1970s:

> I mean, once, for better or worse, once drugs fell into the culture, that just really pushed the whole thing into a whole different direction in a way, because where once… I think everybody enjoyed having some music available. But it changed it quite fundamentally when everybody was just getting completely ripped and sitting around listening to music. And I think it became, then it really became a social institution, because that was what people did. They didn't go to the movies, they didn't go to the mall… no, they sat around and got wasted and listened to music. And it was anticipated, it was like, "oh boy, I'm going be finished with school soon, I'll be finished with work, homework" or whatever it was, "and we'll all get some people together and we'll relax and have some fun and listen to music." So it did eventually fall into the culture. I think it was popular with a smaller set of people before that.[82]

Some audiophiles, once they have acquired their own high-end audio system, keep that system for long periods of time – when asked about their current systems, several audiophiles mentioned that certain components had been part of their systems for over a decade. Others, motivated by their realization experiences where substantial differences between components were heard, remained curious about the possibilities of improving or changing the sound of their systems, and chose to "upgrade" their equipment. Upgrading is another point of conflict within the community, and frequently becomes the subject of criticism from non-audiophiles, particularly when it is associated with "tweaking," or small changes or additions to systems that

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[80] Interview, 06/28/07.

[81] Interview, 05/29/07.

[82] Interview, 05/02/07.

appear to have no technical or scientific basis.[83] In spite of this, upgrades and changes to systems help to keep audiophiles interested in the hobby, and are important for dealers and manufacturers as well, many of whom, in efforts to inspire brand loyalty, offer different levels of equipment and encourage users to move up when their finances and other circumstances allow. Ron, who expressed skepticism about the high-end audio industry generally, characterized the approach of some manufacturers towards upgrading:

> In the high-end audio world there is a brand named Naim, OK? And these guys go around and they sell you their amplifier for whatever. And then they say, "well, after a couple years you're going to be tired, so we will sell you a new power supply and a new funky doughnut that you can put on top that makes your amp sound better." And they get these people addicted to upgrading.[84]

Indeed, many high-end manufacturers large enough to have different lines of equipment market to customers the possibility of switching components to an upper-tier model in the future. In contrast to Ron, Mike presented this as a benefit to customers:

> Once we get that customer, we also have an upgrade path for him or her that they can start with our entry level, as their situation changes, as their resources improve, they might say, "well, gosh, I've really enjoyed this amplifier, now I'm ready for the next step in the line." And so it's our goal, is that by having the more affordable product, we give people access to the brand and then a path to grow within the brand.[85]

Retail shops also facilitate upgrading. Paul mentioned that he offers customers a full year to trade in equipment for the full price they paid, even for used equipment, if they want to upgrade. Upgrading is therefore seen as another part of growing the industry, giving new audiophiles both an entry point with lower-priced equipment and a way of building up to higher performance equipment, keeping both ends of the industry active. But, as Ron suggested, some audiophiles'

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[83] See Perlman, "Consuming Audio"; see also Chapter 6 for a discussion of CD tweak products.

[84] Interview, 04/26/07.

[85] Interview, 06/10/07.

approach to upgrading and acquisition of system components can be destablizing, as we shall see.

Much like the demonstration and realization stages, the acquisition stage is marked by social interaction, guidance, and mentoring from a variety of individuals within the community, including dealers, equipment reviewers for magazines, and friends. For new audiophiles, the process can be intimidating, both financially and technically. Once they begin the process, making decisions about what to buy and how to proceed can be daunting and complicated, regardless of the new audiophile's level of enthusiasm. For these reasons, as many of the above examples show, dealers and salespeople, magazine reviewers, and friends often adopt the role of mentor for the new audiophile. Once the new audiophile has acquired a system of their own, they frequently become mentors themselves.

Mentoring

Following acquisition, new audiophiles often enter the *mentorship* stage, where they adopt the role of guide for music lovers who may also have an interest in the hobby. Mentors help new audiophiles with demonstrations, putting systems together, and sometimes use their connections with the community to help new audiophiles find both new and used equipment. Mentoring experiences are often described by audiophiles as providing their own kind of satisfaction, particularly when they witness a music lover having a similar realization experience to their own. Mentoring is another part of what makes the process of becoming an audiophile cyclical, and is critical to both bringing new members into the community, and keeping existing members engaged.

Thad, whose neighbor had been a mentor to him, observed that this mentoring behavior rubbed off on him when he acquired his own system. He described how he would select music that he felt demonstrated the capabilities of his system particularly well when he had people over. "One thing I loved doing," he said, "if people were around and they were interested, was sort of demonstrating the power of the speakers [and amplifiers] by using [a particular song] where it's got the super duper low bass. That always kind of blows people's minds if they listen to it." To Thad, part of mentoring was helping music lovers appreciate not only the aesthetic qualities of music reproduced on a high-end system, but the accessibility of such systems for a reasonable amount of money.

> Once I got into it... I also kind of adopted that semi-populist approach. I mean, I'm not a populist about most things, but one thing I definitely agree with that I have come across in certain audio reviewers' writing is this idea that you can get great sound for virtually any budget. I mean, obviously it's gonna be incremental, how good it is, but there are people out there trying to kind of educate the public about this idea that, you know, you don't have to just settle for whatever they're selling at the Sears electronics section or whatever it might be. And that if you find somebody with a little bit of knowledge and willingness to help you, you know, understand what the budget will allow you to do, and then match some components together thoughtfully, you can get some great sound. And so I always thought, to the extent that I could, if somebody expressed an interest in equipment, I was happy to talk about it or happy to kind of demonstrate what you can do or hear with it.[86]

The motivations for mentorship were interpreted differently by some audiophiles. Although he emphasized his own connections with music as the reason for his interest in high-end audio, Joseph commented that "audiophiles love to show off their stuff."

> You know, they spend a lot of money on this, they want to share, they want for people to be wowed by what they've got, so that they would show it to their friends and their relatives and their neighbors, who all think they're crazy to buy this stuff, you know. But they paid... you know, it's just like when you buy a car. Guess what? You don't buy a car just to get from point A to point B, do you? You want to show it off. It's like people spend $200,000 on a Ferrari, you know, it gets you from one place to another just the same, but wouldn't it be nice for you to be seen with it? So it's the same deal.[87]

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[86] Interview, 03/30/07.

[87] Interview, 04/24/07.

For Paul, an unsuccessful mentoring experience can lead to frustration for the mentor if the potential audiophile reacts poorly. He suggested that "showing off" was, in contrast to Joseph's comments, not a strong motivation:

> Two-channel music lovers, that's for them. Your stereo is for you. It's always for you. You don't have to show it off, you don't care about showing it off. In fact, maybe you don't want to show it off. There aren't that many people that'll appreciate it anyway. Most audiophiles I know are lonely in that respect. They're the only one of their friends who are really into it. Maybe that gets moved a little bit, but it's not like... it's not a social avocation.[88]

When I asked for clarification later in our conversation, he added:

> My experience is, for every one person who goes "wow" and really gets into it, 10 people listen to it and go, "that's great, but I can't believe it costs so much money." So, when I'm saying it's lonely, I don't think most people want to... most audiophiles I know don't want to hear that, and I'm not really interested in people's comments. I don't want to hear why it's so expensive. There's a kind of a sour grapes attitude about it.[89]

Several audiophiles noted that high-end audio magazines played a significant role in their learning about both the equipment and the community. In Thad's description of his own acquisition process, he noted that the influence of reviewers, and his contact with one particular reviewer, helped make up for his inability to audition all of the equipment he used in his system before buying it.

> All the gear in my system, since it's been kind of properly high-end, has basically been gear that's been vetted by one person or another at [online high-end audio review website] *Soundstage!*, mainly [editor and reviewer] Marc [Mickelson], again because, first, I sort of came to respect and appreciate his point of view, his reviewing style. And then I made contact with him, and sort of got to qualify that even further. So whereas it wasn't usually possible for me to actually go and listen to gear before buying it or matching it to other parts of my system, I did what I could to kind of query certain things with Marc... so basically, through talking to other people and a lot of reading, I was able to establish some sort of baseline of confidence that my untested system selection would still be OK. And for the most part, it has been, at least as far as I can tell.[90]

Many magazine reviewers and editors emphasized the importance of mentoring during our conversations. One high-end editor described how his magazine tries to support new audiophiles

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[88] Interview, 05/31/07.

[89] Ibid.

[90] Interview, 03/30/07.

by including reviews of affordable equipment, and acknowledging the different constraints new audiophiles may feel as they join the hobby:

> Most people haven't heard of [brands like] Rotel or NAD. It's so easy for magazines and people in high-end to get this mindset of what is mainstream and what is esoteric, and what's affordable and what's not. And to a lot of people, a $1000 Rotel integrated amplifier is a significant step for them if they're looking at a Pioneer receiver. This is a big leap, and an important leap in favoring sound quality and performance over loads of buttons and features. And we need to embrace that type of person and encourage them... The old model was to review an inexpensive product, and point out its shortcomings relative to the state of the art. "Here's how it fails. Here's how it doesn't deliver..." So now the approach is, "here's how this product will enrich your life, and here's how it's better than mass-market products that you would pay almost the same money for," and talk about the virtues of the product and how well it does at reproducing music... There has to be the point of entry, and... good-sounding affordable products are the way to get them into the hobby.[91]

But he also saw the presentation of reviews as a way to educate and encourage new audiophiles to learn about higher-quality products should they feel motivated to upgrade or keep exploring:

> We do give the extra space to the more expensive products, and I think that serves the reader, because the entry level reader doesn't want to read a 6 page dissertation on a power amplifier. They're more interested in: is this good, what should I buy? So... up front of the magazine, we have the less expensive products with the shorter reviews, and then as the reviews section progresses, the reviews get longer, the prices increase, and then we end up with the [most] cutting-edge [products], which [are] some very expensive products. That's meant more as a... it's as much product review as it is a vehicle for exploring some aspect of music reproduction in a thoughtful way, and more technical detail. So the reader can pick and choose among that spectrum of whatever he's interested in. The entry-level reader may get the magazine for "which $700 speaker should I buy," and see this stuff in the back of the magazine, and kind of peek into it or look at it occasionally, and see that there's a whole other level to this field that he didn't know about. But it's a way of introducing him to that.[92]

The pricing of high-end audio equipment is one of the most significant barriers to entry in the hobby, although most audiophiles expressed the feeling that, as Thad observed, quality sound is possible at almost any budget. Communicating about the availability and quality of affordable equipment becomes an important task for the magazines, as well as for retailers and audiophiles who might encourage or guide music lovers to become audiophiles. Bob suggested that part of

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[91] Interview, 03/11/07.

[92] Ibid.

his interest in both the hobby and the retail side of the industry is knowing that price does not necessarily correlate with enjoyment:

> I'd say that there are clients that we have who have spent as much money on their system as, you know, I've earned to date, and you know, they don't listen to it with as much passion, or they don't get as much from it as some people who bought a $600 pair of speakers and a $400 receiver to put on it, and the guy's listening to ZZ Top, you know, and turning it up to 11, and he can, and he doesn't worry about it breaking. This is why it's great for me.[93]

But many audiophiles feel that the magazines frequently fall short in shepherding new audiophiles into the hobby. Marcus suggested that "these magazines, like most review magazines, should be something to get you to go out and do your own investigation at some level, do whatever you can do within your environment. But, nobody [does] it. I shouldn't say nobody [does] it, but people tend to just sort of slavishly follow, and say, 'I must have this, and now that I do, it must be good.'" He attributed this "slavishness" on the part of some audiophiles to "a vein of insecurity," but also suggested that the magazines did not do enough to encourage readers to trust their own opinions of products.[94] This was echoed by Paul, who further felt the magazines were insufficiently critical of the equipment under review. "The joke these days is that there is no such thing as a bad *Stereophile* review," he said. "And in fact, there's a certain amount of truth to that."

> Doing a review is about getting people to think. At least that's what I think it's about... a good review from *Stereophile* would bring lots and lots of people in the front door. It doesn't do that anymore. And I don't think it does it with *Absolute Sound* either, although maybe a little bit better....In part, they squandered some of their equity because they... haven't been particularly selective in terms of how they write reviews... reviews that I think sound pretty good are really, when you talk to the reviewer about it privately... the reviewer really thinks that the product was really pretty awful. Reviews that are over-the-top positive are given out to things that just don't deserve it. And there are too many of them. Every month, there's another review that says, "this is the greatest thing in the world." Well, they're not, you know? So... I don't think people believe it anymore. Why should they? ...I think people have just gotten sick of it. I've gotten sick of it. I just look for the conclusion and see whether I sell it these days... And I don't want to do that. I

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[93] Interview, 04/27/07.

[94] Interview, 05/02/07.

> want to get mad at it occasionally. I want to get happy with it. I want it to be, to take a position. That's what a review's supposed to do.[95]

The difficulties that Marcus, Paul, and other audiophiles describe reveal the range of feelings towards the magazines within the community, but also the importance of interaction for new audiophiles with existing audiophiles to help them navigate what can sometimes be confusing territory. Writers and editors for *Stereophile* and *The Absolute Sound* acknowledge and occasionally remind readers that reviews are only the informed opinion of the reviewer rather than the final word on a product, but clearly many audiophiles felt the message did not always get through.

Beyond these frustrations, interactions between mentors and mentees often prove satisfying for both, and can occur in a variety of circumstances. Audiophiles often develop a certain approach or philosophy for introducing new audiophiles or music lovers to the hobby. "I always like to say that helping somebody buy audio, it's like buying good Christmas presents," John said. "If you're a good Christmas present buyer, you find something that you know your friend will like, not necessarily what *you* will like."

> One of the things that I think about high-end audio is that, it has to be at least a certain level of experience to make people intrigued enough that they're drawn in, that they want to go investigate and go further with it. If it's just a Bose thing or if it's just a mass-market thing, music becomes a real background experience to people, and it's something that they do while they're chopping vegetables or whatever. But it has to get to a certain level of excitement, of quality, of accuracy in reproduction, where people are captivated enough that they really, they just want to sit there and listen, and they don't want to do anything else.[96]

John recognized that this was no easy task. "One of the biggest challenges is to just get everybody in our overstimulated world to just sit down on the couch for five minutes and shut up

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[95] Interview, 05/31/07.

[96] Interview, 06/27/07.

and listen."[97] Dan felt the same way: "that's another kind of a weirdness that doesn't make it any easier today, is to get people to the point where they'll let their defenses down, stop using the analytical side of their mind every second, and let it in. That's like a key thing to getting somebody going is to make sure that they have an experience, you know, that you can tell was profound for them."[98]

While mentoring involves more than just demonstrating a system for a music lover, this is often a key part of the mentor's role. Creating a comfortable atmosphere for demonstrations and opportunities for learning are key challenges for audiophiles hoping to share the hobby with music lovers, particularly for retailers. Demonstrations are often viewed as learning opportunities or educational experiences from the perspective of the mentor. Bruce, a shop owner, explained his approach to new customers this way:

> All the products that I sell... I'm trying to define for you what I think high-end means... I try to find for each person that I meet, whether they have musical pre-knowledge or not, how I would use their knowledge... I, as an expert, I'm really trying to be a teacher. It means a catalyst to their own self-discovery. But I'm framing it for them, I'm saying "I...have come up with a way that you can feel secure using the knowledge, and awakening the knowledge, that you have to judge the outcome of the music systems that I'm offering, to determine whether you think they objectively reenact the music accurately, and then decide whether you like it or not. And if you like it, buy it. And if you don't like it, tell me what you don't like about it, and maybe I can make it that you will like it."[99]

In non-retail settings, some audiophiles endeavor to create a low-pressure atmosphere for a demonstration. John described an experience of introducing a music lover to high-end audio this way:

> A good friend of ours and his wife, we were out to dinner... and Brian knows [I'm an audiophile], but his wife doesn't really quite know... And they were talking about how... his wife is going on and on about how they just bought a Bose for their living room. And I'm always real polite about that, I'm not a stereo snob. And she's like, "well, you know, and it's so amazing, and it's this and this..." and Brian said, "well, you know, John kind of

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[97] Ibid.

[98] Interview, 06/28/07.

[99] Interview, 08/21/07.

> does this for a living," and he said, "he's really got a pretty amazing hi-fi at his house." And she's like, "well, it can't be better than our Bose," you know, and blah blah blah. And I said, "it's probably a little better than your Bose." And she's like, "well, we need to hear it!" So they came over to the house at about 8:30, and I put something... actually, I put the Beatles "Love" on, because she'd been listening to that all week in her car... And she just went, "I've never heard anything like this before. I can't even believe this." ...we must've stayed up and listened to records until one o'clock in the morning... she said, "wow... if you would've told me that you guys sat on a couch and listened to records till one o'clock in the morning on a Saturday night," she said, "I would've thought you were really mental." But she said, "you know, I could do this all the time." And I said, "well... you've just answered the question."[100]

Manufacturers also approach communicating with both new and existing customers as opportunities to educate them about design philosophy and approach, and about the technical details of equipment. Luke, a manufacturer's representative, described how his company builds their website to facilitate this, and try to make it easier for customers unfamiliar with the technology to interpret product literature and advertisements:

> The education section [of our website] is a little bit of a rebellious decision on our part because... there is an awful lot of marketing that drives the most successful products in the industry... By successful I mean sometimes the product sells based on marketing merits and less on performance aspects. Which is fine as long as the consumer is aware... they're aware of those facts. The problem is most consumers are not aware. They're misguided. And the education section is, in a sense, an attempt to educate people without bashing other products or anything of that sort, just giving them information that, hopefully, they can digest at their own pace and come back and get more. So that they can make a really good, informed decision.[101]

Dan reinforced the idea of the salesperson educating the new customer. To him, some of that educational experience meant undoing mistaken assumptions or correcting misinformation:

> A great deal of the information that you have to impart to people basically is de-programming them of the false information with which they have been painted. That is probably the single hardest part of the job. But if you don't learn to do it, you're not going to get anywhere because people have already heard this and been told that, and you've got to get through, you know, like, "how big is the woofer? Does this matter?"...it's kind of finding your customer's wavelength, what they can handle. Maybe push it a little bit because once they see you're good-hearted, they'll realize they're getting attention. They're actually getting someone who is focusing on their particular situation. So then maybe they'll start to let their defenses down... people only buy when they're ready to buy. So it's better to just kind of give them information, you know, and show them things now.[102]

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[100] Ibid.

[101] Interview, 06/22/07.

[102] Interview, 06/28/07.

In spite of their good intentions, audiophiles do sometimes become overzealous in their efforts to educate music lovers and share the high-end hobby with others. Stan noted that his energy for demonstrating had become a joke between him and his wife: "when we have dinner parties, usually at the end of the dinner party as people are getting on their coats, I'm like, 'wait, wait, wait, you need to listen to this!' Cause I know they're leaving anyway, so if it drives them out, it drives them out. That always drives [my wife] batshit, because... I don't know, I just like to do it."[103] "I was the ultimate hi-fi bore," Tony told me. "You know, generally people will tolerate a certain amount of, 'here, sit here, listen to this, did you ever hear anything like that before?' You'd get reactions from people who got it, to people who were somewhat polite, to people who just got that glazed-eye, 'get-me-out-of-here' expression." He described one particular experience of realizing that his strongly held opinions on audio equipment were not universally welcomed by guests:

> I remember one night, I had this real eye-opening experience. We'd gone out to dinner with a couple that we were quite close to, and we were sitting back at the house, and I was playing LPs, and the wife of the other couple had mentioned that they just bought her mother a CD player. And I went into this tirade about the evils of CDs, and how bad they were, you know, la la la. And we are having quite a spirited debate, until she finally said, "you know, this isn't actually what I want to be talking about. And besides that, my mother has arthritis, she couldn't even pick up an LP. But a CD, and she can press play." And I go, "oh no, I have become boring and intolerant. I need to watch this." 'Cause she was right. I was arguing CD on a moral ground, which... it's not a moral issue at all. It really did come down to, this woman had chosen a way of getting music into her life, and who was I to argue with that?[104]

The idea of people "getting music into their lives" ultimately provides a great deal of the energy for mentoring. The emotional power of music, and what several audiophiles described as music's positive, "healing" capabilities, were the focus of many comments about mentoring. Audiophiles speak of high-end audio systems helping them feel "closer to the musicians,"

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[103] Interview, 10/16/07.

[104] Interview, 05/22/07.

revealing aspects of recordings that might have been previously inaudible on other systems, and helping them get a better sense of the message that composers and performers are trying to convey. The belief in a high-end system's ability to do this more successfully than a mass-market system is a key part of the overall high-end audio ethos, and influences the process of mentorship. "I think music listening is a nourishing, enriching experience," Donald said. "It seems to me the more we have of that, the better place the world would be, if people have this uplifting engaging experience on a regular basis." When I asked how he connected this idea with high-end audio technology, he said, "it lets me hear my favorite recording artists, musicians, more of their intent and expression than I would have if I'd never been exposed to high-end audio. And to hear all that detail and the depth is a much deeper emotional and intellectual connection with the music through high-quality audio."[105]

Mentoring provides opportunities for both existing audiophiles and new audiophiles to expand their social connections with the high-end audio community, learn about new equipment, and help to keep the community vibrant, interesting, and growing for its members. Like the other stages, mentorship is an ongoing part of being an audiophile, and is critical for new audiophiles just beginning to learn about the hobby. Marcus, who otherwise expressed skepticism about and frustration with the high-end audio community during our interview, told me,

> You know, I'm not a doctor. I'm not able to immediately see that I've helped somebody be better on a daily basis...so on the rare occasion that it does show a real tangible impact on somebody, it's great. And I, you know, I think that music has a tremendous capability to influence people's states of health and mind and all the rest of it. So I know that when somebody gets something nice at any level, that it's a good thing. And that's fine. That's fun.[106]

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[105] Interview, 03/11/07.

[106] Interview, 05/02/07.

In spite of frustrations many audiophiles expressed with retail experiences, both as dealers and as customers, the process of becoming an audiophile is often described in positive terms. For music lovers, realizations about the quality of music reproduction available through high-end audio systems is a source of inspiration and pleasure, as many of the comments included so far reveal. However, as with any social process, there are ways that the stages involved in becoming an audiophile, and particular blocks that some music lovers encounter along the way, can complicate the experience. The following two sections explore some of these complications, and how audiophiles recognize and have tried to deal with them.

Women and High-End Audio

Some academic research about hi-fi and high-end audio has focused on the presence of hi-fi systems in domestic and family environments, and the frequently gendered interactions surrounding them. Keir Keightley has argued that during the 1950s in the United States, men used hi-fi as a "means of reclaiming domestic space from their spouses," rendering that space "masculine" within the household.[107] Susan Douglas has observed that the continuum of amateur radio to hi-fi was largely male-dominated.[108] *Stereophile's* latest media kit indicates that their subscriber base is 99% male.[109] The barriers to acquisition of a high-end audio system identified by audiophiles are most frequently money, space, and what many audiophiles jokingly refer to as WAF, or "wife acceptance factor." While this idea is increasingly treated as a humorous

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[107] Keir Keightley, "'Turn it down!' she shrieked: gender, domestic space, and high fidelity, 1948-59," *Popular Music* **15**, no. 2 (May 1996): 149-177, on 150. See also Kirsten Haring, *Ham Radio's Technical Culture* (Cambridge: MIT Press, 2006).

[108] Susan Douglas, "Audio Outlaws: Radio and Phonograph Enthusiasts," in *Possible Dreams: Enthusiasm for Technology in America*, ed. John L. Wright (Dearborn: Henry Ford Museum Press, 1992): 44-59.

[109] Stereophile media kit, available from http://www.stereophile.com (accessed accessed 03/11/09).

throwback to the early days of hi-fi, and a commentary on audiophiles' tendencies to forego feasibility in favor of a desirable sound (one salesman told me, "[a loudspeaker] could look like a toilet seat, and they wouldn't care if it sounded good"), the marginalizing of women in high-end audio remains a source of concern and discussion in the community.[110]

The subject of women in high-end audio has come up frequently in enthusiast magazines, where concern has been expressed about the absence of women from the hobby, possible mistreatment of women in retail settings, or assumptions, held by both men and women, that despite whatever love of music they may have, women are simply not interested in home audio. Sallie Reynolds, a managing editor and later a reviewer at *The Absolute Sound*, wrote a series of articles about women's involvement in the high-end audio industry in the lat 1980s, citing a variety of women-led companies she encountered at high-end audio shows. But she also found the reinforcement of negative stereotypes and assumptions about women, sometimes by women themselves. She described a demonstration at the Consumer Electronics Show led by Sheryl Lee Wilson of Wilson Audio Specialties, a loudspeaker manufacturer:

> Then comes a reading of Edith Sitwell's poems put to music (Walton's *Façade*). Nancy Kennedy's powerful voice fills the room. Her message and her delivery strong and loud. And female. And firm and sure of self. It makes the three rows of men squirm a bit; and when it fades out, Sheryl dimples and says, "I wouldn't want to get into an argument with her. She'd eat me alive." Then goes on to talk of WAF (wife appeal factor). Sheryl is no wimp and it is painful and irritating to see her cutting her own power by falling back on one myth of the female after another.[111]

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[110] For a discussion of gender and family dynamics during the post-war hi-fi era, see Keightley, "'Turn it down!' she shrieked." See also Haring, *Ham Radio's Technical Culture*.

[111] Sallie Reynolds, "Dames in Toyland, Part 1: The City of the Plain," *The Absolute Sound* **13**, 52 (Spring 1988): 60-78, on 64. Although Reynolds writes that the "a" in WAF stands for "appeal," most other references to WAF suggest that it stands for "acceptance." Which of the words is more appropriate in the context of women's experiences with high-end audio is an important part of the overall discussion. Several interviewees, including John and Stan, cited the visual and design appeal of modern high-end equipment as important to their wives. "Appeal" in some ways captures the desire expressed by audiophiles to be more inclusive of women, but "acceptance" is the more commonly used word.

Another female writer for *The Absolute Sound*, Enid Lumley, contributed to Reynolds' series, writing about her own experiences as a woman interested in audio. Her process of becoming an audiophile mirrored that of many of her male counterparts, but with added complications. She described how she once quit a job as a technician at a repair shop after discovering that she was making half the wage of a male employee with the same job and same skills. Reflecting on the subject of women and high-end audio, she wrote:

> I wish more women would get into it and I extend an invitation for them to do so. I think they would have much to contribute, and they would have a pile of fun. Audio is an endlessly fascinating hobby, with endlessly fascinating people to associate with. I'd like to see the day when the subject of men and women becomes simply that of kindred spirits sharing a common love of good music and sound with each other as human beings. Human beings who are on earth for a limited period of time, living in a stressful and troubled world in which good music and good sound nourish our tattered souls and make us whole, again – men and women together, sharing a very beautiful thing.[112]

In 1994, *The Absolute Sound* also ran a series of articles by audiophile and violinist Vanessa Vyvyanne du Pre on the subject of why more women were not audiophiles. Du Pre took a more critical (and less purple) approach than Lumley, citing a variety of factors to explain women's' absence from the high-end audio community, including sexism, "boorish" salesmen in retail shops, and poor reliability of some equipment. She was especially critical of *Stereophile* reviewer Corey Greenberg who, in a report from the 1991 Summer Consumer Electronics SHow, exhibited a "gruesome display of testosteronic ebullience" by including in his discussion of equipment a segment devoted to "the best babes of the show," mostly manufacturer's representatives or saleswomen, who he identified by name. "I do wish to say," she wrote,

> that these (admittedly rare) uncouth remarks about women in audio magazines have usually done more to ridicule the culprit himself than to oppress any woman. Still, if I had

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[112] Lumley was a regular contributor to the magazine during the 1970s and early 1980s, but her claims to hearing differences in her audio system based on factors such as interference from overhead power lines were considered ludicrous and unsupportable by many readers. Her articles also became a lighting rod for criticism of the entirety of the "subjective" or "golden-ear" segment of the audiophile hobby by the measurement-oriented "objectivist" or "meter reader" segment. Enid Lumley, "Dames in Toyland, Part II: Enid's Adventures in Audioland," *The Absolute Sound* **13**, 52 (Spring 1988): 80-84, on 84.

> attended a hi-fi show, and my name (along with a description of my body, however flattering the comments) then appeared in the high-end magazines' pages, I am sure that, out of self-conscious embarrassment, I would stay away from the next hi-fi show.[113]

Du Pre's critique of sexism in the high-end audio world was more broad than many previous discussions. Like Reynolds, du Pre expressed frustration with what she described as the more "subtle" forms of sexism against women in the audio world:

> ...I weary of the constant references to wife acceptance factor (WAF). Not because I think this isn't an important variable in selling audio equipment; it's just that I would prefer more focus on selling to women who are the primary decision-makers, or purchasers, when it comes to hi-fi. In other words, focus not only on disapproving wives, but also on women who are interested in hi-fi, whether they be single or married.[114]

But she followed these observations by arguing that, on the whole, sexism against women in the high-end audio world "isn't all that bad."

> The chauvinism exists, but very often it is offset by chivalry – men's eagerness to help a woman who wants to participate in, if not join, the audio club. I think it evens out – a woman may be somewhat oppressed by chauvinism, but she is just as likely to receive preferential treatment via chivalry. The truth of the matter is, a lot of male audiophiles are extremely eager for women to join their ranks, simply because men, in just about everything they do, enjoy a woman's friendly company.[115]

She further argued that sexism operated in the other direction as well, noting that the significance of "wife acceptance factor" came, in part, from women's attitudes towards men's interests in the hobby. Women, she suggested, created conditions where their husbands or boyfriends had to become "supplicants" in order to pursue their hobby in shared living spaces. "I think women," she wrote, "especially wives, should recognize that they possess, and too often unfairly wield, this kind of power." She called for a shift in general attitude among women towards men's interests in high-end audio:

> Women should also, at the very least, acknowledge that their husbands' audio interests are legitimate rather than ridiculous, and around issues of audio, interact with their

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[113] Vanessa Vyvyanne du Pre, "Women Against the High-End: Audiophilia is a Dead End," *The Absolute Sound* **18**, no. 93 (Late Winter 1994): 28-40, on 30.

[114] Ibid.

[115] Ibid.

> husbands in a more friendly fashion so that difficult, but mature and friendly, compromises can be worked out. The listening room/living room distinction might thus be abolished in favor of joint participation in the enjoyment of mutually purchased, and pleasantly shared, audio gear... it is true that men have their toys – whether cars, computers, cameras, audio, etc. But most of the time this practice is quite benign, and although there are instances when it goes too far, such instances do not warrant the sweeping generalization that men playing with their toys is ridiculous, contemptible, or wrong.[116]

Du Pre also raised the issue of differences in hearing between men and women. Making a somewhat vague allusion to a "government study," du Pre suggested that men's hearing tends to be far weaker in the upper registers than women's hearing, and as men enter middle age, they experience gradual hearing loss, often exacerbated by listening at volumes women find excessive. This resulted in equipment designs, mostly created and evaluated by men, that tended to emphasize or boost the higher frequencies, driving women out of the room. Citing (and criticizing) Corey Greenberg once again, du Pre gave an example of a particular phono cartridge:

> The aforementioned audio writer, Corey Greenberg, loves the Sumiko Blue Point cartridge. I believe it is the most gratingly bright cartridge in audio I have heard. And now, don't tell me I must have gotten a bad sample. I tried three before I gave up. Other women I know have tried them. The verdict is always the same: a thin, tinny, sharp edge to the highs... The Sumiko Blue Point makes music sound like breaking glass. Yet Corey Greenberg, who, because he is an audio reviewer, presumably has easy access to a wide variety of cartridges, uses that piece of tin and plastic as his reference cartridge?! But then, I do recall reading a review in which Mr. Greenberg was going on about how he likes to play a certain piece of rock music with the stereo turned almost all the way up, while playing along on his Fender electric guitar through his Fender Super Reverb amp, which is turned all the way up until, for him, everything is pleasingly loud. Two of my male friends have Fender Super Reverb amps. I have heard them, and they are very, very loud turned even halfway up. No wonder this writer... loves the Sumiko Blue Point. It is probably the only cartridge in existence which can adequately compensate for his inability to hear highs.[117]

The idea of women's hearing as different from men's was echoed in some interviews. Ron, an engineer, suggested this difference was one reason for the failure of Sony's high-resolution Super Audio CD (SACD) format: "Number one... Sony wouldn't share their rights,

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[116] Ibid., 30, 32.

[117] Ibid., 34. Greenberg was known for an irreverent, jokey style of writing, and while du Pre's complaints about his "best babes at the show" commentary is easily legitimated, his descriptions of turning his guitar amplifier up all the way to play along with a song also played at full volume on his stereo was very possibly an exaggeration on his part meant to entertain readers.

but number two is that there are high-frequency artifacts that men cannot hear, and that ladies can, because of the nature of our hearing. And so the ladies don't like the way the thing sounds."[118] "Women have innately different hearing," Marcus told me. "I hesitate to say better, but I think it's that they're sensitive to different, and more sensitive to lesser amounts of distortion. They can't handle it." These differences, he felt, contributed to the difficulties male retailers sometimes encounter in selling equipment to women audiophiles. He described an experience from his early audiophile days that cemented this impression:

> [When] I was working at [a high-end shop], and [my apartment] was the place where we did all the experiments... we were doing amplifiers one day. I had bi-amped them, so, you know, the woofer amp was already set, we were just checking out top-end amps. And I don't know how many we had... half a dozen? And girlfriends were all there, so there were probably, you know, 10 of us in the living room. And the women were doing this and doing that, you know... I jokingly say knitting. But they were paying no attention to the stupidity going on around them. And we went through one solid-state amp after another, and then I hooked up an Audio Research [tube amp], and the instant it went on, every woman in the room went, "that's better," and went right back to whatever they were doing. And, you know, we're all, "well, you know, that one's a little, and the sibilance, grumble grumble." We agreed, of course, that was the best sounding of the bunch, but it was just so instantaneous. ...They have a sensitivity to certain things, and they just hear differently, and arguably better.[119]

During my conversation with Stan, he frequently referred to his wife as, if not a direct participant in gear purchases, a significant influence on his decision-making beyond negotiating the financial issues. For Stan, his wife's input, particularly given her professional skills as a designer, were important considerations – "I do vet the things I buy with Paula," he told me, "because she's a design-head." At the same time, he laughed about a particular argument they had over his purchase of a rather large pair of loudspeakers:

> [A shop in town was] having a closeout sale... and there were a pair of demo Thiel [loudspeakers], which... I think they were like five or $6,000. And they were, you know, I think they were making an off-the-books sale, and so they said, "if you can bring cash,

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[118] Interview, 04/26/07.

[119] Interview, 05/02/07. Bi-amping refers to the practice of using separate amplifiers to drive different parts of the frequency spectrum. In this example, Marcus was using one type of amplifiers for the low frequencies and another for the high frequencies. Bi-amping is only possible with loudspeakers with multiple binding posts corresponding to the woofer, or low-frequency driver, and tweeter, or high-frequency driver.

> you can have these speakers for $3000." So I went home and told Paula about the speakers. And I... I actually did not deliberately mislead her. I forgot how big they were. But I said, "yeah, they're bigger than [our existing loudspeakers], but they're not huge." And she said, "no, no way, those are too big." And I said, "oh, c'mon." And like I didn't sleep all night cause I knew they would sell the next day. And I woke up in the morning and the first thing I did, I said, "come on, Paula..." and she said, "okay, okay, you want to buy new speakers? Fine." So she came home to these speakers, which were bigger than I had described, and she had been upset with the original description. She was actually really kind of pissed off. She wanted them to go back, and I said they weren't going back. So the next, that same week she bought [a] painting. She said, "alright, fuck you. You're going to spend $5000 on speakers? I'm going to buy an oil painting." So that oil painting by... Kent Williams, his only self portrait, now hangs in our apartment as a result of her being *so* pissed off with those big speakers.[120]

While the subject of women in high-end audio continues to be discussed in magazines and elsewhere in the community, many audiophiles expressed confidence that the industry and community were doing better to include women. "I mean, my daughter's 13," John told me. "She's got, you know, a Mac mini. She's got a flatscreen monitor. She has an iPod. She has a Motorola Q phone. All that stuff… so we're raising a whole generation of women that are knowledgeable and comfortable with technology." Although John's story about introducing a female friend to high-end audio cited earlier in this chapter involved music and sound quality, he also cited more stereotypical assumptions about how manufacturers could appeal to female customers, particularly through the physical design of components:

> If it's not something your wife or girlfriend likes, you're always at a disadvantage. And, you know, considering women make so many of the buying decisions in every other aspect of life, the guys who finally figure it out and tailor this more to a female audience are just going... to succeed in spades because, you know, if your wife or girlfriend comes home and says, "hey dude, let's buy a new $10,000 CD player," you're not going to say, "no, let's get a chair instead." So, I mean, that's another part that that world has just completely ignored. And some of the gear now that's coming out is a lot more aesthetically pleasing. I mean, back in my day it was all a bunch of just big black boxes. And there's been a lot of gear from a lot of different companies that not only sounds good but looks really good and integrates into your world a lot easier than it used to.[121]

Not everyone felt that the small number of women involved in high-end audio was really a problem. Sherry, a business owner, made several observations when asked if she felt this was

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[120] Interview, 10/16/07.

[121] Interview, 06/27/07.

an issue. When I asked about women's retail experiences, recalling du Pre's criticisms in *The Absolute Sound*, she said, "Dealers are imperfect human beings, as the rest of us are, and they run their businesses to the best of their ability," she said.

> Now, they're primarily men-owned and -operated businesses, so they will tend to act and behave in male-oriented ways. This is not their premeditated attempt to exclude women at all. I think they just really don't know how all that well. And I think that if they could, they would. This is not like a bias or a sexist orientation by any means... I mean, they'd sell to a frog if they could, you know. The idea is to cultivate customers and to sell your stuff. And if they, if they could, they would. So I don't see anything malevolent in the industry's inability to attract women to it.

She further observed that, in some cases, sales practices or characteristics of community behavior may be equally alienating to some men as they are to some women, reflecting the intimidation some new audiophiles feel at the prospect of acquiring their own systems:

> These same people who own and operate these businesses tend to be technically oriented, and they love the gear and they love the stuff. So they are going to tend to present their products in that way, which for women is not maybe the best way for them to be appealed to. But there are also significant numbers of men who also don't like being addressed that way. So I don't think that this is strictly a female phenomenon. I think that there are a lot of male customers that are not predisposed to liking walking into an audio store because you just don't know the jargon and you don't know the gear, and the people are not trained necessarily very well to know how to make you feel comfortable, and to speak in plain language...

Finally, she suggested that the male orientation of the high-end audio hobby was perhaps the result of a healthy economy and society:

> I think is extremely important to realize that, in a free society, and in a free market, people do what they want to do. There's nothing sinister about this. The fact that women are not appearing in droves in these stores, or are creating businesses that have to do with this type of technology, is a reflection of free choices made by free people, and reflecting their natures. So I am very comfortable with... you know, my big thing is that people do what they want to do, and that they shop where they want to shop and work where they want to work and buy what they want to buy and live how they want to live, and if it tends to congregate according to one sex, well, that sounds pretty normal if it's all done freely and voluntarily... you know, there's no correction, in other words, that I think should be attempted to be made, no social engineering is required here... to me these disparities feel artificial.[122]

The issue of women in high-end audio continues to be a source of some discussion within the community, but not to the extent that it was during the 1980s and 1990s. The readership for

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[122] Interview, 01/24/08.

Stereophile magazine, with a current circulation of 74,000, remains 99% male.[123] But a number of prominent companies have women in leadership positions, including Kathy Gornik at Thiel Audio and Rondi D'Agostino of Krell, both of whom have been involved at their respective companies since their foundings. At Manley Labs, Eveanna Manley is both the leader of the company and chief engineer. *The Absolute Sound* has two women reviewers on staff (Sue Kraft and Sallie Reynolds). My own observations at high-end audio expositions suggest that the attendees are predominantly male and women attending alone are rare, but there were a significant number of couples. In the larger display rooms (20 seats or more), the average number of women listeners hovered around 10%.[124] While the high-end audio community continues to clearly be male-dominated, appealing to more women is an ongoing aim among community members.

Cycles of involvement

Asking how people become audiophiles also necessarily raises the question of how people *stop* being audiophiles, or leave the high-end audio community. Despite an inherent sampling bias towards people who are still, in some way, involved in the hobby, several interviewees shared stories marked by an absence of high-end audio gear, and in some cases, music, in their lives. These periods were often associated with economic and personal hardship that forced their high-end audio hobby to the "back burner" while other priorities were addressed. But for those audiophiles who sold their systems or otherwise had to give up the sophisticated

[123] Although not specified in the media kit, presumably the demographic information is obtained from reader surveys, which the magazine conducts occasionally. *Stereophile* Print & Web Media Kit, available from http://www.stereophile.com (accessed 03/11/09).

[124] This is distinct from the number of women representatives and sales people. At all of the expositions I attended for this research (a total of four between 2007 and 2008), I saw that many companies had women employees staffing the listening rooms.

technology of high-end audio reproduction, they never lost their interest in music. Audiophiles who felt that life circumstances had separated them from music described these situations with a distinct sense of loss, while the coming and going of gear was less traumatic.

In his study of the hi-fi culture in the post-war United States, Jeffery Tang argues that audiophiles "[were] not a collection of casual music lovers, but a tribe of fanatics whose zeal approached that of the religious crusader or the drug addict."[125] While not an apt description of the community on which this current study is based, several interviewees, including Ron, Thad, and John, did characterize their own relationships with audio or the relationships of others they'd observed as "obsessive" and the high-end audio hobby as an "addiction." Several interviewees rejected the label "audiophile" because of its association with this obsessive character. "I'm not an audiophile," Tom told me. "I just love music, and this is a means to get to that music."[126] Salespeople joked about the obsessive customers with whom they sometimes interacted – people Marcus described as "audiopaths." "We get phone calls from lots of people who I, unfairly perhaps, describe as 'out on a day pass'," he said.

> People who we recognize immediately, by voice, who all of us [at the shop], every single one of us, have spoken to some of these people, repeatedly. And they ask the same sort of questions. And they're asking about ludicrous products they will never, ever own. And, you know, "should I get this… ." you know, I'm fooling around, but, "should I get this spade lug or that spade lug?" Which, by the way, is not quite so far out as you might think. But they ask about obscure questions, they ask about seemingly reasonable questions. "What do you think is the best preamp with this and this and this and this?" Until they call up three weeks later and ask the next person who happens to answer the phone the same exact question.[127]

Others described the "seductive" aspects of the hobby leading to obsessive behavior. Thad's experience, while not typical, was particularly striking:

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[125] Jeffrey Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975" (Ph.D. Thesis, University of Pennsylvania, 2004), 241.

[126] Interview, 04/25/07.

[127] Interview, 05/02/07.

> I really didn't have [the money] to spend [on high-end gear], technically, but I was always able to rationalize these kinds of things ...I have to be, in all honesty... I basically went into massive amounts of debt in my pursuit of this hobby. And the money that I borrowed, effectively, to pursue it... the amount of money that I dumped into it has been a big part of my longer-term financial struggle and downfall. So, you know, it's like... I suppose it's like a lot of kind of hobbies that people become obsessed with, you know... it's very easy because it's so seductive, and because there's this omnipresent sort of background rationale in your mind about the sort of critical importance of achieving optimum sound, that if you just get this new interconnect or new CD transport or whatever it might be, your system is going to be so much better. And then of course as soon as you do that, you're on to thinking about the next thing you need to change or upgrade or whatever. And I am highly susceptible to that sort of thing, so I was... while on the one hand, I was really enjoying all of this, I was also getting myself into financial trouble.[128]

For Thad, financial pressures eventually compelled him to sell most of his system. Other audiophiles described financial issues causing a shift in priorities. "In '96, my business, the economy in [my town] kind of took a dump for about a year, and I had to kind of... I had to kind of put [my high-end hobby] on the back burner for a while," John told me.

> You know, I really didn't spend much time with it. We had just had our daughter, and life was pretty scattered, and it was something that... you know, I ended up selling most of my system to a good friend of mine... I traded out a little work to a friend of mine for a pair of [loudspeakers], and I had an amp that I built myself again, and just a... I still had my [turntable] from way back when... it was kind of a dark period. '96 and seven and eight were really, I just didn't have any time for hi-fi.[129]

Significantly, however, as he told this story, John pointed out that "I didn't get rid of any of my records or CDs, but I went back down to about a $1500 system again." Thad, too, held on to all of his music, despite changes in his system and general financial struggles. For Theodore, an engineer and business owner, his own cycles of involvement as a young man were governed by his immigration to the United States. "At that time, audio took a definitely back seat to much more important activities," he said. "I had to just build a new life in a new country." But, like Thad and John, he retained his love of music during this period.

> So of course, very quickly, [my brother and I] bought a system which I thought was good. It was essentially Technics equipment, and whatnot. And I was enjoying music of course. At least I could play my records. I started buying records and so on. But definitely it was not a big part of my life at the time because certainly most of it was consumed by,

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[128] Interview, 03/30/07.

[129] Interview, 06/27/07.

> essentially, getting established in a new country, because we had to do so much. And that's how it was for a number of years, maybe for 10 years.[130]

After having worked in high-end retail, run his own shop, and then switched gears and taken a teaching position at a technical school, Bob also described a period of his life when he cycled out of the audiophile hobby: "I fell out of the ability to act enthusiastic [as a teacher], and I knew that that was going to be doing a disservice to my classes. And I was having personal drama at the time, too, so I decided, I decided to… I just decided to give it up. [And my audiophile hobby], it had faded into obscurity. I'd actually packed up my audio system."[131] But a connection with a friend who was also an audiophile helped him to maintain his connection to music:

> My best friend, who was sort of an audio hobbyist all his life also, and who, through me, got into the really high-end stuff, had, while I was working in audio, assembled a system of his own that was very nice… And so we kind of had a regular Friday night get-together where we would get together and drink whiskey and listen to vinyl. And sometimes CDs too. And that was my, he was my continuing, you know, like, contact with good music… That was my only connection. I got completely out of it professionally… I guess I sort of blamed myself for getting too artsy there for awhile. And so I sort of pulled back and got really technical and into teaching, and "I'm going to be a, you know, I'm going to have a real job now and not play around anymore." But I was temporarily misguided and… you know, I just… I put false ideas in my own head, I guess, about what I ought to be doing, which is what you love. You've got to do what you love.[132]

Cycles of involvement can also come from following a technological path in building an audio system that proves unsatisfying, and losing interest in listening to music as a result. Tom described how, after many years of selling high-end audio equipment, he had assembled a very sophisticated personal system, but was not getting much enjoyment from it.

> My last big system was as audiophile as you're going to get. It was a Pass Labs LF5 tube gain stage, single-ended class A solid-state amplifier, you know… it could heat your room at any given point in time. A passive line stage… well, first it was a Wadia CD player with digital volume control. But it was a little too digital, so I got a passive line stage and I had this unbelievable transparent presentation. It was just ridiculous. But

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[130] Interview, 06/06/07.

[131] Interview, 04/27/07.

[132] Ibid.

> completely, what ended up... I couldn't figure out what it was. It was lacking soul. It had absolutely no soul whatsoever... I do listen to some various, you know, eclectic music, but I'm more R&B-based. I mean, I worship at the altar of James Brown and Ray Charles on a regular basis. I mean, Otis Redding and Marvin Gaye... R&B and blues moves me big-time. And I was listening to those... listening to Art Neville with [the Meters] And, you know, the only reason your feet ain't tapping is cause you're dead... or deaf, one of the two. And I'm listening to it, and I'm like... my feet ain't tapping. I'm just like, "this is wrong. This is just wrong." And I didn't know what to do about it.[133]

It wasn't until a demonstration of some equipment from the Scottish company Linn that Tom felt he rediscovered what had been missing from his music system, which he sold and replaced with Linn equipment. The result, for him, was a reinvigoration of his interest in music:

> I've got a thousand CDs, and [I was] listening to five of them because they are the only ones that sounded good on my system, because they were really really well-recorded. Meanwhile, my Zappa collection was not getting paid attention to, my Sun Ra collection was just lying there collecting dust, you know, and all my Meters stuff, all my R&B, was just not being played. I was playing [high-end audio record label] AudioQuest recordings. Oh god! I just... I was in this pit of despair, until I finally listened to [the Linn gear] which for me, hit all the right notes. Do I think Linn gear is the best gear on the planet? No. It's the best gear for me.[134]

Tom's experience illustrates how, for many audiophiles, the process of demonstration, realization, and acquisition is often repeated throughout their experiences as audiophiles.

Several audiophiles observed that their reduced participation in the hobby and amount of time they could devote to listening to music stemmed from other life circumstances. "Unfortunately," Luke, a manufacturer's representative, told me, "my lifestyle right now is such that, being married and having so many responsibilities with [my company], traveling on business consistently, putting in much more than 40 hours a week... it has separated me from my music."[135] Family and work issues were cited by several audiophiles as contributing factors that meant less time for music. "You know, 60s and 70s, into the 80s," Marcus told me, "I was single."

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[133] Interview, 04/25/07.

[134] Ibid.

[135] Interview, 06/22/07.

> I did what I wanted to do, in essence, or what I could afford to do. So there was lots of time for music, lots of time for stereos and playing and experimenting and buying and selling, all that hand-waving kind of stuff. But my life changed when I got married... for myself, when I started spending more time going out with one woman more seriously and then getting married, and then, obviously, everything changes. And just because of time. You know, I was working and being with this person and developing other things and spending money on other things... so the emphasis just started to shift there. And then when I had kids, started to have kids, and it was like... one of the guys here [at the shop], a technician, I gave him my turntable because it had been sitting I don't even know how long, because I realized as soon as I had kids, partly because of the nature of my home, I just didn't have a really good place for a good sound system... I sort of gave it up, cause I couldn't find an environment in which to put it. I couldn't set it up the way I would like it. I couldn't even have the stuff that I would want. So it fell by the wayside, and then just the amount of time that I spend here, you know, the time that I spend not being in the [demonstration] rooms, and the number of years I've been doing it, my personal involvement with the music and the stuff is, you know, I won't say it's nonexistent, but it's drastically reduced.[136]

Other audiophiles made similar observations. Bob said that "you can't really take care of the baby and listen to a record at the same time," while Joseph recalled that as his young son had, at one point, "tried to bias my tube amp," leading to the conclusion that some of the more fragile pieces would need to be either replaced with something more kid-friendly, or just removed from the living room.[137] For people like Luke, Marcus, and Tom, professional involvement in the high-end audio industry does not guarantee a connection with music or with the equipment used to reproduce it, as the demands of business travel and sales activities limit the time audiophiles can spend listening.

Conclusion

The process of becoming an audiophile is not monolithic nor universal. People become audiophiles as a result of a variety of experiences with both music and with music reproduction technologies. Many audiophiles would surely disagree about the necessary ingredients and processes for making someone into an audiophile. However, as I have shown, audiophiles also

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[136] Interview, 05/02/07.

[137] Interview 04/27/07, and 04/24/07.

have many shared experiences and traits that helped to create the opportunity to join the high-end audio community. As with any community, particularly communities united around a shared enthusiasm for a particular hobby, the diversity of experiences, opinions, and tastes is balanced by what the members have in common. I have shown that in addition to a love of music and music reproduction, audiophiles have many shared experiences. Focusing on these experiences can increase our understanding of the community, and its relationships with technology, gender, and economics.

Much of the academic and popular literature about high-end audio tends to paint the community as largely techno-fetishistic, white, male, wealthy, tweaky, and/or frivolous. To be sure, audiophiles can and do act like snobs, and the industry has what one engineer described as a "kook element" that is perhaps more visible than other communities and industries. "You have to remember," he told me, "you can't condemn an industry because there's some kook element to it. I think any industry has [that]."[138] The emphasis on these elements in both academic and popular literature results in a lopsided presentation of the community that obscures the nuances that make high-end audio a useful topic of social and historical study. I have shown that a commitment to and love of music is pervasive regardless of audiophiles' backgrounds or current social status, and the relationships community members have with the technologies of home music reproduction suggests that consumption is governed, at least in part, by aesthetic sensibilities and emotional experiences that warrant further study. Examining the social aspects of the community, particularly the process of joining it, can help to inject some of this nuance back into the discussion.

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[138] Interview, 01/08/08.

The process of becoming an audiophile shows that emotional responses to music, aesthetic concerns, and enthusiasm play significant roles in the formation, maintenance, and growth of this community. In the following chapter, I will describe how the community coalesced in the 1960s, 1970s and 1980s around particular ideas about fidelity, and the conflicts that arose between "subjectivist" and "objectivist" audiophiles that came to be known as the "Great Debate."

Chapter 4:

The "Great Debate" – Subjectivity, Science, and the Origins of High-End Audio

> By definition, the "high end" is concerned with the current state of the art. If there is to be any progress in advancing the state of the art, there must be a focus on *real* problems and flaws in stereophonic and musical reproduction (still far from perfect) and on sonic differences that can be repeatedly demonstrated, isolated, labeled, and quantified. Without this element of practicality or common sense, for most of us the World of the High End will continue to be Tweaksville, a sort of Lotus Land populated by a dreamy lunatic fringe out of touch with reality.
>
> – Alan Lofft, *Stereo Review*, October 1982[1]

> Measurements are essentially subjective in and of themselves because they prove nothing except that which the experimenter subjectively wishes to prove. Measurements per se are only useful if the experimenter outlines exactly the context of their use, what he hopes to prove with the measurements, how well he proves what he set out to prove and what independent verification he has that he proved what he thought he proved... We are not "against" measurements. We are against measurements presented as fact without knowing the context in which those measurements were taken.
>
> – Harry Pearson, *The Absolute Sound*, October 1982[2]

In their seminal book *Leviathan and the Air-Pump*, Steven Shapin and Simon Schaffer explore the origins and forms of the scientific method through the work of the 17th century experimentalist Robert Boyle, and Boyle's conflicts with natural philosopher Thomas Hobbes. Shapin and Schaffer argue that Boyle's pneumatics experiments established both "a heuristic model of how authentic scientific knowledge should be secured," and "crystal[ized] forms of social organization and [acted] as a means of regulating social interaction within the scientific community."[3] The scientific method, they argue, was and is "integrated into patterns of activity,"

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[1] Alan Lofft, "Sense and Nonsense in High-End Hi-Fi," *Stereo Review* **47**, no. 10 (October 1982), 62-69, on 69.

[2] Harry Pearson, "Editorial," *The Absolute Sound* **7**, no. 28 (October 1982), 7-8, on 7 and 8.

[3] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump* (Princeton: Princeton University Press, 1985), 4, 14.

where "solutions to the problem of knowledge are embedded within practical solutions to the problem of social order, and that different practical solutions to the problem of social order encapsulate contrasting practical solutions to the problem of knowledge."[4] Scientific experimentation, as practiced by Boyle and his colleagues at the Royal Society of London, was not, in other words, simply an implicitly sensible approach to understanding nature. It was instead a process that privileged a particular vision of both nature and social hierarchy that was intimately tied to the social and political circumstances into which it emerged.

In the world of home audio reproduction, much of the conflict between different communities has hinged on similar questions, with issues of experimental practice at the center of the debates. Some high-end audio enthusiasts claim that listening for extended periods in a home environment, where the human ear is the arbiter of the somewhat elusive concept of "fidelity," is the most legitimate and useful manner by which to evaluate the quality of home audio equipment. Others believe that assessments of quality are best derived through technical measurements and controlled listening tests that produce quantitative results for statistical analysis, enabling both engineers and end users to weigh products against one another with maximum "objectivity." But, as sociologists Wendy Espeland and Mitchell Stevens have shown, the quantification of a process or an experience for the purposes of assessing quality, making economic decisions, or in order to compare otherwise disparate things is a social exercise fraught with complication.[5] Ethnomusicologist Marc Perlman has described how audiophile "tweaks" of audio systems and components, which have "no scientifically accepted relationship to the

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[4] Ibid., 15.

[5] Wendy Espeland and Mitchell Stevens, "Commensuration as a Social Process," *Annual Review of Sociology* **24** (1998): 313-343.

technological principles of the audio device," have engendered conflict with "the technology's chief source of epistemic authority: audio engineering."[6] While tweaks and tweak products were certainly a significant part of the conflicts in the home audio world, many of the most vehement arguments have erupted not so much around particular products as around the overall processes of assessing quality, and the manner in which the findings from such assessments are reported. Less an argument over whether or not measurement and quantification have value, the disagreements within the home audio world have had more to do with *when*, *how*, and *for what purpose* quantification can and should be applied to explain the performance of music reproduction systems. In other words, what came to be known as the "Great Debate" within the audiophile community was not about numbers *per se*, but more what numbers could and could not reveal about fidelity.[7]

These differences in approach to home audio have been categorized by some scholars, and by many in the audio community, as "subjective" versus "objective." While such divisions are visible in the enthusiast literature, closer inspection of the behavior of audiophiles, including their reflections and perspectives on their hobby, reveals the "subjective" and "objective" labels to be somewhat deficient. Marc Perlman's designations of "golden ears" and "meter readers" are

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[6] Marc Perlman, "Consuming Audio: An Introduction to Tweak Theory," in Rene Lysloff and Leslie Gay, eds, *Music and Technoculture* (Middletown: Wesleyan University Press, 2003), 346-357, on 347.

[7] "The Great Debate" served as the title of a paper presented by Stanley Lipshitz and John Vanderkooy at the Audio Engineering Society convention in February of 1980, to be discussed later in the chapter. Stanley Lipshitz and John Vanderkooy, "The Great Debate: Subjective Evaluation" (paper presented at the 65th Audio Engineering Society convention, London, England, February 25-28, 1980). Reprints of AES conference papers cited throughout this chapter are available through the AES website at http://www.aes.org.

also derived from audiophiles' own language, but these, too, are insufficiently descriptive.[8] Many so-called subjectivist audiophiles are quite comfortable with numbers and possess substantial technical ability and training. Likewise, many in the objectivist camp believe wholeheartedly that subjective listening tests can reveal a great deal about sound quality in certain system components, as long as those tests are performed in the proper way and under the right conditions. In addition, the different groups also share a variety of traits, including suspicion of the influence of advertising on component reviews in magazines and, more importantly, a love of music.

In this chapter I will adopt a designation for those who fall into the "subjectivist" camp favored by reviewer and current Editor-in-Chief at *The Absolute Sound*, Robert Harley: "observational listeners." To describe those in the "objectivist" camp, I will use "double-blind listeners," based on their use of double-blind listening tests as a way to measure the subjective qualities of audio components, particularly loudspeakers.[9] While somewhat more cumbersome and dependent on visual rather than sonic metaphors, these descriptions do more to capture the differences in methods of analyzing quality that are at the heart of what separates these groups. Considering that much of the conflict revolves around these differences, these terms are appropriate, if imperfect, labels. Further, identifying both camps as "listeners" acknowledges that despite the emphasis on quantification and measurement among the so-called objectivists, there is general agreement among all concerned that the ultimate goal of any audio system is the

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[8] The term "golden ear" is sometimes used derisively by both camps, although less among the "subjective" camp – for many years *The Absolute Sound*'s annual product awards were called the "golden ear" awards. Despite his magazine's focus on the subjective qualities of audio equipment, Harry Pearson refused the subjective label for his reviewing process while Holt continued to use this term to describe his own process.

[9] In cases where members of these different groups use "subjectivist" and "objectivist" to describe themselves and each other, these labels will, of course, be retained.

reproduction of music in the home with the highest possible fidelity. Objectivists are, in other words, also listeners and also lovers of music. Applying any labels to the audiophile community invites the assumption that these groups are far more monolithic than the data gathered for this dissertation can support, but I will show that a diverse range of opinions, values, and approaches to home audio exist among and between the observational and double-blind listeners.

In previous chapters, I described high-end audio systems from a functional perspective, and explored the social process of becoming an audiophile. In this chapter, I will focus on the how community coalesced, and the debates over science and proper testing procedures that have framed its formation, expansion, and continued existence from the early 1960s to the present. I will show that despite their privileging of observational and subjective attributes of audio equipment, observational listeners were as committed, at least in principle, to "standards" of fidelity as the double-blind listeners. These standards, however, proved hard to pin down or establish consistently, particularly against ongoing resistance from double-blind listeners. A part of that resistance came in the form of the ABX Comparator, an electromechanical device for conducing double-blind listening tests. The Comparator was seen by double-blind listeners as a means through which to prove, statistically and with appropriate scientific detachment, whether or not the subtleties described by observational listeners were indeed audible. To the observational listeners, the device was merely another example of scientists designing instrumentation to prove what they were already biased to believe was true. By the early 1990s, some among the observational listeners challenged the very idea that the experience of listening to music could be approached in a scientific and quantifiable manner, while others questioned whether focusing too much on emotional responses pulled the community away from its original

goals for high-fidelity reproduction. Ultimately, the disagreements and discussions between and among observational and double-blind listeners served to simultaneously foster the growth of the community throughout this period, and complicate its goals.

With the aim of capturing the context and trajectory of the "Great Debate," this chapter follows its progress through the pages of high-end audio's most influential publications, *Stereophile* and *The Absolute Sound.* These two magazines (whose foundings in 1962 and 1973, respectively) bracket the emergence of the high-end audio community, and helped to establish the high-end audio ethos that emphasized observational listening and subjective evaluation of audio equipment. While the magazines shared a focus on observational listening, stylistically they were quite different, as were the personalities of their founders. *Stereophile*'s J. Gordon Holt was among the first audiophiles to emphasize the subjective characteristics of home audio equipment, laying the groundwork and the vocabulary for subjective equipment reviewing. *The Absolute Sound*'s Harry Pearson pushed both the vocabulary and reviewing practices in a dramatic and critical direction through the 1970s and 1980s, appealing to many audiophiles' sense of passion for music. Together, they came to represent high-end audio and the practice of observational listening, and in different ways, engaged in defending their practices in the pages of their magazines.

Representing the other side of the "Great Debate" through this period was the mainstream hi-fi magazine *Stereo Review,* and many members of the Audio Engineering Society (AES). *Stereo Review*'s method of assessing quality, spearheaded by engineer and columnist Julian Hirsch, tended to focus on measured performance and other "objective" criteria. *Stereo Review* concentrated on a different range of products than either *Stereophile* or *The Absolute Sound* –

mainly equipment from large manufacturers such as Sony, Philips, Sanyo, Kenwood, and others. Only very occasionally did *Stereo Review* review or test equipment from the small-scale, boutique manufacturers whose products appeared in the pages of *Stereophile* and *The Absolute Sound*. *Stereo Review* also had a circulation that was much greater than either *Stereophile* or *The Absolute Sound*. In 1982, the circulation of *Stereophile* was listed at about 3,800, *The Absolute Sound* at 10,875, while *Stereo Review*'s was 540,000.[10] Although the products that appeared in *Stereo Review* tended to be less expensive (often by a wide margin) than those in either of the so-called "underground" magazines, they, too, attempted to define what constituted fidelity: in this case, measurable characteristics and statistical data gathered from highly-controlled listening tests with expert listeners. The AES was formed in the spring of 1947 and remains the premier professional society for audio engineers working in music production, film sound, sound reinforcement, and hardware design. Over the course of its history, through its bimonthly journal and annual conferences, the AES has covered issues related to acoustics, psychoacoustics and neuroscience, digital audio, loudspeaker design, concert hall design, marketing, education, and other aspects of audio engineering. As the high-end audio community grew during the 1970s and 1980s, its reviewing methodologies and equipment preferences began attracting more attention from the engineering-oriented AES, much of it negative. Reviews, articles, and studies from both *Stereo Review* and the AES will provide a contrast to the observational and subjective approaches of the high-end audio magazines.

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[10] Lofft, "Sense and Nonsense in High-End Hi-Fi," 64. *Stereophile*'s circulation increased dramatically following Larry Archibald's take-over as publisher in 1982, increased to 15,000 by the end of 1983. John Atkinson, "40 Years of Stereophile: What Happened When?" available from http://www.stereophile.com/features/708/index.html (accessed May 8, 2008 - originally published in vol. 25, no. 11, November, 2002).

J. Gordon Holt and The Stereophile

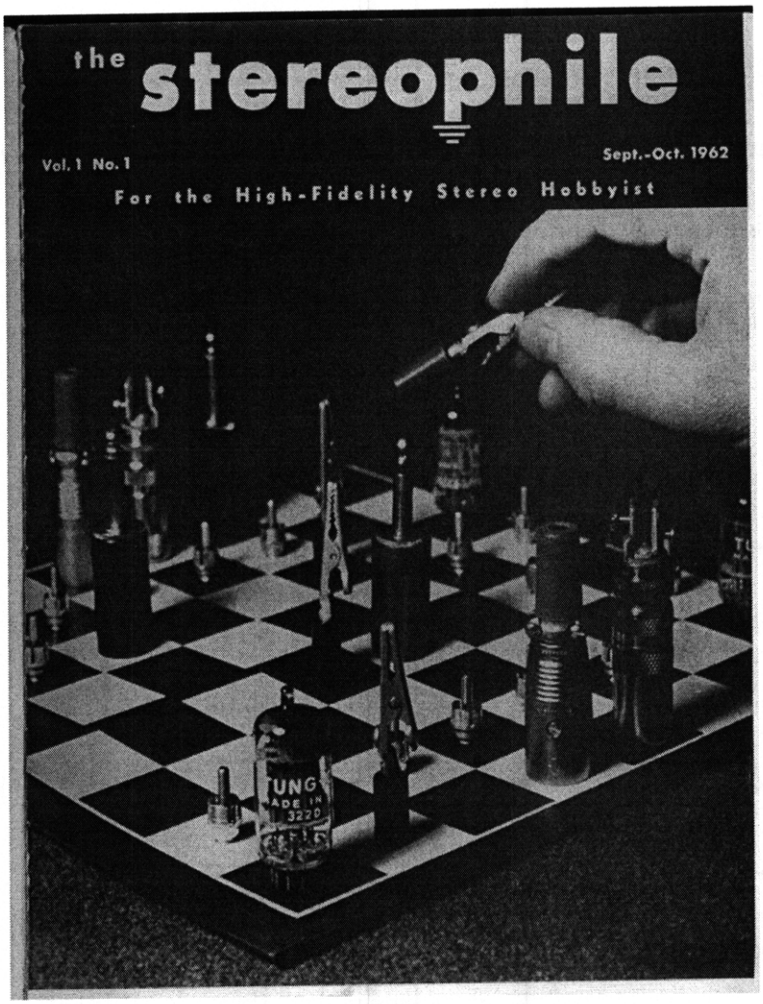

Figure 4.1 - The cover of the first issue of *The Stereophile*, September-October 1962. Used with permission.

Scholarly treatment of hi-fi and high-end audio by historians has often emphasized the obsessive characteristics of the mostly male audiophile community, exploring the gendered interactions hi-fi equipment often provoked and the odd, sometimes irrational, behaviors of audiophiles.[11] Some have argued, contrary to the rhetoric of those in the high-end audio community, that high-fidelity was something consumers had to be convinced to want.[12] But hi-fi enthusiasts were not exclusively fixated on laying claim to their own domestic spaces where music and sound could be measured rather than listened to. Although the commercial success of

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[11] See Joseph O'Connell, "The Fine-Tuning of a Golden Ear: High-End Audio and the Evolutionary Model of Technology," *Technology and Culture* **33** (January 1992): 1-37; Marc Perlman, "Consuming Audio"; Marc Perlman, "Golden Ears and Meter Readers: The Contest for Epistemic Authority in Audiophilia," *Social Studies of Science* **34** (October 2004): 783-807; Jeffery Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975," Ph.D. Thesis, University of Pennsylvania, 2004; Susan Douglas, "Audio Outlaws: Radio and Phonograph Enthusiasts," in John L. Wright, ed., *Possible Dreams: Enthusiasm for Technology in America* (Dearborn: Henry Ford Museum & Greenfield Village, 1992), 44-59; Keir Keightley, "'Turn it down!' she shrieked: gender, domestic space, and high fidelity, 1948-59," *Popular Music* **15**, no. 2 (May 1996): 149-177.

[12] Alexander Magoun, "Shaping the Sound of Music: The Evolution of the Phonograph Record, 1877-1950" (Ph.D thesis, University of Maryland, 2000).

home audio technologies such as the LP and stereo recording suggested a desire on the part of the general public for advancements in home music reproduction (not to discount the influences of marketing efforts), the history of hi-fi and high-end audio is frequently told as if the enjoyment of music was of secondary importance.[13] By the early 1960s, while obsessive audiophiles may have dominated popular press articles about hi-fi, a shift was quietly taking place within the hi-fi community that would ultimately lead to the formation of a separate subculture that came to be known as "high-end audio." That shift began with J. Gordon Holt.

"I was born in North Carolina, and lived there until I was five," Holt told *Stereophile's* Steven Stone in a 1997 interview celebrating the magazine's 35th year of publication. He described his childhood with what was by then an irreverence familiar to the magazine's readers: "We moved to Melbourne, Australia until I was 17. Then my father dropped dead and my mother and I came back here. She bought a house in Pennsylvania, and since then I haven't lived in any one place longer than 10 years." In 1945, when he was 15,

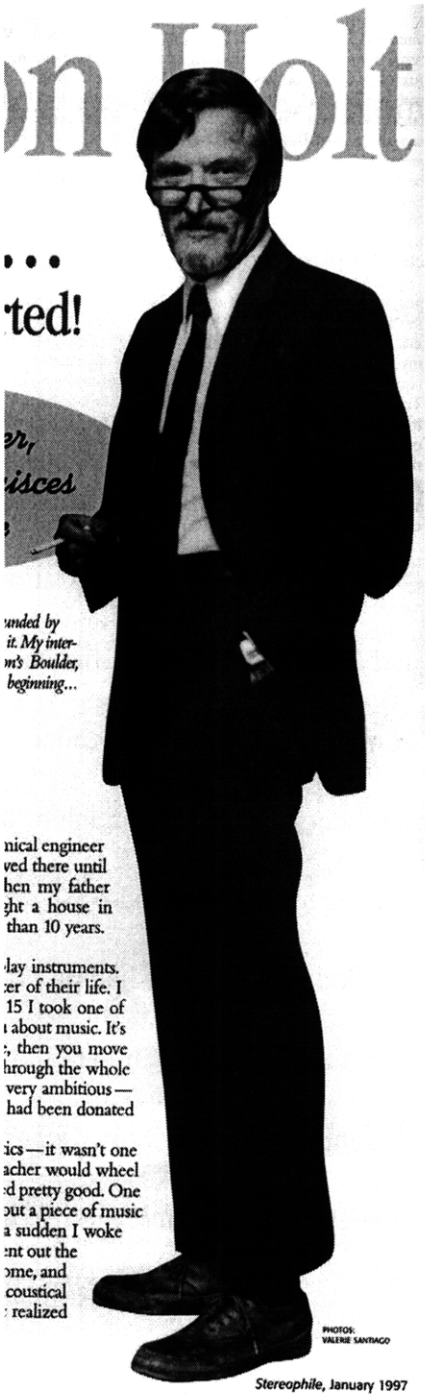

Figure 4.2 - A photo of J. Gordon Holt included in a profile celebrating *Stereophile*'s 35th anniversary (from *Stereophile* **20**, no. 1, 1997, pg. 74). Used with permission.

[13] Naturally, both the LP and stereo had their detractors who felt some new phonograph technologies were a step backwards compared with the existing media. Some audiophiles have suggested that this is always true when a new technology or a new medium is introduced, but that most technologies are gradually refined to the point where they can provide a greater level of satisfaction than previously available.

Holt developed an interest in music through "one of these stupid music-education courses in school" where he "had great difficulty staying awake" until the instructor played a particular piece of music that got his attention.[14] "Not until the Prelude to Act III of Wagner's *Lohengrin* was I stirred from my apathy," he recalled in 1974, "and I was so stirred I bought my own recording of it, to play on a little wind-up acoustical Victrola. Somehow, it didn't sound quite the same, and I was determined to find out why. And that is how, in one fell swoop, I became hooked on both classical music and high fidelity."[15]

Following this realization, Holt experimented and tinkered with his family's phonograph, and also began making amateur recordings, developing an expertise with the then-new medium of magnetic tape. He attended Lehigh University with the intention of becoming an electrical engineer, having built much of his own audio equipment from scratch, and written construction articles for amateur radio magazines. "But [I] soon learned that engineering involved math," he recalled, "for which I had no talent."[16] After struggling with engineering for two years, he switched to journalism. Holt describe to Stone that in Lehigh's journalism program at the time, students received A's for stories sold, regardless of their quality. Holt managed to sell two articles to *High Fidelity* magazine in 1953, and joined the staff two years later. In between, after taking a cartooning course in New York City, Holt sold hi-fi-related cartoons to a variety of

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[14] Steven Stone, "J. Gordon Holt – 35 Years and Just Getting Started," *Stereophile* **20**, no. 1 (January 1997): 74-88, on 74.

[15] J. Gordon Holt, "How It All Began," *Stereophile: Vol 1, Issues 1 through 12* (1974), 1.

[16] Ibid.

magazines, and would later put his drawing abilities and sense of humor to work in *The Stereophile*.[17]

Holt served as a technical expert and wrote equipment reviews for *High Fidelity* and its engineering-oriented sister publication, *Audiocraft*, where he had a regular column about tape recording. *Audiocraft*, which began publication in 1955, proved to be very popular with readers, quickly reaching a circulation of 30,000.[18] But both *High Fidelity* and *Audiocraft* were sold to Billboard Publications in 1958, after which *Audiocraft* ceased publication (Holt speculated that *Audiocraft*'s comparatively cheaper ad rates meant it was capturing advertisers from *High Fidelity*, costing the publisher money).[19] The new corporate environment at *High Fidelity* did not suit Holt well. As he described in the introduction to the 1974 anthology of *The Stereophile*'s first 12 issues,

> I watched, first with incredulity and then with growing disgust, how the purchase of a year's advertising contract could virtually insure a manufacturer against publication of an unfavorable report. Critical reports were either watered down to minimize the critical comment, or were simply suppressed when it proved impossible to express in an "acceptable" manner the fact that we were unable to test something because all three samples submitted to us had blown up when we switched them on.[20]

Holt also struggled with the magazine's editors and publishers over what he felt were the important sonic details of the equipment under review – details that were primarily subjective. "In those days they wanted descriptive articles," he recalled. "I was having constant problems

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[17] Stone, "35 Years and Just Getting Started," 77.

[18] Edward T. Dell, "25 Years of Stereophile: Edward T. Dell offers a tribute to the father of subjective reviewing," *Stereophile* **10**, no. 1 (January 1987): 75-83, on 77. It also gained distinction for, among other things, publishing technical equipment reports previously available only in newsletter form from a group known as Hirsch-Houck Labs. Julian Hirsch, who did the bulk of the writing for Hirsch-Houck Labs, would go on to be *Stereo Review*'s primary reviewer and technical expert from 1961 to 1998.

[19] Stone, "35 Years and Just Getting Started," 77.

[20] Holt, "How It All Began," 1.

with the publisher, who kept insisting I couldn't hear the things that I kept reporting that I was hearing. I was a trouble maker."[21] He also described how the publisher actively tried to prevent him from writing bad reviews of equipment from manufacturers who advertised in the magazine. When asked by Stone about the worst piece of equipment he'd ever reviewed, Holt recalled an experience at *High Fidelity*:

> There was an amplifier made by Sherwood. I think it was mono. The first one we got blew a tube right out of the box. We replaced the tube and it blew that tube. The second one we got caught fire. The third one wouldn't turn on at all – no trouble with the fuse, it just wouldn't work. The fourth one worked. So I reported all this in the review. The publisher apparently missed it; I think he used to just go through and read the end of the review. The manufacturer pulled his advertising, and of course I got all of the blame. After a while I just got fed up and frustrated.[22]

Shortly after, Holt quit *High Fidelity* and went to work for Paul Weathers, an engineer who designed phono cartridges. Holt felt that the Weathers stereo phono cartridge easily beat the competition in terms of sound quality, but that as a small business with virtually no advertising budget, none of the major hi-fi magazines gave it much attention.[23] Holt's responsibilities at Weathers included writing technical manuals and bulletins that were distributed to dealers. Holt included recommended recordings in his bulletins, and soon noticed that "we were distributing more than three times as many of the [bulletins] as we had dealers. Seems they were handing them out to their customers... I figured maybe I was on to something."[24] Soon after, in 1962, Holt founded *The Stereophile*.[25]

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[21] Stone, "35 years and Just Getting Started," 77.

[22] Ibid.

[23] Holt, "How It All Began," 1.

[24] Stone, "35 Years and Just Getting Started," 79.

[25] The "The" in the title of the magazine was dropped in 1977, starting with volume 4, number 1, the 15th anniversary issue.

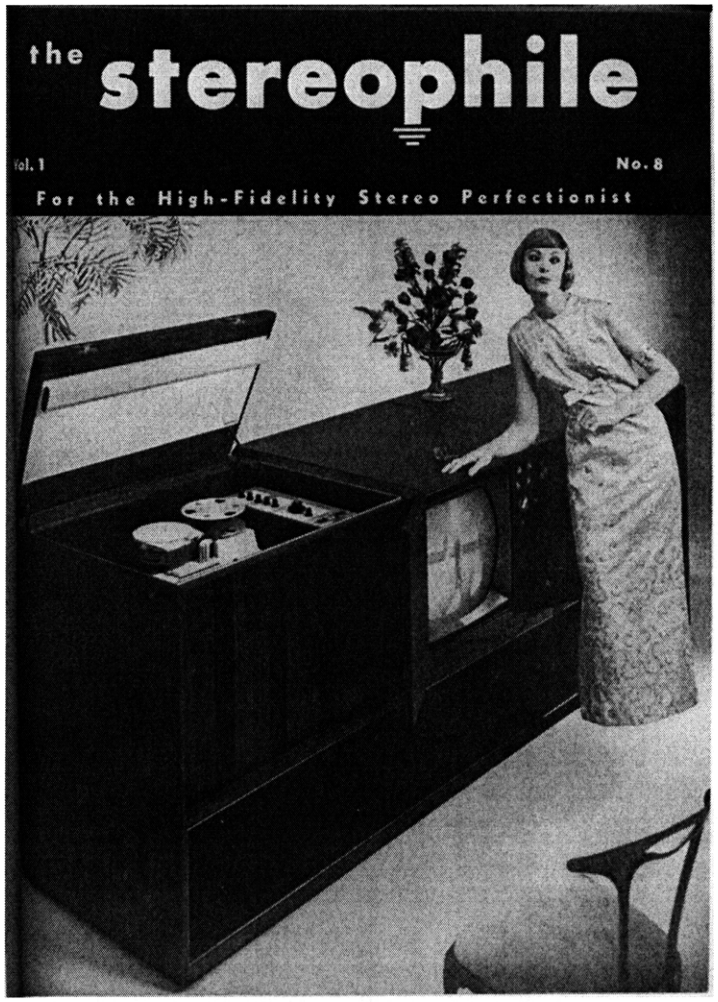

Figure 4.3 - Cover of *The Stereophile* 1, no. 8, August 1964. Used with permission.

The fledgling magazine's staff was quite small, with Holt and his wife, Polly, as the only permanent staff members for the first 16 years of publication. Holt used his cartooning and layout skills to add some humor to the magazine's early issues, including whimsical drawings done under a pseudonym, and detailed technical diagrams and charts. The magazine's covers were particularly entertaining. The cover of the August, 1964 issue featured a promotional photograph of a $30,000 Ampex "home-entertainment center" that included a reel-to-reel video tape recorder and a built-in television, flanked by an attractive model. Holt used his airbrushing skills to give the model a severe wandering eye and remove her feet (or, as he described it, to leave her with "a conspicuous lack of underpinnings").[26] "That was the first time we realized that a substantial number of our readers had actually been looking at the covers," he later wrote.[27] Two years later, another cover featured a photograph of a sophisticated audio measuring device from the Heath Company. Only

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[26] Holt, *The Stereophile, Volume 1, Issues 1 – 12.*

[27] Ibid.

on close inspection could readers tell that Holt had changed "Heath" to "Beast", and the scale of the device's analog voltmeter now ranged from "lousy" to "fair" to "whoopee!"[28]

Beyond these touches of humor, Holt also distinguished his magazine by keeping it free of advertisements until the mid-1970s. "We didn't take ads initially because we wanted to establish our credibility," he told Stone in 1997.

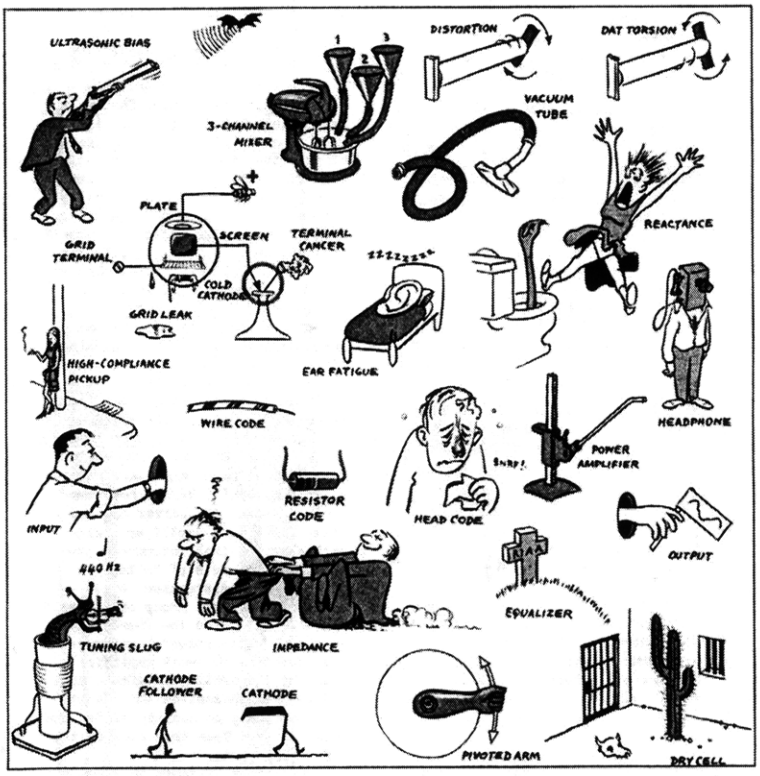

Figure 4.5 - Holt frequently used his cartooning skills to add humor to the magazine. These drawings appeared on the cover of the Spring/Summer 1973 issue. Used with permission

> We knew very well, even back then, that consumers were very cautious about the relationship between advertisers and publishers. They just assumed that any magazine that took ads was heavily influenced by advertisers. And my experience at *High Fidelity* had indicated that this was true.[29]

In the inaugural issue, Holt penned a satirical article titled "How to Write an Ad" under the pseudonym Lucius Wordburger, where he exorcised some of his frustration from his days at *High Fidelity*. In the article, he described different types of advertisements and how to produce them. "The most common [type of ad] these days is the display advertisement," he wrote,

> Which is a picture of something interesting, accompanied by as few words as possible. The picture must accomplish two things: It must catch the eye, which is why sleek female models are used in so many display ads. And it must also create the desired impression.

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[28] *The Stereophile*, vol. **1**, no. 12, (Spring 1966).

[29] Stone, "35 Years and Just Getting Started," 81.

> It is not good practice to show Fidel Castro using your product, even if you have five unsolicited endorsements from him in your files. Endorsements are In, but Castro is Out.

"The text ad," he went on, "is much more fun to do than the display ad, because words offer far more opportunities for ambiguity than do pictures."[30] Ambiguity about a product's sound, in Holt's view, was the staple of advertising claims from manufacturers, and justified both his exclusion of advertisements from the early issues of the magazine, and his approach to equipment reviewing. By being ad-free, Holt believed he could avoid the ethically questionable practices of the larger, popular hi-fi magazines.

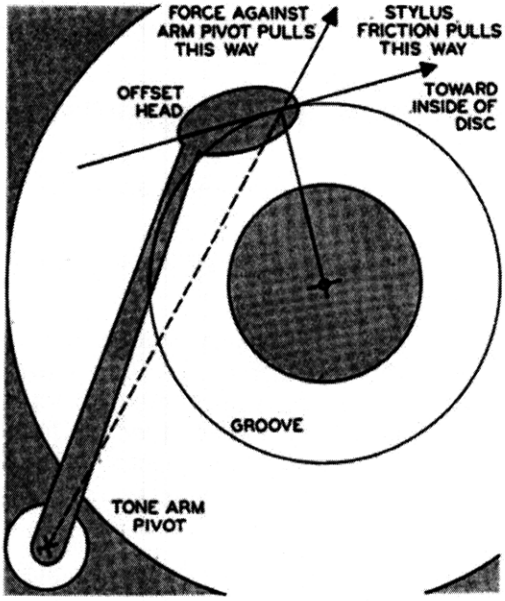

Figure 4.4 - A drawing of tonearm geometry included with an article about eliminating tracking distortion. Holt frequently included technical drawings along with his how-to articles (from *The Stereophile* **1**, no. 2, January/February 1963, pg. 4). Used with permission.

In addition to equipment reviews, many early issues of *The Stereophile* included technical and how-to articles, frequently accompanied by graphs, charts, and illustrations. Issues 2 and 3, for example, dealt with the problem of tracing distortion in phonograph systems, and how to adjust a tonearm and cartridge to eliminate it.[31] Issue 4 featured a detailed article (complete with technical drawings) on "defluttering" an Ampex 601 tape machine.[32] Holt also used feature articles to address trends or problems in the home music reproduction industry more broadly.

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[30] Lucius Wordburger (aka J. Gordon Holt), "How to Write an Ad," *The Stereophile* **1**, no. 1 (September-October 1962): 8, 17, on 8.

[31] J. Gordon Holt, "Tracing Distortion And What to Do About It (Part One of Two Parts)," *The Stereophile* **1**, no. 2 (November-December, 1962): 7-8, 16; J. Gordon Holt, "Tracing Distortion And What to Do About It (Conclusion)," *The Stereophile* **1**, no. 3 (January-February 1963): 3-5.

[32] J. Gordon Holt, "De-Fluttering the Ampex 601," *The Stereophile* **1**, no. 4 (March-April 1963): 6-8.

For example, in 1963 Holt took on RCA-Victor's proposed "Dynagroove" phonograph system, which was designed to compensate for the distortions caused by wide modulations in some records that styli of phono cartridges were unable to track. After listening to some Dynagroove releases, Holt felt that RCA's system was

> inimical to musical integrity, for not only does it constantly "rearrange" the original bass/ treble balance of the music, it evidently excuses the use of more dynamic compression than we have encountered since the latter days of the 78-rpm disc. If this constitutes 'an evolution in the art of record,' to quote RCA-Victor, then we are obliged to incite the industry to counter-evolution, for this is one kind of hanky-panky that no home-type tone control will ever be able to compensate for.[33]

His overall emphasis on listening and music led Holt to also include record reviews, despite calls from some of his charter subscribers that he "not waste precious space" with reviews when there were other music magazines that did so already. Holt disagreed, suggesting that while some record reviewers did a fine job reporting on the music, most of them were not concerned with sound. Holt suggested that *The Stereophile*'s contribution to music reviewing could be to include an analysis of the quality of the recordings in addition to comments about the performance. Record reviews became a staple of the magazine, and have continued to the present.[34]

Another staple was the Letters section, where within the first year of publication, lines of conflict were drawn that would persist and grow more heated over time. In the March-April issue of 1963, a reader from Allentown, PA, complained that he had yet to see any negative reviews of equipment in the magazine. "One reason I subscribed to your magazine was because I hoped you would tell the truth about all the crummy equipment that is on the market," he wrote, "but I have yet to see you call any product really bad."

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[33] J. Gordon Holt, "Down with Dynagroove!" As We See It, *The Stereophile* **1**, no. 4 (March-April 1963): 2.

[34] J. Gordon Holt, "Stereophile Reports on Recordings," *The Stereophile* **1**, no. 1 (September-October 1962): 14-15, on 14.

> I thought that, having no advertisers, you would be able to do this, but all your equipment reports to date have ranged between raves and semi-raves. Is it that you have not yet tested any poor equipment, or are you afraid to condemn something bad when you come across it? Let's see you put some teeth in your test reports. The manufacturers of cheap junk have been protected for entirely too long by all the audio publications, but you have no excuse for doing this.[35]

Holt replied that "we don't have the space to devote to reports on junk, and we do not believe our readers are interested in junk. We do not see our equipment reports as a medium for venting our spleen, but rather as a means of alerting our readers to components they might be interested in." He did, however, suggest that they would take manufacturers to task when "their advertising is so blatantly misleading as to demand refutation."[36] For some audiophiles, such as Carl, an engineer in his 50's, "the Letters were the best thing about *Stereophile*." But he also expressed some disappointment with the recent incarnation of the magazine, and attributed much of that disappointment to a de-emphasis on reader letters: "*Stereophile*'s gone downhill, I think, a lot in the last two or three years. And one of the things I see them doing that just bugs the heck out of me is they're cutting their Letters section down, you know, they're paring it way down... That's why I read *Stereophile*. The number one thing was the Letters."[37]

Holt also established an approach to hi-fi from a systems standpoint within the first year of *The Stereophile*'s publication. Prompted by a reader letter regarding the incompatibility of a particular speaker and power amplifier, Holt wrote an article on loudspeaker impedance

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[35] R. Schwenk, "Call for Condemnation," Letters, *The Stereophile* **1**, no. 4 (March-April 1963): 17.

[36] Ibid. The feeling that Holt was not hard enough on the equipment he reviewed would grow more pronounced in the following decades. Marcus, a salesman and systems designer, told me, "we used to call him J. Gordon 'I never met a product I didn't like' Holt. He would say nice things about anything that wound up in the magazine." Interview, 05/02/07. Paul, a shop owner, expressed frustration with glowing reviews of products in both *Stereophile* and *The Absolute Sound* that he felt, based on his own listening, were unearned. Interview, 05/31/07. See Chapter 3 for additional details. Holt did, in fact, temper his enthusiasm for certain products over time, as illustrated by examples in Chapters 5 and 6.

[37] Interview, 09/24/07.

matching, including directions on building a small attenuating device to compensate for incompatibilities.[38] Impedance matching, a controversial issue with double-blind listeners in later years, was based on the idea that an amplifier's output power should match as closely as possible a loudspeaker's ability to convert that power into sound. A low-powered amplifier with a high-impedance loudspeaker would result in a strained sound as the amplifier attempted to overcome the loudspeaker's resistance to being driven, whereas a powerful amplifier with a low-impedance loudspeaker could result in the loudspeaker being unable to cope with the amplifier's output signal – in both cases, the sound would be degraded. Although Holt offered a do-it-yourself solution to this issue in his article, he emphasized the importance of well-paired components for optimum performance. This systems approach would become a central tenet of the high-end audio ethos.

But this approach was not without its vagaries. He argued that the typical method of assembling hi-fi systems, which he described as "balancing one component's colorations against those of another," could cause problems when higher-quality components were substituted into the system. "Each time [a hi-fi expert] substitute[s] a new [component] for comparison purposes," he wrote, "their judgments of it are valid only insofar as that component is related to the rest of their own particular system."[39] This early recognition of the problems of system assembly foreshadowed one of the many sides of the debates between double-blind and observational listeners in the coming years. Specifically, double-blind listeners held that observational listeners reviewing equipment in their homes did so under insufficiently controlled

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[38] J. Gordon Holt, "Loudspeaker Impedance Matching," *The Stereophile* **1**, no. 5 (May-June 1963): 3-4, 16.

[39] J. Gordon Holt, "Why Hi-Fi Experts Disagree," *The Stereophile* **1**, no. 4 (March-April 1963): 3-5, on 5.

conditions. While Holt acknowledged this issue, he nonetheless conducted reviews this way, and continued to discuss and consider systems-related issues throughout his career as a reviewer.

Holt's approach to reviewing also stemmed from his belief that the popular magazines' focus on measurements and manufacturer's specifications was not useful to readers since, in his experience, the specifications and measurements of an electronic component or loudspeaker did not necessarily correspond with the resulting sound. Instead, he aimed for what he called "subjective reviewing." In the introduction to the equipment reports in *The Stereophile*'s first issue, Holt described this approach:

> *Stereophile* Reports on Equipment are primarily subjective reports, based on actual use of components in the home. Instrument tests will be employed where these are easily duplicated by the average buyer, but we will rely mainly on subjective evaluations because components that measure identically do not necessarily sound similar, and because audio equipment is, after all, designed to be used and listened to.[40]

In the first issue, Holt reviewed the stereo phono cartridge and tonearm made by his former employer, Paul Weathers, and included both measured technical details as well as evaluations from listening:

> Response checks using the Westrex 1-A and London's stereo test disc showed a slightly rising top – up about 0.5 db at 10 kc and 3 db at 15 kc. Both channels of two samples were within their rated 1 db limit of output imbalance. Total unweighted noise measured 56 db below a 7 cm/sec 1 kc signal, which is completely inaudible, and since there are no inductive elements in the cartridge, it is not susceptible to hum interference from poorly shielded phono motors...
>
> It is on listening tests, though, where this pickup really shows its capabilities. Separation, on widely miked discs, is so close to complete that we have never been aware of separation as a consideration. The sound is as vast and spacious as that from two-track tapes... the high-end rise is not severe enough or sharp enough to cause spitting or sizzling colorations, and is in fact not even perceptible on most loudspeaker systems. But when the speaker is flat or slightly rising in response above 10 kc, the rise is audible as a subtle extra string sheen and brass bite.[41]

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[40] J. Gordon Holt, "Stereophile Reports on Equipment," *The Stereophile* **1**, 1 (September-October 1962): 12.

[41] J. Gordon Holt, "Weathers PS-11 Professional Stereo Pickup System," *The Stereophile* **1**, no. 1 (September-October 1962): 12-13, 18, on 13. The abbreviation "kc" stood for "kilocycles" and was a measurement of frequency. By the 1970s, kc was replaced by the more common "Hertz" or "Hz".

Although later reviews tended to include fewer measurements (until editor John Atkinson formalized the inclusion of measurements for all equipment reviewed by the magazine in 1989), Holt's descriptive language for the sound produced by different parts of an audio system – words and phrases such as "spitting," "sizzling," "string sheen" and "brass bite" – formed the core of his writing style. While Holt did not invent subjective impressions of reproduced sound, nor much of the vocabulary he used to describe them (and did not claim to), he significantly expanded the vocabulary, applying it to different parts of an audio system, and formalized the connections between certain descriptive terms and different parts of the frequency spectrum. In the Winter

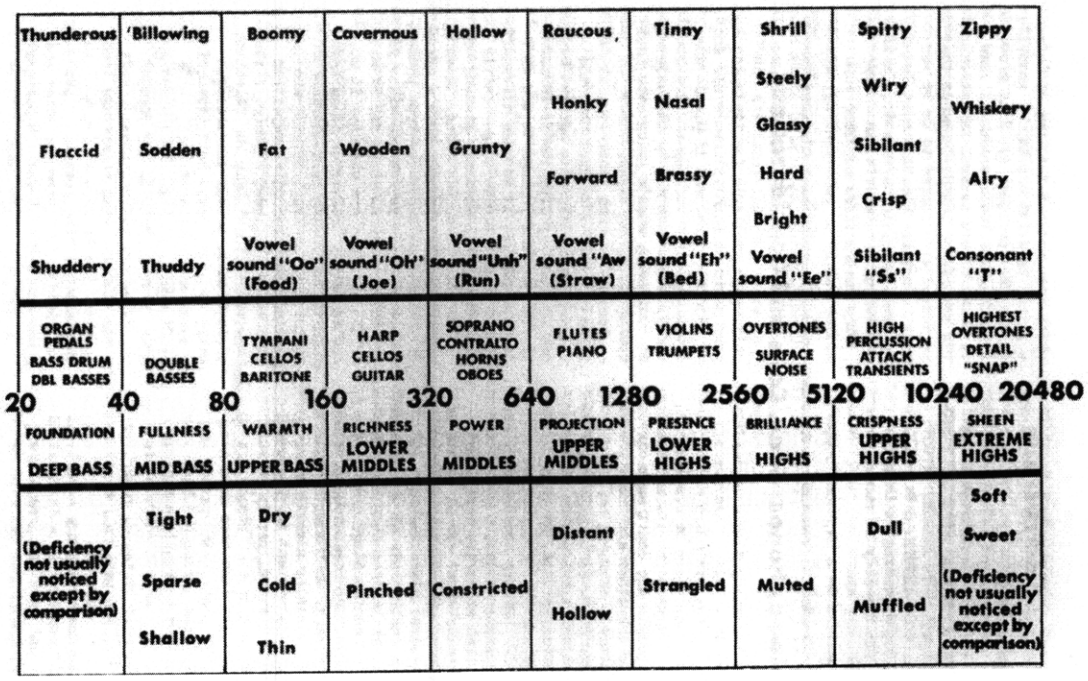

Figure 4.6 - The original caption read: "EDITOR'S NOTE: Most of the imagery used in the above chart was concocted by Ye Editor over a period of 18 years of comparative analytical listening. Now that we are big-heartedly making it available to the world at large, you will undoubtedly see some of the terminology appearing in other hi-fi rags. When you do, just remember that You saw it in Stereophile first." (from *The Stereophile* **3**, no. 4, Winter 1971/72, pg. 5). Used with permission.

1971/1972 issue, Holt published a chart showing the various terms and their association with different orchestral instruments, shown in Figure 4.6

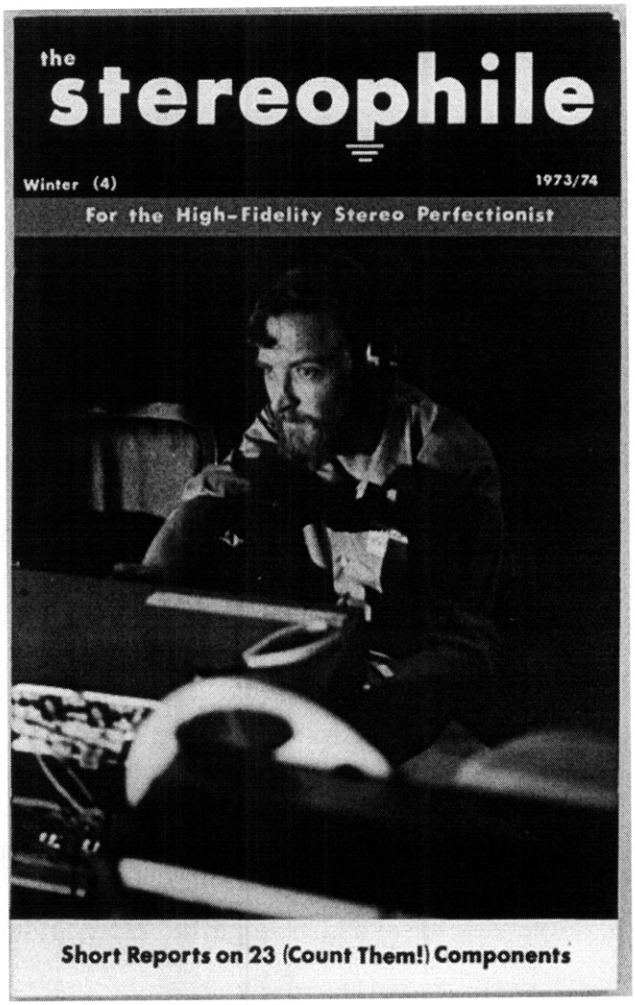

Figure 4.7 - Holt was an active amateur recording engineer, a hobby he began as a teenager (cover of *The Stereophile* **3**, no. 4, Winter 1973/74). Used with permission.

Although frequently accused of being anti-science and anti-engineering, Holt's perspective on the relationship between measured performance and subjective performance was more complicated. "Measurements can help to describe a component's performance," he wrote in a 1963 article titled, "Why Hi-Fi Experts Disagree," "but the final criterion for judging reproduced fidelity has always been the ear, and when we start to fall back on subjective judgments, we always end up with a diversity of opinions."[42] This same article contained a variety of other key observations, and amounted to an establishment of Holt's fundamental approach to hi-fi. Among other things, he described his ideas about what "fidelity" meant, and how it should influence purchasing decisions among hi-fi enthusiasts. "Many writers of books and articles about high fidelity advise the prospective buyer merely to choose what sounds good to him," he wrote.

> Certainly, there is no sense in anybody's choosing a music system whose sound he doesn't like, but in a field where definite standards of quality exist, simply liking something does not necessarily mean that it is good, by those standards. A person who likes abstract art, for instance, may be judging it by any number of criteria, but resemblance to the original scene is not one of them. If it were evaluated on the basis of its "fidelity," or resemblance to the original scene, it would have to be adjudged a very poor copy.

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[42] Holt, "Why Hi-Fi Experts Disagree," 3.

> Similarly, the listener who prefers his sound shrill and brassy is perfectly entitled to his preference, but *he* is not choosing on the basis of fidelity, either.[43]

Although harder to define in some respects than measured and quantified performance, fidelity was the standard against which Holt believed components and systems should be evaluated.

For Holt, this position on fidelity meant specific types of music could be considered high-fidelity, namely orchestral music and other types of acoustic music. "Sound recording may eventually become a creative art in its own right," he continued, "producing musical sounds that bear no relation to any natural sounds. Indeed, some branches of it – pops and so-called electronic music – are already well on their way in that direction. This is *not* high fidelity, though, and there's no sense pretending that it is."[44] Holt further expressed the belief that the fidelity of a home music system should be measured not against the original performance, but against the *recording* of the original performance. "If a system reproduces a recording the way it was intended to sound," he argued, "that is, if it makes distant miking sound distant and close miking sound as close as it actually was – then we can justifiably say that the system is reproducing this aspect of the recording with fidelity. If the other aspects of the sound – frequency range, instrumental timbres and so on – come through as they were recorded, then the reproduction is a high-fidelity one." Over time, Holt would become more flexible with regard to rock recordings and other types of music that made use of the "creative" aspects of sound recording. By 1979 he had expanded his notion of fidelity, stating explicitly that it was "live sound" that served as the standard against which equipment performance should be measured.[45]

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[43] Ibid., 4, emphasis in original

[44] Ibid., emphasis in original.

[45] J. Gordon Holt, "Equipment" *Stereophile* **4**, 5 (1979): 9. It is possible that this shift was motivated by increasing influence of Pearson's magazine, in which the stated standard for reviews was live music.

"High fidelity may be a science," he argued, "but it is not an exact science. There are enough things about it that aren't understood to leave room for a goodly amount of educated opinion."[46] Not all of these opinions, however, were equally valid in Holt's view. Holt offered a somewhat cynical taxonomy of hi-fi experts, including the "slide-rule worshipper," who emphasized the importance of measurements; the "drum beater," who recommended certain companies based on past rather than current equipment quality; the "I-am-more-musically-sensitive-than-thou," who is "prone to writing impassioned, dogmatic letters to newspapers and magazines, condemning everything"; and the "I-have-found-the-answer," who "assembled his dream system in the mid-1950s, and if there is a better one, he would rather not know about it." For the hi-fi consumer, Holt suggested that the most valuable role for experts is as guides to the "intrinsically excellent" components who allow the consumer to make up his own mind. "If no combination of really good components sounds good to you," he concluded, "then you probably don't really want high fidelity, and can forget all about the expert opinions. They don't agree anyway."[47]

By emphasizing the importance of subject responses to home audio equipment, Holt set himself up for confrontation with the hi-fi community's measurement-oriented members. But this emphasis, coupled with Holt's beliefs regarding fidelity and his conviction that the important aspects of fidelity in home music reproduction could be described with the appropriate vocabulary, established a particular aesthetic point of view that would come to be largely shared, at least in the abstract, within the high-end audio community. Despite the importance of subjectivity, Holt's position suggests the belief in a kind of universal aesthetics of musical art,

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[46] Holt, "Why Hi-Fi Experts Disagree," 4.

[47] Ibid., 5.

and indeed the language used to describe those aesthetic properties was standardized and intended to be understandable to all.

Harry Pearson and The Absolute Sound

> J. Gordon Holt, I think, was like the first really friendly guy that made this stuff really accessible, that was a real subjective guy, and was always trying to find good stuff to listen to and was very passionate about it. And Harry was kind of a guy who really took it to the next level. Harry was the guy that was... I mean, back in the day, was actually kind of snooty about it... but he was the one that really pushed the envelope.
>
> - John, a reviewer[48]

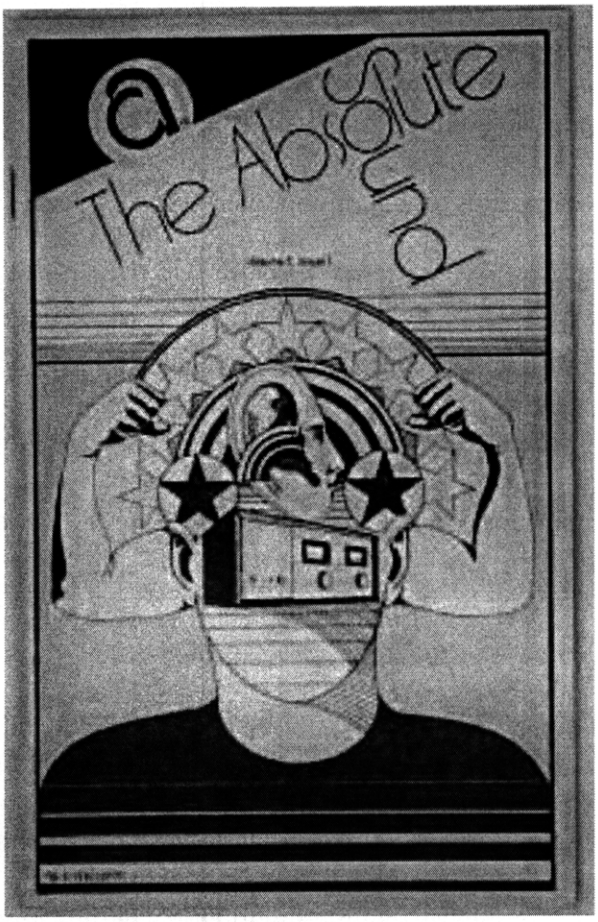

Figure 4.8 - The cover of issue 1 of *The Absolute Sound*, 1973.

"The title is of this magazine is part of what it's all about," wrote Harry Pearson in the editorial to the first issue of *The Absolute Sound* in the Spring of 1973. "The absolute sound is the sound of music itself."[49] Pearson, a longtime subscriber to *The Stereophile*, launched his own enthusiast publication in part out of frustration with Holt's somewhat unpredictable publication schedule. "My original intent was to publish four issues," Pearson later wrote, and to "inspire my mentor, J. Gordon Holt, to regular publication (and, I think, by example, to demonstrate ways

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[48] Interview, 06/27/07.

[49] Harry Pearson, "Viewpoints," reprinted in *The Absolute Sound* **17**, no. 86 (March/April 1993): 90-91, on 90.

he could improve his product)."[50] But his differences with Holt ran somewhat deeper. While Pearson also subscribed to a subjective approach to reviewing, his concept of "the absolute sound" and his point of reference for reviewing were not the same as those governing *The Stereophile*. While Holt argued in *The Stereophile*'s early years that fidelity in reproduction should be judged against the *recording* of a performance, Pearson believed the performance itself was the only legitimate reference for fidelity.

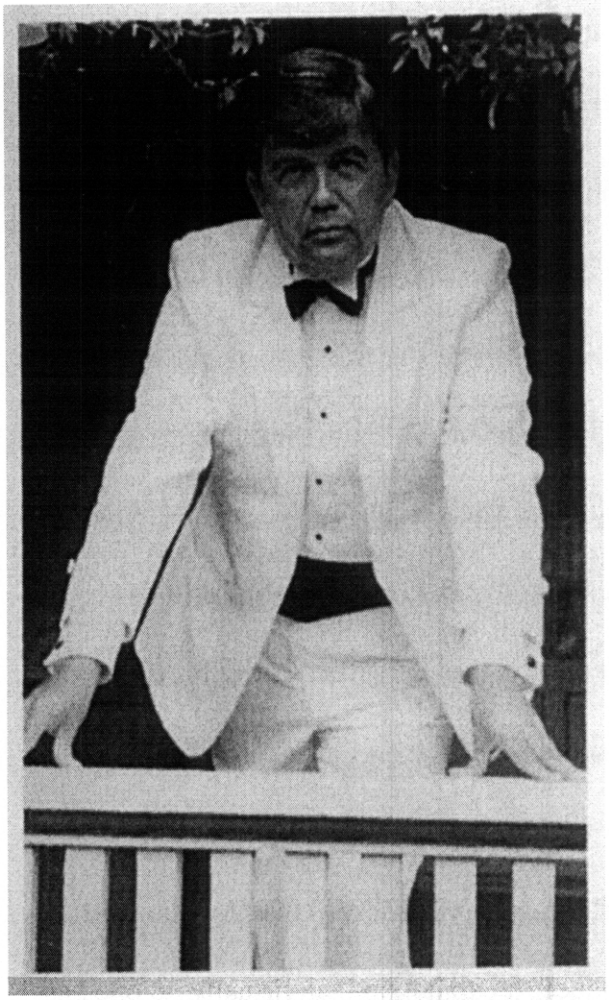

Figure 4.9 - Harry Pearson in 1985 (from Ken Kessler and Steve Harris, *Sound Bites*, pg ix).

"I decided upon the title *The Absolute Sound* for this magazine in the autumn of 1972," he wrote in a response to a reader letter in 1986. "The word 'absolute' was intended to be understood in its philosophical sense, and not in the sense of finality or perfection, two ways in which the dim of wit persist in misunderstanding its meaning."[51] To illustrate his meaning, he described his concept of absolutes in terms of two different varieties of highly-regarded champagne. "Even after the widespread consensus among experts is achieved on the fine

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[50] Harry Pearson, "Quo Vadis High End?" *The Absolute Sound* **13**, no. 52 (Spring 1988): 6-10, on 6. Some of Pearson's differences with Holt appeared before his founding of *The Absolute Sound.* A letter from Pearson citing deficiencies in the sound of early Dynaco solid-state equipment appears in an issue of *The Stereophile* from 1967, Harry Pearson, "Dyna, Ortofon, Sony and KLH," Letters, *The Stereophile* **2**, no. 3 & 4 (Autumn/Winter 1967): 27. A more thorough discussion of the performance of early solid-state equipment can be found in Chapter 5.

[51] Harry Pearson and A. T. King, "Mysteries of *The Absolute Sound*," Letters, *The Absolute Sound* **10**, no. 40 (Winter 1986): 36-38, on 36.

points of these two classics," he wrote, "there is no absolute champagne against which the scientific judgment, the absolute judgment, may be made. But a live sound occurring in space is an absolute because it is the standard against which we can judge any (unamplified) reproduced sound." Revealing his musical preferences, he observed that "the sound of rock, like the taste of Jack Daniels, because it is amplified, has no ultimate antecedent, and thus the sound of rock becomes a matter of taste. It has become an end in itself, in a sense, rather like the sound of contemporary digital encoding which, if you are to appreciate at all, you must appreciate as an art form in itself, with no referential reality."[52] "'The absolute sound,'" Pearson later described, "is the sound of unamplified music occurring in a real space, usually a large room or concert hall."[53]

Not all audiophiles were persuaded by this idea. Reader A.T. King, responding to the often strongly-worded critiques of products from the magazine's reviewers, wrote in a letter to Pearson in 1986 that he was "mystified by the objective and godly resonance of this lofty title when I am presented with ringing endorsements of products that are subsequently buried in a haze of carping criticism." "Your elegant rag is, in sooth," he went on, "an 'audio forum', another down-to-earth, classy name for the kind of rebuttals that your staff revels in."[54] English scholar Aden Evens has described Pearson's concept as "disturbing," and observed that this standard privileges Western classical music, and further introduces a paradox in that virtually no one has

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[52] Ibid.

[53] Harry Pearson, "How to Read *The Absolute Sound*," *The Absolute Sound*, no. 129 (April/May 2001): 39-49, 39.

[54] Pearson and King, "Mysteries of *The Absolute Sound*," 36.

the opportunity to compare a live performance and a recording made of that performance.[55] Still, the notion proved powerful among audiophiles. If Holt established the foundation for the high-end audio community, it was Pearson who named it "high-end" and catalyzed its growth.

Stylistically, Pearson adopted a more dramatic, and often harsher, tone than Holt, and sought to make his magazine appealing to audiophiles on an emotional as well as an intellectual level. The differences in writing style and standards for fidelity were, not surprisingly, particularly evident in divergent reviews of the same products. For example, both magazines reviewed Dynaco's PAT-5 solid-state preamplifier in the mid-1970s. Holt described its sound in terms of his reference preamplifier, the vacuum tube-based Audio Research SP-3-A:

> [The PAT-5] is still better than Audio Research's SP-3, but then the SP-3 has since been bettered by the SP-3A, which was slightly better than the PAT-5 in one respect (definition) but not quite as good in others. Fortunately for ARC, the SP-3A-I followed closely on the heels of the SP-3A, and managed to top the PAT-5 by a small margin in transparency and sweetness, and to equal it in detail, balance, bass range and tautness, and freedom from noise.[56]

Pearson's impressions were quite different:

> I feel compelled to say that, try as I might, I am unable to view the PAT-5 as anything other than a highly colored electronic device which has a definite personality it imprints on all program material. It is less faithful to the sound of music than its competitors, although some will undoubtedly find its colorations attractive, even delectable. It is a spectacular departure from sonic truth and, for Dyna, an unhappy break in their tradition of giving the customer a realistic illusion of musical truth at a price within the range of reason.[57]

Pearson's position on measurements and specifications was, at least in *The Absolute Sound's* early days, similar to Holt's. "We have no brief against measurements and numbers,"

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[55] Aden Evens, *Sound Ideas: Music, Machines, and Experience* (Minneapolis: University of Minnesota Press, 2005), 7.

[56] J. Gordon Holt, "Dyna PAT-5 Preamp," *The Stereophile* **3**, no.2 (Summer 1975): 4-7.

[57] Harry Pearson, "Comments: Dyna PAT-5," *The Absolute Sound* **2**, no. 7 (Winter 1975-76): 242. Although this comment is particularly short, in other instances Pearson's comments on other reviewer's reviews in the magazine could get quite lengthy. The brevity of this comment points to Pearson's negative feelings about this product more than limitations on space or other considerations.

Pearson stated in his first editorial. "They are sometimes revealing, but, just as often, they are confusing. The ear is an infinitely more subtle and sophisticated measuring device than the entire battery of modern test equipment." Pearson claimed that all of the magazine's reviewers were "inveterate concertgoers" and thus sufficiently familiar with "the absolute sound of music" to justify their comments on equipment used to reproduce it in the home.[58] Like *The Stereophile*, *The Absolute Sound* did not take advertisements from manufacturers initially, although dealer advertisements were allowed. Instead, Pearson claimed, the magazine would subsist on subscription fees, and was staffed by "professionals from many walks of life" whose lack of financial dependence on the magazine would, Pearson reasoned, result in more freely-expressed opinions and feelings about equipment under review.[59]

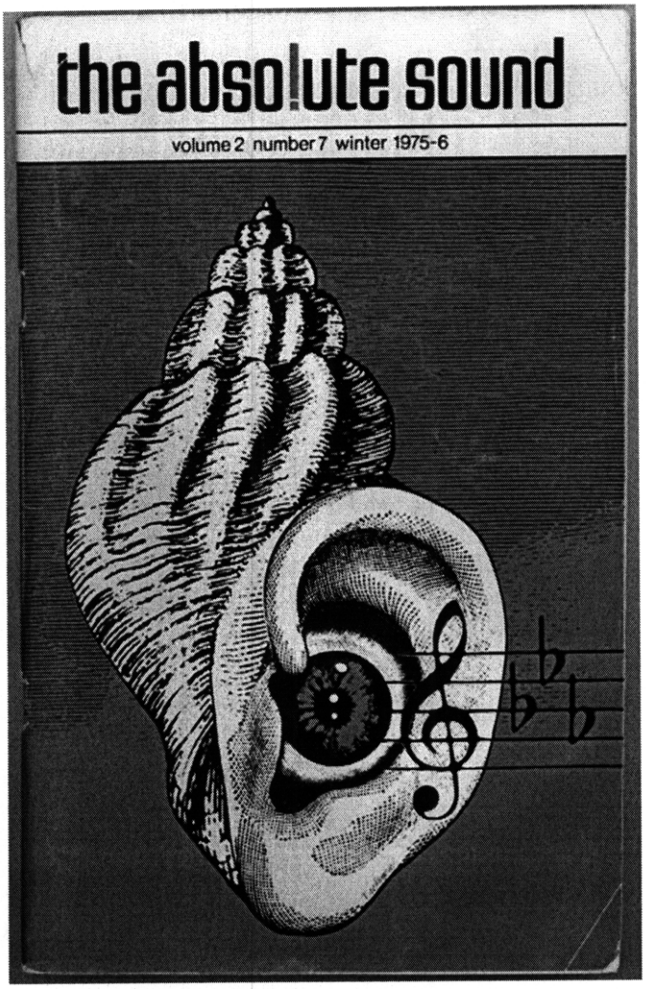

Figure 4.10 - Early issues of *The Absolute Sound* often featured drawings or paintings on the front covers, and photographs, taken by Harry Pearson, on the back covers (from *The Absolute Sound* **2**, no. 7, Winter 1975-76).

He further claimed that it was not his intention to compete with *The Stereophile*, to which he offered a commendation, along with the subscription address and cost for interested readers, in his first editorial. But not everyone felt

[58] Pearson, "Viewpoints," 90.

[59] Ibid., 91.

that Pearson was honest in this claim. In a letter to *The Stereophile* in their Autumn 1975 issue, a reader questioned why Holt had yet to acknowledge *The Absolute Sound*, despite the fact that the newer magazine was longer (about 100 pages compared with *The Stereophile*'s average of around 60) and had "the kind of draconic approach to reporting that your blurb sheets seemed to promise but your magazine never delivered." Holt replied that while *The Stereophile* had been ready to welcome another subjective-oriented publication into the fold, he "recall[ed] having been told, during a phone conversation with Mr. Pearson prior to his first issue, that he was 'sorry to have to do it,' but he was going to 'put us out of business.'" Although Pearson denied making any such comments, Holt observed that the number of letters attacking *The Stereophile* that Pearson published in his first issue suggested that Pearson clearly viewed *The Stereophile* as "the enemy." Holt argued that while the two magazines sometimes had divergent opinions on some equipment, "one is right considerably more often than the other," and that *The Absolute Sound* "has in fact been criticized on occasion for being more personal than objective (or subjective) in its reportage." But, in closing, he offered the subscription address for readers who "aren't too put off by its occasional gutter vernacular lapses into *National-Enquirer*-type sensationalism."[60]

While Pearson's intentions toward *The Stereophile* are unclear, he was very clear in targeting the mainstream hi-fi magazines, namely *Stereo Review* and its chief reviewer, Julian Hirsch. Again, sharing Holt's perspective that reviews were best conducted under extended listening in a home environment, Pearson wrote "we at *The Absolute Sound* have a profound distrust of instant analysis and careless A/B switching arrangements."

> There is a difference between what sounds good on a quick listening and what sounds natural over the long haul. Many reviewers, for example, profess to hear no difference between certain highly esteemed preamplifiers and basic amplifiers (e. g. Julian Hirsch

[60] Desmond Harvey, "The Absolute Sound," Letters, *The Stereophile* 3, no. 3 (Autumn 1975): 48.

> on the Phase Linear 700). What such assertions show us is either a tin ear (Mr. Hirsch), or someone who doesn't know how to listen to music. We do not pretend to argue that it is easy to develop a golden ear, since that takes time and experience, but we think anyone can, given the will and a bit of patience.[61]

Here, Pearson introduced something of a conundrum for his readers attempting to navigate these concepts and the reviewing style of the magazine. Although Holt himself did the vast bulk of the reviewing for *The Stereophile* in its first two decades of publication, he tended to focus on consensus with other reviewers as to both particular characteristics and overall fidelity of equipment under review. Pearson, on the other hand, published dissenting opinions among the reviewing staff, and often added his own comments to a reviewer's piece either as a follow-up article or in footnotes. Tony, a reviewer who had written for *The Absolute Sound*, described Pearson as "the master of the barbed footnote" and said "*The Absolute Sound* was Harry's magazine, and he kind of liked to keep the writers fighting for his approval."[62] While Pearson offered up the possibility that anyone could become a "golden ear" with practice and patience, given his concept of a single, absolute standard against which fidelity could be judged, diverging opinions *could not* be equally valid – a paradox reviewers would occasionally struggle with as high-end audio equipment became more sophisticated.

Yet the concept of "the absolute sound," and Pearson's more confrontational style, captured the attention of a number of audiophiles interviewed for this project. Donald, a reviewer, found Pearson's idea of an absolute reference especially useful:

> When Harry Pearson founded *The Absolute Sound* in 1973, a stroke of brilliance was the creation of the name and the concept of [judging] music reproduction equipment by how it compares with the sound of live instruments in an acoustic space, that we have an absolute reference, that we know what it should sound like, and we use that as the

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[61] Harry Pearson, "Viewpoints," 90.

[62] Interview, 05/22/07.

> benchmark by which to judge audio products. That was... I mean, it sounds simple now, but it was a leap at the time.[63]

Tony recalled Pearson's discussions of music's emotional power that drew him initially to *The Absolute Sound*:

> [Harry Pearson] wrote about the emotional experience of listening to music, and how improving the resolution of the system improved your relationship to the music itself. He didn't have a sonic checklist, that every review would be, "the bass is profound, the midrange is translucent..." He had a specific vocabulary, which is startling to encounter for the first time, as had Gordon [Holt]. But Harry managed to make it seem important, but at the same time, very much about becoming a better listener. And I really reacted to that. He had strong writing chops, he connected very much with what I thought of as the better me, and I sort of wanted to be a part of that community very badly. And I think that most readers of the magazine at that time did.[64]

Phillip, another reviewer, had similar feelings:

> I was a true believer [in *The Absolute Sound*] because it really rescued me from audio hell when I first heard a good system. That the publisher and the editor Harry Pearson... he, basically, him and Gordon Holt at *Stereophile* championed, you know, good sound and "Don't read the measurements. The measurements are taking us down a blind alley. You have to use your ears because your ears are what you're listening on. And the measurements... all these measurements freaks have really taken us down a dark path to bad sound." And they were right. So they're both my heroes. But I thought *TAS* was a more enjoyable magazine, and it was more highly respected and it was less of a yahoo read. It was more erudite and intellectual. So I was a true believer right from the beginning.[65]

Others, however, were critical of Pearson and of the influence *The Absolute Sound* came to wield in the community. Marcus, a salesman who had worked for hi-fi dealers during the 1970s when the magazine was gaining popularity, was among the most critical, and went as far as suggesting that Pearson disrupted the systems approach to high fidelity championed by Holt and others by offering glowing reports of individual components upon which some readers would become fixated.

> *The Absolute Sound* popped up, and we could always tell when an issue would come out because, you know... people would call up [the shop], "hey, do you have the new

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[63] Interview, 03/11/07.

[64] Interview, 05/22/07.

[65] Interview, 05/29/07.

> Blipophonic 7?" What the hell is that? "Oh, well, it's this awesome preamplifier!" Oh really? New *Absolute Sound* come out? "Yeah!" Oh. You heard the thing? "No, no, but I was just..." So, in one fell swoop, this guy had changed the whole concept of... there was no high-end concept, but the whole idea of finding a way to integrate all these parts together to make it work well, and thinking about it as a concept... high-end went from an adjective describing stuff... to a noun. It became a thing, it became the stuff. Which was for him very self-serving and very smart because it gave him a constant forum to pontificate. And so everybody started rushing around madly trying to get the new whatever the heck it was, and lost total sight of what they liked, or even if they liked anything in particular, which I found very destructive and annoying.[66]

Marcus believed that Pearson, who he felt structured *The Absolute Sound* "largely as an ego exercise," was personally responsible for the collapse of some small manufacturing firms whose products he reviewed, even if the reviews were positive.

> What he did was to create an environment of fear... because if he said something bad, you know, goodbye. So [the manufacturers] would come up with these one-off modifications or something like it, and he'd go, "okay, it's alright now." But what would happen is, he'd come up with something, some relatively obscure product, and praise it to the sky. Everybody would suddenly want it, the manufacturer gets swamped with orders, they go out and buy materials they needed to make something close to the number of orders. By the time they got all the parts in and got started with it, it was the next issue, and he was onto something else, and they went out of business. And he did that to more people who were really making good products, who, if given an opportunity, in a rational universe, would probably still be in business today. But he buried them. And I thought that was a shame, really... I mean, he didn't try to put people out of business, but he wasn't really looking back. He was always looking forward, and I don't think he saw the wake of destruction that he left.[67]

The language of high-end audio

Both Holt and Pearson expressed the belief that anyone, given the time, patience and interest, could become a discriminating listener, while at the same time arguing that only certain types of music and listening under proper conditions could establish a legitimate basis for that discrimination. But they also each recognized that readers of their magazines may not immediately understand the various terms used to describe the sound quality of different components, and why the vocabulary was important. Both magazines, therefore, set out at

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[66] Interview, 05/02/07.

[67] Ibid.

various times to explain the language of high-end audio reviewing, both directly and in the context of specific product reviews, with the expectation that the reader had a least a basic knowledge of audio, or was willing to learn. "One of the problems for the beginning reader is the language we use," Pearson wrote in 2001.

> You may have walked in at the middle of the movie. We cannot continually go back and explain simple concepts and fundamental words. You'll have to know what a preamp is and how to distinguish between a cartridge and a stylus in order to begin to "get" it. You should know a little about certain concepts fundamental to audio, such as diffraction, time delay, voltage versus current, tubes versus transistors, levels high and low, and the like.[68]

The language of high fidelity includes two categories of words: those used to describe to particular components in an audio system, like *woofer*, *tweeter* and *crossover*; and those used to describe the quality of sound a system can produce, such as *neutral* and *accurate*. Some terms, like *distortion*, straddle this divide by being both measurable and audible, although the audibility of certain kinds of distortion is disputed, as we shall see. To some audiophiles, particularly Pearson, the descriptive language used by mainstream hi-fi magazines had become largely meaningless by the early 1970s. "How many times," Pearson asked in his first editorial, "has *High Fidelity* assured us that the speakers it tests are 'utterly transparent and neutral, without a hint of boxiness' and yak-yak-yak. The answer is, too many times. Because it is to *High Fidelity*'s commercial advantage to be relative, instead of absolute – Absolutes are Offensive."[69] To better communicate the qualities of equipment under review, both Holt and Pearson, and other reviewers in each of their respective magazines, expanded upon these familiar terms with new words like "aliveness," "continuousness," "palpability," and "character." [70]

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[68] Pearson, "How To Read *The Absolute Sound*," (April/May 2001), 39.

[69] Harry Pearson, "How to Read *The Absolute Sound*," *The Absolute Sound* **7**, no. 26 (June 1982): 179.

[70] Many more examples of the language of subjective reviews can be found in Chapters 5 and 6, including examples from Holt, Pearson, and a variety of other reviewers for both *Stereophile* and *The Absolute Sound.*

Holt's approach to the language of subjective reviewing was built around terminology that had "been around since before Edison" and was familiar to musicians who had long used terms like "euphonic," "strident," "rich" and "mellow." He further cited the RCA *Radiotron Designer's Handbook* as the source of many valuable subjective terms that were still in use in the 1990s.[71] "Most subjective audio terms that are not drawn from everyday usage (such as 'strident') fall into three categories," he wrote.

> 1) onomatopoeia – words that sound like what they describe; 2) imagery – words that evoke a mental image; and 3) sensory – words that relate things we hear to more familiar things we see or touch. For example, the term "boomy" is onomatopoeic, because a bass peak sounds like the word "boom." The term "airy" elicits an image of expansive openness, like a large, high ceiling to room with lots of big windows, to describe treble extension that seemingly has no limit. Another sensorial term "gritty" will have immediate meaning to anyone who has ever chewed lettuce with sand in it.[72]

Other terms, like "soundstaging" and "resolution," had meaning, he suggested, only for audiophiles, and sometimes different subjective terms had the same or similar meanings. "Don't be put off by this," he told readers. "Subjective terminology can never be as precise as the language of physics. But imprecise or not, it's still a much more meaningful way of describing reproduced sound than just saying, 'it sounds fine.'"[73]

Holt also recognized that not all readers could be expected to automatically understand what the specialized language of the magazine was meant to convey. "Many letters we receive express bewilderment and irritation with some of our terminology," he wrote in a 1985 editorial. "This seems to imply that our equipment reports don't get through to some of you."[74] He offered

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[71] J. Gordon Holt, "Sounds like? Part one: J. Gordon Holt offers a guide to subjective reviewing and begins a three-part glossary of subjective terms," *Stereophile* **16**, no. 7 (July 1993): 59-69, on 63.

[72] Ibid.

[73] Ibid.

[74] J. Gordon Holt, "What I mean is..." *Stereophile* **8**, no. 6 (October 1985): 5-7, on 5.

a variety of example terms to aid readers in understanding not only what the terms were meant to describe, but how they were related to one another, and how, illustrated by the chart in Figure 4.6, some terms could be associated with different instruments and parts of the frequency spectrum. "I think I can safely assume that words like 'shrill,' 'boomy,' and 'raucous' are easily understood," he wrote,

> But let's take "bright," which carries different meanings for different people. To some, "brightness" is what is heard when the frequency range above 8 kHz has a rising response. This adds sizzle to cymbals, exaggerated sibilance to voice, and heightened sharpness to such hard transient attacks as the sound of struck wood blocks and triangle. But to call these instances "brightness" is wrong. They're more properly called "wispiness," "tizz," "sibilance," or "edginess," depending on the severity of the rise.

"I presume superior knowledge of this terminology," he stated, "because I invented it."[75] He also suggested that the terms could be understood as related to one another by degree:

> "Brightness" or "brilliance" results when you slightly elevate the frequency range between 3000 and 8000 Hz. Elevate that range a little more and you get "hardness," which can then climb through "shrillness," "stridency," and "screechiness." Screechiness produces the sensation that one's ear lobes are about to be severed, flush with the temples, by daggers of sound. In a truly dreadful system, excessive brightness makes you flinch.[76]

Holt took his efforts to standardize and communicate the details of various audio terms, both subjective and engineering-oriented, a step further by publishing a book, *The Audio Glossary*, in 1990.[77] In it, Holt mixed the language of audio engineering and the language of subjective reviewing, providing definitions for engineering terms such as "conversion efficiency" and "pink noise," and subjective terms such as "sweet," "golden," and "coarse." Holt's glossary, which was also published in successive issues of *Stereophile* in the early 1990s, showed his roots

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[75] Ibid. Although Holt recognized that a good deal of subjective terminology came from other sources, and that the idea of subjective reviewing was not his invention, there were a variety of terms that he introduced into the subjective audio lexicon through his magazine. See Stone, "35 Years and Just Getting Started."

[76] Ibid.

[77] J. Gordon Holt, *The Audio Glossary* (Peterborough: Amateur Audio Press, 1990).

and interests in engineering, but also his contention that, while measurements provided some valuable information about a piece of audio equipment, the sound of that equipment was best described subjectively.

Pearson's use of subjective language was different from Holt's. In the June 1982 issue of *The Absolute Sound*, Pearson reprinted the first issue's editorial under the heading, "How to Read *The Absolute Sound*," and also expanded his discussion of reviewing vocabulary in a "Special Report" on solid-state power amplifiers.[78] Pearson began the report by revisiting what he and others at the magazine were listening for when analyzing power amplifiers, and the vocabulary they used to describe those qualities. Some were familiar to hi-fi enthusiasts, such as "soundstage," meaning the ability of a system to "re-create... the illusion of a concert hall stage before you," while others were specific to Pearson's approach. Among them was the term "character." "Character," Pearson described, referred to "the overall 'sound' of the equipment, its 'personality,' so to speak. This may be related to a combination of frequency response, distortion, and phase products."[79] Pearson's twist on this idea had its roots in Eastern philosophy. "In this regard, we have developed the terminology yang (the Chinese concept for the masculine principle, hence, bright, like fire, dry, even white) and yin (the feminine principle, hence, dark, moist, forgiving)."[80] These different qualities could be heard as the device imprinted its "character" upon the sound it was reproducing, which was considered anathema to the high-end ethos that the reproducing equipment should do as little as possible to alter the audio signal.

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[78] Harry Pearson, "The Estate of Solid-State Amplifiers," *The Absolute Sound* **7**, no. 26 (June 1982): 213-230.

[79] Ibid., 214.

[80] Ibid. Pearson added a footnote to this sentence stating, "I am describing the concepts, not endorsing a sexist viewpoint."

"Ideally," he said, "the reviewer would be unable to describe an amp as either yin or yang."[81] Other aspects of sound were frequently described in visual terms, particularly using colors and qualities of light.

Over the years Pearson expanded the concepts at the root of *The Absolute Sound*'s reviewing philosophy, which he would occasionally explain and expand upon. "The art of audio criticism rises or falls on the effectiveness of the language we use to describe sound," he wrote in 2001.[82] "We have come to understand that a unit's character may not be determined by frequency-response aberrations," he wrote,

> But rather, character most probably derives from the component's strengths and weaknesses in reproducing dynamic gradients. Consider, for the moment, that virtually no electronic component has a range of dynamic contrasts that is uniform throughout the frequency spectrum. Units with constricted dynamics at the top of the spectrum and a more expansive dynamic in the lower frequencies will invariably sound dark. Units with expanding dynamics in the mid- to upper-mid-bass (the range of the brass) and a top octave roll-off will have a kind of "golden" or bronzed sound.[83]

Another term he described was "immediacy," confessing that "there probably is a better word to describe this phenomenon."

> Immediacy you can hear in the breath a flute player takes, in the feel of the 'air' around a performer (sometimes we get the sense we can tell, with today's reference-quality systems, the relative humidity of that air), in the splitting of the air, its parting, just before you hear the first note played. You'll know you have immediacy when, during playback, the sound of music itself surprises.[84]

Interviewees who were reviewers, some of whom had written for either *The Absolute Sound* or *Stereophile* (or both) had their own approaches to using subjective language in their reviews. "Harry [Pearson] is famous for his use of Eastern philosophy," Tony told me. "He talks

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[81] Ibid.

[82] Pearson, "How To Read *The Absolute Sound*," (April/May 2001), 42.

[83] Ibid., 44.

[84] Ibid., 45.

about thing having more 'yin' or 'yang'-like natures. And it seemed to me that yin and yang sometimes seemed to switch, which I guess might be in the nature of yin and yang, but I was never comfortable or felt that I totally comprehended what that was talking about." Other terms, he said, seemed clear to him right away: "There were other things that were words that, say, I'd never seen before that I instantly understood. I believe [*Stereophile* editor] John [Atkinson]... coined the word 'spitchy,' in referring to a tweeter. And the first time you hear the word 'spitchy,' you immediately know what that has to be." Other reviewing terms left him bemused:

> And then there are things that are so deliciously nonsensical that the first time you hear them that you adapt them to the rest of your life. I can think of [one example], "see-through transparency." That just cracked me up when I read it cause I knew that [the reviewer] was being perfectly sincere, and at the same time it's just such a ridiculous concept. I mean, what other kind of transparency is there?[85]

Demonstrating what was a common self-awareness among interviewees, he also noted the "social aspects" of the language: "Audiophiles use the jargon because jargon identifies us as audiophiles," he said, "and I think that all cultures use jargon for that reason."[86]

As valuable as the descriptive vocabulary may be for subjective reviewers, several acknowledged the difficulty in deploying that language in a meaningful way. Ben observed that the unique challenge of the descriptive exercise was not clear to many would-be reviewers:

> I think a lot of people get into audio reviewing thinking, "oh wow, this seems like it's so much fun. Stuff gets sent to you, and you get to play with it." Yeah, but at some point you have to sit down and write about it, and so you really have to want to do that. It's not easy writing either. It's not like looking out the window and saying, "oh, I see a tree there." It's much more complicated than that because you're sort of taking one sensation and then turning it into words, which is a whole lot tougher.[87]

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[85] Interview, 05/20/07.

[86] Ibid.

[87] Interview, 03/21/07.

"[Reviewing audio equipment requires] the ability to translate what you hear into words," he went on. "Not only because at some point you're going to be writing about it, but because words are the way that we come to understand, and if you don't have a word for something, how can you know what it is?"[88] This belief in the power of language to convey useful information about sound is a key aspect of the observational listening approach to audio.

The process and language of subjective reviewing pioneered by Holt and Pearson, and expanded by their reviewing staffs, purposely set them against the mainstream hi-fi publications of the day, particularly *Stereo Review*. The approach of that magazine, and its primary reviewer, Julian Hirsch, was held up (especially in *The Absolute Sound*) as the epitome of what was wrong with the high fidelity industry. *Stereo Review* was accused of being a tool of manufacturers and advertisers, and its staff (particularly Hirsch) as subscribing to the outmoded assumption that if two pieces of equipment have the same measured results, they will sound identical. But the staff of *Stereo Review* had equally strong opinions about the "underground" audio press, whose methods and language were seen as sloppy, unscientific, and riddled with bias. For double-blind listeners, the language of subjective reviewing exemplified what was wrong with high-end audio and the methods of observational listeners. By the late 1970s and early 1980s, the "Great Debate" between these two camps was in full swing.

Julian Hirsch and Stereo Review

Despite being a frequent target of the observational listeners for his measurement-oriented methods, Julian Hirsch was a dedicated hi-fi enthusiast whose approach to assessing audio equipment using engineering-style bench tests defined *Stereo Review's* approach to home

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[88] Ibid.

audio. Hirsch was born in 1922 in New York City, was trained as an electrical engineer at Cooper Union, and received radar training in the Army during World War II. His interest in audio dated back to his teenage years, and following his service in the Army, he set about building his own home audio equipment. "I built [an] amplifier using a pair of 807 tubes, transmitting tubes with which I was very familiar," he recalled in a 1986 interview in *Stereo Review*,

> and a power supply that I constructed out of World War II surplus parts. It put out something on the order of 12 watts at the clipping point, and when you got down below 10 watts or so the distortion was well under 0.1 percent, about ten times less than commercial amps in those days. It was a great amp. It could give you flat feet if you carried it around too much![89]

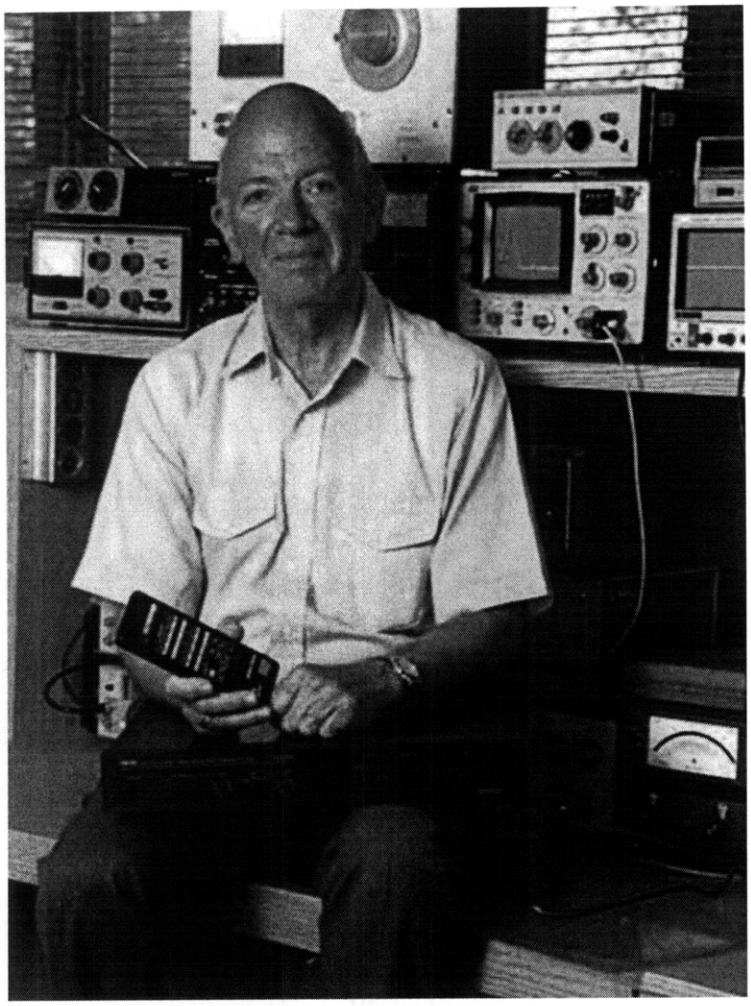

Figure 4.11 - Julian Hirsch in 1986 (from *Stereo Review* **51**, no. 9, 1986, pg. 81).

In 1954, Hirsch, his friend and co-worker Gladden Houck, and several other hi-fi enthusiasts began producing the *Audio League Report*, a pamphlet-sized publication filled with measurements and tests of a variety of hi-fi equipment, and offered subscriptions for $3 a year. At the time, Hirsch worked for

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[89] Michael Smolen, " Julian Hirsch: a silver anniversary salute to the Director of Hirsch-Houck laboratories," *Stereo Review* **51**, no. 9 (September 1986): 81-87, on 82.

General Precision Laboratories in Pleasantville, New York, and was able to use their sophisticated test equipment for the *Report*. Hirsch's tests frequently revealed, among other things, that manufacturers' claims in advertising and specifications did not match up with the real-world performance of their equipment.[90]

The *Audio League Report* turned out to be far more popular than Hirsch had anticipated, and within three years had 5,000 subscribers. Like Holt during the early years of *The Stereophile*, Hirsch did most of the testing, writing, and subscription management himself, with help from his wife. He formed the independent Hirsch-Houck Labs for testing audio equipment with partner Gladden Houck in 1957, and turned the business operations of the *Report* over to the soon-to-be-defunct enthusiast magazine *Audiocraft* in 1958. 1958 was also the year the Ziff Davis publishing company established *Hi-Fi Music Review*, quickly renamed *Hi-Fi/Stereo Review* with the advent of stereo recording, and eventually simply *Stereo Review*. Ziff Davis began employing Hirsch-Houck Labs for testing services in 1960 for another of their publications, and in 1961, Hirsch-Houck tests began appearing in *Stereo Review*. Hirsch began writing a monthly column entitled "Technical Talk" that same year, which he used to explain some of his testing procedures for equipment under review, and to explore a wide array of audio-related topics. The column soon became one of the magazine's most popular features.[91]

Early on, Hirsch established a matter-of-fact approach to reviewing audio equipment that relied on what would come to be labeled an "objectivist" set of procedures. Often his reviews focused primarily on comparisons between the manufacturer's specifications for a piece of

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[90] Ibid., 82-83.

[91] Ibid., 83; Staff, "Julian Hirsch, 1922-2003," *Sound & Vision* (November 2003): available from http://www.soundandvisionmag.com/wildcard/521/julian-hirsch-1922-2003.html, accessed 12/02/08.

equipment and his own measurements of that equipment, as well as the equipment's functional characteristics and ease-of-use. His reviews often read as detailed descriptions of features and specifications with minimal, if any, detail about how a product sounded. Sonic characteristics, he argud, could be explained through measured performance, although he included listening in his overall testing procedures and, like Holt, frequently reminded readers of the importance of listening to equipment for themselves before making buying decisions.[92] He observed that there was no such thing as a component that would be "best" for everyone, and a variety of considerations – aesthetic, economic, and so on – would naturally govern an individual's choice of components. "As in all human activities," he wrote, "a modicum of common sense and good judgment goes a long way when selecting components for a high fidelity system."[93]

"I have been listening to and evaluating high-fidelity components for nearly thirty years," Hirsch wrote in a "Technical Talk" article in 1982, "and I have *never* heard a significant difference between two supposedly similar electronic components [such as pre- and power amplifiers] that could not be explained by measurable electrical differences." This position was not without subtlety, however. "In the case of the electromechanical transducers," he continued,

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[92] In 1983, Hirsch wrote, "I can only reiterate my suggestion that you listen for yourself and choose the speaker in the price range you can afford whose sound is most pleasing to *you*. No review can be as valid in guiding *your* purchase decision as that approach, although we can offer guidance in determining which speakers are worth auditioning and which can be excluded from consideration. Just try not to get carried away by advertising hyperbole." That same year, Holt, in an article about buying equipment from small manufacturers, wrote, "Every serious audiophile has a taste for a certain kind of sound, and someone else's recommendation is no guarantee that its sound will suit your taste. You can get a good component by simply, blindly, following a recommendation in *Stereophile*, but you may not get one you like. To ensure that, you must a listen to it first." Julian Hirsch, "Do You Hear What I Hear?" Technical Talk, *Stereo Review* **48**, no. 2 (February 1983): 27-28, on 28, emphasis in original; J. Gordon Holt, "The Dilemma of Exotica, or 'What's a Buyer To Do?'" *Stereophile* **6**, no. 4 (1983): 3-5, on 5.

[93] Julian Hirsch, "Equipment Specifications One," Technical Talk, *Stereo Review* **22**, no. 5 (May 1969): 37-38, on 37.

"such as phono cartridges, microphones, and speakers, the situation is quite different."[94] More so than electronic or passive components such as cables, transducers did appear to Hirsch to affect the sound from an audio system in ways that were not predictable with measurements – a position Hirsch held consistently throughout his career. In a 1968 "Technical Talk" article on speaker testing, Hirsch began by stating, "I don't know how to test speakers." This statement was not "an expression of self-doubt," he continued, but rather an acknowledgment of the unique difficulties in obtaining objective measurements of loudspeakers that could accurately communicate how they would sound:

> The measurement of speaker parameters such as frequency response, distortion, polar pattern or dispersion, efficiency, and such matters has been treated extensively in the technical press. Perhaps too extensively, since there are almost as many different test techniques as there are workers in the field. The real problem is that none of these tests, or any combination of them of which I am aware, can describe unambiguously, even to a skilled interpreter, precisely what a given loudspeaker will sound like in a typical home listening environment.[95]

The following year, in a review of 12 stereo phono cartridges, Hirsch suggested that cartridge testing presented similar difficulties as loudspeaker testing:

> Armed with an imposing array of special test records, we measured most of the obvious characteristics of a cartridge, including the required tracking force, output-signal level, frequency response and crosstalk, square-wave and tone-burst distortion, and intermodulation distortion. When you examine our test data... you may be more impressed by their similarities than by their differences. So were we. Even where a difference appeared, it was not always obvious what its audible subjective effect, if any, would be. One must conclude, as we did, that these tests, valuable as they may be as an indication of various factors, are not in all cases measuring what we hear, since there *are* some differences in the sounds of the various cartridges that do not seem to be related to the measured data.

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[94] Julian Hirsch, "Does Everything Have a 'Sound'?" Technical Talk, *Stereo Review* **47**, 9 (September 1982): 28-29, on 28, emphasis in original.

[95] Julian Hirsch, "Speaker Testing," Technical Talk, *Stereo Review*, **21**, no. 8 (August 1968): 33-34, on 33.

"Inevitably," he concluded, "as with loudspeaker testing, we rely on our ears for the final judgment."[96]

Despite the similarities in this regard to both Holt and Pearson, Hirsch's approach to reviewing and writing about audio equipment was quite different. Unlike the reviews in *Stereophile* and *The Absolute Sound*, Hirsch conducted his tests – measurement and listening – in his lab space rather than his living room, and eschewed the language of subjective reviewing. The bulk of Hirsch's reviews described the functional characteristics of the product under test, with very little, if any, description of their sound. His review of a preamplifier from the SAE company in 1982 was typical of his approach:

> There is provision for an optional speaker switching device that plugs into a socket in the rear of the [preamplifier], making it possible to switch the power amplifier outputs to either or both of two pairs of speakers. There is a headphone jack on the front panel. Whenever the preamplifier is plugged into an energized AC outlet, a small "on standby" power supply keeps the computer memories active and illuminates a red LED next to the standby button. A momentary touch of standby turns on the preamplifier, extinguishes the light, and turns on red LEDs next to the various last used selector buttons.[97]

Although he did not use the language of subjective reviewing himself, he often addressed the issues it raised in his "Technical Talk" pieces. "Even in that rare event [that a significant difference exists between components]," he wrote, "how does one describe a totally subjective experience so as to convey its essence to another person?"

> When I read that some coloration is analogous to a particular physical texture or color, I rarely feel that I understand exactly what the author is trying to convey. Frequently, when I test the same product (typically a speaker, since I have seldom seen these rare qualities attributed to other components), I do hear an apparent 'coloration,' but I can rarely relate it in any way to the unique – and frequently far-fetched – verbal imagery used by others to describe (presumably) the same effect.[98]

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[96] Julian Hirsch and Gladden Houck, "Laboratory Tests of Twelve Stereo Cartridges," *Stereo Review* **22**, no. 1 (July 1969): 57-63, on 57.

[97] Julian Hirsch, "SAE P101 Preamplifier," *Stereo Review* **47**, no. 7 (July 1982): 30-31, on 30.

[98] Hirsch, "Does Everything Have a 'Sound'?" 29.

"Such terms as 'graininess,' 'definition,' 'haziness,' and the like are entirely too specific and personal to have much meaning to another individual," he wrote in 1983, "especially one who is not sharing the same listening experience."[99]

A, B, and X: Double-Blind Listening Tests

By the early 1980s, the "Great Debate" was also taking shape within the Audio Engineering Society, where several outspoken members began writing articles and giving presentations about the shortcomings of subjective testing, and the value of double-blind testing. Among the first came from two professors of acoustics and audio engineering at the University of Waterloo in Ontario, Canada: Stanley Lipshitz and John Vanderkooy. At the 65th annual AES convention in London in 1980, Lipshitz and Vanderkooy presented a paper entitled, "The Great Debate: Subjective Evaluation," in which they argued that "highly controlled tests are necessary to transform subjective evaluation to an objective plane so that preferences and bias can be eliminated, in the quest for determining the accuracy of an audio component."[100] Criticizing the "emotive epithets" used in the high-end audio press to describe the sound qualities of various components, Lipshitz and Vanderkooy argued that "while everyone is entitled to a personal preference and opinion, this opinion is meaningless to anyone else unless it is possible to demonstrate that the opinion has some elements of objectivity, consistency and repeatability – all necessary components of any rational approach to the subject."[101] In order to provide the necessary controls for subjective testing, the authors advocated for the use of switch boxes that

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[99] Julian Hirsch, "Do You Hear What I Hear?" 27-28.

[100] Lipschitz and Vanderkooy, "The Great Debate," 1.

[101] Ibid., 3.

would allow for user-controlled switching between components during a listening test so that immediate comparisons could be made. To that end, they provided circuit diagrams for the device they had in mind to perform this task.[102]

The following year, at the AES's 69th convention in Los Angeles, Floyd Toole, an audio engineer and researcher at the National Research Council in Canada, offered further detail regarding how controlled subjective listening tests could produce scientifically valid results.[103] In his presentation, "Listening Tests – Turning Opinion into Fact," Toole described listening as the "alpha and omega of audio." "In every case," he wrote, "the commerce of the audio industry is being influenced by subjective judgments."

> It would be gratifying if this conscientious listening alone led to improvements in audio. Indeed audio quality is good and improving, but probably more as a result of technical than subjective criticism. Still, in spite of technical progress and a great deal of serious listening, there are glaring examples of imperfection, particularly in recordings and transducers. It is, I think, no accident that these are areas where objective measures are the least developed and where subjective judgments carry the most weight.[104]

Toole argued that the process of subjective evaluation opened the door to "many opportunities for subtle yet persuasive psychological factors to complicate what might otherwise appear to be a simple situation."[105] By eliminating those factors through various controls, which he acknowledged were "unfortunately... repetitive, regimented, tedious, and... inclined to restrict the vocabulary of listener responses," data collection could be focused strictly on the "experimental parameter" of the test, and could be quite reliable in predicting and measuring the

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[102] Ibid., 13-17.

[103] Since its founding, the AES has expanded the number of its conferences and conventions, including the establishment of regional conferences, and held more than one convention annually. The numbering scheme for conferences and conventions, therefore, does not always correspond to the years in which they have taken place.

[104] Floyd Toole, "Listening Tests – Turning Opinion into Fact" (paper presented at the 69th Audio Engineering Society convention, Los Angeles, United States, May 12-15 1981), 1.

[105] Ibid., 2.

quality of devices such as loudspeakers.[106] Following the tenets of the scientific method, Toole argued that listening tests should be "reproducible at different times and places, with different listeners," focused only on the "audible characteristics of the product or parameter under examination," and "reveal the magnitude of audible differences or a measure of absolute values on the appropriate subjective scales." To that end, he offered an experimental protocol for testing loudspeakers that included careful selection of source material, room dimensions, and loudspeaker positioning to mimic as closely as possible a living room-type setting. The loudspeakers should be separated from the listeners by an opaque but "acoustically transparent" screen, and listeners given a checklist and scale on which to record their reactions to the various tests, enabling the quantification of results and minimizing the use of "poetic" language to describe the sounds of devices under test. Toole noted that the choice of listeners was also important: hi-fi enthusiasts tended to produce more statistically reliable results than non-enthusiasts, and that "listening is a skill that can be improved by training and experience."[107] Although he observed that "listeners occasionally leave [such tests] with bruised egos," the testing procedures appeared to work insofar as they validated that, "in general, products that measure well, do well in listening tests."[108] Expertise in listening was something that those on

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[106] Ibid.

[107] Ibid., 13.

[108] Ibid.

both sides of the testing issue could agree was critical.[109]

Figure 4.12 - David Clark (r) with the Audio Research Corporation's William Z. Johnson at the Winter CES in 1987 (for more on William Johnson and Audio Research, see Chapter 5 -- from *Stereophile* **10** no. 2, pg. 38). Used with permission.

The same convention featured a related presentation by David Clark, who was to become one of double-blind listening's greatest advocates. Clark was the head of the ABX Company in Troy, Michigan, and a member of the Southeastern Michigan Woofer and Tweeter Marching Society (SMWTMS), a hi-fi club. In his presentation, Clark described a technique for performing the type of double-blind tests advocated by Lipshitz and Vanderkooy using a device of his own design that he called the ABX Comparator. The Comparator could be used to test a variety of components in an audio system, including source components, preamplifiers, and power amplifiers. "Subjective testing of audio equipment will always be necessary," he noted at

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[109] Toole's work in this area was highly influential among hi-fi enthusiasts. The National Research Council had a sophisticated anechoic chamber that Toole and his colleagues used to perform loudspeaker measurements, and as a publicly-funded facility, those measurements (and sometimes the facility itself) were made available to various Canadian and occasionally American loudspeaker manufacturing firms. Toole eventually became the President of the Audio Engineering Society, and later led the engineering efforts of Harman International, a large American electronics and loudspeaker manufacturing firm that acquired such brands as JBL, Infinity, and Revel, and electronics from Harman/Kardon, Lexicon, and Mark Levinson Audio Systems. Toole was responsible for building testing facilities for both anechoic and subjective measurement of loudspeakers, and the Revel brand – Harman's high-end addition to its loudspeaker lineup – has consistently received very positive reviews in the high-end audio press. See Floyd Toole, *Sound Reproduction: Loudspeakers and Rooms* (Boston: Focal Press, 2008).

the beginning of his talk, "because audio's end result is a subjective experience."[110] Obtaining useful subjective data was difficult, and required "high resolution" testing apparatus that eliminated as many variables as possible during a listening session. Such resolution, he argued, was unlikely to come from "casual" listening sessions of the kind favored by the high-end audio press, but could be obtained using controlled, double-blind methods that the Comparator made possible.

The Comparator consisted of a module with two inputs (marked A and B), one output, and a handheld controller. The module included physical relays for joining one of the two inputs to the output, and logic circuitry to randomly assign one of the two inputs to the output for each successive trial, and store that selection in memory so that it could be displayed at the end of a session. The handheld controller had one button marked "A," one marked "B," and one marked "X." Buttons A and B connected the devices plugged into inputs A and B, respectively, to the output to allow listeners to familiarize themselves with the sound of each device. Once the double-blind part of the test began, listeners would press the button marked X, which triggered the module to assign *either* input A or input B to the output. For each trial in a double-blind listening test, listeners would mark a score sheet noting whether they believed the device currently in the X position was device A or B, and if they preferred its sound. Neither the listener nor the person administering the test knew which device was connected during each trial, making listening tests with the Comparator double-blind.

By allowing the listener to control when the switching took place during each trial, Clark felt the Comparator deflated the argument among observational listeners that double-blind tests

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[110] David Clark, "High Resolution Subjective Testing Using a Double Blind Comparator" (paper presented at the 69th Audio Engineering Society convention, Los Angeles, United States, May 12-15 1981), 1.

were "stressful" for listeners to the point of invalidating the results. He conceded that the tests could be stressful in other ways, however. "One's first use of the double-blind comparator can be distressing because one expects to be able to immediately sort between components and is not able to do so. This has led many reviewers and designers to dismiss this test as, in some way, masking the sonic identities." Displaying a supreme (and perhaps naïve) confidence in the appeal of "rational" and "objective" testing procedures, he wrote, "with persistence, however, human hearing limitations are accepted and useful testing begins."[111]

The ABX Comparator was among the first commercially available switch boxes of the type Lipshitz and Vanderkooy had in mind, and it found a somewhat unlikely advocate in J. Gordon Holt. In the July 1982 issue of *Stereophile*, Holt wrote a feature article about the ABX Comparator.[112] While noting a few shortcomings in its design, including the potential for impedance mismatching between components that could become "the kind of uncontrolled variable which tends to undermine the validity of any scientific experiment," he was largely enthusiastic about the device.[113] "I can only hope that ABX sells a lot of these," he wrote, targeting both *Stereo Review* as well as other subjective audio journals, "for the more people (and audio groups) who own them, the more overwhelming will be the evidence that trained listeners can hear things that Julian Hirsch can't measure. By God, how I'd like to put some 'underground' reporters' claims to fame to the test with this."[114]

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[111] Ibid., 9.

[112] J. Gordon Holt, "The ABX Comparator," *Stereophile* **5**, no. 5 (July 1982): 11-14, on 11.

[113] Ibid.

[114] Ibid., 14.

Holt's enthusiasm for the Comparator came in part from his increasing frustration during this period with the direction subjective audio appeared to be headed. "To audiophiles who are aware that their household line voltage changes under varying loads," he wrote in a 1981 editorial, "and have observed the absolutely fantastic differences in the sound of their system when the next-door neighbor turns on junior's nightlight, it may come as a surprise to learn that there are folks out there who think you're full of crap."[115] The "establishment" audio press and organizations like the AES were lashing out at the observational listeners and "underground" press "not because we are hearing things that can't be measured, but because we can't prove it."[116] "We have claimed for so long that we could hear things the scientific establishment doubts we can hear," he wrote, "and disagreed so much about what we hear, that so-called subjective testing has lost the last vestiges of its credibility."

> This has not been helped at all by recent assertions that reproduced sound is fouled up by the proximity to equipment or tables of metal, wood, concrete, carpeting and people, nor by claims that interconnecting wires must be dimensioned to within a ridiculous fraction of an inch to avoid total destruction of fidelity. We have even heard a report recently of reproduced sound being "dramatically" improved by the placing of a small container of water beneath the resting position of the stylus, even though the stylus never came near it!
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> I'm not claiming that any of this is impossible. "Impossible" is a very strong word, often freely used these days by people with an overweening desire to be proven wrong. What I am saying is that allegations like these are so hard for a scientific mind to swallow that anyone who makes them without at least offering some sort of proof that they are audible lays him (or her) self open to ridicule, derision, and out of hand dismissal as a full-blown crackpot.[117]

The ABX Comparator could "offer hope of proving, for the first time, whether some of the less credible observations of perfectionists have any basis in reality or are just magnificently

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[115] J. Gordon Holt, "Credibility Gap," As We See It, *Stereophile* **4**, no. 9 (November 1981): 2-6, on 2.

[116] Ibid.

[117] J. Gordon Holt, "The Truth Should Out," As We See It, *Stereophile* **5**, no. 5 (July 1982): 3-4.

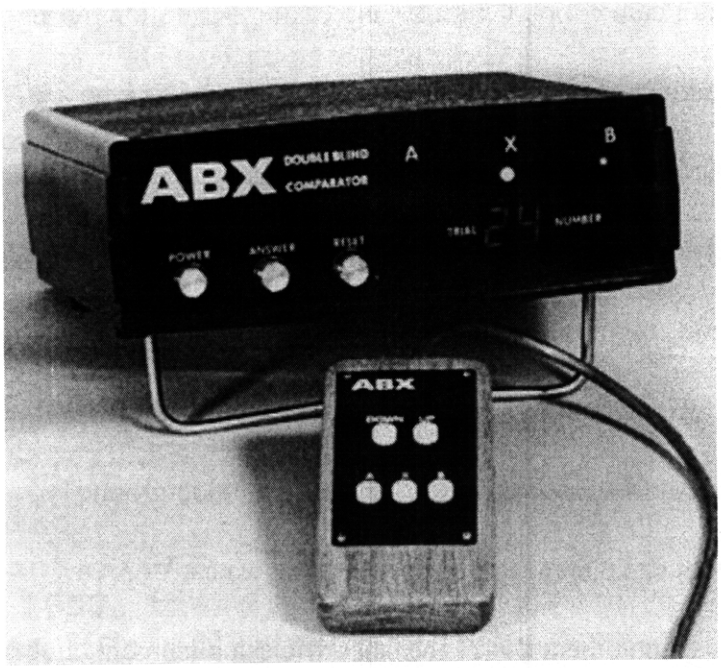

Figure 4.13 - The ABX Comparator (from *Stereophile* **5**, no. 5, pg. 13). Used with permission.

conceived self-deceptions."[118] The device, he suggested, "takes the fraud out of subjective testing."[119]

But Holt was neither dismissive of observational listening as a practice, nor did he completely embrace the "scientific" approach to testing audio equipment. His rejection of double-blind testing for his own reviewing and for *Stereophile* as a whole can be understood in part as coming from his continued focus on the audio system as a *system*. Although product reviews in *Stereophile* generally focused on a single component, they were always written in the context of a reviewer's overall system, and the room or space in which that system was used. Introducing double-blind controls would have disrupted Holt's sense of the audio system acting as a whole, despite whatever controls the listener was given using the ABX Comparator. He was also suspicious that what he interpreted as a sharper turn towards measurement and double-blind testing among the mainstream audio magazines such as *Stereo Review* might be coming from pressure from advertisers. "The 'establishment' audio press… has recently abandoned its former stance of open-mindedness [towards observational listening] and has mounted a campaign to discredit all 'observations' which cannot be correlated with universally accepted measurements," he wrote in 1981. "I can only speculate on their motives

[118] Ibid., 4.

[119] Ibid., 3.

for this – whether they see it as an aid and comfort to most of their advertisers, whether it is a means of bolstering reader confidence in their equipment reports (a confidence which has been getting shakier in recent years) or whether they are convinced that no one can hear anything they can't hear is open to question, but no answers can be forthcoming."[120]

Holt further saw the exclusive use of measurements to evaluate quality as wrongheaded, not only because of the subjective differences that came to light only during observational listening, but also because of what the emphasis on contemporary measurement practices and techniques meant for the future of audio:

> When these audio writers tell us that they can measure anything we can hear, what they are really saying (although none has yet had the temerity to admit this) is that all the meaningful measurements of audio equipment have been devised, therefore any measurements which have not as yet been devised are meaningless. This sounds familiar. Several hundred years ago, the world's scientific community – such as it was – declared that everything that man could learn about the universe had already been learned. Not surprisingly, this statement was followed by a couple of hundred years of intellectual stagnation which we now, disparagingly, call "the dark ages." It would appear that one of the things those wise scientists had not learned is that people never learn.[121]

He remained unconvinced that double-blind tests were the best way to assess quality in audio equipment, but acknowledged that, despite his own concerns that he would not fare well in such tests, the high-end audio community had an obligation to attempt by whatever means possible to demonstrate to the scientific community that their observations were meaningful. "*Stereophile* has neither the funds nor the time (nor, for that matter, the inclination) to organize [a double-blind] experiment," he concluded, "but I have a lot of ideas to contribute on the subject of setting it up, choosing the listeners and so on, and – at the dire risk of my credibility – I'll be happy to serve as a listening panelist."[122]

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[120] Holt, "Credibility Gap," 3.

[121] Ibid., 4.

[122] Ibid., 6.

Pearson rarely addressed the issue of A/B testing in *The Absolute Sound*, but did note in the first issue's editorial that he found such tests "careless" and expressed a "profound distrust" of them.[123] In the March/June 1981 issue, he published letters from Arnold Krueger, a SMWTMS member along with David Clark, and *International Audio Review*'s Peter Moncrieff regarding a series of double-blind tests conducted by Moncrieff's magazine. Like Clark, Krueger was a proponent of double-blind testing, but took umbrage with Moncrieff's testing methodology, which he believed was seriously flawed. Although he published the letters, Pearson was mostly uninterested in the specifics of Moncrieff and Krueger's disagreement. "With this exchange," Pearson wrote in his editorial comments following the two letters, "we draw the curtain on the A/B debate until that if-ever date when somebody has something new to add to the discussion. We similarly drew the veil over letters from Dr. Stanley Lipshitz et al a few issues back because he refused to address our criticisms of his vague methodologies."

> I must say that I think the pro-no differences folks have, by vigorously pursuing publicity and by pronouncing their viewpoint sacrosanct, demonstrated a huge ego investment in proving that differences do not exist. It is therefore logical that these efforts of humility should see a huge ego lurking behind every disagreement. Their refusal to specifically outlined their methodologies and to name the participants in their "listening" sessions deprives detached critics (and we number ourselves detached from this debate) the opportunity to scrutinize their errors.

"Unless all electronics are perfect," he continued, "it is pointless to argue that differences do not exist between them." He suggested those in the double-blind listening camp, Lipshitz and Krueger in particular, "are to be taken as seriously as those who insist that the earth is flat." "The most fascinating point they have raised," he argued, "and probably one that belongs in the

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[123] Harry Pearson, "Viewpoints," 90. In his 1975 review of the Dynaco PAT-5 preamplifier, *The Absolute Sound* reviewer Harry F. Lavo refers to "A-B comparisons" between the PAT-5 and preamplifiers from Marantz, Luxman, and Audio Research. The exact test procedures are not described, but given Pearson's objections to switcher-controlled A/B tests, we can assume that comparisons were made by physically reconnecting interconnects between the different units under test. Harry F. Lavo, "Dyna PAT-5," *The Absolute Sound* **2**, no. 7 (Winter 1975-76): 239-241, on 238.

domain of the psychologist, is how ordinarily intelligent men who believe there are no differences in components subconsciously arranged to prove it."[124]

To some extent, Holt's willingness to engage in debates over observational listening versus double-blind testing suggests an interest on his part in maintaining a connection with the engineering side of the audio world, and establishing the value of observational listening with this community. Pearson, while frequently acknowledging the technical accomplishments of high-end audio equipment designers, displayed no such interest, and tended to express his support for observational listening and objections to the positions of double-blind listeners with much greater hostility than Holt. Over the next few years, Holt and the *Stereophile* staff engaged far more directly in "the Great Debate" while Pearson and *The Absolute Sound* remained detached.

"Sense and Nonsense"

Although Hirsch regularly expressed his opinions regarding proper testing procedures and what qualities could and could not be reliably discussed in a review, among the most controversial articles to appear on the issues of testing and the subjective versus objective debate in *Stereo Review* was penned by a guest author, Alan Lofft. Lofft was himself a long-time audiophile, musician, and editor of the Canadian hi-fi journal, *Audioscene Canada*, and had participated in some double-blind testing led by Floyd Toole at the Canadian National Research Council. In his 1982 article, "Sense and Nonsense in High-End Hi-Fi," Lofft described the high-end audio community, including equipment manufacturers, shop owners, and reviewers and

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[124] Harry Pearson, "The Hear-No-Difference School vs. Moncrieff," *The Absolute Sound* **6**, nos. 21 & 22 (March/June 1981): 58.

editors for *Stereophile* and *The Absolute Sound*, as "cultish" and "fetishistic" when it came to their expensive equipment, which in his estimation was desirable largely for its exclusivity and high prices than for any type of demonstrable performance advantages. "Certain high-end components," he wrote,

> are able, whether through mystique, aesthetic design, underground endorsement, or sheer performance, to acquire enviable reputations and to carry price tags that place them far beyond the reach of most audiophiles. The Goldmund and Win Labs turntables, for instance, are basically manual turntables that, with their respective tonearms, cost around $5,000. The Win, in particular, is certainly a strikingly beautiful piece of industrial design, but does it or the Goldmund turntable do the job of playing a record at the correct speed, with negligible wow, flutter, rumble, or sensitivity to external vibration, $4500 better than a good manual, quartz lock, direct drive model equipped with a first-rate tonearm? For that matter, does the Goldmund offer a $3500 increment in performance over that of, say, an Oracle [turntable] equipped with a custom arm? Clearly, it does not. So there must be some intangibles bound up in the appeal of these components, elusive factors that can't be found in test reports or specification sheets.[125]

Regarding a particular high-end phono cartridge, Lofft targeted the coverage in another, much smaller underground high-end audio journal:

> Early reports on the $1000 Koetsu cartridge in *The Audio Critic* indicated that the cartridge body was hand carved out of wood "... by the retired chief engineer of Supex, a gentleman by the name of Sugano, who makes each sample by hand in collaboration with his son and sells only about one out of three... only a few dozen have reached these shores..." The poetic image of the old man and his son hand building this cartridge in minute quantities proved to be irresistible to high-end audiophiles.[126]

Lofft further criticized the observational magazines' "obscure" language used to describe the qualities of such equipment, like "musicality" and "focus." But his primary critique centered on the "wildly subjective and uncontrolled product assessments" conducted by the observational magazines. "Surely all audiophiles, audio writers, and engineers would agree that the goal of sound reproducing equipment is sonic accuracy," he wrote.

> If we are to determine how effective a component is in achieving this, we must have a standardized and understandable set of measurement techniques that correlate strongly

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[125] Lofft, "Sense and Nonsense in High-End Hi-Fi," 64. $5000 in 1982 is equal to around $11,000 in 2007 dollars.

[126] Ibid.

> with what we subjectively hear. The only way to achieve this is to bring as much objectivity as possible to listening tests, eliminating such extraneous variables as psychological bias related to price or brand-name and preconceived notions about performance that might color our impressions of what we hear.[127]

Bringing objectivity to listening tests could be achieved, he suggested, through the use of double-blind testing with switching equipment like the ABX Comparator.

Lofft's article provoked a swift response from both *Stereophile* and *The Absolute Sound.* Holt published a letter he also sent to *Stereo Review* in the October, 1982 issue of *Stereophile*, detailing his impressions of Lofft's piece. "Actually, I thought the article was excellent," he wrote, "and do not take issue with most of what Mr. Lofft said. It was, sadly, all too true." But, he continued,

> what I DO resent is *Stereophile* magazine being tarred with the same brush which blackened the names of some of the more deserving members of our kind... We do NOT rhapsodize over the smallest increment of improved definition, imaging, transient response and subsonics, and for not so doing we have earned the scorn of most of the other "undergrounders".[128]

Holt also took exception with Lofft's argument that "if two amplifiers measure virtually the same in terms of flat frequency response and low distortion they should sound the same," and if they did sound different, it meant a flaw in measurement techniques.[129] While Holt revealed some skepticism of the "audio purist's claim" that amplifiers with identical measurements can sound different, he also noted that "observation has convinced me that amplifiers which measure identically on simple THD [total harmonic distortion] and frequency-response tests do indeed sound different." By attempting to describe those differences, Holt argued, the magazine was giving readers more useful information than if they "merely quot[ed] test results" and said "they

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[127] Ibid., 66.

[128] J. Gordon Holt, "The Truth about High-End," *Stereophile*, **5**, no. 8 (October 1982): 3-4, on 3.

[129] Lofft, "Sense and Nonsense in High-End Hi-fi," 66.

were 'splendid.'"[130] "Throughout our entire 20 years of publication," he wrote in defense of *Stereophile*'s approach,

> we have endeavored to maintain as high a level of technical accuracy as we can, and to eschew any taint of mysticism, occultism or spiritualism. And although we feel that *Stereo Review* is being too reactionary by denying the validity of subjective testing, we also feel that much of what is reported by the underground press to be audible and significant is in fact nothing more than self-deception... We are ashamed of what subjective testing has become and what it has done to audio testing, and our frequent potshots at the lunatic fringe is a major reason why our circulation is as small as it is and as sane as it is. But we still insist that subjective testing has its place in audio reporting. Yes, it has yielded some bizarre flights of obfuscatory fancy, but it IS possible to describe reproduced sound in terms understandable to all.[131]

Pearson's response to Lofft was less direct, but his editorial in the October, 1982 issue of *The Absolute Sound* revisited some of the core principles behind the magazine's reviewing philosophy and confronted the issue of measurements. He rejected the label of "subjective," arguing that measurements and objective-oriented reviewing processes, such as those practiced at *Stereo Review*, were just as subjective as the "observational" style of reviewing practiced by *The Absolute Sound.* "Measurements are essentially subjective in and of themselves," he wrote, "because they prove nothing except that which the experimenter subjectively wishes to prove."[132] He further sought to counter the suggestion, with a vague attribution to the "British press," that high-end audio reviewing occupied the same role as wine or food criticism. "There is no absolute hamburger," he wrote, but "there is an absolute sound, real music performed in real space. Our job is to identify the ways in which components change real sounds."[133] He suggested that the reviews in *The Absolute Sound* were in fact less subjective and more valid

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[130] Holt, "The Truth about High-End," 4.

[131] Ibid.

[132] Pearson, "Editorial," 7.

[133] Ibid.

than those in other magazines – including *Stereo Review* and *Stereophile* – because they included more detail about the context surrounding a particular reviewer's findings about a product. In so doing, he reiterated his claim to the universality of the magazine's findings vis-à-vis equipment under review:

> ...the context of their use is a key element in determining the worth of any measurement. This magazine, for instance, believes in stating the "context" in which its listening sessions take place because we believe that anyone who cares to can, by duplicating our procedures, hear exactly what we hear. We think that describing what we hear – using our listening procedures – is no more a subjective process than our saying that the sun rose this morning. Observations aren't subjective simply because they are perceived through the senses.

"Subjectivity," he wrote, "is the ascribing of meaning to observations."[134]

Pearson made no direct mention of Lofft in his editorial, instead letting his readers speak for him. Under the heading "*Stereo Review* vs. The High End," the same issue contained several letters from readers angered by Lofft's depiction of the community. "Alan Lofft's article in the October *Stereo Review* sent me hurtling to my library for relief," wrote a reader from Columbia, Missouri. "[His article] was so bad, so obviously malicious and consciously distorting of the facts that a strong antidote was required. I turned to Lewis Mumford."[135] The reader referred to Mumford's *The Myth of the Machine, Vol. II* (or *The Pentagon of Power*), and cited Mumford's argument that "the greatest mistake of our technically trained elite has been 'the trading of the totality of human experience for that minute portion that can be observed in a limited time span and interpreted in terms of mass and motion.'" By appealing to so-called objectivity, the reader continued, these "elites" utilized a "powerful controlling device" to "set the content and limit of

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[134] Ibid.

[135] Val Germann, Letter to the editor, *The Absolute Sound* 7, no. 28 (December 1982): 12-13, on 12.

debate," which he felt *Stereo Review*, in collusion with mass manufacturers, was attempting to do:

> The world of the mass merchandiser requires order. It requires the somnolent rigor of a Julian Hirsch review, not the more complicated summation of autonomous reactions of trained listeners. These mass merchandisers are reaffirming, through articles like Lofft's, their claim to their share of technocratic superiority. The rise and, let's face it, acclaim that *TAS* and other "underground" publications have received are threats to that claim. If the majority of the listeners in the US began to make economic decisions based on *TAS* methods, then individual human judgments would become the basis of industrial survival. This, my friends, is just too "disorderly" for almost any corporate entity.[136]

Another reader referenced science explicitly in his argument against Lofft and, by extension, *Stereo Review*:

> It is well known to mathematicians (of which I am one) that the relationship between the physical structure of an object and its acoustic properties is very complex; in fact, it is generally complex beyond the scope of current computational technique. The idea that a small number of measurements suffice to characterize the sound produced by a piece of audio equipment is scientifically naïve.[137]

Elsewhere in this same letter, the reader noted Lofft's argument that subtle differences between audio system components under review could not be recalled with sufficient detail to justify the reviewing process by the underground journals. "For hundreds of years," he wrote, "violinists (and other instrumental musicians) have pursued, in purchasing instruments, acoustic properties at least as subtle as those discussed in high-end audio."

> According to Mr. Lofft, these properties must be too subtle to be even remembered for more than a few moments. And yet all violinists agree that they exist, and agree without benefit of scientific measurements on which violins have the best properties (only minor variations of taste mar this unanimity). The amounts of money involved often dwarf the cost of even "high-end" components. But no one thinks of this as "tweak"iness or "obsession."[138]

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[136] Ibid., 13.

[137] Robert E. Greene, Letter to the editor, *The Absolute Sound* 7, no. 28 (December 1982): 13-14, on 13. Greene went on to write equipment reviews and other articles for *The Absolute Sound.*

[138] Ibid.

The Numbers Game

Until 1983, discussions of double-blind versus observational listening in *Stereophile*, *The Absolute Sound*, and *Stereo Review* were largely academic, as none of the magazines had conducted their own such tests. But that year, with the help of David Clark, *Stereo Review* published the results of a double-blind listening test of one of the most controversial parts of the audio system: loudspeaker cables. Questions about the audibility of speaker and interconnect cables had become one of the main points of disagreement between the observational and double-blind listeners. Observational listeners such as Holt believed that the audibility of cables was a "good bet" among a variety of other "possibilities" and "improbables" in the audiophile community.[139] The staff of *Stereo Review* was significantly more skeptical. "Some serious audiophiles strongly believe that the seemingly innocuous wires used to connect stereo amplifiers to loudspeakers actually have a considerable effect on a system's overall sound quality," wrote *Stereo Review's* Laurence Greenhill.

> Unsatisfied with the performance of 16 gauge heavy-duty lamp cord or "zip" cord ("gauge" is a measure of thickness; the lower the number, the thicker the wire), these purists install exotic, expensive, and physically imposing cables instead. A 30 foot run of special audio cable may cost anywhere from $55 (for a pair of Monster Cables) to more than $300 (for Levinson wire). After purchase, these thick and massive wires are terminated with special lugs or pressure fitting banana plugs ($25 per pair), coated with a contact cleaner (Cramoline), and installed with loving care.[140]

Greenhill noted that the stated position of *Stereo Review* on specialty cables was that cables heavier than 16 gauge with special connectors amounted to "electronic overkill" for most home

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[139] J. Gordon Holt, "Good Bets, Possibilities, and Improbables," *Stereophile* **6**, no. 2 (1983): 3-6, on 4.

[140] Laurence Greenhill, "Speaker Cables: Can You Hear the Difference?" *Stereo Review* **48**, no. 8 (August 1983): 46-51, on 46. Greenhill, a research psychiatrist, went on to do equipment reviews for *Stereophile*. The Monster cables would have cost $115, the Levinson cable $625, and the banana plugs $52 in 2007 dollars,

audio systems, and that whatever audible differences might be present should be measurable.[141] But he described his and Clark's approach to the process of conducting the tests as open-minded. Measurements conducted by Julian Hirsch of the inductance, resistance, and capacitance of audiophile cables versus standard 16-guage "zip cord" appeared "too small to explain the apparently huge audible differences that are sometimes reported," so an ABX test was arranged with an all-male panel of 11 listeners using 16-gauge lamp cord (~$18 for 30 feet; $37 in 2007 dollars), 24-gauge loudspeaker cable available from most hi-fi and electronics stores (~$1.80 for 30 feet; $3.75 in 2007 dollars), and two 30-foot lengths of Monster Cable speaker cables ($55 per pair; $115 in 2007 dollars).[142]

Panelists were asked to fill out "an elaborate, eight-page questionnaire" to determine their backgrounds in audio and attitudes about the audibility of cables, as well as specific responses to the open, or "sighted," listening test. In the open listening tests, where the panelists knew which cables were in the system at any given point, Greenhill noted that some described "deeper bass, more impact, more ambience, and a fuller, lusher sound with greater transparency" from the Monster cables, and a "congealed and homogenized" sound from the 16-gauge cables. The 24-gauge cables exhibited "a drop in level and rolloffs in frequency response at both ends of the audio spectrum," resulting in a "clipped and compressed" sound.[143] In the double-blind tests

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[141] Ibid.

[142] Ibid. The tests, Greenhill stated, were searching for two "levels of significance": "statistical significance" meant that listeners had to correctly identify differences 55% of the time; "psychoacoustic significance" meant these correct identifications must occur 75% of the time – a number Greenhill described as "generally accepted" in the audio field. Ibid., 50. High-end components were used for the rest of the system, including a power amplifier from New Zealand-based manufacturer Perreaux, speakers from British firms Spendor and KEF, and Mark Levinson pre- and power amplifiers – equipment that was generally not reviewed by the magazine.

[143] Ibid., 48.

using the ABX comparator, the results were quite different. Greenhill observed that listeners picked out the 24-gauge cable with a "high degree of statistical significance" in blind tests with noise signals where gain levels had not been matched (due to the thinner cable's increased resistance, a greater amount of the signal was lost on its way to the loudspeakers than with the thicker cables, making the thinner cables easier to distinguish by panelists). Comparisons between the Monster cable and 16-gauge zip cord with noise signals also showed statistical significance, with panelists favoring the Monster cables. But the statistical significance disappeared when a musical signal rather than a noise signal was used to compare the two cables, and psychoacoustic significance was not found in any of the tests with musical signals. "So what do our 50 hours of testing, scoring, comparing, and listening to speaker cables amount to?" Greenhill asked in the concluding paragraph.

> Only that 16 gauge lamp cord and Monster Cable are indistinguishable from each other with music and seem to be superior to the 24 gauge wire commonly sold or given away as "speaker cable." Remember, however, that it was a *measurable* characteristic – higher resistance per foot – that made 24 gauge sound different from the other cables. If the cable runs were only 6 instead of 30 feet, the overall cable resistances would have been lower and our tests would probably have found no audible differences between the three cables. This project was unable to validate the sonic benefits claimed for exotic speaker cables over common 16 gauge zip cord. We can only conclude, therefore, that there is little advantage besides pride of ownership in using these thick, expensive wires.[144]

Reader responses to the speaker cable test were mixed. In the October 1983 issue, one reader complained that the use of A/B switching resulted in the masking of subtle differences, and accused *Stereo Review* of being "a constant wall in the way of progress, since almost all meaningful improvements in music reproduction have come from the 'freak' companies that your publication tries so hard to discredit."[145] In the same issue the magazine also published a letter

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[144] Ibid., 51, emphasis in original.

[145] Jack Shafton, "Speaker Cables," Letters, *Stereo Review* **48**, no. 10 (October 1983): 8-9, on 8.

from the president of Monster Cable, Noel Lee, expressing his dismay at both the methods and findings of the test. "I was amazed and disappointed at the results of your speaker cable evaluation," he wrote, "since the conclusions drawn run counter to all of the careful market research conducted by our firm, Monster Cable, in the last several years."

> Your writer's conclusion that "... there is little advantage besides pride of ownership in using the slick, expensive wires" was not the conclusion of the nearly 3000 Monster Cable purchasers who participated in a warranty/response card survey in 1981-1982. Among those responding, 56% indicated "an overall significant improvement," 42% attested to a "noticeable improvement," and only 2% wrote back that they heard no difference in system performance... We have a loyal, committed base of dealers worldwide and tens of thousands of satisfied customers who have purchased our products over the years... That's why we are very disturbed at *Stereo Review*'s implication that our products' success has been the result of a carefully engineered marketing coup and little more.

"We invite any of your readers to visit one of our dealers to conduct his or her own independent evaluation," he concluded. "Under the proper conditions, I'd be willing to bet 10 pounds of Monster Cable that they'll hear definite improvements in sound quality." *Stereo Review*'s editorial reply to Lee's letter asked, "Do those 'proper conditions' you mentioned include blindfolds?"[146]

During this period, following Larry Archibald's purchase of *Stereophile* from J. Gordon Holt in 1982, *Stereophile*'s circulation had increased dramatically from 3200 subscribers when Archibald took over to 15,000 by the end of 1983.[147] Debates over the merits and drawbacks of double-blind testing began to appear more frequently in *Stereophile* in the following years. Referring to Holt's earlier review of the ABX Comparator, reader C. J. Huss wrote to the magazine in 1985 wondering why *Stereophile* did not appear to use it or some other method of

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[146] Noel Lee, "Speaker Cables," Letters, *Stereo Review* **48**, no. 10 (October 1983): 8-9.

[147] By 1989 the circulation rate was nearly 50,000, and over 68,000 by 1991. The early increase in subscriptions was due, in part, to Archibald's use of direct marketing techniques following his purchase of the magazine in 1982. Atkinson, "40 Years of Stereophile."

double-blind testing for reviews.[148] "We never purchased an ABX comparator for several reasons," Holt replied.

> First, we have never felt the need for it. Second, we are finding that, regardless of "controls," an A/B test doesn't reveal small differences between components as well as does prolonged listening. (Yes, one can listen for prolonged periods to A, B, or X, but when one can obtain the same results without a comparator, who needs it? We find enough consistency in the independently prepared reports of our various reviewers to pretty much rule out "prejudices" or self-deception.)[149]

Archibald also chimed in, expressing concern that ABX testing might actually be masking audible differences between components, and commenting that he hoped Laurence Greenhill and the Boston Audio Society's E. Brad Meyer, each of whom were in the midst of conducting ABX tests on audio components, would offer their perspectives. Two issues later, Meyer replied, calling Holt's assertions that ABX testing was unnecessary at the magazine "a bit disingenuous." Meyer observed that his own experiences with ABX testing had demonstrated that differences that seemed clearly audible between components when the devices under test were known became much more difficult to discern when blind conditions were imposed. "But subtler characteristics may be harder to identify with the Comparator," he conceded, "especially given the habitual rapid switching that the device seems to encourage."[150] Although the ABX Comparator allowed for longer listening sessions, many listeners lacked the patience to use it in this manner, and making rapid changes could induce anxiety in the listener that would reduce the accuracy of the test. "These or other mechanisms may, at any time, give a false negative result in a test for audibility," he wrote.

> I can never disprove the existence of sonic characteristics that for some reason don't show up in a double-blind test. But some differences, including many that seem quite

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[148] C. J. Huss, "ABX and CD," Letters, *Stereophile* **8**, no. 5 (September 1985): 16-17, on 16.

[149] Ibid., 17.

[150] E. Brad Meyer, "A-B Testing," *Stereophile* **8**, no. 7 (December 1985): 11-12, 16, on 11.

> subtle, do show up in such trials. The distinction between the two kinds of characteristics is a useful one: I think those that do show up in double-blinds are more important, and more worth spending money on, than those that don't. Many people disagree; that's what keeps high-end audio alive.[151]

The following year, University of Manitoba psychology professor Les Leventhal sent an article to *Stereophile* based on a talk he delivered at the 1985 AES convention entitled "How Conventional Statistical Analyses Can Prevent Finding Audible Differences In Listening Tests." Responding to C. J. Huss's letter about the lack of ABX testing at the magazine, Leventhal stated that "I do not know whether these 'subtle differences' [claimed by observational listeners] are real or imaginary. But I do know that many listening tests using the ABX comparator, including many published tests... are conducted and analyzed in such a way that subtle differences actually heard by the listener will likely go unidentified by the experimenter when the data is analyzed."[152] Referring to another of Greenhill and Clark's double-blind tests published in the April 1985 issue of *Audio* magazine, Leventhal argued that the statistical "level of significance" Greenhill and Clark used to analyze their data created a serious problem in their experimental design. In particular, Leventhal focused on the problems of what statisticians call Type 1 and Type 2 errors. A Type 1 error is, in essence, reporting that something is true when it is in fact false, and a Type 2 error is just the opposite. Take, for example, a smoke alarm. If the alarm goes off and there is no smoke, this would be a Type 1 error. If there is smoke and the alarm fails to sound, this is a Type 2 error. By increasing the sensitivity of the alarm, the chance of the alarm not sounding when smoke is present is reduced, but the chance of it going off when nothing is present is increased. Decreasing the sensitivity has the opposite effect. With scientific

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[151] Ibid., 12.

[152] Les Leventhal, "The Highs and Lows of Double-Blind Testing," *Stereophile* **9**, no. 2 (March 1986): 22-26, on 22.

experiments, as with fire alarms, researchers make trade-offs between increasing the risk of either Type 1 or Type 2 errors by adjusting the sensitivity of their experimental apparatus.

In the case of double-blind testing of audio equipment, a Type 1 error "consisted of mistakenly concluding that inaudible differences are audible," while a Type 2 error was "concluding that audible differences were inaudible" (the fear expressed by the *Stereophile* staff).[153] The significance level selected by Greenhill and Clark, Leventhal argued, was not suitable given the small number of trials conducted for each of their listening tests.[154] By reducing the risk of Type 1 errors in their experiments, Clark and Greenhill were effectively increasing the risk of Type 2 errors, undermining Clark's claim of "high resolution" in double-blind ABX tests. The "unavoidable conclusion" from his analysis, Leventhal suggested, was that, "if one intends to employ the .05 significance level to determine whether differences are audible, then conducting a small-trial listening test in order to find true subtle differences between components will result in an unacceptably high risk of overlooking those differences."[155]

But Leventhal's article was not an unfettered victory for observational listeners. He criticized Holt's contention, in his response to Huss's letter, that consistency in reports on equipment from different reviewers eliminated the need for double-blind testing. "Research methodologists know that prejudice and self-deception are not so easily ruled out by employing independent reviewers," he wrote.

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[153] Ibid., 22.

[154] The number of trials – or, in statistics parlance, the N – in the *Audio* article Leventhal cited was 16.

[155] Ibid., 24.

> The reason is that, while reviewers may listen to and report on equipment without consulting or communicating with each other, there may nevertheless be commonalities among them which lead them to make similar errors. For example, independent reviewers may have similar expectations (e.g., they may expect tube products to sound less bright) or similar preferences (e.g., they may like, or think they like, tube equipment). Similarity of reviews from "independent" reviewers is consistent not only with Mr. Holt's interpretation that the reviews reveal the truth about components, but with another interpretation: the reviewers are all mistaken, the similarity having been produced by, say, similar expectations... The point is that there are many commonalities among people in general and underground equipment reviewers in particular, some known and probably some *unknown*, that may produce similar errors in seemingly independent reviews. At best, an editor can take steps to eliminate or counteract the effects of only the *known* commonalities. However, the strength of double-blind (or single blind) method is that it eliminates the effects of not only known but unknown commonalities as well.[156]

Two issues later, *Stereophile* published a lively back-and-forth between Clark and Leventhal addressing Leventhal's previous article, giving it a three-ring introduction: "Ladies and gentlemen! Step right up! See the Academic take on the might of the Engineering Establishment and jump through hoops of *real fire*! See the Engineering Establishment use 'real science' to support its entrenched position!" Clark was not so amused. "Les Leventhal's critique of the statistical analysis commonly used in blind subjective testing is misleading, erroneous, and borders on the incompetent," he began, accusing Leventhal of misunderstanding both the purposes and benefits of double-blind testing.

> He says we may erroneously conclude that no difference is audible in a particular test. He is mistaken. We never make that error (he calls it "Type 2 error"), because we never formally conclude that any difference is inaudible. We may make some informal statements of our opinions or we may issue a challenge to others to prove that they can hear the difference, but this is a far cry from making Leventhal's "Type 2 error."... Let's suppose we altered our statistical criteria, as Leventhal suggests, so that it would be possible to conclude – with some certainty – the difference was not heard in the test. What might we accomplish and what is the price we have to pay? We might prove that these listeners in this room didn't hear a certain difference using somebody's "reference" equipment. Who cares? Some other groups may well be able to hear this difference. The price we pay is lost statistical power to prove what we really want to know: what it is we can hear.[157]

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[156] Ibid., 26, emphasis in original

[157] David Clark, Les Leventhal and John Atkinson, "The Double-Blind and the Not-So-Blind," *Stereophile* **9**, no. 5 (August 1986): 84-93, on 84-85, emphasis in original.

In addition, Clark suggested that a greater number of trials and/or listeners "may work for psychology experiments, running laboratory rats through a maze back at the university," but was unsuitable for subjective listening tests where the goal was to prevent listeners from "becom[ing] jaded or emotionally drained" by the test procedures.[158]

Leventhal began his response to Clark by observing that Clark and others conducting double-blind listening tests had been "subjected to a great deal of vitriolic criticism, in my opinion undeservedly," and remarked that his goal was "improving already good work" that he had commented on in his previous piece.[159] Still, he found himself somewhat at a loss as to what precisely Clark was objecting to since his argument was based upon "uncontroversial statistics, demonstrated mathematically [that] can be found in any good textbook in elementary statistics," and stated that Clark's objections revealed a "misunderstanding of elementary statistics or research methodology."[160] Leventhal further observed that, in spite of Clark's phrasing, he did not invent the concept of Type 1 and Type 2 errors – they were, as he put it, as fundamental to statistics as Ohm's Law was to engineering.[161] In closing, he suggested that he would be "greatly displeased" by anyone singling out David Clark, or double-blind testing, for criticism within the "Great Debate," stating that "I was able to mount a precise and mathematically derivable criticism of their statistical techniques only because they had first taken pains to search out mathematically rigorous and methodologically repeatable methodological techniques. I believe

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[158] Ibid., 85.

[159] Ibid., 85, 87.

[160] Ibid., 87.

[161] Ibid., 92.

this to be a great improvement over what came before."[162]

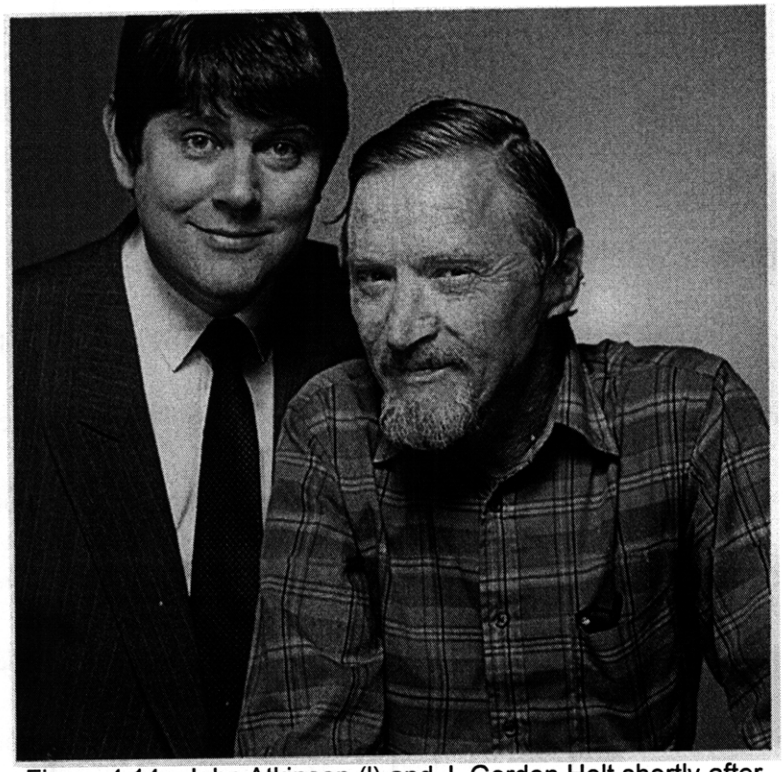

Figure 4.14 - John Atkinson (l) and J. Gordon Holt shortly after Atkinson joined *Stereophile* (from *Stereophile* **20**, no. 1, 1997, pg. 79). Used with permission.

The final contribution to the article came from *Stereophile*'s Managing Editor, John Atkinson. Atkinson had recently joined the magazine at the invitation of Holt and Archibald, leaving his previous editorial position at the British audio magazine, *Hi-Fi News and Record Review*.[163] Although his new position had been announced only four months earlier, Atkinson's take on the controversy between Clark and Leventhal was consistent with *Stereophile*'s previous statements vis-à-vis double-blind testing and the "objectivist" contingent of the home audio community who utilized it. "As I see it," he wrote, "the real crux of the matter is that so much of the so-called 'objective' test work carried out in the field of hi-fi reproduction, at least as far as the testing of actual products is concerned, produces no results."

> The people organizing the tests do not want to admit that their time has been wasted, and so do not want to admit that the results are meaningless. In addition, the listening conditions in such tests, as indicated by Mr. Clark, are far removed from the manner in which people usually enjoy reproduced music. When two products which so obviously differ when listened to on a casual basis – "casual" in the sense that the listener has no bias towards hearing or not hearing a difference – cannot be distinguished in a test, then

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[162] Ibid.

[163] Atkinson's new position was announced in the April 1986 issue of *Stereophile*.

> I would suggest that, much as it upsets Mr. Clark, the only conclusion to draw is that the test is flawed. The beauty of Mr. Leventhal's paper is that it suggests reasons as to why this should be the case. And frankly, I find it incomprehensible that Mr. Clark holds up what is possibly the main reason for producing no results, the unnatural listening conditions, as an excuse for not increasing the statistical power of his tests.

"In my opinion," he concluded, "too many of the so-called 'objective' testers retreat behind an academic smokescreen to disguise the fact that all that can be concluded from their double-blind tests is that under the limited circumstances, no difference could be heard."[164]

"A commanding lead"

Despite Leventhal's critique of Clark's experimental and statistical methodology, Clark continued assisting *Stereo Review* with several additional double-blind tests that cut to the core of high-end audio claims regarding audible differences among various home audio components, including CD players and power amplifiers. In 1986, *Stereo Review* conducted double-blind listening tests of six CD players, from the $1,400 Meridian MCD Pro to the $400 Emerson CD-150 ($2650 and $760 in 2007 dollars, respectively). With Clark's assistance and using the ABX Comparator, a panel of 11 listeners from Clark's audio club participated.[165] The test was conducted during a period when CD playback was still highly controversial in the high-end audio world (as we shall see in Chapter 6), and to some extent the magazine sought to test whether claims from observational listeners had any validity. Clark and article author Ian Masters found results quite similar to those of Greenhill and Clark's loudspeaker cable tests: while some

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[164] Ibid., 93.

[165] The experimental design was essentially the same as the test conducted for *Audio* magazine that had been criticized by Leventhal. This test took place before Leventhal's March 1986 article in *Stereophile*, but after his original paper with the AES (presented in October 1985). It is unclear whether Clark was aware of Leventhal's critique prior to his organizing the CD player test, although as a high-profile member of the AES, it is unlikely that he had heard nothing about it. Ian Masters, "Do All CD Players Sound the Same? Listening tests conducted by David L. Clark provide surprising answers," *Stereo Review* **51**, no. 1 (January 1986): 50-57.

differences were noted using noise signals, musical signals tended to produce random results among the panelists. Masters presented the final results as somewhat inconclusive: "The apparent 'personalities' under certain circumstances of [some players] do suggest that all compact disc players are not created equal," he wrote. "These differences may, of course, simply result from their slight differences in frequency response, but that's enough to confirm the view of the 'CD players sound different' faction."

> At the same time, the listening tests confirmed that whatever the inherent differences, they are very small indeed. Even with pure test signals, it seems very unlikely that the differences could be heard except in a direct A/B comparison, and even then only in a comparison as carefully controlled as these tests were. With music, the numbers indicate that the scores were not significant, and it is difficult to imagine a real-life situation in which audible differences could reliably be detected or in which one player would be consistently preferred to another for its sound alone.

"In the end, the main conclusion seems to be that audible differences do exist, but they don't matter unless you think they matter," he said in closing. "Perhaps that will make everyone happy."[166]

The following year, Masters and Clark conducted a double-blind test with power amplifiers using the ABX Comparator.[167] They selected a group of amplifiers representing a wide range of price points, from a $220 Pioneer receiver to a $12,000 Futterman OTL monoblock amplifiers from New York Audio Labs ($400 and $22,000 in 2007 dollars, respectively). They also chose listeners they identified as "believers" and "skeptics" with regard

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[166] Ibid., 56.

[167] Ian Masters, "Do All Amplifiers Sound the Same? David L. Clark attempts to find an answer to one of hi-fi's most hotly debated questions," *Stereo Review* **52**, no. 1 (January 1987): 78-84. Interestingly, for each of *Stereo Review*'s tests, the associated equipment, including preamplifiers, loudspeakers, source components and cables were universally considered "high-end." This particular test used an Audio Research SP-11 hybrid tube/ transistor preamplifier, a Meridian MCD Pro CD player, and Magnepan MG-IIIa planar magnetic loudspeakers – equipment that did not appear in the pages of *Stereo Review* in any other instance, either in advertisements or product reviews. It is possible that such equipment was selected to satisfy/placate the "believers" among the listening panel.

to whether audible differences between power amplifiers existed. The panel was larger than previous panels, with 25 total listeners participating. This time, the results appeared to be more definitive: none of the listeners, believers or skeptics, scored above the significance level for being able to reliably hear differences between the amplifiers. Regardless, Masters noted that "this is just the beginning – few scientists would place a great deal of weight on the results of a single experiment, however extensive, and particularly not an early one."

> The testing techniques must, and will, be refined, and the larger body of data will be collected as more such tests are performed in the years to come. Readers, and the audio industry, will no doubt be free with their comments and advice about these procedures and findings, and *Stereo Review* welcomes that.
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> But for now, the evidence would seem to suggest that distinctive amplifier sounds, if they exist at all, are so minute that they form a poor basis for choosing one amplifier over another. Certainly there are still differences between amps, but we are unlikely to hear them.[168]

The amplifier test caused greater controversy among both *Stereo Review*'s readers and in the high-end audio press than had the CD player or loudspeaker cable tests. Although the magazines' Letters section tended to span only a few pages (unlike either *Stereophile* or *The Absolute Sound*, where the Letters sections were often 20 pages long or more), *Stereo Review*'s editors took the somewhat unusual step of printing responses to the amplifier tests across two separate issues. In the March 1987 issue, one reader criticized *Stereo Review*'s attitude towards subjective testing, arguing that "blind testing can never invalidate the results of the subjective listening tests" because it was "empirically impossible to measure or know what a person hears."[169] Another melodramatically stated that the amplifier listening test article would "take its

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[168] Ibid., 84.

[169] Richard Locasso, "Amplifier Listening Tests," *Stereo Review* **52**, no. 3 (March 1987): 10.

place amongst the works of Oppenheimer, Newton, and Galileo" for its scientific brilliance.[170] Another was more sarcastic: "You're right, all amplifiers sound the same. According to you, so do all CD players, cables, etc. Armed with this new information, I no longer need to read your magazine. After all, any old product will do! Please cancel my subscription and refund the balance."[171]

Despite Pearson's stated detachment from the observational versus double-blind listening debate, the *Stereo Review* tests and the attention they garnered in the audio world did make some appearances in the pages of the *The Absolute Sound.* In 1988, *The Absolute Sound* published a letter from a reader in response to Pearson's "appallingly narrow-minded and illogical arguments against... double-blind testing." The reader noted that, in a private exchange with Pearson, Pearson had stated that double-blind tests "fly in the face of millions of man hours of listening experience," and that knowing that differences between components exist makes going through with A/B tests a "waste of time." "But are the tests valid?" the reader asked. "If not, can they be modified to make them valid? If they can, why not design one to indulge those of us who are skeptical about differences in equipment? Why not embarrass *Stereo Review* with a successfully executed test?"[172] "I am, quite frankly, a little weary with the entire prove-it-exists school when the evidence the differences exist is axiomatic," Pearson replied,

> but not necessarily susceptible to the tests the would be "scientists" devise. Realities do not cease to exist simply because they elude our attempts at quantifying them... I am not a quantifier, nor has this magazine ever subscribed to the efforts to quantify. What we do try to do is identify things that need to be quantified. But we view our position as no less

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[170] Kerry White, "Amplifier Listening Tests," *Stereo Review* **52**, no. 3 (March 1987): 10.

[171] Jim Van Amberg, "Amplifier Listening Tests," *Stereo Review* **52**, no. 3 (March 1987): 10.

[172] Jim Treasure and Harry Pearson, "A/B Testing and the Questing Spirit," *The Absolute Sound* **12**, no. 51 (Winter 1988): 8-11, on 8.

> and no more mystical than your own. Simply as another approach to the data of reality.[173]

Stereo Review continued with further double-blind tests, including with CD players, and a test designed to show whether certain types of distortion were as audible and significant as observational listeners and many audio engineers claimed they were.[174] But the power amplifier tests left a lasting mark. In the November 1988 issue, *The Absolute Sound's* music writer, Michael Fremer, described his experiences at the June 1988 Consumer Electronics Show wherein he confronted David Clark, telling him, "anyone who can't hear differences between amplifiers shouldn't be reviewing hi-fi equipment," and volunteering to participate in a double-blind amplifier test with the "guarantee" that he would be able to identify audible differences.[175] Clark took him up on his offer and arranged a test to take place at the AES convention in November of that year, which pitted two esoteric power amplifiers against an inexpensive "audio workhorse."[176] Fremer acted as host while volunteers from the AES administered the tests. The test results were deemed statistically insignificant – save Fremer's test, where, as promised, he scored five out of five correct answers. At the panel discussion where the results were

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[173] Ibid., 10, 11.

[174] Ian Masters, "The Audibility of Distortion," *Stereo Review*, **54**, no. 1 (January 1989): 72-78.

[175] Michael Fremer, "*The Absolute Sound* at AES: 1: the Double-blind Amplifier Tests, November 1988," *The Absolute Sound* **14**, no. 61 (September/October 1989): 36-42, on 36.

[176] The esoteric amplifiers were a tube-driven model from VTL and a solid-state model from Threshold. Fremer described a conflict between Clark and VTL's David Manley, which made Clark sound somewhat duplicitous. Clark had explained that, the night before the tests, he would analyze the amplifiers with his test equipment and set the gain levels correctly via discrete resisters on a wafer board that would be attached to each amplifier's outputs. But Manley apparently found that Clark had included more than resistors on the boards: "Clark had inserted a resistance/capacitance equalizer network in the Crown amplifier's input circuitry to beef up its high-frequency performance, and he also added a resistor in its output circuit to lessen the load presented by the [loudspeaker]. Furthermore, he over-attenuated the VTL, making it obviously lower in volume compared to the other amps – at least to my ears and to those of Manley and the *TAS* staffer Michael Gray." Fremer, "*The Absolute Sound* at AES," 38.

announced, Floyd Toole criticized the "underground" magazines for "not really advancing the state-of-the-art," but also noted that he had spoken privately with both Holt and Pearson, and each had expressed a desire to do more testing, but were limited by budget constraints.[177] Overall, Fremer portrayed the panel and subsequent discussion with the audience as lively and respectful.

Others were unsatisfied with the state of the "Great Debate" at the beginning of the 1990s. At the 8th International Conference of the AES in May of 1990, Stanley Lipshitz offered his interpretation of what had and had not changed since his and Vanderkooy's presentation a decade earlier. "A lot of water has passed under the bridge in the intervening years," he wrote, "but our hopes of a decade ago, that the validity of the [double-blind] method would be generally accepted by the audio press and adopted wherever feasible, have not been realized."[178] He suspected the observational listening-oriented press of cynically perpetuating the debate in order to boost both their egos and magazine sales. The ongoing arguments, he wrote, were detrimental to the advancement of audio reproduction "There are enough important audible degradations still present in the audio chain that it is a waste of effort to go chasing after possibly illusory new ones." It was further an "abrogation of responsibility on the part of a large segment of the audio reviewing community" to place the responsibility for verifying fantastical claims on the audio consumer, particularly given the sums of money involved.[179] "In conclusion," he wrote,

> I would like to comment briefly on a frequently heard but nonsensical request which the "subjectivists" make of us "objectivists", namely that we undertake tests to substantiate

[177] Ibid., 41.

[178] Stanley Lipshtiz, "The Great Debate – Some Reflections 10 Years Later," (paper presented at the 8th International Audio Engineering Society conference, Washington DC, United States, May 3-6 1990), 121-123, on 121.

[179] Ibid., 122.

> their claims for the audibility of a certain effect. How can you expect someone who professes not to be able to hear something to demonstrate its audibility? The onus clearly falls on those who claim that they can hear the difference to be willing to subject their claims to the harsh reality of a blind test. Only by so doing can the validity of some of these assertions be either proven or refuted, and in the process can the field of audio engineering truly be advanced.[180]

At the same meeting, AES member and reviewer Tom Nousaine offered a summary of 22 double-blind amplifier tests that had been performed by a variety of groups over the previous 14 years in an effort to demonstrate who was "winning" the "Great Debate." While he stated that most of the tests used "good scientific controls," the double-blind side of the "Great Debate" appeared to have "a commanding lead."[181] He was most critical of tests performed by observational listening-oriented journals, including *Stereophile* and *Hi-Fi News and Record Review*, both of which had conducted their own double-blind tests with results that seemed to confirm the validity of observational listening. "A few tentative generalizations can be made" about the current state of the debate between observational and double-blind listeners, he stated.

> First, the switched ABX test appeared to have the most resolving power of the methods employed. More significant results were recorded using this technique although that may be because more malfunctioning amplifiers were used. The fact that significance was obtained with relative regularity suggests that, at a minimum, the ABX technique can resolve differences when they exist. Second, the existence of a cadre of sensitive "golden ears" has not appeared. There are suggestions of this from time to time in the press but no data supports this claim and no study has turned them up. If they exist, they simply have not revealed themselves in any provable manner... in summary, there has been no evidence to support the conclusion that factors other than linear response and output capability contribute to the sound of well-designed power amplifiers. Many factors can contribute to the subjective enjoyment of a given amplifier [but] sound quality differences are not among them.[182]

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[180] Ibid., 123.

[181] Tom Nousaine, "The Great Debate: Is Anyone Winning?" (paper presented at the 8th International Audio Engineering Society convention, Washington DC, United States, May 3-6 1990), 117-120, on 117.

[182] Ibid., 119, 120.

"Audio McCarthyism"

Meanwhile, as members of the AES, including Floyd Toole, continued their own studies using double-blind methods to demonstrate when differences were and were not audible in a variety of audio components, in 1989 *Stereophile* began to include a variety of bench-test measurements with its subjective equipment reports. To that end, the magazine hired a new Technical Editor, Robert Harley, to run their testing laboratory and report his findings with each equipment review. Harley came to the job having taught audio engineering in California and spent several years working in the CD mastering industry. He became one of the most passionate advocates of observational listening.

In the August 1989 issue of *Stereophile*, John Atkinson announced that the magazine would begin including measurements with their subjective reviews of equipment. Despite his advocacy of observational listening, Atkinson stated that measurements would aid the magazine in three ways: revealing problematic equipment before it was sent to any of the reviewers, building a "database" of measurements that could aid the process of making correlations between those measurements and what reviewers heard, and "ensur[ing] that there isn't some simple reason for a component to sound the way it does."[183] Harley was entrusted with performing

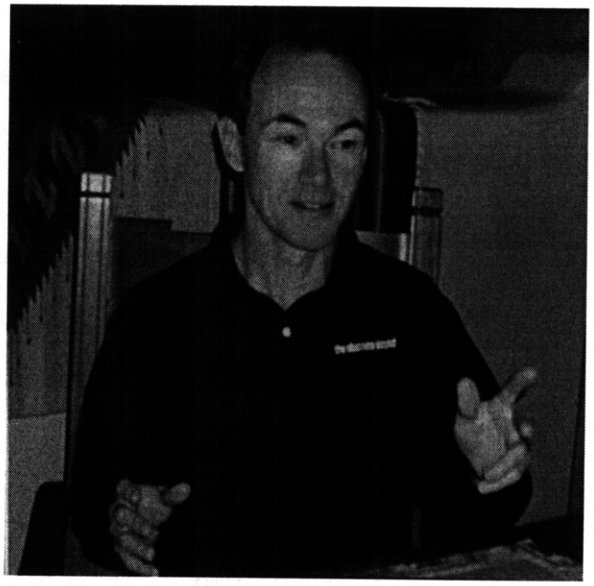

Figure 4.15 - Robert Harley in 2006 (from *The Absolute Sound* no. 162, pg. 106).

[183] John Atkinson, "Must we test? Yes we must!" *Stereophile* **12**, no. 8 (August 1989): 5-13, on 11.

the measurements, and also served as an equipment reviewer. In an editorial in the following issue, Harley reiterated the importance of Atkinson's previous statements regarding the correlation between measurements and reviewers' subjective observations, and offered his perspective on the value of measurements that echoed comments from Harry Pearson years earlier:

> It can be argued that "objective" measurements are, in reality, subjective. One must make a subjective decision as to which "objective" measurements are important. For example, the decision to measure and include in every review the amplifier's [total harmonic distortion] specification implies that the reviewer thinks THD is an important performance criterion. This belief is certainly subjective.[184]

Over the course of the next two years, Harley became increasingly critical of the "engineering establishment" and their reliance on double-blind testing not only because of his belief, shared by the *Stereophile* staff, that subtle differences between components were masked by such tests, but also because the purpose of high-end audio systems – the enjoyment of music – was incompatible with this approach. Having attended the same AES conference that produced Lipshitz's updated reflections on the "Great Debate" and Nousaine's claims of a "commanding lead" by the double-blind listeners, Harley found the general attitude among the AES leadership towards audiophiles unfair and harsh. "During the [AES] conference, there was a blatant and widespread antagonism toward the audiophile," he wrote in a July 1990 editorial in *Stereophile*.

> In fact, the mere mention of the word "audiophile" (usually in a derisive tone of voice) brought contemptuous laughter from the audience. The general belief among the AES appears to be that audio engineering is sufficiently advanced that virtually no sonic differences exist between competently designed and manufactured products. Furthermore, it is believed that any phenomenon that can be heard can be measured with existing instruments. If a sonic difference cannot be measured, it doesn't exist. Those who hear differences (audiophiles) but cannot prove their existence rationally are grouped with believers in astrology and a flat earth.

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[184] Robert Harley, "A Matter of Measurements," *Stereophile* **12**, no. 9 (September 1989): 5-7, on 4.

"More important, however," he went on, "is the AES's exclusion of the listening experience from the study of audio. If all differences can be measured, why listen?"[185] Here Harley made a significant distinction between listening for the sake of making quality assessments, and the "listening experience," which, to him, had more to do with the connection between music and listener on an emotional level. "Unlike other endeavors," he argued,

> where the result of science is more obvious (the measurement of a bridges' strength, for example), audio reproduction is different in that the goal of good audio engineering – the satisfying communication of the musical experience – is an intensely personal event that defies analysis by scientific method... the musical experience is not scientifically defensible because it defies measurement. It contains no matter, has no energy, and cannot be measured by any "objective" instruments. Therefore, it has no physical reality and exists only in people's minds. Furthermore, listening is antithetically opposed to a cornerstone of the scientific method: objectivity. The scientist must be detached from the event, a passive observer, so as not to become a variable in the experiments. He shouldn't care what the results are. In addition, a phenomenon under study must be quantifiable and repeatable under different conditions, with different subjects, different scientists, but with the same measurement techniques.[186]

Other experiences at the 91st AES convention held the following year sparked significantly more anger and frustration. A panel had been organized around the explicit question of whether there was any "scientific proof" that expensive speaker cables sounded better than cheap cables, and the not entirely implicit question of whether vendors of expensive cables were engaged in consumer fraud. To the latter end, the panel organizer, Dan Dugan, had included on the panel a representative from the New York Department of Consumer Affairs, a move that led Harley to argue that despite Dugan's stated interest in speaker cables, "the meeting's real and unstated purpose was to attack audiophiles and critical listeners in general."[187] In keeping with the critique of testing methods that had animated the "Great Debate" for years,

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[185] Robert Harley, "Deeper Meanings," *Stereophile* **13**, no. 7 (July 1990): 5-15, on 7.

[186] Ibid., 5, 9.

[187] Robert Harley, "Audio McCarthyism: Robert Harley reports from the 1991 Audio Engineering Society Convention's loudspeaker cable workshop," *Stereophile* **15**, no. 1 (January 1992): 6-21, on 6.

Harley described an ABX loudspeaker cable test that Dugan had set-up using a "hastily thrown together" audio system in a room "far too large for the amplifier's and loudspeakers' loudness capabilities." The loudspeakers, a floorstanding design, had been set-up on four foot high tables, and most of the audience members were seated in front of either of the two speakers rather than between them. He added that the panelists' lapel microphones also picked up the sound from the loudspeakers and rebroadcast it throughout the large room over the PA system, creating a delayed and "colored" version of the original signal that confused and irritated audience members.[188]

But it was Dugan's inclusion of the Department of Consumer Affairs representative on the panel that was most offensive to Harley. The representative, Wilfredo Lopez, offered the final comments on the panel, suggesting that, although he did not understand most of the terminology and technical descriptions of the previous panelists, loudspeaker cables were the type of consumer product at risk for misrepresentation in advertising by retailers, and claims of misrepresentation could result in prosecution and fines. In this way, Harley portrayed the "Great Debate" as having moved from a subjective-and-objective issue to a legal one, where the threat of prosecution might work where statistics and scientific arguments had thus far failed. Harley accused Dugan of engaging in McCarthyist tactics by using the loudspeaker cable panel as a disguise for a broader attack on the high-end audio industry and community as a whole. "A fundamental characteristic of McCarthyism is the 'false conformity' created by fear of persecution," he wrote.

> What greater false conformity is there than the retailer who is forced to tell his customers – under penalty of law – that all loudspeaker cables and interconnects sound the same, even though he knows it isn't true? Threatening retailers with financial penalties and forcing them to sign the Department of Consumer Affairs "assurance of discontinuance"

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[188] Ibid., 7, 9.

> smacks of the Spanish Inquisition in which heretics were tortured into recanting their beliefs.[189]

If Dugan and others at the AES truly wanted to understand the importance of observational listening and subjectivity in audio, Harley suggested they should read Robert Pirsig's *Zen and the Art of Motorcycle Maintenance*, Michael Polanyi's *Personal Knowledge*, Jacob Bronowski's *Science and Human Values*, and Thomas Kuhn's *The Structure of Scientific Revolutions.*[190]

It was at this same convention that Harley issued his most detailed critique in a presentation entitled, "The Role of Critical Listening in Evaluating Audio Equipment Quality." He sought to counter several of what he identified as typical "objectivist" complains about observational listeners, particularly that observational assessments of audio equipment are insufficiently rigorous. "Much observational listening as practiced by magazine reviewers is conducted under carefully controlled conditions," he suggested, "more controlled, in fact, than the conditions present during many other stages of the music recording and reproduction processes."

> Levels between components are matched within 0.1 dB or less. Linear differences, such as whether the product is polarity inverting or not, are accounted for. Listening sessions are conducted daily for weeks or months before the review is written. A wide range of familiar source material is used over long periods of time in over a variety of equipment, precluding the possibility of describing a particular characteristic to a component that is actually a characteristic of the recording... All of us became reviewers because of our lifelong dedications to music and music reproduction technology. We take our responsibility to readers – and to audio truth – seriously; our attitude is the antithesis of caprice or whim.[191]

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[189] Ibid., 21.

[190] Ibid., 19fn.

[191] Robert Harley, "The Role of Critical Listening in Evaluating Audio Equipment Quality," (paper presented at the 91st AES Convention, New York, October 1991); reprinted in Harley, *The Complete Guide to High-End Audio*, 2004, 551-575, on 553.

The "Great Debate" was, he argued, at its core "symptomatic of the uncertainty of science's capacity to encompass within its domain all forms of knowledge."[192] Reiterating his critique from his earlier *Stereophile* article, he argued that science itself was not value-free, and that scientists regularly engaged in formulating hypotheses about nature based on values that could hardly be construed as "objective." The existence of ideal objectivity, which he identified as deeply rooted in Western thought, was a "false premise."[193] Instead, Harley preferred an interpretation of knowledge based upon the work of scholars such as Michael Polanyi and Mihaly Csikszentmihalyi, and the writings of Robert Pirsig. Following the small-scale systems and feedback-oriented vision of audio systems articulated by Holt, Harley argued that regardless of the subjective aspects of double-blind testing, "quantifying audio equipment performance is destined to fail because measurement excludes the listener's role in music reproduction." "Sound," he wrote, "is merely vibrating air molecules; the brain processes that vibration into music, then recognizes the music's meaning and, on occasion, finds ecstasy in that meaning. Without this processing within the listener's brain, music doesn't exist."[194]

Conclusion

Despite Harley's arguments in favor of observational listening, some observational listeners, including Holt, believed that, by the early 1990s, high-end audio was headed in the wrong direction. At the 1992 Summer Consumer Electronics Show, in a speech to a gathering of high-end audio industry leaders, Holt recalled that in hi-fi's early days, the "holy grail" of hi-fi

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[192] Ibid., 552.

[193] Ibid., 555.

[194] Ibid., 557.

was the perfect reproduction of live music. Although he and others knew this could never be accomplished, "the search for it gave us a purpose and a direction – somewhere to go and something to aim for." He observed that public relations materials given out at the CES stated that high-end audio's purpose remained the "pursuit of the live music experience," but he argued that the veracity of this claim was debatable given the current state of home audio technology. "No one today would claim seriously that our reproducing system sounds 'just like the real thing,'" he said, "and we're right. I've heard hundreds of classical concerts, a few stadium rock concerts, and a number of electric instruments playing in nightclubs and music stores, and I can attest that the vast majority of so-called high-end systems don't come close to reproducing these sounds." What was worse, however, was that within the high-end community, "we seem to have come to a tacit agreement that it's no longer necessary, or even desirable, for a home music system to sound like the real thing." In something of a contrast with Harley's position, Holt argued that "the idea that all we are trying to do is make equipment that gives the listener some sort of magical emotional response to a mystical experience called 'music' is all well and good, but it isn't what high-end is all about." Although high-end audio had become a multimillion dollar industry, it was an "empty triumph" because the original goals of reproducing sound in the home that sounded like live music had not been achieved. Holt urged those in attendance to "get back to basics" and refocus high-end audio on these goals.[195]

In the years since, whether or not high-end audio has refocused on these goals has continued as a subject of debate within the community. Although proponents of double-blind

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[195] J. Gordon Holt, "Where Did We Go Wrong? J. Gordon Holt celebrates the three decades since he founded *Stereophile* by examining how far away the goal of high fidelity still lies," *Stereophile* **15**, no. 9 (September 1992): 7-11.

listening tests have continued to advocate for their use in assessing audio equipment quality, the "Great Debate" has become far less heated than it was during the 1980s and 1990s, and double-blind testing procedures have not become the norm that researchers like Lipshitz and Vanderkooy hoped they would be. High-end audio instead underwent a variety of other challenges, most significantly from the rise of home theater during the 1990s, and the popularization of MP3s at the turn of the century. More troubling to people like Holt were the emphases, as he suggested in 1992, on personal preferences and emotional responses rather than accuracy in component design and reviewing, which at present have left him feeling as if high-end audio has completely "lost its way".[196]

But despite disagreements regarding the validity of observational listening and the purposes it should serve within the high-end audio community, the emphasis on subjectivity played an important role in some of the most significant technological changes within high-end audio. In the next two chapters, I will explore the role of observational and subjective aesthetic impressions of new audio technologies, and how the high-end audio community received, responded to, and sometimes rejected technologies that were otherwise embraced by mainstream consumers.

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[196] John Atkinson, "45 Years of *Stereophile*," *Stereophile* **30**, no. 11 (November 2007): 3.

Chapter 5:

"This preamp sounds like nothing!"

Vacuum Tubes, Transistors, and Convergence

> The radio tube is a marvelous device. Although it appears to be a fragile affair constructed of metal and glass, in reality it is a rugged instrument that makes possible the performing of operations, amazing in conception, with a precision and a certainty that is astounding. It is an exceedingly sensitive and accurate instrument – the product of coordinated efforts of engineers and craftsmen. Its construction requires materials from every corner of the earth. Its use is world-wide. Its future possibilities, even in the light of present day accomplishments, are but dimly foreseen, for each development opens new fields of design and application.
>
> – *The RCA Radiotron Manual*, 1929.[1]

> Now, when you speak about technology... technology has not improved. If you're talking about the nature of the technology, in other words, has solid-state brought improvements over tubes? The answer is simply no. Simply, absolutely not. [My 1964 Fisher] tube receiver that put out about 30 W per channel RMS, that, if you listen to it today, sounds a heck of a lot better than anything that you can find... that was solid-state, that was in the $2000-$3000 price range. So, technology makes things faster, quicker, cheaper... it's very rare that technology advances performance quality.
>
> – Paul, a shop owner, 2007.[2]

When engineers at the Radio Corporation of America wrote the introduction for the *Radiotron Manual* in 1929, vacuum tubes could be found in virtually every electronic device – commercial, domestic, or military. As signal amplifiers, vacuum tubes helped enable the spread of telephone networks. As transmitters and receivers of radio signals, they made possible advancements in both civilian and military wireless communication. As converters of alternating current to direct current, they acted as a bridge between electricity distribution and its application in a variety of different electric tools and products. The authors of the *Radiotron Manual* clearly believed the vacuum tube capable of almost any task in the world of electronics, although they

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[1] Radio Corporation of America, *The RCA Radiotron Manual* (Harrison: RCA Radiotron Inc, 1929), 1.

[2] Interview, 05/31/07.

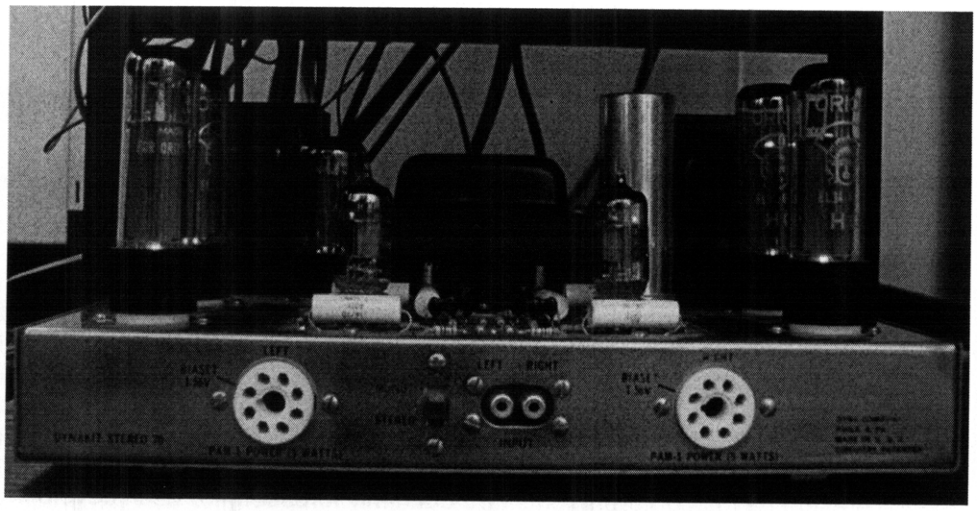

Figure 5.1 - A Dynaco Stereo 70 vacuum tube power amplifier.

could not have envisioned the complexity of the vacuum tube's journey through the technology changes of the 20th century, or that this device's "future possibilities" would be governed in large part by its aesthetic qualities and abilities as an amplifier for music reproduction.

In my more melodramatic moments, I like to imagine the story of the vacuum tube as akin to a Hollywood biopic, such as the story of Johnny Cash in "Walk the Line" or Ray Charles in "Ray." Biopics often begin with a young hero displaying talents incongruous with his modest beginnings, being shepherded through maturity by a variety of mentors, reaching unprecedented peaks of public adulation and, after a series of dramatic tribulations, ultimately reemerging with a revitalized, if somewhat attenuated, popularity. In the case of the vacuum tube, of course, the drug and alcohol abuse that typifies these stories is absent, but the equally typical "redemption through love" aspect is an important part of the tube's story. As with the aforementioned Man in Black, the vacuum tube's fall from grace in the 1960s, following the commercialization of the solid-state transistor, was not career-ending. It was instead part of a broader technological shift that the tube endured thanks to enthusiastic user communities whose devotion was marked by aesthetic rather than economic, nostalgic, or even technical considerations. Although inefficient,

failure-prone, and, as one person put it to me, "dangerous to both children and pets," vacuum tubes, like these venerable recording artists, endure because people love what they can do with music. That love, and its ability to influence technological development and innovation, is the subject of this chapter.

In previous chapters, I have shown how the high-end audio community's relationships with the technologies of home music reproduction speak to a variety of themes within the history and sociology of technology. The efforts at small-scale system building, role of users in technological innovation, and the influences of aesthetic considerations and technological enthusiasm are especially relevant to the story of the vacuum tube in this community. In Chapter 1, I established a model for small-scale system building derived from the concept of "feedback" articulated by scholars such as Norbert Wiener.[3] In this model, high-end audio enthusiasts, as a particular type of user, engage in system building efforts with the aim of maximizing the aesthetic and emotional rewards of high-fidelity music playback in the home where the user and their aesthetic preferences are as much a part of the system as any electronic component. I also showed how, in the history and sociology of technology, scholars have demonstrated user influences in the development of technologies from the Model T to the refrigerator to the electronic synthesizer, and many scholars from outside these fields have further shown how users

[3] See Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge, MIT Press: 1948, 1961); David Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Baltimore, Johns Hopkins University Press: 2002).

contribute to, and in some senses are the primary forces behind, technological innovation in many areas.[4]

In her edited volume, *Biographies of Scientific Objects*, historian of science Lorraine Daston asks how some things, such as the "interior[s] of animal bodies" and "shapes of crystals" become what she describes as "scientific objects," while others, like "dust wreaths on windy days" do not.[5] Daston finds that in the 16th century, natural philosophers engaged in attempts to explain "preternatural" phenomena – things which were simultaneously "extraordinary" and "natural," that could be observed but not often explained – but by the 18th century many of these efforts had been dismissed as "oddities" and "anomalies" by the scientific establishment that had itself emerged during this period.[6] In particular, Daston questions the "ontological, epistemological, methodological, functional, symbolical, and/or aesthetic features [that] qualify or disqualify" different objects and phenomena from consideration as scientific objects.[7] Daston argues that the discarding of preternatural phenomena from the scope of worthwhile scientific investigation did not occur because these phenomena ceased to exist, but because they failed to

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[4] See John Kasson, *Civilizing the Machine: Technology and Republican Values in America, 1776-1900*, (New York: Penguin Books, 1976); Joseph Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950*, (New York: Oxford University Press, 1983); Thomas Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970*, (New York: Viking Press, 1989); Trevor Pinch and Ronald Kline, "Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States," *Technology and Culture* **37** (1996): 763-795; Ruth Schwartz Cowan, "The 'Industrial Revolution' in the Home: Household Technology and Social Change in the 20th Century," *Technology and Culture* **17**, 1976, 1-23; Robert Post, *High Performance: The Culture and Technology of Drag Racing, 1950-2000*, (Baltimore: Johns Hopkins University Press, 2001); Trevor Pinch and Frank Trocco, *Analog Days: The Invention and Impact of the Moog Synthesizer*, (Cambridge: Harvard University Press, 2002); Eric von Hippel, *The Sources of Innovation* (New York: Oxford University Press, 1988); Eric von Hippel, "Economics of Product Development by Users: The Impact of 'Sticky' Local Information," *Management Science* **44**, no. 5 (1998), 629-644; David Lucsko, *Manufacturing Muscle: The Hot Rod Industry and the American Fascination with Speed, 1915-1984*, (Ph.D. Thesis, MIT, 2005).

[5] Lorraine Daston, "Preternatural Philosophy," in Lorraine Daston, ed., *Biographies of Scientific Objects* (Chicago: University of Chicago Press, 2000): 15-41, on 15.

[6] Ibid., 18-19.

[7] Ibid., 15.

fit within the emergent norms of scientific practice during the period of her study – norms that did not leave space for the "marvels," "wonder," and "enthusiasm" associated with preternatural philosophy. We may ask similar questions about the vacuum tube as a technological object: what qualified or disqualified it from being considered for use in home audio systems? What did it symbolize to users? What functional and aesthetic properties made vacuum tubes an attractive choice to high-end audio enthusiasts *after* they had been largely supplanted by solid-state transistors in most consumer electronics? As the "epistemology of fidelity" changed from the 1960s through the 1980s, how did impressions of the vacuum tube change within and outside of this community, and why? What kind of an object is a vacuum tube to this community?

In this chapter, I will show how high-end audio enthusiasts effectively re-appropriated an object that otherwise appeared destined to disappear from the technological landscape, describing their motivations for doing so using the language of observational listening, and the particular aesthetic sensibilities of this community described in previous chapters. The story of the vacuum tube in the high-end audio community is representative of this community's process of system building with specific aesthetic aims for home music reproduction. But it further represents a story of innovation that challenges notions of economic and technological determinism. Although the high-end audio community is small compared with the larger consumer electronics marketplace, and not all audiophiles prefer the sound of tube-driven equipment, the ongoing use of vacuum tubes in this community suggests that boundaries between what counts as "advanced" or "cutting-edge" technology, and what counts as

"outmoded" or "antiquated" technology, are more fluid than they appear on the surface.[8] To borrow from Sherry Turkle, I will present the vacuum tube as a particular kind of "evocative object," with aesthetic properties that are visual as well as sonic, and whose functional behavior inspires a kind of organic interpretation by some audiophiles that establishes another set of technical and non-technical boundaries that the tube crosses.[9] Viewed through the glass envelope of a vacuum tube, technological innovation becomes as much about redefining these boundaries, and the meaning of fidelity, as it is about manipulating the technology itself. Given its long history and dramatic ups and downs over the course of the 20th century, the vacuum tube offers us a valuable "object to think with" about innovation, aesthetics, and enthusiasm in shaping the path of a technological artifact.

I begin with a brief overview of the development of the triode vacuum tube, focusing on its role in the spread of early radio and, in the post-war period, in home audio and early hi-fi systems. I will then discuss the transistor and its commercialization, which wrought significant changes in the landscape of hi-fi technologies, as it did in many other areas. While extensive detail about both tube and transistor development are beyond the scope of this dissertation, the technical differences between them, and how these relate to differences in the sounds they produce, merit some description.[10] Therefore, this chapter will also include brief technical

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[8] One business owner estimated the revenues of the entire high-end audio industry at around $1 billion annually – the same amount Apple Inc. recorded in net profits during the first quarter of 2007. Anon., "Apple Reports First Quarter Results," (available from http://www.apple.com/pr/library/2007/01/17results.html), accessed 01/16/09.

[9] Sherry Turkle, "Introduction: The Things That Matter," in Sherry Turkle, ed., *Evocative Objects: Things We Think With* (Cambridge: MIT Press, 2007): 3-10.

[10] Excellent resources on the development of vacuum tubes and early radio include Hugh Aitken, *The Continuous Wave: Technology and American Radio, 1900-1932* (Princeton: Princeton University Press, 1985) and Sungook Hong, *Wireless: From Marconi's Black-Box to the Audion* (Cambridge: MIT Press, 2001); for transistor development, see Michael Riordan and Lillian Hoddeson, *Crystal Fire: The Invention of the Transistor and the Birth of the Information Age* (New York: Norton, 1997).

discussions of some of the behaviors of vacuum tubes and transistors relevant to their uses in sound reproduction, and how these and other non-technical but subjectively audible differences were received by the audiophile community.

Next, I will show how, in the early 1970s after transistors had become the dominant devices in hi-fi equipment, tubes were revitalized in what audiophiles describe as a "tube renaissance," led by the Audio Research Corporation.[11] But by mid-decade, several companies developing solid-state equipment had begun to garner accolades from the burgeoning high-end audio community, and some engineers also began experimenting with "hybrid" designs that used both tubes and transistors. These designs expanded the range of available equipment and enabled further mixing and matching of components, a staple of audiophile system building practices. As engineers designing high-end audio equipment with both solid-state and tube devices confronted the advantages and disadvantages of each artifact, they helped to bring about what many audiophiles have described as a "convergence" of tube and transistor sound by the mid-1980s.

High-end audiophiles were not the only, or even the largest, community interested in the sound of tube-driven equipment. Electric guitar players and designers of guitar amplifiers have contributed a great deal to the tube's continued existence.[12] But in the area of home music reproduction, it was the high-end audio community that demonstrated an interest in tube technology after the transistor became the dominant choice for most manufacturers, and helped

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[11] During the tube renaissance of the early 1970s, a variety of other audio technologies, such as planar magnetic loudspeakers and advanced turntable set-ups, as well as efforts by small, boutique firms such as Mark Levinson Audio Systems to improve solid-state designs, were also fueling a resurgence of interest in home music reproduction among audiophiles.

[12] For a discussion of guitar players and vacuum tubes, see Trevor Pinch and David Reinecke, "Technostalgia: How Old Gear Lives on in New Music," in Karin Bijsterveld and José van Dijck, eds., *Sound Souvenirs: Audio Technologies, Memory, and Cultural Practices* (forthcoming).

to preserve the technology despite their small numbers.[13] As in previous chapters, I will rely primarily on oral history interviews with members of the high-end audio community, and high-end audio enthusiast publications. In spite of resurgent interest among some audiophiles, by the early 1970s mainstream audio publications such as *Stereo Review*, which had a much larger circulation than either *Stereophile* or *The Absolute Sound,* no longer did reviews of tube equipment.[14] Most of the examples for this chapter are therefore drawn from the pages of *Stereophile* and *The Absolute Sound*, and from the experiences of audiophiles interviewed for this dissertation.

The Triode

The birth of the vacuum tube occurred during the period Thomas Hughes has described as the "age of enthusiasm" in the United States. Characterized by "remarkably prolific inventors" such as Thomas Edison, and the creation of "massive systems for producing and using" a whole variety of technological artifacts from the automobile to the telephone, Hughes

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[13] In 1982, *Stereo Review* contributor Alan Lofft listed that magazine's circulation at 540,000, *Stereophile*'s at 3800, and *The Absolute Sound*'s at 11,000. *Stereophile*'s circulation grew dramatically following the purchase of the magazine by Larry Archibald that same year, rising to 15,000 by the end of 1983. Alan Lofft, "Sense and Nonsense in High-End Hi-Fi: A Critical Look at the World of Esoteric Audio," *Stereo Review* 10, 47 (October 1982): 62-69, on 63; John Atkinson, "40 Years of *Stereophile*: What Happened When," *Stereophile* 25, 11 (November 2002): available at http://www.stereophile.com/features/708/index.html (accessed 05/28/08). Despite their small sizes, these magazines, along with enthusiastic shop owners and users, were able to rally support for firms manufacturing tube equipment to the point that, by 1994, an estimated 200 American firms were manufacturing tube-based home audio equipment. 200 is the estimate of William Johnson – while his view was probably more reliable than most, exact numbers regarding the make-up of the high-end audio manufacturing sector in the United States – or, as the Consumer Electronics Association describes it, "specialty audio" – have never been especially reliable. One manufacturer told me that coming up with hard-and-fast numbers regarding the size of the industry has been an ongoing challenge for the CEA, but that the most recent estimates put the component audio industry at about $1B per year, and that of the 2000 manufacturers that are members of the CEA, approximately 80% have annual revenues of less than $30 M. Robert Harley, "High Definition? Audio Research founder William Z. Johnson talks with Robert Harley," *Stereophile* **17**, 8 (August 1994): 82-89, on 83; interview, 01/24/08.

[14] While Julian Hirsch did conduct a review of the Counterpoint SA-3000 hybrid preamplifier in the April 1990 issue, *Stereo Review* never reviewed any tube products from Audio Research, Conrad-Johnson, VTL, Berning, or other tube and hybrid manufacturers mentioned in this chapter. Julian Hirsch, "Counterpoint SA-3000 preamplifier," *Stereo Review* **55**, no. 4 (April 1990): 42-44.

describes the era between 1870 and 1970 when inventors, entrepreneurs, and "system builders" set about building a "second creation" in America through the socially and economically beneficial application of new technologies.[15] Hughes acknowledges that the temptation to describe this period of rapid and radical technological change in purely celebratory language belies the difficulties, failures, fighting, and unintended consequences that were also inevitably part of these processes. Perhaps more than any other technological artifact, the vacuum tube was pushed and pulled by the intensity of the conflicts that arose within this larger story of America's technological transformation. As historian Sungook Hong has argued, the history of the triode vacuum tube is a "human history – of engineers, scientists, businessmen, patent lawyers, amateurs, and their successes, their accidental discoveries, their misunderstandings, and their frustrations."[16] The invention of the triode vacuum tube represented not only a significant shift in the technologies of radio broadcasting, but also ushered in the age of "electronics," or the use of electric signals to change and control the behavior of other electric signals. The vacuum tube became, in the words of historian Hugh Aitken, "without hyperbole, one of the pivotal inventions of the twentieth century."[17]

The triode vacuum tube descended from Thomas Edison's experiments with incandescent lamps in the 1880's, and further experiments by John Ambrose Fleming, an employee of the British Marconi Company in England, in the early 20th century. In 1904, Fleming's experiments

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[15] Thomas Hughes, *American Genesis: a Century of American Innovation and Technological Enthusiasm, 1870-1970* (Chicago: University of Chicago Press, 1989), 3. In many ways this era was an extension of American philosophy and thought about technology and the role of engineering in the formation of the young republic in the 18th and 19th centuries. See also Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964); David Nye, *America as a Second Creation* (Cambridge: MIT Press, 2003); Chapter 1.

[16] Hong, *Wireless*, 155.

[17] Aitken, *The Continuous Wave*, 217.

led to the development of the first vacuum tube, which became known as the diode based on its two-element construction. Fleming's diode consisted of a filament and a metal plate inside of an evacuated glass bulb. When the filament was supplied with electrical current from a battery, causing the filament material to become glowing hot, an independent electrical current flowed from the plate when the plate was connected to the positive terminal of the battery. This phenomenon eventually came to be known as "thermionic emission," or the characteristic of certain materials to emit electrons when heated. Edison had noticed this behavior in his experiments with incandescent lamps, but came to no conclusions as to its cause (although the phenomenon was called the "Edison effect" by researchers at the time). Fleming discovered that when the plate was connected to the battery's negative terminal, the current flow from the plate ceased. Because current flowed from the plate *only* when the plate was positively charged, Fleming's diode was thus capable of converting alternating current (AC) to direct current (DC) – a phenomenon known as "rectification." While alternating current was the standard for the delivery of electricity in the United States, direct current made possible a wide array of electrical devices, such as motors, which required a continuous flow of electricity for proper operation. The ability of Fleming's diode to convert AC to DC made it indispensable to the budding electronics field.[18]

Working from Fleming's design, American inventor Lee De Forest experimented with modifications that eventually led to the invention of the triode vacuum tube in 1906. The triode, which De Forest's called the "audion" for its application to radio broadcasting and reception, was

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[18] For excellent (if somewhat complex for non-engineers) explanations of diode and triode vacuum tube behavior generally, see John Rider, *Inside the Vacuum Tube* (Peterborough: Amateur Audio Press, 1945/2002), and Departments of the Army and the Air Force, *Basic Theory and Application of Electron Tubes* (Washington DC: US Government Printing Office, 1952; reprinted by Audio Amateur Inc.).

much like Fleming's diode with an important added feature: a third electrode or "grid," as shown in Figure 5.2. When supplied with its own electrical charge, the grid could regulate the flow of electrons from the filament to the plate. De Forest discovered that the grid could be modulated by radio waves, making the triode a very sensitive detector of those waves.[19]

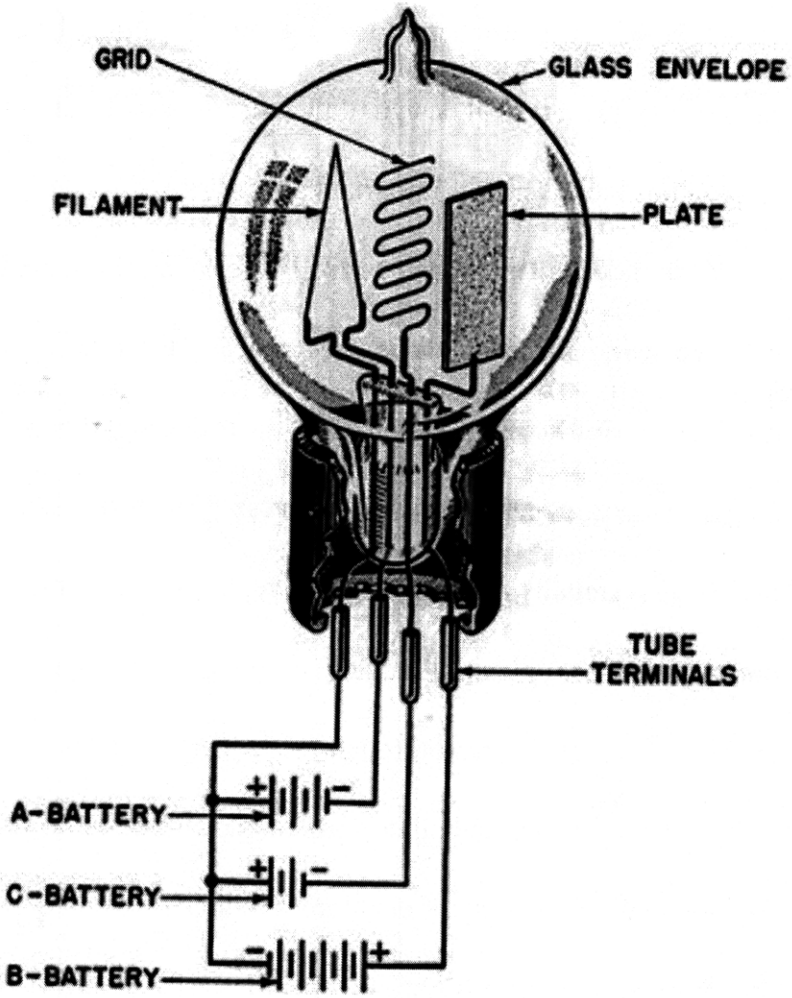

Figure 5.2 - a drawing of an early 20th-century triode vacuum tube (from the Department of the Army and the Air Force, *Basic Theory and Application of Electron Tubes,* 1952, pg.4).

But De Forest's modification of Fleming's design also had a number of other applications that came to light in the following years. Among them was the discovery, made by De Forest and a several other researchers, that the triode could also amplify electrical signals – a characteristic of particular interest to telephone companies.[20] By 1912 the triode's potential as an

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[19] De Forest's claims to the triode were the subject of multi-year patent lawsuits, and his personal and professional life was, to say the least, complicated. For an excellent retelling of these conflicts, see Aitken, *The Continuous Wave.*

[20] These researchers included Fritz Lowenstein and John Hays Hammond, who were independent inventors, although Lowenstein had been working with triodes at the Radio Telephone Company before it went out of business. Lowenstein applied for a patent on his "grid bias" for the triode vacuum tube amplifier in 1912, which AT&T later bought for $150,000. With the grid bias modification, Lowenstein created what was essentially a Class A amplifier out of the triode, although this designation was not used until later. De Forest also applied for a patent on the triode as an amplifier that same year. Aitken, *The Continuous Wave*, 226-228.

amplifier was clear, although difficulties in controlling the amplified signal, reducing distortion, and refining the physical design of the tube persisted. Efforts to control the triode's behavior in early radios led to another important discovery about its capabilities. Hugh Aitken suggests that de Forest, independent inventor Fritz Lowenstein, and a graduate student at Columbia University named Edwin Armstrong, discovered at nearly the same time that if the behavior of an overloaded triode could be controlled, the triode could be used not only as a receptor, but also as an oscillator, or generator, of radio waves.[21] The triode's capabilities as a radio frequency oscillator eventually made it a feasible replacement for much more cumbersome contemporary broadcasting technologies – namely Reginald Fessenden's spark gap generator, and helped enable radio's rapid spread throughout the United States in the 1920s and beyond.

While triodes and other types of vacuum tubes played significant roles in the development of a variety of electronics in the following decades, their use in amplifier circuits was of greatest interest to early hi-fi enthusiasts. Home hi-fis began to appear after the Second World War, and tube-powered audio equipment was manufactured by American companies such as H.H. Scott, Fisher, McIntosh and Marantz.[22] By the 1950s, vacuum tube-driven radios, preamplifiers, and power amplifiers were common fixtures in the homes of hi-fi hobbyists. Vacuum tubes continued to be critical to a variety of other electronics endeavors as well, such as

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[21] This particular discovery of the triode's capabilities led to some of the most protracted legal battles over patent claims, particularly between de Forest and Armstrong, and served as another example of de Forest clearly making a discovery, but not clearly knowing what the implications of that discovery could be. Ibid., 238-242.

[22] Many high-end audio reviewers note early experiences with equipment made by these corporations as critical in their experiences as audiophiles. Marantz and McIntosh still manufacture high-end equipment, while Fisher has turned towards a wider consumer market. H.H. Scott was purchased by the Emerson Corporation which manufactures low-priced general consumer gear under the Scott name. For historical information about H.H. Scott, including photos and descriptions of various pre- and power amplifiers, tuners and other tube-powered equipment, see http://www.hhscott.com/.

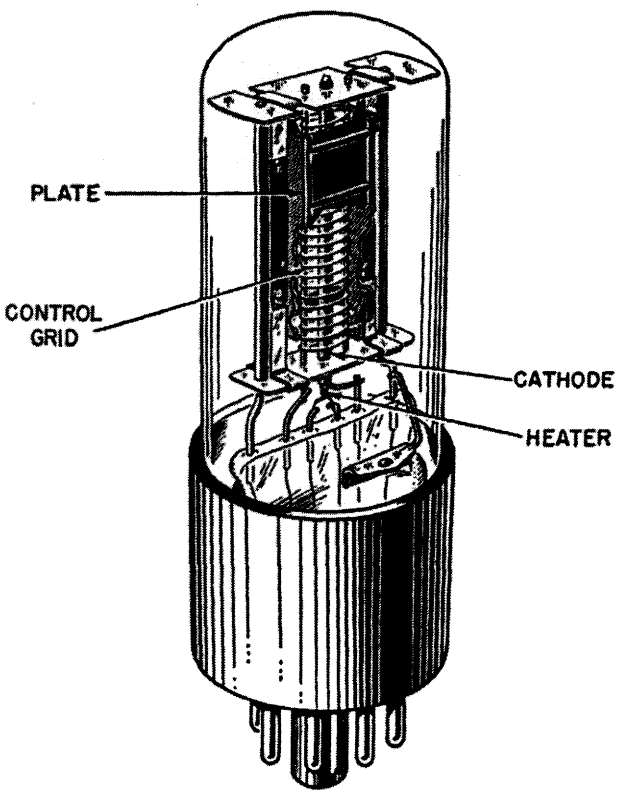

Figure 5.3 - a cut-away drawing of a modern triode vacuum tube (from the Department of the Army and the Air Force, *Basic Theory and Application of Electron Tubes*, 1952, pg. 40).

early computers.[23] But tubes also had limitations that made them frustrating to work with. Tube amplifiers operate at high voltages and low currents, while loudspeakers are high current and low voltage devices, giving amplifiers and loudspeakers different impedance characteristics (impedance referring to the overall resistance of a device to an alternating electrical signal).[24] In order to match their different impedance characteristics and maximize the power transfer between the amplifier and loudspeaker, the output of the tubes is "coupled" to the loudspeaker through a device called an output transformer. The output transformer was long considered the weakest link in most tube amplifier designs, and the part of an amplifier that had the greatest potential to negatively affect

[23] One of the most well-known applications of vacuum tubes was in the world's first electronic digital computer, ENIAC, which utilized 18,000 vacuum tubes and required a massive cooling system. Following ENIAC's completion in 1946, many subsequent computing projects utilized vacuum tubes as both relays and amplifiers, but in decreasing numbers. As computing technology advanced, tubes became less and less practical. They consumed large amounts of power, generated tremendous heat, and failed often. John von Neumann is said to have described the procedures necessary to keep ENIAC running, including tracking down and replacing failed tubes, as analogous to "fighting the Battle of the Bulge every day." Discussion of ENIAC and a photograph of the cooling vents can be found in Herman Goldstine, *The Computer from Pascal to Neumann*, Princeton: Princeton University Press, 1972 (von Neumann quote on 145).

[24] Although amplifiers operate with direct current, loudspeakers require an alternating current to create the back-and-forth piston motions of the driver cones.

the resulting sound.[25] Other issues, such as the inefficiencies of tubes and their tendency to fail, may have been irritating for hi-fi hobbyists whose audio systems only utilized a few of them per component, but could cause substantial problems for large-scale computer systems such as the SAGE Air Defense System, which in the late 1950s used 55,000 tubes in each of its computer installations.[26] For these applications, an alternative was soon available that would eventually make its way into the hi-fi world as well.

Enter the Transistor

In 1947, the invention of the first solid-state transistor helped usher in a significant shift in consumer, commercial, and military electronics. "Solid-state" was the label applied to the study of the physics of metals, insulators, and what were known as "semiconducting" materials such as germanium and silicon, in the period following the Second World War. As Michael Riordan and Lillian Hoddeson put it in their history of the transistor's development, *Crystal Fire*, the core of this new field of study had to do with the "quantum-mechanical treatment of how electrons cavort about within crystals."[27] This "cavorting" of electrons through certain crystalline substances mimicked the behavior of vacuum tube rectifiers and amplifiers, but in smaller and more efficient packages.

The device that would come to be known as the transistor (for a "resistor" that can amplify a "transferred" electrical signal) was designed by Walter Brattain, John Bardeen, and

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[25] Transistors operate with a high enough current that output transformers are unnecessary, and the absence of the output transformer was the source of early enthusiasm about solid-state audio technology.

[26] Paul Ceruzzi, *A History of Modern Computing* (Cambridge: MIT Press, 1998), 51-52.

[27] Riordan and Hoddeson, *Crystal Fire*, 68.

William Shockley at Bell Telephone Laboratories.[28] In December of 1947, Bardeen and Brattain perfected an arrangement of polystyrene, gold foil, and the semiconducting element germanium that could amplify an electrical signal to nearly 100 times its original strength.[29] Their device, known as a point-contact transistor, was smaller than a vacuum tube, but its design was awkward, fragile, and difficult to manufacture. Shockley postulated that similar effects could be achieved by arranging the semiconducting material in a sandwich-like form, creating boundaries or "junctions" to produce the same effects as Bardeen and Brattain's contact points, and devised what became known as a bipolar junction transistor. Junction transistors were smaller and easier to manufacture than point-contact transistors, and became the dominant transistor type by the 1960s.[30]

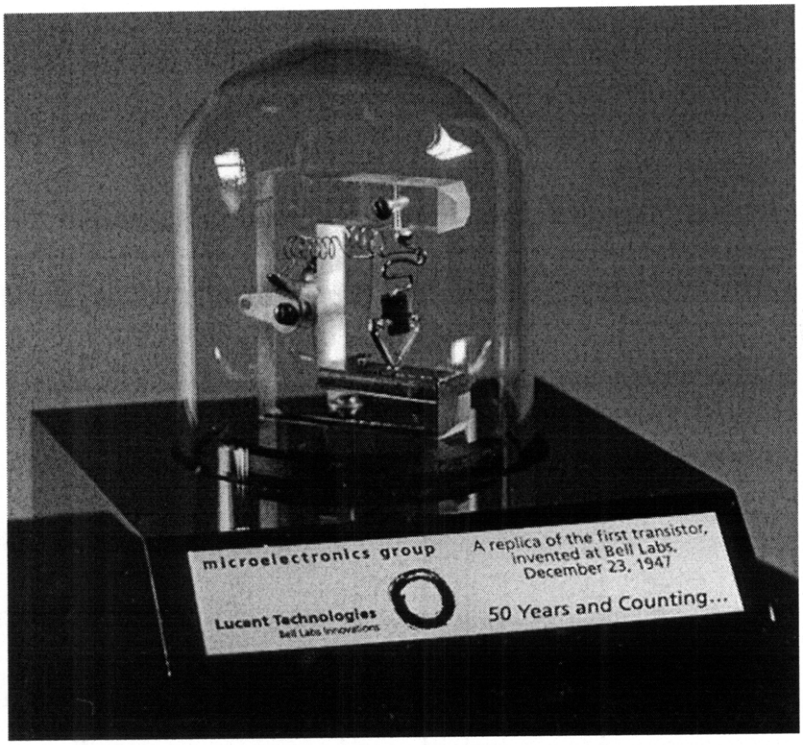

Figure 5.4 - A replica of Brattain and Bardeen's first point contact transistor (from http://en.wikipedia.org/wiki/File:Replica-of-first-transistor.jpg; accessed 05/20/09).

Although transistors could perform many of the functions of vacuum tubes, their behavior was often quite different. Some vacuum tubes in

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[28] Their efforts earned them the Nobel Prize in Physics in 1956. Ibid., 8.

[29] A cross-sectional diagram of the original device built by Bardeen and Brattain appears in Riordan and Hoddeson, *Crystal Fire*, 138.

[30] Like the vacuum tube, the transistor was also the subject of numerous patent and personal fights. Shockley in particular was a divisive character who alienated many of his colleagues, including Bardeen and Brattain. Ibid., 168-194.

computing systems were quite fast at performing the rapid on/off switching used in early logic circuits for binary calculations. However, in order to operate at the speeds necessary for rapid calculations, the tubes had to be supplied with power constantly so that when they were called upon by the computer system to perform switching operations, they could do so quickly. Transistors had no such power requirement, and were therefore able to operate more efficiently and, soon enough, with switching speeds equal to or greater than vacuum tubes.[31] Beyond military computing applications, demands of the growing commercial computer market helped push transistor development during the 1960s and 1970s. Although in 1959 IBM released a mainframe computer with transistors, known as the 7090, the design was based on their 709 mainframe where transistors were substituted for tubes. The first computer designed with transistors from the ground up came from the Digital Equipment Corporation in 1959, known as the PDP-1. Although only a modest commercial success, the PDP-1 laid the groundwork for the evolution of small computing systems, and solidified Digital's position as one of the most influential computer manufacturers in the world.[32]

Advances in transistor design eventually led to the creation of integrated circuits and microprocessors that could perform many of the functions of multiple discrete transistors in microscopic packages. The military was one of the largest consumers of this new technology during the height of the Cold War. Donald Mackenzie has observed that in 1962, every integrated circuit produced in the United States was purchased by the military, and by 1965, the military was still consuming 70% of available stocks. This early adoption had risks, however. The widespread use of silicon-based integrated circuits in the guidance systems of Minuteman II

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[31] Ibid., 202-203.

[32] Ceruzzi, *A History of Modern Computing*, 127-130.

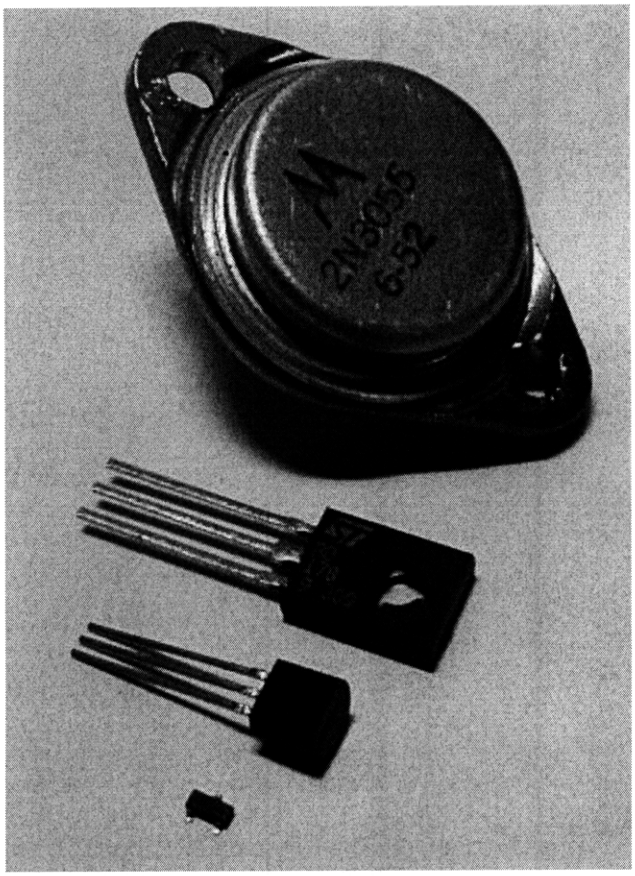

Figure 5-5 - Assorted discrete transistors (from http://en.wikipedia.org/wiki/File:Transistorer_(croped).jpg; accessed 05/20/09).

missiles backfired when the devices began failing, requiring replacement of the electronics in the entire stockpile.[33] Other risks came from developments in transistor manufacturing and decreases in unit costs. Ken Olsen, one of the founders of the Digital Equipment Corporation, recalled that one type of transistor used for the PDP-1 cost $12.50 a piece in 1959. They bought 1000 of them, and before they were built into any products, the price dropped to $8 a piece, resulting in a $4000 loss before a single PDP-1 had been sold.[34] Despite these frustrations, the importance of these developments is difficult to overstate. Paul Ceruzzi suggests that the computer market that had developed by the 1990s simply "would not have happened" without the ongoing efforts of solid-state physics researchers, and companies such as the Digital Equipment Corporation, to perfect and miniaturize transistors.[35]

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[33] Donald Mackenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge: MIT Press, 1990), 207. For further details about military uptake of transistor and semi-conductor technology during the Cold War, see Edward Jones-Imhotep, "Disciplining Technology: Electronic Reliability, Cold-War Military Culture and the Topside Ionogram," *History and Technology* **17** (2000): 125-175; Edward Jones-Imhotep, "Icons and Electronics," *Historical Studies in the Natural Sciences* **38**, no 3 (2008): 405-450.

[34] Kenneth Olsen, *Digital Equipment Corporation: The First Twenty Five Years (Address to the Newcomen Society in North America, Boston, September 21, 1982)*, (New York: Newcomen Society in North America, 1983).

[35] Ibid., 13.

Outside of the computer industry, among the first commercial applications of transistors was for small radios. The first transistor radio was the pocket-sized Regency TR1, shown in Figure 5.6, which went to market in October of 1954. Although initial production runs were small – only 1,500 by year's end – they grew to over 100,000 by the end of 1955.[36] It was during this same period that a relatively small Japanese firm called Tokyo Tsushin Kogyo (later known as Sony) began developing their own transistor-based products such as radios and tape recorders and, along with other Japanese firms, entered the hi-fi equipment market in the 1960s.[37]

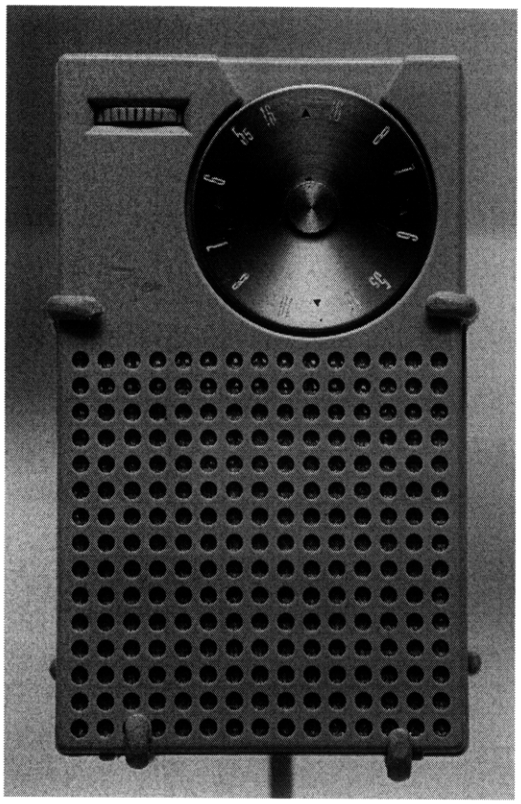

Figure 5.6 - The Regency TR-1 portable transistor radio, 1954 (from http://en.wikipedia.org/wiki/File:Regency_transistor_radio.jpg, accessed 03/16/09).

Many mainstay American hi-fi companies, such as Dynaco, continued to manufacture products with vacuum tubes well into the 1960s, but transistors had begun to take over much of the tube's territory by the middle of the decade. Solid-state audio equipment began to appear in earnest in 1965, and by 1970, vacuum tubes had all but vanished from new hi-fi products.[38]

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[36] Riordan and Hoddeson, *Crystal Fire*, 212.

[37] Ibid., 213-217.

[38] J. Gordon Holt, "Audio Research SP-11 preamplifier," *Stereophile* **9**, no. 4 (June 1986): 121-124, on 121.

Early Transistor-based Hi-Fi – Subjective Impressions

Early reactions among hi-fi enthusiasts to solid-state audio equipment were mixed, but many, particularly in the early 1960s, were hopeful. As in other applications, transistors offered a variety of potential advantages over tubes for hi-fi equipment. But the new technology was still a mystery for many hi-fi enthusiasts, whose concerns were both technical and aesthetic. Although transistor designs were just starting to appear in hi-fi equipment in the early 1960s, these concerns were already a topic of discussion in hi-fi magazines. Holt addressed some of them in the first issue of *Stereophile* in 1962.[39] "Transistors just do not behave like tubes," he wrote.

> Transistor amplifiers whose measured distortion is higher than that of the cheapest [tube] "hi-fi" amplifiers somehow manage to sound much better than they should, and the absence of an output transformer from most transistor amplifiers (the low-impedance transistors connect directly to the speaker) eliminates most of the annoyance value of marginal overload on peak passages. As a result, a transistor amplifier seems to produce far more clean power than a tube amplifier of the same rated output.[40]

But Holt also noticed differences in the sound produced by transistor-driven amplifiers compared with their tube counterparts:

> Even more significant, however, is the "transistor sound" at low output levels. Even the feeblest (a 3-watter, for instance) sound like high-powered amplifiers when operating at low levels. They are transparent, crisp, and have the same kind of bass solidity that high-power advocates have always attributed to the monster amplifier's reserve of speaker-controlling watts. So the superiority of the high-powered tube amplifier is not just a matter of reserve power. *Just what it is a matter of is still open to question*, but we may be in a better position to answer this when we get the opportunity of comparing high-powered transistor amplifiers with their betubed competitors. Tube amplifiers have fouled up the power question for years, because the low-powered ones so often suffered from shortcomings that had nothing to do with the simple fact that they were 10- or 12- or 15-watt amplifiers. Transistors may change the picture.[41]

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[39] The original title of Holt's magazine was *The Stereophile*. The "the" in the title was dropped in 1977, starting with volume 4, number 1, the 15th anniversary issue.

[40] J. Gordon Holt, "Amplifier Power: How Much is Enough?" *The Stereophile* **1**, 1, (September-October 1962): 3-5, on 5.

[41] Ibid., emphasis added.

Change the picture they did, although the changes came in a form Holt found unfortunate. A variety of American hi-fi electronics firms, including KLH, Marantz, Dynaco, Fisher, and HH Scott "acceded to the pressures of the marketplace and introduced 'solid-state' models," Holt later wrote, "whether or not these happened to sound as good as their previous tube type units."[42] Despite any lingering questions about transistor sound, Holt began hearing positive qualities in some, though not all, of the early solid-state equipment provided to *Stereophile* for review. In addition, the measured characteristics of this equipment, particularly with regard to distortion and noise, were often superior to tube designs at the time. "[The amplifier's noise] measured 47 DB down... relative to a 10 MV, 1KC input," Holt said of the KLH Model 16 power amplifier in 1966. "All of this noise was...low enough that it was barely audible through a speaker of typically low efficiency with the gain wide open and one ear right in front of the speaker."[43] But Holt's interests in the Model 16, in keeping with his observational approach, were primarily focused on its sonic qualities, particularly as they compared with tube equipment:

> Sonically, the most significant thing (to us) about the KLH 16 is that it sounds less "transistor" and more high-quality "tube" than any medium priced solid-state unit we have heard. In comparison with top grade tube equipment, it was very slightly bass heavy (for reasons which escape us) and a little brilliant, the latter quality doubtless stemming from the slightly elevated shelf in the frequency response above 1000 cps. At moderate to high listening levels, it had that quality of effortlessness and tight control that we've observed in other good transistor amplifiers, but it had less of the gritty "transistor sound" than any competitively priced unit we've heard.

"Direct, hairsplitting comparisons between the Model 16 and top-notch tube equipment showed the 16 to have a shade less transparency," he concluded, "but we have yet to find another ready-built amplifier in its price and power range that will equal it."[44]

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[42] J. Gordon Holt, "Dynaco Stereo 120 Transistor Amplifier," *The Stereophile* **2**, 1 (Summer 1966): 6-7, on 6.

[43] J. Gordon Holt, "KLH Model 16 Amplifier," *The Stereophile* **1**, 11 (September 1966): 7-8, on 8. Prior to the 1970s, measurements of frequency response were labeled with "cps" or "cycles per second" rather than the now ubiquitous Hertz or Hz. The designation "KC" refers to "kilocycles," later called kilohertz or kHz.

[44] Ibid.

Holt's enthusiasm for solid-state equipment remained somewhat subdued during this period, but Dynaco's entry into the solid-state equipment market piqued his interest. In 1966 and 1968, he reviewed Dynaco's first solid-state products: the Stereo 120 power amplifier and the PAT-4 preamplifier, respectively. "Dynaco was one of the last of the holdouts," in the commercial release of solid-state equipment, Holt observed, "preferring, according to their advertisements, to wait until they could produce a solid-state unit that was at least as good as their best tube types."[45] In Holt's reviews of these products, his impressions of the differences between solid-state and tube sound, and solid-state's perceived advantages, became more specific. "The Stereo 120 seemed able to elicit noticeably deeper, and tighter, bass from all cone type woofers than did any of the tube amplifiers," he noted, bass reproduction being an area where solid-state designs seemed, to Holt and others, to excel in general compared with tube designs.[46] "Summing up," he said,

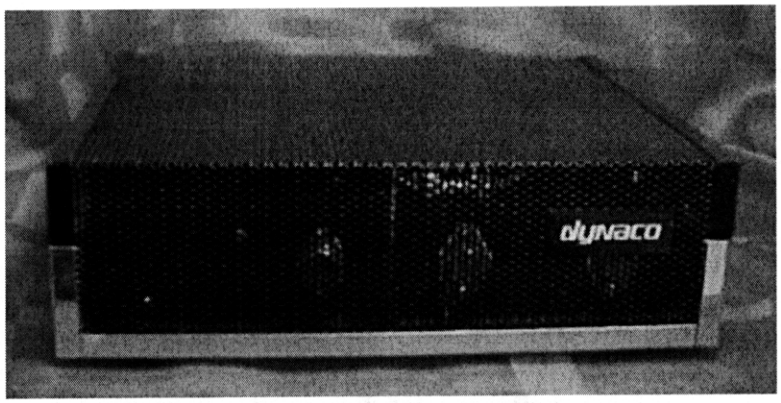

Figure 5.7 - Dynaco Stereo 120 solid-state power amplifier (from http://home.indy.net/~gregdunn/dynaco/components/ST120/index.html, accessed 01/23/09).

> we are finally forced to do an about-face on our long-held conviction that transistor amps are not for the perfectionist. Not only does this one seem to have no sound of its own, it also makes most loudspeakers sound *better* than do other amplifiers. This kind of performance, finally, justifies switching from tubes to transistors. It's a sad commentary on the industry that the justification has to come three years after the switch [by other manufacturers].[47]

[45] Holt, "Dynaco Stereo 120 Transistor Amplifier," 6.

[46] Ibid., 7.

[47] Ibid., emphasis in original.

Regarding preamplifiers, Holt had been less impressed with the available solid-state units to that point. But the Dynaco PAT-4, that company's first transistor-based preamplifier, received a very positive review. Holt described performing a "by-pass test" with the PAT-4, which involved connecting source components, such as a tape deck, directly to the power amplifier in order to demonstrate what sonic changes, if any, resulted from having the preamplifier in the signal path. "We have never yet found any preamp that did not add at least a subtle coloration – a little extra bass or a little added high-end roughness – to the sound," he said, "although the [Dynaco] PAS-3x and the Marantz 7C (not the 7T) came as close to perfection as anything we have ever tested. Now, both of these have been bettered – sonically, at least."[48] Although Holt criticized the PAT-4's performance through its phono inputs, regarding the by-pass test he declared the preamplifier to be second to none:

> With all of its tone controls and filters set to flat, and feeding any high-level input, we were simply unable to tell whether we were listening to the original "raw" signal or the output from the PAT-4. In this respect, we cannot see how any preamp, present or future, could surpass the PAT-4.[49]

His feelings, however, were not shared by everyone. Harry Pearson, an early subscriber to *Stereophile*, wrote in a letter to the magazine that the sound of the PAT-4 was "distinctly inferior" to Dynaco's less-expensive tube-driven equipment. "It seemed to me," he wrote, "that the mid-range was elevated and that the extreme highs and lows were either somewhat deficient or

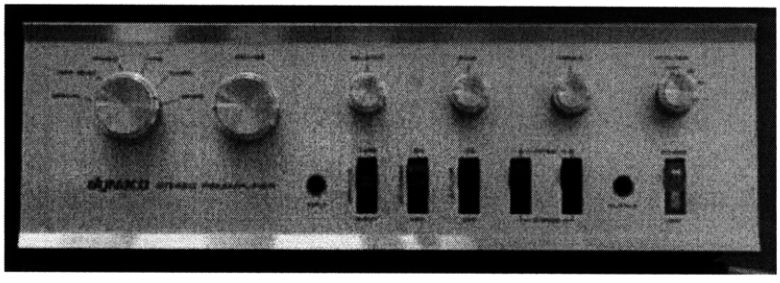

Figure 5.8 - A Dynaco PAT-4 solid-state preamplifier (from http://home.indy.net/~gregdunn/dynaco/components/PAT4/index.html, accessed 01/23/09).

[48] J. Gordon Holt, "Dyanco PAT-4 Stereo Preamp," *Stereophile*, **2**, 8 (Spring 1968): 13-19, on 15.

[49] Ibid.

simply had a different coloration. I did not like the roughness of the sound."[50] Over time and with more exposure to the sound of solid-state equipment, Holt's perspective shifted. Responding to an interview question many years later about which reviews he was most proud of, he said,

> Reviews I'm proud of? I can't think of any. But I can think of some I'm not proud of. One was the Dynaco PAT-4. It was the first solid-state preamp that I had heard, and it did all these marvelous things. It was detailed and quick and crisp, and it had this fabulous deep-type low end. I wrote the review accordingly and it appeared in Vol.2 No.6. It was several weeks later that I started hearing that it was doing other things less well than the tube stuff I had.[51]

Other audiophiles recalled similar shifts in their impressions of early transistor-based amplifiers and preamplifiers. William, a business owner, told me that Dynaco's early solid-state equipment "sounded a lot worse" than their tube equipment, "but people figured that, 'hey, this must be better, because it's new. It sounds different from the tube units because it's better.'"[52] Phillip, a reviewer, recalled his own experience with the PAT-4 after years of building and listening to Dynaco's tube-driven amplifiers and preamplifiers:

> Dynaco came out with solid-state, you know, end of the tube era, no more noise, no more distortion. It was like a panacea, this is gonna change everything. And of course I wanted to be right on top of that. So I went out and I bought a Dyna PAT platform, which was their solid-state preamp. And I built the kit, and I hooked it up, and it sucked. I mean, it sounded terrible. It was just such a big step down. And I called up Dynaco, and they said "oh, you just have to get used to it... you're used to the distortion from tubes and noise, and this is so much cleaner and clearer. You're just not used to it." So I lived with it, and it never got any better. And then I figured... I'd probably have to get rid of [my] tube [power] amp and get a solid-state amp... I guess it was the model [120], their first solid-state amp, and [I] put that in. And that made the sound one step worse and one step better. It was better in some ways, but worse in most ways. And that was my first

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[50] Harry Pearson, "Dyna, Ortofon, Sony and KLH", *Stereophile* **2**, no. 3 & 4 (Autumn/Winter 1967): 27.

[51] Steven Stone, "J. Gordon Holt – 35 Years and Just Getting Started," *Stereophile* **20**, no. 1 (January 1997): 74-88, on 85. In a follow-up review to the PAT-4 in the late 1960s, Holt acknowledged that the preamplifier had significant sonic problems that had taken some time for him to notice.

[52] Interview, 07/12/07.

> lesson in: don't believe the baloney that you read, and don't believe statistics, and don't believe specs necessarily, because even if the specs are better, they can sound worse.[53]

The experiences of audiophiles like Phillip with the new solid-state equipment, Pearson's negative reaction to the PAT-4, and Holt's later realizations about its shortcomings, set the stage for a series of significant changes within the hi-fi hobby. Solid-state equipment came to dominate the mainstream consumer electronics market in the United States, particularly with radios and hi-fi systems. For example, in 1940 there were fewer than 50 million radio receivers in the US, but by 1965 that number had surpassed 194 million, and by 1970 had grown to over 400 million.[54] Phillip described the situation this way:

> What happened to the industry is that it was homegrown in America when it was a tube-based industry. And you had McIntosh, Marantz... Pilot, Fisher, all these companies, both on the West and the East coast. The big issue is when solid-state came in, which was really kind of mid-60s, mid-to-late 60s, that really created a big problem for all the audio companies. They had to switch to solid-state, and at the same time, the Japanese were coming on strong and companies like Kenwood and Sansui and Pioneer and a few others... they came into the market building gear that was McIntosh quality. And you can still find some of those pieces at garage sales, and they're incredibly good and built to really high specs, but of course they were much cheaper than what Americans were building, and it really knocked the industry for a loop... almost put a lot of them out of

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[53] Interview, 05/29/07. The feeling that an "all transistor" system would solve some of the problems heard with transistor preamplifiers and tube power amplifiers, or vice versa, was echoed in debates about the sound of digitally recorded music in the late 1970s and early 1980s. Prior to the release of the CD, digital mastering of analog vinyl records had become a topic of debate among audiophiles, some of whom felt the poor sonic qualities of digitally mastered records would be eliminated when an "all digital" system – the compact disc – was available. See Chapter 6 for details.

[54] Barry Sherman, *Telecommunications Management: Broadcasting/Cable and the New Technologies* (New York: McGraw Hill, 1995), 83.

> business. And it basically killed off Fisher, which eventually ended up being sold to Sanyo. To a great degree it really killed off the American audio industry.[55]

As the hi-fi hobby gained popularity throughout the 1960s, some audiophiles became disenchanted with what they saw as a largely marketing- and technical specifications-driven hi-fi equipment industry that alienated users from the core of their interest in the hobby: listening to music. As David Wilson of Wilson Audio Specialties, a loudspeaker manufacturer, recalled in a 2006 address to the London Hi-Fi show, "[Hi-fi] consumer products were as much as possible... reduced to cheap content commodities, whose desirability in the customer's eyes was increasingly founded on what the marketers called 'perceived value.' The 'perceived' part of that phrase is the troubling part to me."[56] By the early 1970s, many audiophiles were similarly troubled, unsatisfied with the sound quality available from contemporary solid-state hi-fi equipment, looking and listening for a reason to stay interested in the hobby.

Tube Renaissance

> At a trade show in Washington, DC in 1970, I was displaying our [vacuum tube-based] Dual 50 [amplifier] and SP-1 and 2 [preamplifiers], and an engineer walked up to me. He was obviously very, very angry, and he said, "you've set the audio industry back 20 years!" We had a discussion about it, but I don't think he was convinced.

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[55] Interview, 05/29/07. Associations between tubes and the American audio industry, and transistors and the Japanese audio industry – and the various qualities of the sound produced by each – have been raised by other authors, particularly O'Connell, as primary reasons for the tube's resurgence. O'Connell suggests xenophobia associated with the "threat" of Japanese dominance of the consumer electronics market, and the mediocrity of sound many audiophiles feared would be the result, was a key issue. These debates arose again with the advent of the CD, which was treated by many audiophiles as a marketing ploy by Sony and other Japanese manufacturers to reassert their dominance during a period of general economic stagnation. While magazines such as *Stereophile* and *The Absolute Sound* ran editorials and commentary bashing the Japanese audio industry, most of the discussion remained focused on the sound the equipment produced. Holt was more sympathetic to Japanese efforts, particularly with early CD players, than many other reviewers. Even Pearson, whose hatred of CD sound was greater than most, acknowledged that a CD playback system by the Japanese high-end firm Accuphase was responsible for changing his mind about the medium. While arguments about xenophobia and nationalism are relevant, they don't appear significant enough to act as the sole drivers behind the resurgence of interest in vacuum tubes among American audiophiles, and are consistent with broader American attitudes towards Japan during the early 1980s, and go largely unattributed in O'Connell's article. See Joseph O'Connell, "The Fine-Tuning of a Golden Ear: High-End Audio and the Evolutionary Model of Technology," *Technology and Culture* **33**, no. 1 (January 1992): 1-37, on 27-28; see also John Dower, *War Without Mercy: Race and Power in the Pacific War* (New York: Pantheon, 1987).

[56] David Wilson, Keynote Address, London Hi-Fi Show 2006, available at http://www.wilsonaudio.com/culture/podcasts.php (accessed 08/27/08).

- William Z. Johnson, Audio Research Corporation[57]

Most high-end enthusiasts identify the 1970s as the time when the concept of "high-end" audio came into being, owing to the early efforts of J. Gordon Holt, and Harry Pearson of *The Absolute Sound*, who was the first to coin the phrase "high-end audio."[58] Holt's and Pearson's efforts to push hi-fi in a more subjective direction, with the sound of live music setting the standard for judgment of equipment quality, helped to create opportunities for a new crop of small manufacturers to enter the marketplace with tube-driven equipment that, despite measurements and specifications, provided a more aesthetically satisfying and "accurate" reproduction of music for many audiophiles.

Reflecting on this period years later, Holt suggested that "much of the blame" for the resurgence of interest in tube-powered equipment among audiophiles could be laid at the feet of a single company: the Audio Research Corporation.[59] The company's founder, William Z. Johnson, was an electrical engineer who had been building custom tube-powered amplifiers since the early 1950s. In 1970, he bought back his amplifier patents from his employer, and founded Audio Research on the principle that vacuum tubes produced superior sound quality in audio equipment than transistors.[60] Holt described the company's beginnings as "modest," with an "understated advertising campaign, and a commitment to an 'obsolete' technology that

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[57] Robert Harley, "High Definition?" 82.

[58] The conceptual side of high-end audio revolved around three main practices: observational listening and subjective analysis of audio equipment, suspicion of manufacturer's specifications, technical measurements, and marketing efforts behind mainstream consumer audio electronics, and the rejection of what was considered the overly-"tweaky" aspects of hi-fi culture that tended to emphasize measured aspects of sound over the enjoyment and emotional fulfillment of listening to music. Details about the subjective analysis and other aspects of high-end audio are discussed in Chapter 4.

[59] Holt, "Audio Research SP-11 preamplifier," 121.

[60] Ibid.

everyone 'knew' was dead (the old, overheating, mortal vacuum tube)." Suggesting that Audio Research did not generate a great deal of interest among audiophiles "until *The Absolute Sound* 'discovered' them in the mid 1970s," Johnson's efforts were nonetheless "a revelation!"

Figure 5.9 - An Audio Research SP-2C vacuum tube preamplifier (from http://www.arcdb.ws/SP2/SP2.html, accessed 01/23/09).

> The embodiment of what we now think of as "the tube sound," they were rich, warm, liquid, and silky-smooth where the solid-state competition was stark, steely, wiry, taut, and lean, with an overlay of fuzzy grunge at the top. *TAS's* enthusiasm for this kind of sound was soon echoed by *Stereophile*, and suddenly ARC started getting the recognition it should have had all along.[61]

Johnson later said he had been open to new solid-state technologies in the late 1960s and early 1970s, but was dissatisfied with their sound. "I tried transistors," Johnson told *Stereophile's* Robert Harley in a 1994 interview, "but I thought the sound that I was able to generate with various design approaches was horrendous – it was terrible. Then when FETs [field effect transistors] came along, I tried again. And while we were able to design circuits with some relatively good numbers, the sound quality still wasn't there."[62]

Stereophile obtained their first Audio Research preamplifier for review in 1971. Dubbed the SP-2C (shown in Figure 5.9), it was priced at $550 – significantly more than the solid-state Dynaco PAT-4, which in 1968 cost $130 ($2815 and $775 in 2007 dollars, respectively). Somewhat reminiscent of his early enthusiasm for the PAT-4 (but not a comment he appeared embarrassed by later) Holt stated that the SP-2C was "unquestionably the finest-sounding preamplifier we have tested to date," and that the sound was "extremely lucid and detailed, but

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[61] Ibid.

[62] Harley, "High Definition?", 83.

without a trace of the hardness or graininess that characterizes most other preamps."[63] Two years later, in a review of the updated version of the preamplifier, Holt observed that "quite simply, [this preamp] modifies the input signal less than any other preamp that is currently available... and what change it does effect... is of a kind that the ear finds much more agreeable than the typical solid-state hardness... or vacuum-tube haziness."[64]

Reflected in Holt's review, and consistent with what many audiophiles were looking for from their audio components, the advantages of Johnson's tube designs came from what they were *not* doing to the signal from a record or tape. The distortions added to music by other devices, particularly solid-state devices, became more noticeable after Audio Research's products eliminated them. But Johnson's designs further revealed undesirable aspects of other tube-based designs – distortions that Holt describes as "haziness." This freedom from the sonic problems of both early vacuum tube designs and newer transistor-based equipment represented a significant step towards what both Holt and Pearson argued was the goal of any hi-fi system: the most accurate and, by extension, emotionally powerful representation of live music possible. The desire for "neutral"-sounding equipment, and Audio Research's ability to better fulfill this desire for many audiophiles in the early 1970s, solidified the firm's reputation in the budding high-end community as a top-tier electronics producer. As Holt put it in a gushing 1975 review of the 115-pound, $2685 behemoth D-150 power amplifier, "What does this betubed monster sound like? Nothing. Simply nothing at all."[65]

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[63] J. Gordon Holt, "Audio Research SP-2C Preamp and Dual-50D Power Amp," *The Stereophile* **2** (Summer 1971): 19.

[64] J. Gordon Holt, "Audio Research SP-3 Preamp," *The Stereophile* **2** (Summer/Autumn 1973): 10-12, on 10.

[65] J. Gordon Holt, "Audio Research Dual 150 Power Amplifier," *The Stereophile* **3**, no. 11 (Winter, 1975/1976): 12-14, on 13.

But Audio Research was not the only company whose tube equipment was getting the attention of audiophiles in the early and mid-1970s. Dan, a salesman, remembered a critical experience with a device by the Japanese manufacturer Sansui, one of only a few Japanese firms to make tube-driven hi-fi equipment during this period:

> I was 23 or 22 or something like that. And this buddy of mine, we were staying in Santa Cruz, I see this thing sitting there, and I say, "what's that?" And he goes, "I don't know, it's some amplifier. I never use it." It was one of, if not the, first Sansui integrated amplifiers. They've always used the model designation of "7" in that category. This was an AU7, and it was a tube thing, okay? So he gives me this thing for nothing. I scrounge up a pair of speakers at the local shop and a turntable, and I'm back in a hi-fi, and that is when I first learned a little bit about tubes. That would be 19... 73 or something, 1974. Just this little $10 unit, and all of a sudden it was like, "wow. Gosh, there are some pretty amazing sound coming out of this thing," you know...well before the current interest in tubes.[66]

Stan, a high-end audio enthusiast, had a similar experience with some tube-driven equipment from Marantz:

> When I got out of high school, I lived for a while with a guy who was the producer of the band I was in...you know, he was in the scene. And he had friends who designed equipment, and one of them was in the audio lab at Cal Poly, in San Luis Obispo. And I remember them bringing in equipment, and him talking about the measurements and talking about standing waves set up between the top of the cone and the top of the speaker cabinet, all that kind of stuff. And my buddy had a Marantz [tube amp]. And it just sounded so much fucking better than anything his super intense, geeky, audio engineer friends were... it's like, we would listen to the same recording [through their solid-state amps], like Tchaikovsky or Rachmaninoff, and just hear every single instrument rendered, and like, whoa, that's exhausting, and that's not, frankly, what you'd hear in a concert hall. Give me the warmth and bloom of the Marantz.[67]

The language in these descriptions reveals much of what Holt and others referred to as the "tube sound," and the increasing presence of tube electronics in the high-end audio world led to a concomitant shift of the lexicon of subjective reviewing. The association between tubes and descriptors such as "warmth," "bloom," and "smoothness" suggest an organic quality that audiophiles felt they were hearing from tube-driven equipment, contrasted with the "stark," "steely," "lean," and "cold" sound of solid-state equipment. These descriptions, and experiences

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[66] Interview, 06/28/07.

[67] Interview, 10/16/07.

such as Stan's, corresponded with Holt's and others vague but no less influential assessment that tube-based electronics simply sounded more "musical" than solid-state products, and validated the efforts of Audio Research and the several other small companies who soon began to manufacture tube-driven audio equipment, including Conrad-Johnson, Berning, Precision Fidelity, Counterpoint, New York Audio Labs, and Vacuum Tube Logic. Indeed, Pearson noted in 1975 that Johnson's early designs had shown that "tube technology is far from finished."[68]

Some audiophiles were less pleased with the sonic results of the tube renaissance, and criticized tube designs that sounded overly distorted and "euphonic." Others, including several *Stereophile* reviewers, felt that the tube sound was more pleasing, more musical, and more emotionally-involving than the transistor sound. In my interviews with audiophiles, tubes were a frequent topic of discussion and reflection. "From a sonic perspective," Donald, an equipment reviewer, told me, "tubes seem to have a natural ease to them that that just sounds more like live music."

> There are certain tube designs that sound "tubey" and they're meant to sound tubey. They introduce distortions that some people find euphonic. That's not the kind of tube electronics that I like, even though some people enjoy them. I like tubes for what they don't do the signal rather than what they do do the signal. They seem to have more space and bloom, and natural harmonic texture. Even though there are a lot of technical disadvantages to tubes – the need for an output transformer, their high output impedance, their difficulty driving low-impedance loudspeakers. From a purely technical standpoint, they have a lot of drawbacks. But I think those are overweighed by what they do well.[69]

Many interviewees noted that their early exposure to high-end audio often included the realization that vacuum tubes were still in use. Tony, an equipment reviewer, told me that among the many surprises in his first experience with a high-end audio system in the 1980s was the

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[68] Harry Pearson, "Audio Research Dual 76a," *The Absolute Sound* **2**, 7 (Winter 1975/1976): 269-270, on 270.

[69] Interview, 05/04/05.

presence of tube components, which he believed had "gone the way of the dinosaurs."[70] Carl found out about tube equipment first through reading *Stereophile* in the late 1970s and early 1980s, a magazine he was otherwise suspicious of for its subjective approach to reviewing: "I was of the mindset that it was, that was all ancient and gone, and that they didn't even make stereo equipment with [tubes] anymore. And so, yeah, when I got into *Stereophile* and started reading about tubes, it was like, 'wow, I didn't even know this.'"[71] For others, the sound of tube-driven equipment was what sparked their initial interest in the hobby. When he first encountered high-end audio, Frank's experience had been more deeply rooted in car stereos. "High-end home audio for me really didn't hit home," he told me. "At first I'm thinking, 'you know, this is sort of wimpy,' after the sort of high-impact, visceral, overwhelming just... onslaught of car stereo. I wasn't getting it really until I started to mess with vacuum tubes."[72]

For Stan, in addition to sound quality, two other factors unrelated to the sound played into his decision to purchase an Audio Research tube amplifier. "It seems like a funny decision," he said,

> but one of the other things with solid-state is that, frequently it's better to leave the gear on all the time, and I find that very hard to do. I want something I can turn off, you know, just for reasons of use of electricity. You know, it shouldn't be that big a factor, but it is for me, because I can't leave a 100 W per channel thing on. I just... I don't know if I'm a cheapskate, or whether it's the global warming thing, or what. But I... I wanted something I can turn on and off. And that it was expected that you turn it on and off. In fact, you should turn it off, 'cause it's tubes.[73]

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[70] Interview, 05/22/07. The details of Tony's experience can be found in Chapter 3.

[71] Interview, 09/24/07.

[72] Interview, 06/28/07.

[73] Interview, 10/16/07. Since vacuum tubes, unlike transistors, wear out over time, most manufacturers recommend turning tube equipment off when not in use, and allowing it sufficient time to "warm up" when turned back on before listening. Manufacturers of solid-state equipment, by contrast, often suggest leaving the equipment on at all times if possible.

The second issue for him had to do with the design of the amplifier. Stan felt it was important to understand the basics of how the amplifier worked, which was more difficult for him with many of the solid-state products he investigated. "[The Audio Research amplifier] was a signal path that, if at least I didn't understand all the electronics of it, it was a signal path that I can hold in my head. It was very simple."[74] O'Connell has argued that the nostalgic appeal of tubes had to do, in part, with their reflection of a time when technology was easier to understand and, by extension, less alienating.[75] But simple signal paths are also a core aspect of the high-end audio design philosophy, and many audiophiles attribute the good sound they hear from tube equipment to the greater simplicity of their circuits. Aaron, a manufacturer's representative, argued that the characteristic distortions of tubes were more "natural" and inherently pleasing to the human ear than those of transistors:

> Tubes have natural harmonics, even harmonics. Second, fourth, sixth, and so forth. And that is part of the overtones of... if you have a guitar string that vibrates at 200 Hz, the second harmonic is 400, and that is part of the music. That's why a guitar sounds not very bright, especially if you go through tube amplification. Solid-state, especially bipolar transistors, which are different than field effect transistors, FETs, they had uneven harmonics, like third, fifth, seventh, and that is not part of the music. You have to get rid of that by having more circuits, and maybe even negative feedback... And you know, tubes are inherently linear. What goes in, comes out. Very little changes. Solid-state is not. Transistors are not. They are very un-linear, and they have to be helped to do the job.[76]

Ron, an engineer, echoed, this position. When I asked why, as a designer, he would choose to build an amplifier with tubes rather than transistors, he replied, "simplicity." "Architecturally," he told me,

> the closer two surfaces are together, the more the two surfaces play... In terms of electronics, the distance between the critical elements in a tube is on the order of tens of millimeters... in the case of semiconductor materials, the proximity is on the order of nanometers, or micrometers. So you start to get all sorts of capacitance effects, interplay, and you wind up compensating for the physical geometry of the design device –

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[74] Ibid.

[75] O'Connell, "The Fine Tuning of a Golden Ear," 20-26.

[76] Interview, 09/07/07.

> namely, small. And so they have all sorts of complex circuits they can throw in, even if it is something that is as simple as an operational amplifier, which you say, 'geez, that's one chip.' But there's a whole lot of transistors in that chip, and all of them are implementing feedback, they are doing temperature compensation, there's a laundry list of things that they have to do. And in the case of tubes, there's no temperature compensation you really need. There's no real frequency compensation that you're stuck dealing with, so it's a very simple circuit to build as long as you're not afraid of curling your hair with 800 volts.[77]

"If you step back and look at the advantages of tubes over transistors in a high-power analog amplifier," Ken, another engineer told me, "there are a number of advantages."

> One is parasitic capacitances of tubes tend to be much lower and much more linear. They're not modulated by the audio signal. Gain parameters – there's no thermal modulation in a tube either because they're already running hotter than hell, so its parameters are not going to change with the thermal envelope of the signal – I think that has a sonic effect... typical tube circuits are, you're using an output transformer, which provides some isolation at very high frequencies – RF frequencies – and has advantages in RF stability of the circuitry. It has also disadvantages, too, but if you design around them you can minimize those.[78]

But the idea that tubes were simpler to design with was not universal among engineers interviewed for this dissertation. When I asked Theodore, another engineer, about his own tube designs, he noted the difficulties related to the output transformers. "Designing with tubes is a struggle," he said. I asked if there were any other advantages to using tubes rather than transistors from an engineering standpoint, and he said no. "It's really the sound," he told me, adding, "but it's not *just* the sound. I mean, there is something very special about seeing them glow, also. It's like watching a turntable spinning around – you can't discount that aspect of it, why people like it."

Several audiophiles noted this visual element of tubes. O'Connell has argued that the characteristic glow and heat produced by vacuum tubes plays into an overall feeling among audiophiles that tubes were more "lifelike" than transistors – a feeling that inevitably influences

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[77] Interview, 04/26/07. Ron and several other engineers commented on the high voltages and dangers of burns when working with vacuum tubes. Carl also talked about "respecting" tube circuits, warning me that even brushing up against the circuit board of my Dynaco Stereo 70 amplifier could "knock the heck out of you". The possibility of contact with high voltages undermines, to some degree, O'Connell's argument that tubes were a "friendlier" technology than transistors.

[78] Interview, 04/29/05.

their impressions of their musical qualities. "Tubes are warm, they change their characteristics subtly over time, and they age both sonically and visually – their envelopes slowly darkening until they eventually die. Their nature seems less contrary to that of the muse who is entrusted to them."[79] Carl, who was in the process of designing his own solid-state and tube equipment when we talked, noted that for his tube design, he was planning to leave the tubes uncovered and exposed to allow for good ventilation, and because they looked better that way. "Part of the whole tube mystique is the light show," he said.[80] Jim, who was among the most critical of high-end audio, and disparaging of those he referred to as "fanatical" high-end audiophiles, nonetheless recognized this aspect not just of tube technology, but of analog audio technology generally:

> ...there's a delight with analog technology that is absent from solid-state technology, even if it's just those big vacuum tubes glowing. I mean, they're much prettier pieces of equipment to look at. And open reel tape machines with those great big reels going around. I loved them, from the time I was a kid, you know? And turntables and tonearms, it's such a complex system of geometry... there's the nostalgic factor to high-end analog fanaticism. And I do understand it. I love, I much prefer watching a turntable revolve and a tonearm perfectly set up, to watching this static piece of... this CD player, and the drawer goes back in and a few digital numbers, you know? And, again, you've got the vacuum tube equipment, you know, the glowing filaments versus the black box that just sits there, with maybe an LED, or maybe... I mean, older audiophiles, even with their solid-state amplifiers, like mine, that I graduated to, we still loved having big analog power output meters on them. I have an amplifier like that. Or if not an analog, at least a bar graph display showing output, you know? I still have one of those. But, there is that affection for analog technology that... I don't think a lot of [high-end audiophiles] will admit to.[81]

Tube technology also appealed to the tinkering side of the audiophile hobby. As many audiophiles told me, their early experiences with audio came from building and modifying tube-based kits from Dynaco, Heathkit, and other companies (one of Conrad-Johnson's early

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[79] O'Connell, "The Fine Tuning of a Golden Ear," 22.

[80] Interview, 09/24/07.

[81] Interview, 05/07/07.

preamplifiers also was available in kit form in the early 1980s).[82] John, a reviewer, mentioned that his first amplifier was a tube-driven design he had built himself based on the technical data available in the RCA *Radiotron Designer's Handbook.*[83] Through kit building and experimentation, audiophiles learned how to manipulate tubes and tube circuits to achieve different effects and improve the sound of their audio systems. To many, tubes seemed to possess almost magical qualities that extended beyond their technical specifications. William mentioned that when he first met his future business partner, Theodore, who had grown up in Eastern Europe, he was amazed by what Theodore was able to do with an old set of tubes William had assumed had worn out:

> Theodore and I were chatting, and I mentioned that I've got these dead tubes, and I've got to find another source. And Theodore, instead of saying, like, "yeah, you can get them through this catalog," he said, "bring them in. I'll fix them." And I said, "what do you mean?" I mean... I didn't even know what he was getting at, or implying, because, for example, put on the testers that I had, you know, your Heathkit tube tester, [and] the tubes tested for emissions as being dead.[84]

For Theodore, revitalizing tubes that appeared non-functional had been a part of his process of learning about engineering and hi-fi as a young person:

> Going back to my vacuum tube days, we knew that many tubes could be revitalized by reactivation of the cathode, if done properly. And of course, typically in the US where everything is so plentiful, you don't do it, but in [my country] where everything is scarce, you tend to find ways of making things just keep working. And this was one of the procedures a lot of people used... there is a procedure, in many cases, to make the cathode active again, and basically restore of the emissions of the tube. I mean, it's not very difficult procedure itself once you know the basic steps.[85]

William recalled his reaction to getting back his four "dead" tubes, which now tested like new: "that was... impressive to me because it demonstrated in that sense a very very fundamental

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[82] In his review of the Conrad-Johnson PV-3 preamplifier, Holt lists the price as $299 for a kit, and $399 for a fully-assembled and tested version. J. Gordon Holt, "Conrad-Johnson PV-3 Preamplifier," *Stereophile*, **5**, 10 (January 1983): 11-13.

[83] Interview, 06/27/07.

[84] Interview, 06/06/07.

[85] Ibid.

understanding of technology… this was something that was almost like an alchemist working with the older technology to make things new again."[86]

Audiophiles also tinkered with tubes in simpler ways, such as swapping in different brands of the same tube type, known colloquially as "tube rolling," which many felt could make significant sonic differences. Carl described one experience of changing tubes in his preamplifier that even a non-audiophile in his household noticed:

> I bought some new old stock [tubes], a different brand, Phillips, I think it was, a 5751, and swapped those in there. And even my wife could hear it. I asked her… I was listening, going, "okay, maybe I'm just kidding myself here," but it sounded thin and pinched, and there was… the midbass down to the bass just sounded anemic. And she came in to the living room, and I was sitting there listening to it, and I said, "hey, does this sound alright to you?" And she goes, "well, it doesn't sound very bassy to me." And I was like, "there it is," you know, cause she knows nothing about the high-end, and I'm saying, "this dang tube…" it's incredible how much difference, it didn't sound as good. So, this original… tube, the first one that was in there, it was… it tested a little bit on the weak side, but man, it sounded incredible. Just beautiful. So that's the kind of differences you can get with tubes.[87]

FETs, Class A, and Solid-State Developments

The positive responses among reviewers and other audiophiles to tube electronics during the early and mid-1970s did not prevent engineers from continuing to explore what could be done with the sound of solid-state devices. Firms producing transistor-based electronics sought to design their equipment to capture some of the sonic qualities of tube gear while capitalizing on the desirable aesthetic and technical characteristics of transistors, such as better bass response, high efficiency, and reliability. Among the companies producing solid-state equipment that garnered accolades from the high-end audio press were the Threshold Corporation, Mark Levinson Audio Systems, Krell, and Rowland Research. These firms took advantage of changes

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[86] Ibid.

[87] Interview, 09/24/07. "New old stock" refers to tubes that are often decades old, dating back to when they were still being manufactured in the United States and in Europe, but have been in storage or otherwise never used. New old stock (or NOS) tubes often sell for a great deal more than comparable new tubes, although as Carl's example illustrates, they do not always produce pleasing sonic results.

in transistor technology that had yielded, among other things, the field effect transistor, or FET. The bipolar transistors used in early solid-state equipment were inherently non-linear, producing a great deal of distortion that required complex circuitry to control and eliminate – circuitry that many audiophiles believed corrupted the music signal. FETs, on the other hand, behaved more like vacuum tubes, with more linear characteristics that meant less distortion and simpler circuits.[88] Designing circuits with FETs, sometimes in conjunction with bipolar transistors, enabled engineers to produce sound from solid-state equipment that impressed many in the high-end community, even those otherwise fond of the tube sound.

Engineers also experimented with different power amplifier circuit architectures to try and capture some of the good qualities of the tube sound, particularly by using transistors in a configuration known as "Class A." In the output stage of a power amplifier, the voltage signal that has been amplified is converted to a current signal than can drive a loudspeaker. In a Class A circuit, the entirety of the input waveform is amplified by each output device in the output stage – a method that produces a more linear, lower-distortion and, to many audiophiles, a better-sounding signal. But Class A amplifiers are inefficient, and generate a great deal of waste heat.[89] Reviews of early Class A solid-state amplifiers would often note how the heat sinks on the backs and/or sides of the amplifier would become extremely hot during operation. Regardless, Class A amplifiers, particularly when using transistors, were felt by many audiophiles to be the best at reproducing music in comparison with other circuit architectures. In a 1978 review of the Threshold 400A power amp, *The Absolute Sound* reviewer Patrick Donleycott noted that solid-

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[88] The development of reliable FETs was a key component in early integrated circuit design. One of the primary differences between early point-contact transistors and FETs was the use of silicon instead of germanium in FETs. FETs had an aluminum "gate" that acted very much like the grid of triode vacuum tubes to control the current flow. See Riordan and Hoddeson, *Crystal Fire*, 270-271.

[89] Some detail of Class A operation is covered in Chapter 2.

state designs using Class A circuits were "thought to be the design that moves transistors closest to a tube-like sound," and that, despite that magazine's general preference for tube amplification at the time, Threshold had largely succeeded in that effort with this particular amplifier.[90] Indeed, Class A solid-state designs were the first to gain a foothold in the high-end audio world for transistor-based equipment.

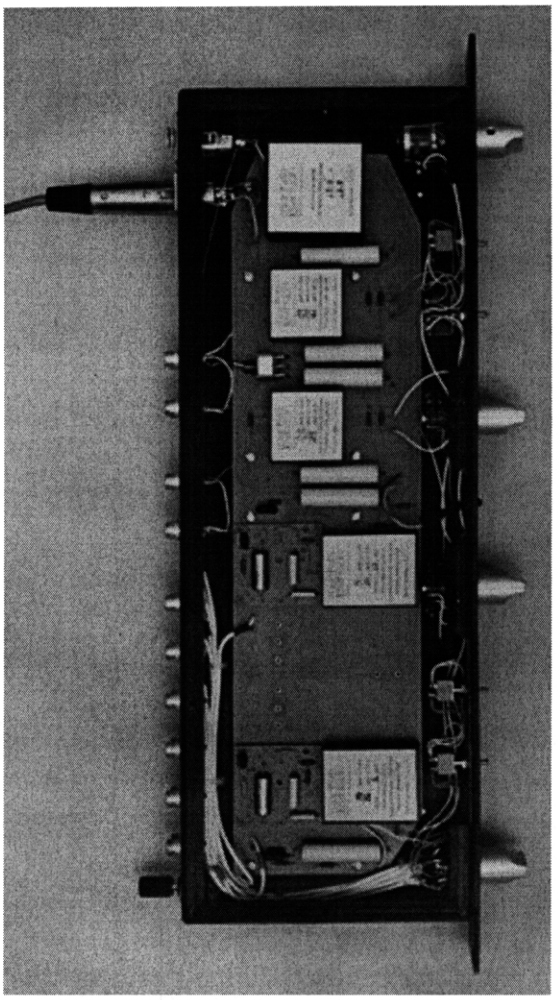

Figure 5.10 - The Mark Levinson Audio Systems JC-2 solid-state preamplifier (from *The Absolute Sound* **2**, no. 7, Winter 1975-76, pg. 249)

Among the first solid-state products to rival tube equipment in the ears of high-end audio reviewers was the Mark Levinson Audio Systems JC-2 preamplifier. The JC-2, shown in Figure 5.10, was the follow-up to Levinson's first preamplifiers, the LNP-1 and LNP-2, and was built with an external power supply unit.[91] "There are several psychological barriers one must overcome if one is to accept the Levinson JC-2 as the finest preamp in the world today," observed Patrick Donleycott in the Winter 1975-76 issue of *The Absolute Sound*. One was the price – the JC-2 cost $1100 ($4240 in 2007 dollars), an almost unheard of sum for audio equipment in 1975. Further, the JC-2 lacked the meters, tone controls, and other familiar features of most other

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[90] Patrick Donleycott, "Threshold 400A," *The Absolute Sound*, **3**, no. 12 (Late Spring 1978): 458-459, on 458.

[91] Separating the power supply from the rest of the circuitry in audio components would become a trend explored by a variety of firms.

preamplifiers, including previous Levinson products. But the biggest surprise for Donleycott was the sound, particularly in comparison with his reference preamplifier, the tube-driven Audio Research SP-3A-1.

> The Levinson is clean – crystal clean. It does not add any grain or hash to the upper midrange and high frequencies and yet it mirror images the frequencies, details and dynamics of any signal that is processed through it. My SP-3a-1, on the other hand, added just a trace of grain in the upper midrange and ever so slightly blurred the detail of fast-moving transients.[92]

Suspecting something was wrong with his Audio Research preamplifier, Donleycott returned it to the factory for servicing. Upon getting it back with a few minor improvements (and a new designation of SP-3a-2), he and fellow unnamed reviewers at *The Absolute Sound* put it and the JC-2 through a battery of distortion analyzing and measurement tests (an unusual move for the magazine), as well as further listening tests, and found it still preferable to the Audio Research preamplifier. Reviewer John Cooledge added a comment to Donleycott's review stating that the only issue with Donleycott's description of the JC-2 was that he had "understated" its performance, and that the preamplifier redefined the state-of-the-art. Pearson commented that "here we have, for the first time, a solid-state preamplifier that, in many ways, rivals the performance of the best tubed units and, in several ways, actually surpasses our reference standard, the Audio Research SP-3a-2." Pearson closed his commentary by observing that the Audio Research preamplifier was still marginally more "musical" in the midrange than the much more expensive Levinson, but the JC-2 had come much closer to the kind of musical presentation he was looking for than he or the other reviewers at the magazine had expected from a solid-state product.[93]

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[92] Patrick Donleycott, "The Levinson JC-2," *The Absolute Sound* **2**, no. 7 (Winter 1975-76): 247-252, on 247.

[93] Ibid., 248, 250.

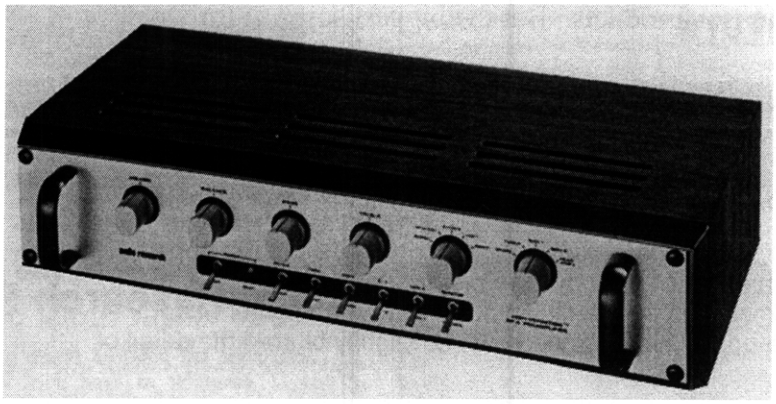

Figure 5.11 - The Audio Research SP-4 solid-state preamplifier (from *Stereophile* **4**, no. 1, pg 16). Used with permission.

Audio Research also branched out into solid-state designs in the 1970s, but was met with a poor response from many audiophiles, including those writing for *Stereophile*. Audio Research's first solid-state preamplifier, the SP-4 (shown in Figure 5.11), was reviewed by Holt and others at the magazine in 1977. Some listeners, Holt explained, felt that the SP-4, and its partner solid-state power amplifier, the D-100, amounted to "Johnson's betrayal" of the audiophile community, and were inconsistent with Audio Research's revival of tube technology only a few years earlier.[94] Holt was less dramatic in his own appraisal of the SP-4, and complimented the physical designs of the new solid-state products as "the sexiest looking, and most impressively beautiful looking… to come down the pike for a long time." But the sound of the new solid-state equipment left something to be desired. "Because of [its physical design]," he continued,

> we clearly wanted the SP-4 to be the best sounding preamp [of those tested]. And because of Audio Research's record for steady sonic improvement from product to product (and modification to modification), we expected this to set a new standard. Like most tube enthusiasts, we hoped that this would have all the positive attributes of ARC's previous model, the tube SP-3A-1, but with the bass detail and impact, and the transient attack capabilities, of the best solid-state equipment. We hoped, in short, for a better SP-3A-1. Well, the SP-4 isn't entirely it![95]

Holt explained that the SP-4 did some things very well, including its midrange reproduction, but its bass response was marred by a "slight heaviness and turgidity." While he felt the SP-4 did a

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[94] This emotional response lends some credence to O'Connell's argument that attachments to tube-driven equipment among audiophiles came from a nostalgic attachment to "an age when technology was less threatening." O'Connell, "The Fine-Tuning of a Golden Ear," 25.

[95] J. Gordon Holt, "Definitive Preamplifier Testing: Audio Research SP-4" *Stereophile* **4**, 1 (1977): 15-17, on 15.

superb job of "mak[ing] instruments stand out... dramatically from the background," he suggested that "the effect is like that of a 3-D movie, although we are not at all certain that the similarity doesn't extend to a certain exaggeration of depth, almost as though those figures etched in space were cardboard cut-outs rather than contoured objects." Summing up, Holt said that the SP-4 was

> a preamp that wipes out every other one tested as far as inner definition, detail, and depth rendition are concerned, but bombs out in terms of musicality and plain, ordinary listenability. We can state with consummate assurance that if you have preferred the sound of the best tube preamps until now, you will despise the SP-4 with a passion. If you have not really been enamored of tubes, you may or may not like the sound of the SP-4, depending on your associated components.[96]

At *The Absolute Sound*, Pearson commented that many people in the high-end audio community had not expected either his magazine or *Stereophile* to "like" the sound of Audio Research's new solid-state equipment – including, apparently, Johnson himself. "The manufacturer," Pearson wrote in an introduction to a review of both the SP-4 and D-100, "in a 'confidential' newsletter to dealers some months ago, warned its dealers not to expect a favorable review from either *Stereophile* or *The Absolute Sound* and went so far as to suggest, in the case of yours truly, withdrawal symptoms if the editor was forced to abandon the tube sound."[97] Johnson also had insisted that the magazine's typical reviewing practice be altered. Normally, reviews in *The Absolute Sound* were peppered with commentary from Pearson and other reviewers, at times disagreeing with the impressions of the primary reviewer. According to Pearson, Johnson insisted that no commentary be allowed, but that each reviewer could write his own, independent review of the products. Further, none of the reviewers' perspectives would be

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[96] Ibid., 16.

[97] Harry Pearson and John Cooledge, "Audio Research Solid-State Electronics," *The Absolute Sound* **3**, no. 6 (Spring 1977): 14-24, on 14.

shared among the reviewing staff until listening tests had been completed. Although he agreed to the terms, Pearson felt Johnson was "making a difficult job even more difficult."[98]

Pearson's general attitude about solid-state amplification was obvious from his introduction. "Many of you will, I trust, recall the days, slightly more than a decade ago, when the big three of audio's golden age were McIntosh, Marantz and Dynaco," he wrote. "Each firm took a decisive step backward when it introduced solid-state components, just as each of the three, from that point on, began to play a far different commercial role in the industry – moving, as it were, into the big time." By way of proving this claim, Pearson offered the following argument:

> Dyna went from the PAS-3x to the PAT-4; McIntosh went from the C-22 to the C-24; Marantz went from the model 7 to the 7T. With some fairly elementary modifications, the tube type preamplifiers listed above (the PAS-3x, the C-22, and the Model 7) can (and do) still hold their own in the contemporary marketplace. And time itself has given the ultimate review to the big three's solid-state inventions. (Some of you may ask how everyone was fooled by the advent of transistorized devices from these firms – all were favorably reviewed by their respective reviewers. The answer, of course, is that not everyone was fooled, just those who did the reviewing.)[99]

While Pearson felt that the solid-state Audio Research equipment did not suffer from the same problems as the early solid-state gear from the aforementioned manufacturers, neither was it particularly inspiring. He described it as "smooth to the point of blandness," and that both the sound and the physical appearance of the equipment suggested "a sort of aural Cadillac. Elegant, silken, and boring."[100] The reviewing staff was unanimous in its agreement that the SP-4 and D-100 did not match up against the best solid-state equipment of the day, and fell far short of Audio Research's tube equipment. John Cooledge wrote that the units were "a mixed bag" and

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[98] Ibid.

[99] Ibid. This is still essentially true – Dynaco tube equipment, such as the venerated Stereo 70 amplifier, can fetch hundreds of dollars in used hi-fi shops or in Internet classifieds and auctions, while their solid-state equipment, such as the Stereo-120, tends to sell for far less.

[100] Ibid., 15.

that while they did some things quite well, such as the reproduction of dynamics, they did other things, like "analytic detail," very poorly.[101]

Not surprisingly, Johnson was displeased with the magazines' reactions. In the manufacturer's comments that accompanied the *The Absolute Sound* review, Johnson wrote that while he respected the "candor" of the magazine and commended the reviewers for "say[ing] what [they] believe" even in the midst of controversy, he was nonetheless "baffled" by their reactions to the SP-4 and D-100. "The majority of our customers have accepted the new products wholeheartedly, with no reservations," he wrote. "A few expressed reservations at first, but after living with the units for a while, contacted us with glowing reports." He also noted that the D-100's average monthly sales were exceeding the unit sales of their tube-driven D-51, D-76a, and D-150 amplifiers combined.[102] In response to the poor *Stereophile* review of the SP-4, Johnson arranged additional listening sessions with Holt and other *Stereophile* reviewers with a slightly-updated version of the preamplifier. Holt acknowledged that Johnson's modifications made improvements over the original review version, but still fell short of the sonic excellence that characterized Audio Research's tube products.[103] Holt later suggested that Johnson's reaction was both pragmatic – in spite of Johnson's claims, poor reviews hurt sales of the new equipment – and personal, and may have contributed to Johnson's reluctance to send equipment to *Stereophile* for review, whether tube or solid-state, in the years following.[104]

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[101] Ibid., 18.

[102] Ibid., Manufacturer's Comments, 18, 19.

[103] Holt, "Definitive Preamplifier Testing" 16.

[104] Holt, "Audio Research SP-11 preamplifier".

But Johnson's experiments with solid-state devices eventually led Audio Research to experiment with circuits using both transistors and tubes – designs referred to as "hybrids." Other firms began experimenting with such designs as well, including Infinity (primarily known for loudspeakers) and the David Berning Company. In an ideal amplification circuit, the amplifying device, whether tube or transistor, will maintain a linear relationship between the input voltage applied to the control grid or gate, and the output current – a graph of such a relationship with voltage on the X-axis and current on the Y-axis would appear as a straight, diagonal line. In reality, this relationship is not linear in either tubes or transistors, and non-linearities are measured, and heard, as distortion in the output signal. Plotting a real-world device shows more of a curve than a straight line, with the ends bent further away from the ideal, and the middle approaching, but never quite becoming, a straight line. Amplifier designers therefore set their circuits to operate as close to this middle range as possible, minimizing distortion. With the advent of FETs, designers observed that the voltage-to-current relationship tended to mirror that of vacuum tubes. Engineers such as David Berning sought to design their hybrid tube/FET circuits such that these distortion characteristics would essentially cancel one another out, creating an amplifier with a more linear, distortion-free output.[105] In a 1979 review of Berning's TF-10 preamp, Holt said that the results of this unusual

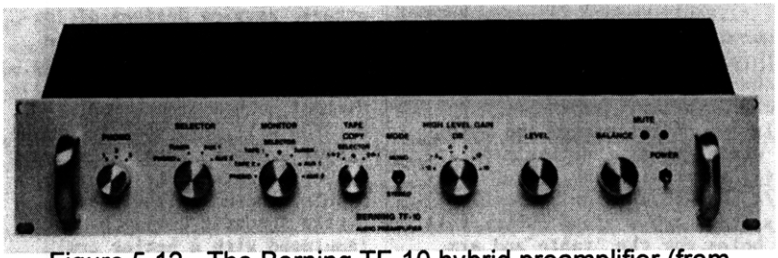

Figure 5.12 - The Berning TF-10 hybrid preamplifier (from *Stereophile* **4**, no. 5, 1979, pg. 12). Used with permission.

[105] Holt explains the details of such a circuit in his review of the Audio Research's SP-9 hybrid preamplifier. But he notes that the arrangement of tubes and FETs also affects their sound. Putting the two devices in a "cascode" configuration, as with the SP-11, yields a cancellation of distortion characteristics – put in "cascade" configuration, such as with the SP-9, the distortion characteristics are added together. Holt suspects this is among the reasons why the SP-11 performed so well and the SP-9 so poorly in his listening tests with the two products. J. Gordon Holt, "Audio Research SP-9 Preamplifier," *Stereophile* **10**, 8 (November 1987): 111-116, on 112.

configuration were excellent:

> The high end is open, delicate and downright exquisite, sounding as if it has no upper limit. Instrumental timbres are reproduced flawlessly, without a trace of hardness or edginess, and depth, detail and inner definition are for all intents and purposes indistinguishable from that of the original program source. The low end is full and rich, yet as taut and detailed as the best we have heard from all solid-state preamplifiers, and the entire middle range has that textureless liquidity we have only heard previously from tube amplifiers that fell short in various other ways. In other words, this is now the preamplifier by which others must be judged.[106]

"The vacuum tube," he said in closing, "does not seem destined for imminent demise."[107]

Audiophiles were also experimenting with hybridization at the system level by combining tube-driven components and solid-state components in the same system. Contrary to assumptions such as those expressed by Phillip regarding his early experience with Dynaco solid-state gear – that a system needed to be either all-solid-state or all-tube – audiophiles extended their approach to building audio systems to the combination of tube- and transistor-based products to try and maximize the advantages offered by each. As Frank, a manufacturer's representative, described it, "[I] finally sort of settled on, as a personal favorite, the combination of vacuum tube preamplification with big, solid-state [power] amplifiers, and that's still what I own today, and listen to today as a reference, and find that to be just, you know, pretty much... as good as it gets."[108]

The "Perfect" Amplifier

While Berning, Infinity, and others combined tubes and transistors in various configurations, another small firm, Conrad-Johnson, focused on all-tube products that quickly

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[106] J. Gordon Holt, "Berning TF-10 Preamp," *Stereophile* **4**, 5 (1979): 11-15, on 13. In a later review of the updated Berning preamp, the TF-12, Holt noted that, as far as he was aware, Berning was the first company to release a hybrid product – a power amplifier – in the early 1970s.

[107] Ibid., 14.

[108] Ibid.

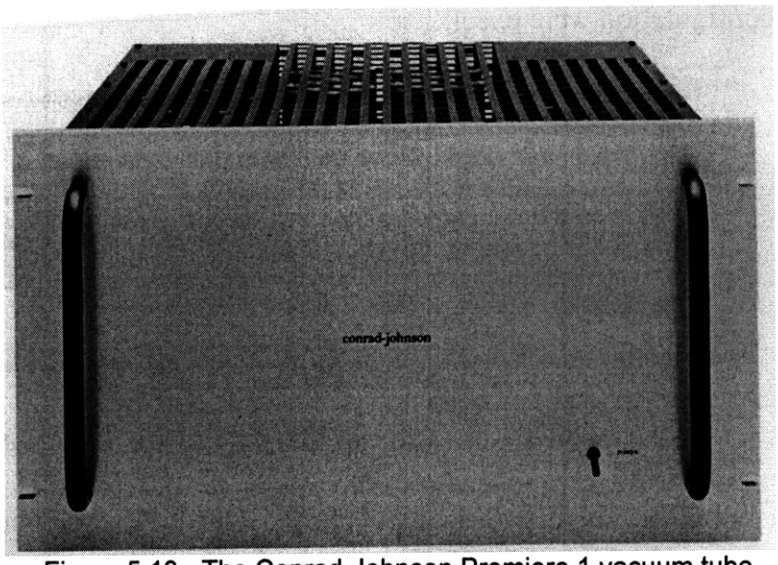

Figure 5.13 - The Conrad-Johnson Premiere 1 vacuum tube power amplifier (from *Stereophile* **6**, no. 5, May 1983, pg. 13). Used with permission.

became favorites among many audiophiles, including Harry Pearson. But a particular product, the Premiere 1 power amplifier, also sparked debate within the high-end community regarding questions of accuracy, perfection, and the assembly of high-end audio systems. Writing about the 12-tube, 117 pound Premiere 1 in 1982, Pearson praised the amplifier while criticizing the company. "Certainly on the basis of their past track record," he wrote,

> no one would have expected the team of Bill Conrad and Lewis Johnson, whom one normally assesses as dull and duller, to be the creators of the world's best amplifier. After all, neither their original preamps (the PV-1, PV-2 and 2a) nor their original amps (the MV-75 and 75a) – while solid, respectable products – showed the spark of genius. The team, in fact, seem more interested in penetrating the mid-fi market, with its sugar plum visions of dollars dancing in the air, than in serving the needs of the high-end community.[109]

Despite this less than complimentary description of the designers and their past products, Pearson felt that the Premiere 1 displayed the "musical truth" so dramatically that it would change the landscape of high-end audio amplifier design forever. In particular, he felt the amplifier reproduced rock music with an ability that surpassed its solid-state competitors. "When the rock aristocracy, from Doug Sax of the Mastering Lab to the technicians behind rock 'n roll, hear this amp," he wrote, "they will require two sets of Pampers."

> The Premier 1 is the greatest rock 'n roll amplifier I've ever heard. It has the low-frequency sock and control of a 1000 W transistor amp and it has what no transistor amp

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[109] Harry Pearson, "The Conrad-Johnson Premiere 1 Amplifier," *The Absolute Sound* **7**, 27 (September 1982): 20-23, on 20. Prior to forming their eponymous company in 1977, Conrad and Johnson were economists employed by the Federal Reserve.

> ever has had, a three-dimensional, holographic ability to reproduce music, no matter how complex or how dynamic or how subtle. The first word that pops into your head when you hear this amp is: authority. And authority is what it has. You can't argue with it; you accept its vision.[110]

Sounding something like Holt regarding the early Audio Research products, Pearson regarded Conrad-Johnson's efforts, in spite of the Premiere 1's all-tube circuitry, as state of the art insofar as it achieved a closer approximation of the sound of live music:

> I'm not saying that things sound "real" all the time with the Premier 1, but I am saying that the lines become blurred and indistinct with this amplifier since it can, in the presence of today's finest gear, occasionally suggest the reality of the concert hall. And this, discreetly put, seems to mark the transition, the turning point (as the I Ching puts it, the return) for recorded sound. From now on, audio is a different ball game and not simply because of the Premier 1, but because the entire high-end has, by a process of infinitely agonizing evolution, finally crossed the line into revolution.[111]

The following year, *Stereophile* published its own review of the same power amplifier. While Holt and others at *Stereophile* were similarly impressed with Conrad-Johnson's efforts, Holt used his review of the Premiere 1 to try and temper some of the enthusiasm exhibited by Pearson, whom he felt did a disservice to the high-end audio industry by suggesting that there was any such thing as a perfect amplifier. "This amplifier was claimed by another magazine to be the best in the world," he said.

> It would be nice if that were true, because this is by no means the most expensive amplifier money can buy. (Citation and Audio Research both have models selling for $5,000.) I think, however, that "the best" is a rash and irresponsible statement to make about any amplifier... the "best" power amplifier for use with one superb loudspeaker may well not be the best amp for use with another superb loudspeaker. Which, then, is the best? So much for that![112]

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[110] Ibid.

[111] Ibid., 21.

[112] J. Gordon Holt, "The Conrad-Johnson Premiere 1 Power Amplifier," *Stereophile* **6**, 5, 1983, 12-14, on 12. The price of the Premiere 1 in this review was listed as $4350. In the Winter 1985 issue of *The Absolute Sound*, Pearson mentioned Holt's comments about his review of the Premiere 1, referring to the magazine as "Stereo-piles," and stating that Holt's argument about the Premiere 1 not working perfectly with every kind of speaker system was akin to saying "that Maserati and Ferrari don't make a great car because you can't drive either efficiently on the Long Island Expressway." Harry Pearson, "Special Reports – Part II: Basic Amplifiers and the Sonic Truth," *The Absolute Sound* **9**, no. 36 (Winter 1985): 46-60, on 47.

For the most part, Holt agreed with Pearson's assessment of the Premiere 1's sound, and made some similar observations vis-à-vis its ability to capture some of the qualities more often associated with solid-state amplifiers while avoiding problems associated with tubes:

> I can see – or rather hear – a lot of what prompted that magazine to go gaga over the Premier 1. It is clean. It is in fact one of the most effortlessly pristine sounding amplifiers around today. Its middle highs (brightness) are almost perfectly neutral, being neither prominent nor subdued. In this respect, it does not sound tubelike. It images superbly, it reproduces apparent depth like few amps I have heard, it has as sumptuously smooth and graceful a high-end... as any amplifier, and it has the kind of low-end heft and authority that is usually elicited only from high-powered solid-state amps with beefed up power supplies.[113]

"But," he reminded readers, "it is not going to be all things to all people." Holt felt particularly strongly that manufacturers, and reviewers, owed it to readers to balance their commentary on any particular component with the acknowledgment that some products worked well with some kinds of loudspeakers, and others did not. As with the Premiere 1, Holt tended to believe that high-powered tube amplifiers did best with electrostatic loudspeakers, but did not perform as well with some dynamic loudspeakers. "There is no such thing as the ideal amplifier or the ideal loudspeaker; there is only the ideal amplifier/loudspeaker combination," he argued. "As long as amplifier and loudspeaker manufacturers continue to pretend that their design is universal, and will work at its best with any good loudspeaker or amplifier, this field is going to continue to chase its tail the way it has for the past 10 years."[114]

Pearson's enthusiasm for the Premiere 1 undoubtedly aided Conrad-Johnson as a business, and helped to sustain the overall feeling within the community that tubes could be a part of, if not the key part of, a state-of-the-art audio system. Holt's positive assessment also contributed to these effects, but by using his review as a platform for arguing broader points

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[113] Ibid., 12-13.

[114] Ibid., 14.

about system assembly, he refocused the debate on the high-end ethos that emphasized the importance of a systems approach to home music reproduction – in other words, that careful combination of components was vital to the achievement of good sound, as opposed to the idea that any one component could be considered "the best" of any particular type. Holt's argument in this particular review could be interpreted as disingenuous given his own penchant in earlier reviews, such as those of the PAT-4 and SP-2C, to make similar declarations as Pearson vis-à-vis the Premiere 1. But Holt believed this was part of his own approach to reviewing, and a learning process that others went through as well. For example, describing his response to early CD players in a 1997 interview, Holt said,

> The problem is, when you have a new medium or a new technology, it very often brings with it new kinds of distortions that you're not used to listening for. Even though some of those distortions were pretty gross [in early CD players], it took me a while to sort them out from the good things. It's a learning process, hearing distortion... the better the equipment you're exposed to, the more critical you become. Every once in a while you look back and say, 'Huh, how could I have ever liked that?' I remember some years ago we had a rather expensive power amplifier in the house. I lived with that thing—I think it was the first Infinity switching amp—for several months, and I finally declared in print, "This amplifier is so good that if nobody ever makes it better, it won't matter." Well, that's another thing that, when I look back on it now, my toes curl.[115]

Pearson, too, suggested in his review of the Premiere 1 that despite his argument that it was "the best amplifier ever made," "we shall someday look back upon the Premier 1 as a crude, proximate device and it will be difficult for our successors to understand (unless they had to endure what we've had to endure) our enthusiasm for this behemoth."[116] The disagreements among audiophiles, or agreements about performance tempered by different approaches to system building as evidenced by Pearson's and Holt's individual reviews of the Premiere 1, were vital to the continued evolution of the community and its technologies.

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[115] Stone, "35 Years and Just Getting Started," 85.

[116] Pearson, "The Conrad-Johnson Premiere 1 Amplifier," 21.

Convergence

The early 1980s also saw continuing innovation with solid-state devices. Despite his preference for tube electronics, in 1982 Harry Pearson called the solid-state Spectral DMC-10 preamplifier "worthy of being ranked alongside the world's best tubed units as a music reproducer."[117] In his description of the DMC-10's sound, he acknowledged his fondness for tubes and used another of his preferred tubed amplifiers for comparison:

> If you were to ask me what the Spectral sounds like, I'd answer the Conrad-Johnson Premiere 2 (a comparison respected by Spectral's Rick Fryer and our own Dave Wilson, themselves no tube dogmatists as HP is suspected of being). If anything, I preferred the tonal balance, overall, of the Spectral since it is more like the real thing. The Conrad-Johnson is extended in the highs, as we noted in the original review, but rather soft (read: slow), a finding reported, incidentally, by Wilson, who says the 2s RIAA accuracy is within .05 DB from 20 to 20,000 Hz which is, in his words, equal to the RIAA accuracy of the far more technologically sophisticated Spectral. And so, if you can imagine the Conrad with a faster, somewhat sweeter extreme top then you'll have an idea of what the Spectral sounds like.[118]

Products from the Threshold Corporation also received a great deal of positive attention in the high-end audio press, but also provided an occasion for Holt to reflect on the direction he felt both solid-state and tube amplification appeared to be headed. "It's interesting how tube and solid-state power amplifiers have been sounding more and more similar of late," Holt wrote in a 1983 review of the $3000 Threshold S/500 Stasis power amplifier.

> Not too many years ago, you could identify the kind of amplifier you were listening to in about 30 seconds (often less). Solid-state amps were tight and controlled at the low end, slightly flat and grainy and rather withdrawn sounding through the middle range, and more or less tipped up and sizzly crisp at the high end. Tube amps were warm, mellow, fat through the midbass, deficient in deep bass, bright and forward in the middle range, and pleasantly, consummately soft at the high end. I tended for some years to assume

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[117] Harry Pearson, "The Spectral DMC-10 Solid-State Preamp," *The Absolute Sound* 7, 27 (September 1982): 28-30, on 28.

[118] Ibid. "RIAA" refers to the Recording Industry Association of America's equalization specifications for phono preamplification. Equalization allows records to be cut in such a way as to maximize the playing time of an LP by reducing the bass information that is cut to the vinyl, which requires wider grooves and can be difficult for phono styli to track. Among other things, the equalization in a phono preamplifier restores the bass information when the LP is played back. to Prior to the 1950s, a variety of equalization curves were in use by different record companies, but by 1958, an equalization scheme originally developed by RCA Victor was adopted by the RIAA, and become the de facto standard. See Alexander Magoun, "Shaping the Sound of Music: The Evolution of the Phonographic Record, 1977-1950," (Ph.D. Dissertation, University of Maryland, 2000).

> that the ultimate correctness, if indeed there is any such thing, played somewhere in between, but whether the tubes or the transistors were hewing closer to the mark was something about which I was not prepared to hazard a guess. Tubes sounded more "musical," but transistors had greater detail and better low end.[119]

Comparing the solid-state Threshold amplifier to the tube-driven Conrad-Johnson Premiere 1, Holt suggested that "the Conrad-Johnson does not have the glaring middle range brightness which, through the years, I have come to associate with tubes, but neither does the Threshold have that withdrawn, distant middle range that was for so long the trademark of the solid-state amplifier." So close were their respective sounds, to Holt's ears, that "the choice might now be made on the basis of personal taste rather than on what sounds good and what sounds awful."[120] In the following issue, Holt felt that another solid-state product, the $750 Audionics CC-3 power amplifier, exhibited a "remarkable amalgam of tube-like sweetness and delicacy with solid-state quickness and detail" in the high frequencies.[121] The following year, Anthony Cordesman described in *Stereophile* the solid-state Robertson Audio 4010 and 6010 power amplifiers as rivaling the best tube amplifiers in terms of their capabilities producing the lower midrange frequencies.[122] As far as many reviewers were concerned, solid-state electronics were achieving a quality of reproduction otherwise reserved for tube equipment. But during this period, the sound of solid-state equipment was still often defined in terms of how it compared with tube equipment, and the sound of tube equipment remained the benchmark for quality.

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[119] J. Gordon Holt, "The Threshold S/500 Stasis Power Amplifier," *Stereophile* **6**, 5 (1983): 23-24, on 23.

[120] Ibid.

[121] J. Gordon Holt, "Audionics CC-3 Power Amplifier," *Stereophile* **6**, 6 (1983): 25-27, on 26.

[122] Anthony Cordesman, "The Robertson 4010 and 6010 Power Amplifiers," *Stereophile* **7**, 5 (September 1984): 36-38, on 37. The 4010 was priced at $895 and the 6010 at $2250. Because of a communication error, Holt also wrote a review of the Robertson 4010 amplifier. Neither Holt nor Cordesman was aware that the other was reviewing the amplifier, and *Stereophile* published both reviews. Holt and Cordesman reached the same basic conclusions about its sound.

While there was general agreement among reviewers at *Stereophile* that, at the very least, well-designed solid-state electronics could compete with the sound of tube equipment, *The Absolute Sound* maintained the position that tube equipment was still superior. Reviewer Tom Miiller, in a 1984 review of the EA-2100 hybrid power amplifier made by the David Berning Company, noted that while a number of talented engineers had been pursuing improved solid-state designs, "[*The Absolute Sound*] has sworn by the old tube technology," reserving their biggest compliments for designs from Audio Research and Conrad-Johnson. Miiller felt that Berning's hybrid efforts yielded exceptionally good "timbral definition." "The EA-2100 not only accurately defines the timbre of primary instruments," he wrote, "but is also locked in on the timbre of background instruments. The scoring of various compositions is instantly more evident."[123] Drawing again upon the traditional problems of both artifacts, he suggested that the hybrid amplifier's reasons for becoming an "instant classic" were "because, simply, it is the first power amplifier that doesn't have any of the hallmark colorations of tubes or transistors."[124] Pearson, however, disagreed with Miiller's assessment. "There are two things I don't like about this amplifier," he wrote in a follow-up to Miiller's review, "and, taken in tandem, they would make me rate it at a much more mundane level than my colleague." First, Pearson complained that the Berning amplifier sounded "anemic" and "weak" in the low frequencies as compared with the Conrad-Johnson Premiere 1, still his preferred amplifier. His "greatest complaint," though,

> perhaps one exacerbated by the lack of foundation, is a peculiar upper midrange glassiness, one evident on massed strings and brass chorales. Even adding a second Berning to the system (which gave me a total of some 340 W per side, since the Berning produces close to 170 W before clipping), did not entirely ameliorate the sense of strain,

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[123] Tom Miiller, "The Berning EA-2100 Amplifier", *The Absolute Sound* 9, 33 (April 1984): 46-51, on 49.

[124] Ibid. 46.

> of the kind of continuing-when-struck effect on percussion I associate with very high frequency ringing.

Ultimately, Pearson felt that while Berning's hybrid design "should have been a breakthrough amplifier design," it sounded "unfinished."[125]

Despite Pearson's insistence that tube amplification still provided the best approximation of live music, more and more reviewers at both magazines began commenting on the similarities they heard in tube and transistor amplifier designs. "Ten years ago," Holt wrote in 1985 in a review of an updated Conrad-Johnson power amplifier, the Premiere 5, "even the best tube amplifier had a uniquely characteristic sound which immediately identified it to experienced listeners."

> The first impression of that sound was one of warmth and forwardness. Comparing it with the sound of a good solid-state amplifier of that time, we would note that the midbass was fat and rich rather than taut, deep bass was often noticeably weak, the entire middle range and middle highs were somewhat prominent, and extreme highs tended to be soft or dull, depending on how you felt about it – but with a superbly musical delicacy, sweetness, and naturalness... There was more: for reasons no one has satisfactorily explained to this day, tubes always seem to reproduce magnificent depth perspective and simply miked recordings. Thus, "the tube sound" was an interesting mixture of strengths and weaknesses, and how you felt about tubes depended entirely on how you felt about each of those aspects of reproduced sound quality. Like digital sound, tube equipment has traditionally been adored or despised, with no neutral camp.

Further, Holt suggested that during that decade, "tubed components and solid-state components have been edging ever closer and sound... it is probably safe to say that the perfect amplifier, if there ever is one, will sound almost exactly midway between the best tube and the best solid-state amplifiers."[126]

Others expressed similar thoughts, and some more philosophical questions. John Nork at *The Absolute Sound* reflected on the tube-versus-transistor debate in the realm of preamplification, where the advantages of tubes had first become apparent in the Audio Research

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[125] Ibid., (Pearson addendum), 51.

[126] J. Gordon Holt, "The Conrad Johnson Premiere Five Power Amplifier," *Stereophile* **8**, no. 7 (December 1985): 80-81, on 80-81.

equipment. In a review of the $2995 solid-state Klyne SK-5 preamplifier, Nork stated that "I have always been disturbed by consistent sonic disparity between the best tube and solid-state preamplifiers."

> Since both groups are measured against the same ideal (the sound of real music), how could they both receive such accolades and yet sound so distinctly different? It was not so long ago that the Levinson JC-2/ML-1 reigned as king of solid-state, and the Audio Research SP-3 series was the vacuum tube champion. Both were held up (in these pages and others) as offering real fidelity to live sound. Yet the same source material played through the two preamps sounded shockingly dissimilar. If the sound quality of preamplifiers were to really improve and evolve into something truly approaching the real thing, and if both tube and solid-state units were part of this progress, the sonic gap between the two would necessarily narrow.[127]

While Nork felt that the SK-5 contributed to this narrowing from the solid-state side, reviewer David Wilson expressed similar sentiments about another solid-state product – the Rowland Research Model 7 power amplifier – in the same issue. He offered a technical explanation for the Model 7's particular "vacuum tube virtues":

> According to studies conducted independently by Curl in the US and Hawksford in the UK, as well as by others, FETs are more tubelike in their electrical behavior and in their sound than are bipolar transistors. FETs, in the transconductance mode, amplify voltage (like tubes) rather than current (like bipolar transistors). Rowland uses FETs in the critical voltage amplification stage at the input, then goes over to bipolars in the driver and output stages, where gain must be in the current domain. Hawksford refers to a "fuzzy distortion" associated with bipolars, but not FETs or tubes, and relates it to a theoretical information floor limitation unique to bipolar transistors. This limitation should be most apparent when the signal levels are lowest – hence Rowland's use of FETs in the inputs. Rowland has found bipolars superior to FETs in the low frequencies, so he uses them where their low-level information limitation is of less consequence, in the driver and output stages.[128]

From technical and aesthetic perspectives, it appeared that the design of both tube and solid-state amplifiers had changed since the reintroduction of tubes in the early 1970s to the point that each was beginning to embody the strengths of the other. But these achievements came at significant cost that was beyond the resources of most audiophiles. Indeed, the products

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[127] John Nork, "The Klyne SK-5 Preamplifier," *The Absolute Sound*, **10**, no. 40 (Winter 1986): 111-115, on 112.

[128] David Wilson, "The return of David A. Wilson: the Krell KMA-200 and Rowland Research Model 7 amplifiers," *The Absolute Sound*, **10**, no. 40, (Winter 1986): 73-80, on 78.

that gained the most positive attention from reviewers insofar as their fidelity was concerned were becoming, as one reviewer put it, "stratospherically expensive."

The cost of neutrality

By the early 1980s, vacuum tube-based equipment had gained a solid foothold in the high-end audio community. Firms such as Audio Research and Conrad-Johnson continued to build increasingly powerful – and expensive – all-tube amplifiers and preamplifiers, while the hybrid experiments of Berning, Audio Research, Luxman, and Lazarus, among others, continued to gain the attention of the high-end audio press. Upstart firms such as VTL (or "Vacuum Tube Logic") sought to capitalize on the interest in tube electronics while offering more affordable products than their more well established competition. At the same time, solid-state designs from Threshold, Krell, Rowland, Klyne, and others also pushed farther into the "magical" territory once dominated by tube designs. Output power (and power consumption) also increased. But these designs also came at higher and higher prices. With both tube and transistor designs, reviewers felt that firms such as Audio Research, Conrad-Johnson, Rowland Research and Krell were pushing the envelope of cost almost as forcefully as that of quality. In the case of the solid-state designs, the cost advantages of transistors realized in other areas of consumer electronics appeared to elude the high-end audio world as amplifiers got bigger, ran hotter, and cost more and more. But by the middle of the decade, more affordable products began to receive accolades from the high-end audio press.

In the first of three reviews of new, powerful, and expensive tube-based amplifiers in a 1985 issue of *Stereophile*, Anthony Cordesman summarized what had emerged as the primary divide between the sound of tube-driven electronics, and the sound of solid-state. "The

enthusiasm for tubes," he wrote, "ultimately boils down to a special sweetness or delicacy in the upper six octaves and a dynamic response that no transistor amplifier – with the possible exception of the Krell KSA-50 or larger mono amps – has yet matched. Many audiophiles are willing to pay several thousand dollars more for the sound, and put up with the occasional problems inherent in today's tubes, just to get this difference."[129] But these new tube amplifiers, particularly the New York Audio Labs Futterman OTL-3, presented him with some interesting twists, and some problems. "OTL" stood for "output transformerless," and "Futterman" referred to the electrical engineer Julius Futterman who, 30 years earlier, had developed a tube-based circuit that eliminated the need for the output transformer. New York Audio Labs' Harvey Rosenberg took Futterman's original design and, among other things, built the amplifier in a monoblock configuration (or one separate amplifier for each stereo channel), with the power supply for each amplifier in a separate chassis, resulting in four large boxes for a full stereo configuration.[130]

While Cordesman described the OTL-3 as a "superbly musical product," he nevertheless acknowledged that its $5800 per pair price tag made it hard to recommend to most audiophiles on limited budgets. "How in hell do I judge whether that special upper octave sweetness and those superior musical dynamics are worth the money to you?" he asked. "The most I can ultimately do with the review is to inspire you to listen to this unit against the competition and judge for yourself."[131] Likening his critique of the OTL-3 to "a wine snob ranking four excellent wines on the basis of some abstract scoring system," Cordesman closed by suggesting that "the

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[129] Anthony Cordesman, "The Futterman OTL-3 Mono Power Amplifier," *Stereophile* 7, 8 (1985): 17-19, on 17.

[130] Ibid.

[131] Ibid., 19.

Futtermans rank with those few luxury products that merit conspicuous consumption on the basis of their sound alone, rather than brand-name or status."[132]

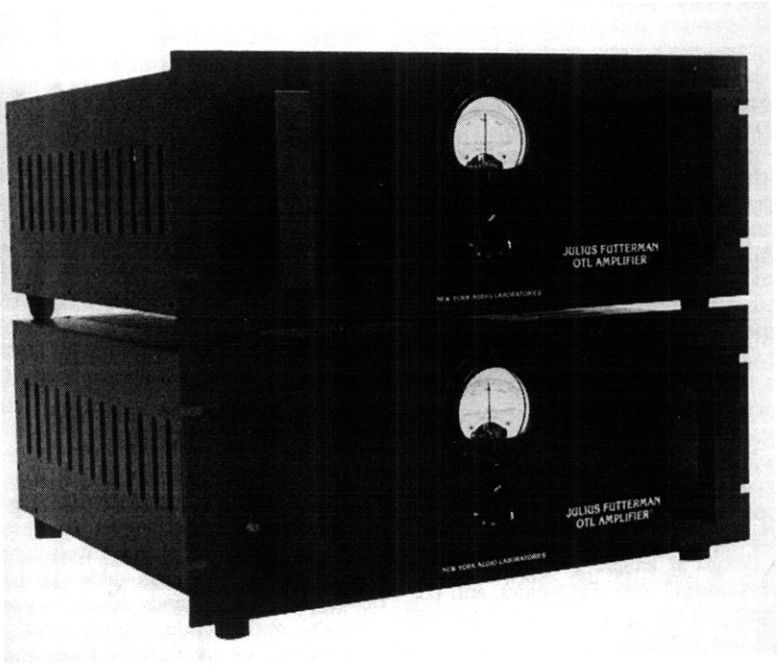

Figure 5.14 - The New York Audio Labs Futterman OTL-3 output-transformerless vacuum tube power amplifier (power supply chassis not shown)(from *Stereophile* **7**, no. 8, 1985, pg17). Used with permission.

Cordesman's use of the term "conspicuous consumption" was rather awkward, and revealed the emergence of some tension within the high-end audio community around the rising cost of top-tier equipment. Coined by the economist Thorstein Veblen, conspicuous consumption referred to lavish spending on luxury products for the purpose of displaying wealth and social status.[133] In this statement, however, Cordesman appeared to conflate conspicuous consumption with spending for the attainment of high fidelity, regardless of status – otherwise a hallmark of the high-end audio ethos. Although expensive electronics existed in the high-end audio community prior to the Futterman OTL-3 and the Audio Research and Conrad-Johnson amplifiers he also reviewed in this same issue, these three amplifiers appeared to reset the bar in terms of both performance and cost.

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[132] Ibid. Scoring wine based on a numbering system is precisely what Robert Parker has done in *Wine Spectator* magazine, engaging in a form of commensuration generally eschewed by the subjective high-end audio community.

[133] Thorstein Veblen, *The Theory of the Leisure Class* (New York: Mentor Books, 1953) (originally published in 1899 by MacMillan).

While Cordesman commented on the strengths of several sub-$1000 amplifiers in comparison with the OTL-3, his review framed its real competition as two other large tube-based designs from Conrad-Johnson and Audio Research. The Conrad-Johnson Premiere 5 was also a monoblock amplifier design, and exceeded the cost of the OTL-3 by $200. Cordesman observed that the Premiere 5 was not as "sweet" as the OTL-3, nor did it have the deep bass power of Krell's solid-state amplifiers. "Yet, it is the least tube-sounding amplifier that Conrad-Johnson has ever made," he wrote. "This may not please tubaholics that are looking for a warm and sybaritic sound, but it will please anyone that listens to music."[134] This comment foreshadowed the emergence of another division within the high-end between audiophiles who preferred the euphonic, "tubey" qualities of some tube amplifiers, and those who preferred tube designs with a "neutral" sound. In closing his review, Cordesman again made allusions to wine, suggesting that while other amplifiers may offer desirable qualities in the high frequencies, the Premiere 5 had the kind of balance associated with the best white wines: "You are seeking clarity and assessing the quality of the aftertaste, rather than seeking bouquet or body. The Premiere 5s give you the balance of the best French white wines without the sweetness or fruitiness of most German wines or the extension and lack of character of most California whites. If this comparison sounds a bit strained, the point is that the highs in the Premier 5s don't."[135]

Cordesman's final review was of the Audio Research D-250 II power amplifier. Unlike the OTL-3 or the Premiere 5, the D-250 II was a single-chassis stereo amplifier, but it fell between the two products in terms of cost at $5995. The D-250 II contained a staggering 32

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[134] Anthony Cordesman, "The Conrad-Johnson Premiere 5 Mono Power Amplifier," *Stereophile*, 7, 8 (1985): 20-23, on 21.

[135] Ibid., 22.

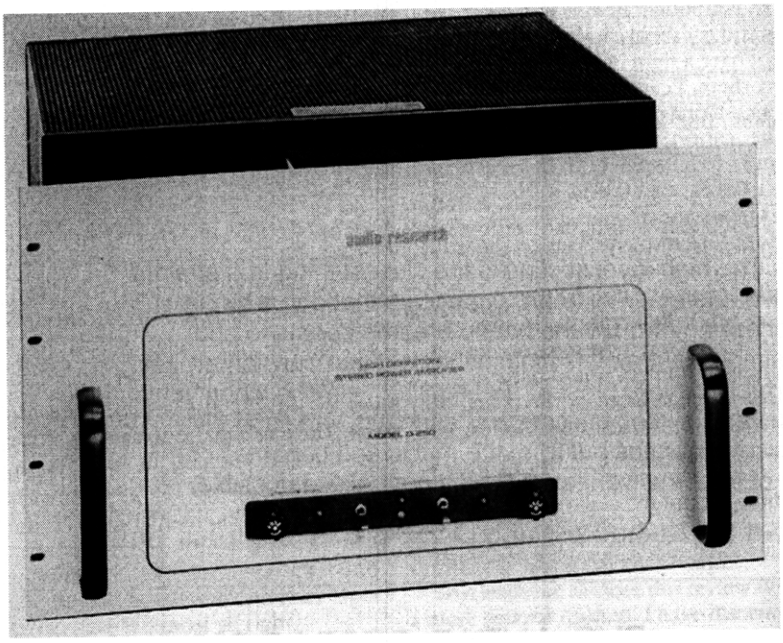

Figure 5.15 - The Audio Research D-250 vacuum tube power amplifier (from *Stereophile* **7**, no. 8, 1985, pg. 24). Used with permission.

tubes, about half used for amplification, and the remainder used for various aspects of electronic control and power regulation. "Once you plug in all these tubes, they cover three of the four sides inside the top cage," he wrote. "Looking down into a 'lit up' Audio Research D-250 II is like peering into a power reactor where someone is in the process of removing all the damping rods."[136] In comparison with the OTL-3, Cordesman again noted a lack of "sweetness" in the D-250 II, as he had the Premiere 5, but stated that "it provides more upper octave detail and not a trace of hardness. The treble, upper midrange, and midrange are in tight and proper balance. They now 'float' together in a musically natural way, and never in a startling or unnatural manner."[137] Summing up, he wrote,

> as for the midrange – which is the ultimate test of any high-end equipment – no other amplifier I know of can provide the close-in frequency balance and dynamics of the D-250 II and still present the impression that all the lower midrange and midrange data is present and in natural balance. Once again, this comes at the cost of spotlighting the forward miking or multi-tracking in many recordings. The Premiere 5s midrange balance is slightly warmer and slightly more merciful with such recordings. As to which is right... well, we're back to the issue of taste.[138]

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[136] Anthony Cordesman, "The Audio Research D-250 II Power Amplifier," *Stereophile* 7, 8 (1985): 23-27, on 24.

[137] Ibid., 25.

[138] Ibid., 27.

In addition to their all-tube products, Audio Research continued to push for this neutrality in both tube-driven and hybrid products. Writing about the Audio Research SP-11 hybrid preamplifier in 1986, Holt remarked,

> This preamp sounds like nothing! The high-level section is the closest thing to a straight wire with gain that I have ever encountered. (I've heard *capacitors* that degrade the sound more than the SP-11!) Processing through the phono preamp seems to add nothing more. The sound is just simply neutral. It is indescribable. I can only lamely say that everything you think is superb about your present preamplifier won't be when you hear the SP-11. Highs are unbelievably sweet, delicate and effortless, yet superbly detailed and focused. Surface noise separates out from the music and becomes one-dimensional, assuming a degree of unobtrusiveness that I did not believe possible.[139]

Following-up on Cordesman's review of the Audio Research D-250 power amplifier, Holt observed that "sonically, the D-250 is in most respects a very un-tubelike amplifier. It has virtually none of that (spurious?) richness and warmth through the midbass, or the soft, velvety sweet high-end, that we tend to associate with tubes… [it] has most of the virtues of the best tube and solid-state amplifiers, with practically none of the weaknesses of either."[140] But, again reflecting some of Cordesman's comments from his earlier reviews, he added,

> there is no question… that this is a rich man's amplifier – the initial purchase price is only the beginning. The amplifier is a veritable power eater, whose frequent use will have a pronounced effect on your electric bill. Then there is the cost of replacement tubes, which can easily run to a cool $1000 a year if you use the amplifier often enough. But I suppose it is reasonable to assume that anyone who can afford a $6,500 power amplifier (or two) can afford to maintain it. In that way, it's something like a yacht; if you have to ask how much it cost, you probably can't afford it.[141]

In the solid-state camp, some manufacturers began pushing their designs into similar sonic territory, with concomitant price increases – some in excess of the latest tube equipment. Threshold's 160-watt SA-1 power amplifier, a monoblock solid-state product, cost $6000 a pair ($11,350 in 2007 dollars). As Holt observed in his 1986 review, this price came to $18.75 per

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[139] Holt, "Audio Research SP-11 Preamplifier," 123, emphasis in original.

[140] J. Gordon Holt, "Audio Research D-250 Power Amplifier," *Stereophile* **9**, 5 (August 1986): 100-105, on 103, 104. Cordesman's earlier review was of a slightly different model, the D-250 II, but the specs were very similar. The cost of the amplifier reviewed by Holt exceeded that reviewed by Cordesman by just over $500.

[141] Ibid., 105.

watt – a number he argued was, in the face of more affordable solid-state products, "lousy".[142] "Only the Mark Levinson ML-2 offers substantially lower dollar/watt value than the SA-1," he wrote, "at an unbelievable $176 a watt!"[143] While neither *Stereophile* nor *The Absolute Sound* tended to base their reviews on numbers, Holt's observations acknowledged the reality that many audiophiles simply could not afford such expensive products. His criticisms also suggested a suspicion of the engineering of these products, as if the assumption that the high-end audio marketplace could absorb such expensive equipment was a free pass towards ignoring final component cost during the design process.

The issue of cost was certainly not lost on the engineers, although approaches to it varied significantly. Mike, a manufacturer's representative for a company that built very expensive amplifiers, described how the chief engineer approached designing new products:

> His goal is always to build the biggest and best first, and then take what he learns in doing that and applying it to more popularly priced stuff in kind of a trickle-down fashion. But he always wants to do it right the first time and go down from there, rather than build a compromise piece to begin with and build up from there. Rather than trying to say, "okay, I need to hit a $5,000 price point and I need to get it on the market by calendar date X," and then go up from there, he says, "well, I've got a design that I think can do this. Let me build it, and let me build it as effectively as I can and as quickly as I can, and then we'll see what happens from there." And that's kind of a scientist at work. That's the engineer at work that says, "let me build it right, let me do the engineering right, let me do the testing right, and when I do that, then I'll build [a more affordable product]."[144]

Other engineers approached the design process differently. One particular engineer, Bob Carver, sought to prove that affordable components could compete sonically with expensive components, whether tube or solid-state.

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[142] J. Gordon Holt, "The Threshold SA-1 Power Amplifier," *Stereophile*, **9**, 1 (January 1986): 85-87, on 87.

[143] Ibid. The ML-2, a highly-respected solid-state class A design, put out only 25 watts, far less than the Threshold.

[144] Interview, 06/01/07.

The "Carver Challenge"

Bob Carver was something of a legend in hi-fi circles. A physicist and engineer, he had founded two electronics firms in the 1970s – Phase Linear and the Carver Corporation – and was well-known for building powerful solid-state hi-fi equipment. In the mid-1980s, Carver set out to develop an inexpensive solid-state power amplifier that would be sonically indistinguishable from a high-performance, expensive tube power amplifier. His method involved mimicking the "transfer function," or changes to an audio signal from the input to the output, of an unnamed but highly-respected and expensive tube design. The process of testing transfer function involved inverting the output signal of the original amplifier, and summing it with the output of the copy amplifier. If a successful copy had been achieved, the signals would cancel each other out completely, and in listening tests, no one – trained listener or otherwise – would be able to tell the difference.[145] His efforts resulted in the M1.0t power amplifier, commercially released in 1987, which Carver claimed measured and sounded identical to the tube amplifier, but cost only $500.

This was not Carver's first attempt at building an inexpensive copy of an expensive high-end product. By the mid-1980s, Carver had established what he called the "Carver Challenge," wherein he would allow a well-known high-end audio devotee to select a high-end amplifier, and he would attempt to duplicate its sound to their satisfaction in an inexpensive and mass-producible product within a matter of days. In so doing, Carver could show that excellent sound was attainable at modest budgets, and that high-end audio enthusiasts' choices of esoteric

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[145] An explanation of transfer functions is available in Robert Harley's quite negative review of a different Carver amplifier designed to mimic a tube amplifier, the Silver 7-t. Robert Harley, "Carver Silver 7-t, Muse Model 150, Vacuum Tube Logic 225W Deluxe," *Stereophile*, **13**, 1 (January 1990): 152-162, on 153.

products (and, in the case of the M1.0t, tubes over transistors) were motivated by something other than sound quality. Despite the possibility that the Carver Challenge could take the wind out of high-end audio's sails (and sales) if they were shown to be unable to hear differences between the reference amplifier and Carver's copy, in 1985 Holt and *Stereophile* publisher Larry Archibald agreed to participate.[146]

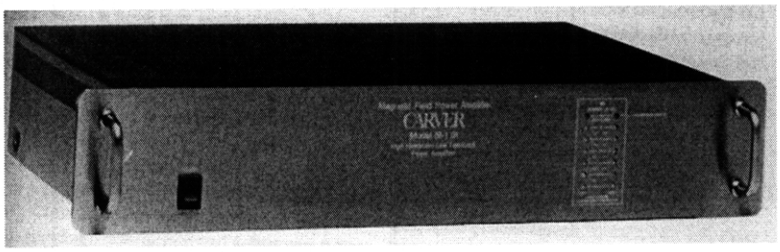

Figure 5.16 - The Carver M1.0t solid-state power amplifier (from *Stereophile* **10**, no. 3, 1987, pg. 117). Used with permission.

As Holt described in a feature article in *Stereophile*, after a few days of exhaustive listening tests and feverish re-calibration and modification of the copy amplifier by Carver, the results of the Carver Challenge surprised and disturbed Holt and Archibald. "We had thrown some of the most revealing tests that we know of at both amps," Holt said, "and they came through identically."

> It is true that there were no "controls" here – no double-blind precautions against prejudices of various kinds. But the lack of these controls should have, if anything, influenced the outcome in the other direction. We wanted Bob to fail. We wanted to hear a difference. Among other things, it would have reassured us that our ears really are among the best in the business...[147]

Writing about the experience in his 1987 review of the M1.0t, Holt said,

> After a mere four days of work, Carver presented us with a solid-state amplifier that, after two days of listening comparisons, we could not distinguish from the reference amplifier. Whether or not we might have heard subtle differences had we listened longer is beside the point, because no two amplifiers – even different samples of the same model – are ever exactly the same; the longer one listens, the more one hears in the sound of any component. The operative requirement here was not that Carver's customized amplifier

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[146] J. Gordon Holt, "The Carver Amplifier Challenge," *Stereophile*, **8**, 6 (1985): 32-44. The Carver Challenge was also described in O'Connell, "The Fine Tuning of a Golden Ear," 17. Although Holt and Archibald explicitly did not identify the amplifier to be copied, it was later revealed to be a Conrad-Johnson design.

[147] Holt, "The Carver Amplifier Challenge," 42.

> be identical to the reference amp, but that it be similar enough that we wouldn't be able to hear the difference. It appeared to meet that requirement.[148]

But after listening to the production model of Carver's experimental amplifier, which was reviewed two years after Holt and Archibald's participation in the Challenge in 1985, Holt began to have doubts about what he was hearing. "Compared with the reference amp," he said,

> the Carver had less (i.e., more neutral) mid bass, better LF [low-frequency] extension, a very similar mid and upper midrange, and a somewhat crisper extreme top. Its bass *quality*, however, was something I was unable to get a handle on, because this seems to change according to what was going on through the upper part of the spectrum. When the signal was predominantly low end, bass definition and control were both excellent. But during moments when the whole orchestra let loose, the LF range was ill-defined and characterless. It was almost as if the amplifier was saying "look, fellas, gimme a break! I can't concentrate on everything at once!"[149]

"Worried about what I had heard," he said, "which contradicted Bob [Carver]'s advertising claims, I foisted both amps off onto our international editor, JA [John Atkinson], and without cueing him as to my own conclusions, asked for a second opinion." Atkinson, who had not participated in the original Challenge with Holt and Archibald, joined the staff of *Stereophile* as editor in 1986 after years editing *Hi-Fi News and Record Review*, a British hi-fi magazine. "If Carver had managed to produce an inexpensive solid-state copy of one of the world's most highly respected tube amplifiers," Atkinson wrote in the introduction to his contribution to the M1.0t review, "it would seem to expose high-end amplifier manufacturers as cynical exploiters, and audiophiles as gullible, if well-heeled, self deluders. Frankly, I was skeptical."[150] Although impressed with the physical design of the M1.0t, after doing some comparative listening on his own, Atkinson's conclusions matched Holt's. *Stereophile* informed Carver of their results, and Carver joined them to do further listening tests, including some double-blind testing between the

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[148] J. Gordon Holt, John Atkinson, and Larry Archibald, "Carver M1.0t Power amplifier," *Stereophile* 10, 3 (April/May 1987): 117-126, on 117, emphasis in original.

[149] Ibid., 118.

[150] Ibid., 119.

amplifiers. Despite feeling that Carver's self-made amplifier switchbox might change the sound or reduce the magnitude of the audible differences between the amplifiers, Atkinson and Holt, along with Archibald, agreed to further tests.

After several rounds of additional listening tests, Atkinson, Holt and Archibald still felt that there were audible differences between Carver's amplifier and the tube amplifier that had served as the reference for his original design – differences that made the Carver amplifier, still impressive for such a comparatively inexpensive product, less appealing sonically than the reference tube amplifier. Anticipating fall-out from some readers, Archibald included an addendum to the M1.0t review. "Of course, the engineering oriented cynics in our audience may well say that our relaxed listening – while knowing the identity of the components – just allows us to make up the supposed characteristics of the amplifiers," he wrote. But he offered as evidence the essentially identical conclusions of both Holt and Atkinson from their individual experiences with the M1.0t prior to the blind tests conducted by Carver – conclusions that were reached independently and without the knowledge of what the other reviewer had heard (specifically, problems in the low- and high-frequency response of the M1.0t, and loss of soundstage and low-frequency detail when dealing with complex musical material). Archibald further offered that the transfer function testing of the reference amp and Carver's production model of the M1.0t revealed "a relatively poor null" in the parts of the frequency range that both Holt and Atkinson identified as problematic. The blind testing had resulted in correct identifications of Carver's amplifier in five out of six tests. "I think it would be a poor scientist

who concluded that the long-term listening results were the results of prejudice or imagination," Archibald concluded.[151]

Carver was displeased not just with the review of the M1.0t, but with the process of the review and additional listening tests, and responded at length in the Manufacturer's Response section of the magazine. His primary complaint was that Archibald, Atkinson and Holt had not done their comparisons between Carver's original prototype amplifier and the M1.0t, but between the original tube reference amplifier that Carver had copied and the M1.0t, leading to audible differences that stemmed not from the M1.0t's failings, but from the inevitable aging and declining performance of the tubes in the reference amplifier.[152] *Stereophile's* claims that Carver had failed to produce a commercial amplifier that matched his original prototype were therefore unfounded. The differences Holt was able to identify in blind tests had been due to differences in signal level between the amplifiers under test, Carver claimed, rather than frequency response, soundstaging, or other sonic characteristics of the M1.0t. Carver also observed that another audio journal, the Canadian *The Inner Ear Report*, had a response to the M1.0t that was the opposite of Atkinson's in almost every respect. This, to Carver, was an indication not only of *Stereophile* having acted in bad faith, but also of the shortcomings of subjective reviewing.[153]

Atkinson's skepticism may have been influenced by some revelations about *Stereophile's* participation in the Carver Challenge that came to light several months after Holt's original write-up of the experience in 1985. In early 1986, Harvey Rosenberg of New York Audio Labs pointed out in a letter to *Stereophile* that, despite his insistence to Holt and Archibald at the time

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[151] Ibid., 126.

[152] Bob Carver, "Carver M1.0t Amplifier," *Stereophile*, **10**, no. 3 (April/May 1987): 206-211.

[153] Ibid., 209.

of the Challenge that he had never listened critically to any "world-class" high-end amplifiers, Carver had undertaken a very similar "challenge" that had been written up in another hi-fi journal in 1982. That time, the amplifier in question was a solid-state Mark Levinson ML-2. Rosenberg also found another article from 1981 about a similar test with another high-end amplifier that Carver would perform for audio club meetings, raising questions about Carver's forthrightness with *Stereophile*, or the agreed-upon procedures of the Challenge, (including Carver's own caveat that he would be able to duplicate the sound of Holt and Archibald's reference amplifier within 48 hours of the first listening tests, having never attempted such a feat in the past). Nevertheless, Rosenberg suggested that Carver's efforts were, in fact, good for high-end audio, and good in particular for promoting vacuum tube amplification. "Oddly enough," he said, "I hope this replication process has succeeded."

> I would love for [Bob Carver] to produce some genuine, red-blooded tube amplifier replicas. It will accelerate the growth of [New York Audio Labs] because it would increase the public's awareness of the unique virtues of tubes. Imitation is the highest form of flattery. If B.C. helps us bring this awareness to a larger music loving public, I will personally give him a big hug and a juicy kiss (just like our midrange)... our industry needs exciting new products. We need to stimulate the music lover by provoking his imagination to higher levels of musical expectation. B.C. should create exciting new audio gizmos that challenge us – this is how every industry grows. We invite your challenge. Your charisma has been misused. I do not believe that your gifts are intended to make you an audio copier. Act like a leader. Let your deeds and works set a new high standard. Join the club, pay your dues, stop hiding behind amplifier challenges, and show us your musical stuff. Go ahead, make my day![154]

As O'Connell has observed, the Carver Challenge did little to undermine the market for tube products at any price – if anything, Carver's products sold quite well, and the market for high-end products built with either tubes or transistors continued to grow into the 1990s. Carver had demonstrated that a close approximation of tube sound was possible with an inexpensive solid-state amplifier. But Holt, Atkinson, and Archibald had further demonstrated that

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[154] Harvey Rosenberg, "Responses to the Carver Challenge," *Stereophile*, 9, 1 (1986): 60-64, on 63. The hi-fi magazine Rosenberg referred to was *The Audio Critic*.

differences in sound between Carver's amplifier and the tube-driven reference amplifier persisted and, to them, mattered.[155] In a 2008 interview with Robert Harley in *The Absolute Sound*, Carver admitted that his claims to being able to recreate the sound of an expensive tube amplifier were due, at least in part, to "youthful arrogance," and that his ability to make his copy amplifier sound so similar to the reference amplifier in such a short amount of time was the result of having "cheated" by doing quite a lot of practicing before the official Challenge got underway. "There's a lot going on behind the curtain," he said.[156] As O'Connell argued, "As long as some difference is present (no matter how slight), and as long as there is a reluctance to equate money with quality, the reference amp remains a defensible choice according to the rules of the audiophile game."[157] But these "rules" were more flexible than O'Connell allows. Although Holt, Pearson, and others within the high-end audio press continued to argue that "accuracy" in the recreation of a live musical experience was the primary goal of a high-end audio system, how accuracy was defined, and what priorities informed audiophile choices, remained subjective and disputed within the community.

The "New Wave"

Despite the controversies of the Carver Challenge, Carver had demonstrated that solid-state equipment could capture at least some of the qualities of the tube sound, and do so at more moderate prices. Without Carver's theatrics, other firms were following suit, and the ability of lower-priced components to capture some of the qualities of higher-priced components began to

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[155] In his comments, Atkinson noted that the Carver amp also sounded deficient in comparison with his personal reference amplifier at the time, a solid-state Krell.

[156] Robert Harley, "TAS Interview: Hi-Fi Maverick! Industry Icon Bob Carver Talks with Robert Harley," *The Absolute Sound*, no. 183 (August 2008): 28-37, on 30.

[157] O'Connell, "The Fine Tuning of a Golden Ear," 20.

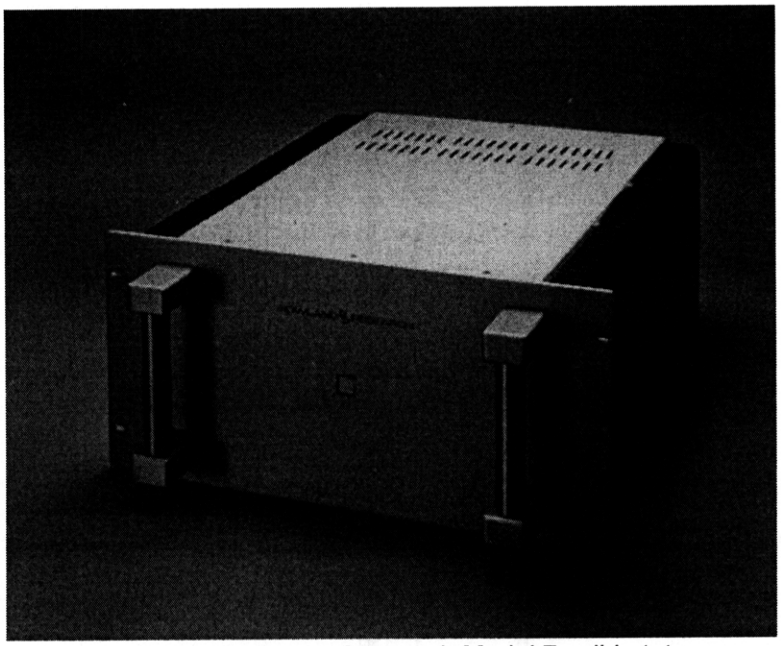

Figure 5.17 - The Rowland Research Model 7 solid-state power amplifier (from *The Absolute Sound* Winter 1986, pg. 76).

appear more regularly in reviews of higher-priced equipment. The Rowland Model 7 power amplifiers reviewed by David Wilson at *The Absolute Sound* were reviewed in *Stereophile* by that magazine's resident tube-o-phile, Dick Olsher. Several *Stereophile* reviewers, including John Atkinson and Anthony Cordesman, used solid-state amplifiers in their reference systems, but Olsher freely admitted his preference for the tube sound in his reviews. "What's missing [from solid-state amplifiers]," he wrote in 1986,

> is the magic of good tube gear. I refer to the palpable realism, the "reach out and touch someone" illusion, that... classic tube gear projects. There's also the question of musical textures: tube mids may be described as either soft or liquid, while solid-state mids in general sound grainier and somewhat "electronic" in nature. Some of you might argue that all of this is nothing more than tube euphonics, and that solid-state speaks the truth. That may be true. But for me, tube gear heightens the illusion of the original soundstage in my listening room; it's addictive! Once you experience this sonic high, it is nearly impossible to do without.[158]

Despite his stated preferences for tubes, Olsher was nonetheless entrusted with the review of the Model 7s. He attributed the "stratospheric asking price" of the power amplifiers to the quality of the chassis and the internal parts, and from a sonic perspective was particularly impressed with their performance in the high frequencies.

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[158] Dick Olsher, "Boulder 500 Power Amplifier," *Stereophile* **9**, 5 (August 1986): 105-107, on 107. Both Holt's and Olsher's comments regarding the lower-priced Eagle 2 solid-state amplifier in comparison with the $6000 + Threshold and Rowland Research amplifiers show that, as with tube products, a similar diversity of solid-state equipment was being developed to cover a variety of tastes and price points, but the top of the top-lines of equipment were becoming, as Olsher put it, stratospherically expensive.

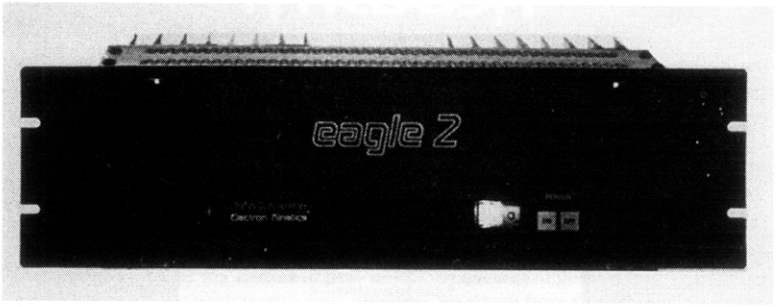

Figure 5.18 - The Electron Kinetics Eagle 2 solid-state power amplifier (from *Stereophile* **8**, no. 4, pg. 44). Used with permission.

> The extreme top is, in fact, the best I've ever heard from any amp – either tubed or solid-state. It is very clean and airy in character, with a touch of sweetness, not syrupy and rolled off as I've heard from some tube amps. The mid-treble and presence regions, down to about 4 kHz, are also exemplary: clean, very smooth, and the little on the soft side. All of this is quite remarkable for solid-state amp. My first reaction to these amps after a quick listen was, 'Gee, they might just cure me of tubophilia.'[159]

Regarding the bass performance, however, he stated that the Model 7s were not able to match the quality of the bass reproduction of the far less expensive solid-state Electron Kinetics Eagle 2 power amplifier, which cost $5505 less than the Model 7.

Olsher's comparison of the $6500 Model 7 and the $995 Eagle 2 pointed to what Anthony Cordesman called a "new wave" in more affordable power amplifiers, both tube and solid-state, that could compete sonically in certain areas with their higher-priced counterparts.[160] With increasing frequency, both *Stereophile* and *The Absolute Sound* lavished praise on several more affordable products in both the tube and solid-state categories, particularly the Eagle 2, and the $600 Adcom GFA-555 power amplifier. In a full review of the Eagle 2 power amplifier the previous year, Stephen Watkinson

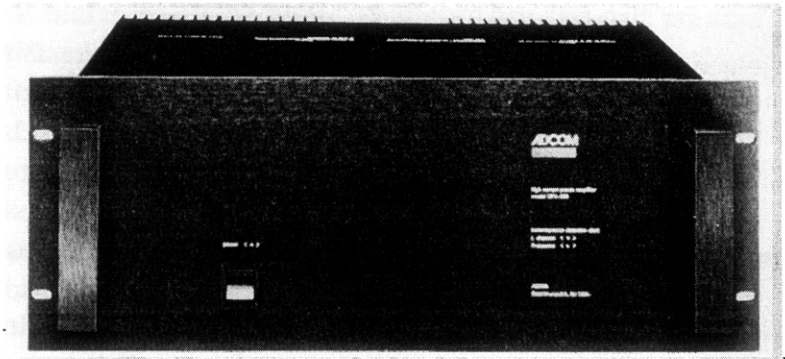

Figure 5.19 - The Adcom GFA-555 solid-state power amplifier (from *Stereophile* 8, no. 4, pg. 46). Used with permission.

[159] Larry Archibald, "Review: Electron Kinetics Eagle 2 Model 7711 Power Amplifier," *Stereophile* **9**, 1 (January 1986): 88-90 on 88 and 89. The importance of power supplies was another aspect of high-end audio equipment engineering that had emerged as critically important by the mid-1980s, led by, among others, engineer Paul McGowan of PS Audio.

[160] "Affordable" is, of course, a relative term – as many audiophiles I interviewed pointed out, the idea of spending $1000 on an audio component is ludicrous to many, if not most, non-audiophiles. For example, adjusted for inflation, the 2007 price of the Eagle 2 would have been nearly $2000. But, among audiophiles, investments made in audio systems often take place over considerable periods of time. It is for this reason that an extensive and active market exists for used high-end audio equipment.

had commented that "a quick glance at the Eagle 2's exterior leaves no doubt that your [money] has not been spent on fancy packaging... the looks of the Little Eagle are plain and uninspired."[161] "The overall sound," he wrote,

> is distinctly solid-state, but with a clean, smooth top end. In fact, the 2's [high frequency] performance is one of its strongest features: the highs are clean, clear, and well extended, with a natural sense of air. Cymbals and brushed drums are nicely detailed, without excess sizzle, and the upper harmonics on violins and woodwinds are reproduced very well. What makes the 2's [high frequency] impressive for its price is a combination of speed and air usually found only on the very best amps.[162]

In the same issue, Anthony Cordesman gushed over the sound of the Adcom GFA-555 power amplifier. "The GFA-555 does everything well, and most things exceptionally well," he wrote. "It provides superb, well-controlled bass with far better speaker load tolerance than most amps. Its midrange and treble are remarkably low in coloration. There is no hint of hardness, and none of the loss of inner detail common to transistor amplifiers."[163] Cordesman felt the sound of the GFA-555 was so good that it rivaled the much more expensive solid-state Krell amplifier that was his reference, while avoiding the "romantic" sound of some tube amplifiers.

More affordable tube designs were coming to market as well. The New York Audio Labs Moscode 600 was another creation of Harvey Rosenberg, designer of the massive (and expensive) OTL-3. Although the 600 was designed with a hybrid circuit, Rosenberg nonetheless felt the amplifier would inspire a great deal of passion among listeners as did his all-tube designs – a feeling he expressed in the product's promotional literature, which Cordesman described in his review:

> the amplifier comes with a diaper so the sonic excitement generated by its use will not embarrass you with "losing control of some private functions." (A little more gentle and a

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[161] Stephen Watkinson, "Electron Kinetics Eagle 2 amplifier," *Stereophile* **8**, 4 (1985): 44-46, on 44.

[162] Ibid.

[163] Anthony Cordesman, "Adcom GFA-555 – a Best Buy Breakthrough or the Start of a New Wave?" *Stereophile*, **8**, 4 (1985): 46-47, on 46.

> little less anal hyperbole would be welcome, Harv, baby.) You are warned not to jump out of the window when you play Prokofiev. You are promised that you will jump for "joy, jiving, diving, twirling and quivering." If this isn't upchucking good prose... I don't know what is.[164]

Cordesman described the sound of the $1295 Moscode 600 as "intensely musical," and added that "if it scarcely competes for most analytic power amplifier, well... romantics are never analytic."[165]

Other affordable tube products received positive reviews as well, but certain products were also revealing the limitations of convergence, and of what could be done sonically with cheaper products. Dick Olsher noted in his 1986 review of the $600 Lazarus tube-driven preamplifier that it "easily surpassed" many audiophile favorites from the past in terms of "its lively and clean sound," including the lauded Berning TF-10 hybrid, which he felt sounded "muddy and veiled in comparison."[166] Still, his overall impression was mixed:

> Unfortunately, the Lazarus is not entirely neutral sounding. There's a slight glare in the upper midrange that adds a little artificial excitement the sound. More worrisome in the long run is its tendency to lighten harmonic structures through the midrange. Instruments come through sounding a little threadbare, like a low-cal salad dressing that has the proper taste, but not the richness of the real thing. The longer I listened, the more aware I became of the lightweight harmonic textures, which principally accounted for my growing irritation with the unit.[167]

Olsher also felt that in spite of the convergence of solid-state and tube sound, some important distinctions remained. Some of these came out in his review of the VTL 30/30 power amplifier, an all-tube product. Compared with solid-state amplifiers, Olsher thought the VTL 30/30 did certain things very well, particularly in its reproduction of soundstaging – an aspect of music reproduction where many audiophiles felt tubes excelled over transistors. But, to Olsher, the

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[164] Anthony Cordesman, "The New York Audio Laboratories Moscode 600 – Surfing Backwards into the New Wave," *Stereophile*, **8**, 5 (1985): 82-84, on 82.

[165] Ibid.

[166] Dick Olsher, "The Lazarus Preamplifier," *Stereophile* **9**, 2 (March 1986): 90-92, on 91.

[167] Ibid.

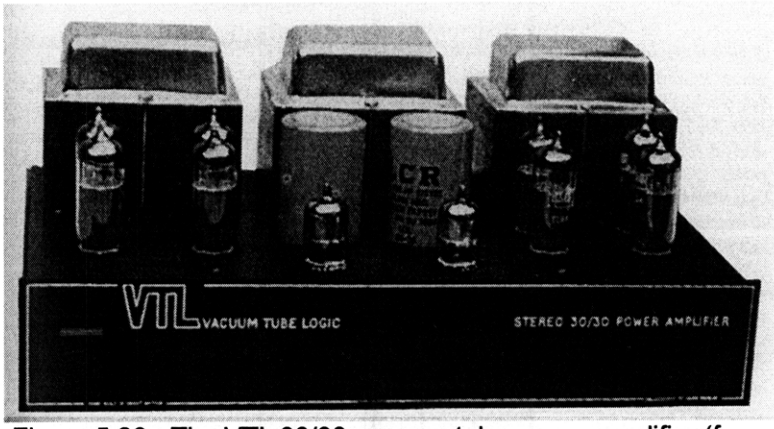

Figure 5.20 - The VTL 30/30 vacuum tube power amplifier (from *Stereophile* **10**, 2, pg. 105). Used with permission.

30/30 lacked the "lush, opulent phrasing of midrange textures and a three dimensionality" of classic tube designs, making the amplifier "less colored" but perhaps not satisfying for tube lovers who were interested in a more "romantic" sound.[168] In spite of the amplifier's relatively low $1040 price tag, Olsher felt that

> the VTL 30/30 loses out sonically to its tube competition: in a big way to the much more expensive gear, and enough so to equipment not that much more expensive that I don't see it as a good value. Compared with the much more expensive Jadis JA-30s, the VTL is much more opaque, with thicker, fuzzier midrange textures, with neither the French amplifier's sharp instrumental focus nor its bass control. Compared with the more expensive (by about $350) Quicksilver mono blocks, the VTL is eclipsed in the area of midrange purity and imaging. Even the very well-regarded Conrad-Johnson MV-50, at $1485, is not that much more costly than the VTL. Were the 30/30 priced, say, around $850, it would have received a hearty recommendation, but at its current asking price of about a kilobuck, I don't see it as competitive in the US audiophile marketplace.[169]

Olsher's comments about the lack of neutrality in the Lazarus preamplifier and the VTL's problematic midrange suggested that tube-based designs did not guarantee quality in the areas where tubes had traditionally been considered superior to transistors. But these comments also point to the tension between the "romantic" sound Olsher suggests some tube enthusiasts were after from their amplifiers, and the "accurate" and "neutral" sound that Holt, Pearson, and other audiophiles had been insisting was the goal of high-end audio. Towards the end of the 1980s and through the 1990s, a new divide emerged between the neutral-sounding tube equipment made by Audio Research, Conrad-Johnson and others, and purposely "euphonic" designs from firms like

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[168] Dick Olsher, "Vacuum Tube Logic 30/30 Power Amplifier," *Stereophile* **10**, 2 (March 1987): 104-106, on 105.

[169] Ibid., 106.

Bel Canto and Cary Audio based on a particular circuit topology known as single-ended triode or SET. SET amplifiers, despite their high levels of harmonic distortion and lack of output power, are considered by some audiophiles to produce what Olsher described as "remarkably sweet" midrange sound that some audiophiles find especially pleasing. But it is generally accepted within the high-end audio community that these amplifiers cannot be considered accurate. Aaron, a manufacturer's representative, described it this way:

> There are people that like this single ended triode in tube amplifiers, which [my company has] never done. Audio research has never done it, McIntosh has never done it. Why? Because there's no bass... and high distortion, and very low power. Because the signal goes through the output transformers only one way, so you don't cancel the distortion. So single ended triode is something more [like] a cult, more of, you know, [some people] are interested in that stuff. But it is... we have built several of those using 300Bs [tubes] and others, and [our engineers] would not put their name on an amplifier like this. Price, very high, very low power, no bass, and high distortion, even if it is tube distortion.[170]

While SET enthusiasts certainly do not represent the majority of high-end audio enthusiasts or even the majority of tube enthusiasts within the community, the popularity of these tube-driven devices begs the question of whether the tube renaissance of the early 1970s that helped to create the high-end audio community also enabled the production of equipment that failed to conform to the high-end audio ethos of fidelity and accuracy in music reproduction.

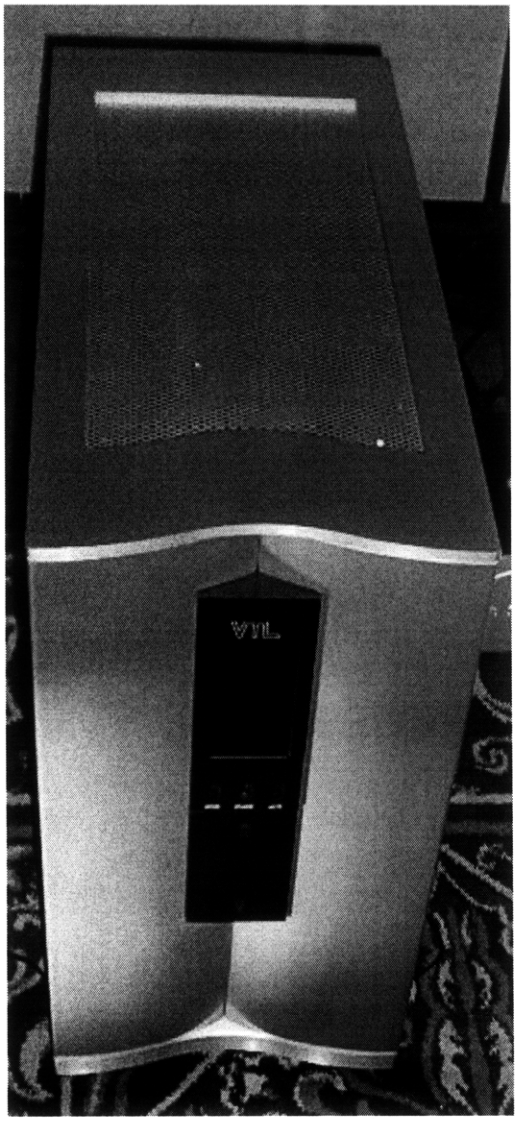

Figure 5.21 - The VTL Siegfried vacuum tube monoblock power amplifier (Home Entertainment Expo 2005, New York).

[170] Interview, 09/07/07.

But it further begs the question of whether this goal was important enough to enough people to sustain the community, or if the availability of a diversity of equipment, both tube and solid-state and representing a wide array of different sounds, was in fact the key thing that kept the interest of audiophiles throughout this period, and helped to draw new people into the community.[171]

Conclusion

The longevity of vacuum tubes in the high-end audio world does not appear threatened in the immediate future. Although new solid-state circuits known as class D or "switching" amplifiers are appearing with greater frequency, offering far greater efficiency than traditional solid-state or tube designs, the general feeling among audiophiles is that these designs need a great deal of refinement before they will seriously rival either traditional solid-state or tube products on the market.[172] Meanwhile, a variety of Chinese firms, and non-Chinese firms who manufacture their equipment in China, are bringing more tube products into the high-end world, often at vastly lower prices than American-made products. While SET amplifiers continue to be popular with some audiophiles, many tube-oriented firms such as Conrad-Johnson, Audio Research, and VTL continue to push tube designs further in the "transparent" and "accurate" direction. While the importance of nostalgia and many audiophile's appreciation of the "light show" aspects of tube electronics cannot be discounted, many of these products, particularly the VTL Siegfried power amplifiers, shown in Figure 5.21, sport very modern, sleek appearances that resemble high-tech computer towers more than mid-century hi-fi gear. Tubes, in other words, continue to straddle the line between high- and low-tech, vintage and modern.

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[171] This debate is covered more thoroughly in Chapter 4.

[172] A discussion of Class D amplification can be found in Chapter 2.

Some audiophiles expressed doubt about the future of vacuum tubes – not from a sonic perspective, but with regard to various other social and economic forces. Marcus, a salesman, expressed perhaps the darkest outlook on the future of both tubes and vinyl records, suggesting that the value of tube electronics came from the "experience" of listening to music through them – an experience that would become less common as social priorities shift, and other factors, such as the manufacturing of tubes, cease to be cost-effective in the parts of the world where they are still made. "Solid-state has improved enough that there is a fair amount of solid-state gear out there which can do much of what some… tube gear can do," he told me.

> But there's still that small differential, and again nobody can explain it. And people talk about harmonics and, you know, odd order harmonics versus even order and why this and that. But again, many people will tell you that the experience, and I'm purposely using that word, of tube systems is more pleasurable than a lot of solid-state…But, obviously, the vast majority of the population is still looking for the easy experience, you know…and as vinyl is ritualistic, so are tubes. Not only are they, they're hot… they're expensive in many cases to retube… you have to be mindful of the fact that they degrade in a way that requires attention. It's work. "I want a distributed audio system off of my computer." Tubes? I don't think so… somewhere along the line, for whatever sociological reason, the people who are into it now are going to drift out of it again, and I doubt that they'll be another group behind them…You have to value the experience. So if the social context doesn't value the experience, [forget it]. And, you know, humans are very forgetful. Or it's difficult to pass on a value, because there's a natural tendency for every generation, whatever that is, to just sort of go [screw you] to the generation before it just out of principle. You know, "that's what you believe in? Screw it." And we become, as a race, we become accustomed to whatever is our norm… So, if tubes are not, if the numbers don't meet the demand of… it will not take long before there will be a generation or a group of people who don't know… and they won't care, and that will be that. It'll be gone. As will, you know, quiet at night, or a lack of light pollution, or whatever. It'll just devolve out.[173]

Other audiophiles had a different outlook. Ben, a reviewer who expressed a fondness for tubes, told me that the convergence of the sound of tube and solid-state equipment has continued since the period covered in this chapter:

> From my perspective, there's almost a human and natural quality that tube equipment portrays that solid-state equipment often misses. Not always – in fact, as the audio world moves on, there's more and more of a convergence between the two. You find tube equipment becoming more sort of accurate, for lack of a better term, and solid-state equipment becoming more euphonic… now the lines are very blurry. You can find very

[173] Interview, 05/02/07.

> beautiful, very lush-sounding solid-state equipment, and you can find very fast, linear sounding tubes.

But he added an important distinction: "It's kind of like the difference between beauty and truth, and truth in the past has always been the domain of solid-state equipment, and beauty the domain of tubes."[174]

Ben's comments serve as a capsule example of what was at the core of the debate within the high-end audio community over tubes and transistors. The tension between "beauty" and "truth" was very directly related to the question of a "pleasing" versus an "accurate" representation of live music. While audiophiles such as Holt and Pearson praised the sound of power amplifiers and preamplifiers with terms like "beautiful" and "gorgeous," these impressions were associated with a product's ability to accurately mimic the aural sensations of a live performance. The equipment, in other words, should impart no artificial euphonic distortions or other artifacts to music in order to make it sound pleasing – the core idea behind the "neutrality" that many reviewers felt they heard in equipment from companies like Audio Research. For Holt in particular, this meant encouraging the industry to produce products that "dare to sound as 'alive' and 'aggressive' as the music they are trying to reproduce."[175] In a sense, from this point of view, beauty and truth were one in the same.

At the same time, as I have shown, the distinction between "pleasing" and "accurate" was often blurry, as was the locus of the beauty/truth that audiophiles professed to desire, particularly when it came to vacuum tube-based audio equipment. For many audiophiles, tube equipment evoked responses that were not entirely fixed to a set of sonic criteria, but included visual aspects

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[174] Interview, 04/20/05.

[175] J. Gordon Holt, "Where did we go wrong? J. Gordon Holt celebrates the three decades since he founded *Stereophile* by examining how far away the goal of High Fidelity still lies," *Stereophile* **15**, no. 9 (September 1992): 9-11, on 11.

as well and, as O'Connell has suggested, a feeling of "naturalness" that can also be attributed to the tube's glow, warmth, changing behavior over time, and eventual death (and, in some cases, potential for resurrection). In light of these characteristics it is easy to see why O'Connell chose to analyze the high-end audio community using a biological metaphor.[176] But such metaphors, and limiting the appeal of tubes to nostalgia and an unattributed audiophile desire for interaction with "non-threatening" technologies, obscures the breadth of the tube's aesthetic appeal in this community.

Regardless of future uncertainties, tubes have maintained an importance in the high-end audio community that would have been difficult to predict in the late 1960s. As I have shown in this chapter, not only did audiophile preferences for the aesthetic qualities of tubes prevent these artifacts from disappearing, they sparked a new series of innovations with what, in other contexts, was an outmoded device. The new life of vacuum tubes in high-end home audio is an example of a non-linear, non-deterministic path of a technological artifact set by aesthetic and emotional, as opposed to purely economic, forces. It is further an example of aesthetically focused innovation, where priorities for design among engineers are governed by forces commensurate with their membership in this small yet passionate community. While issues of nostalgia, elitism, and fetishism are not eliminated completely by the approach I have taken to telling the tube's story during this period, taking aesthetic and subjective impressions and preferences seriously can expand our understanding not only of this particular technological

[176] O'Connell states that, in his article, "[the high-end audio community] was chosen for its intrinsic fascination quite apart from any historiographic model and because it has many features that display technological evolution in a pure form, very much like the drosophila (fruit fly), whose ten-day life cycle and large chromosomes illustrate biological evolution so elegantly in the laboratory." O'Connell, "The Fine Tuning of a Golden Ear," 2.

artifact, but how these things serve as motivators behind design and consumption choices elsewhere.

Chapter 6:
"Perfect Sound Forever" –
Innovation, Aesthetics, and the
Re-making of Compact Disc Playback

The compact disc arrived on the consumer electronics scene in the early 1980s to much fanfare. Advertised by its designers as "perfect forever," the small, silvery plastic discs could reproduce sound with extremely low distortion and without surface noise, turntable rumble, or other troublesome aspects of vinyl record playback. The physical and technical characteristics of the CD system were born of a collaboration between two of the world's most powerful electronics firms: the Dutch firm, Philips, and the Japanese firm, Sony. Between 1979 and 1981, they established what came to be known as the "Red Book" standard for the audio compact disc – so called because of the red cover on the technical specifications manual. Two years after the formal announcement of the Red Book standard in June 1980, compact discs were being sold in Europe and Japan, arriving in the United States in 1983. By the end of that year, 800,000 of the discs had been sold around the world. By 1990, worldwide sales approached 1 billion.[1]

Despite this tremendous commercial success, a particularly dedicated group of music lovers felt CDs had one little problem: they sounded *awful.*

These were the high-end audio enthusiasts, often referred to as "audiophiles" – a community whose passion for music and music reproduction technologies, as we have seen, set them apart from mainstream consumers. While embraced by the general public and pushed by

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[1] Ken C. Pohlmann, *The Compact Disc Handbook*, 2nd ed., The Computer Music and Digital Audio Series V. 5 (Madison, WI: A-R Editions, 1992), 10-12

the wider consumer electronics and record industries, the CD evoked responses from high-end audio enthusiasts that ranged from cautious acceptance to vigorous rejection. Some felt the CD's flaws were inherent in the Red Book standard itself, while others believed the problems were localized in the recording and mastering of compact discs, and the CD players in listeners' homes. But beyond sound quality concerns, the CD system also represented a challenge to audiophiles' customary modes of interaction with the technologies of their hobby. Concerns about the limitations of the Red Book standard, aesthetic desires for improved sound quality, and an inclination toward greater interactivity between user and artifact led to a variety of technical innovations that delayed the acceptance of the CD in this community until years after it had been marketed as a "perfect" medium.

The story of the CD in the high-end audio community touches upon a variety of themes within the history and sociology of technology, particularly those concerning users, the role of aesthetics and enthusiasm in innovation, and the design of small scale socio-technical systems. In their 2003 edited volume, *How Users Matter*, Nelly Oudshoorn and Trevor Pinch show that technological innovation often takes place within a "culturally contested zone" where users, firms, and other stakeholders challenge and redefine the uses and meanings of technologies, at times through deliberate *non*-use.[2] They further show that separating users from designers becomes difficult as identities are blurred inside this contested space. Audiophiles, as a particular kind of user, have occupied this space since the early days of hi-fi. Research on

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[2] Nelly Oudshoorn and Trevor Pinch, *How Users Matter: The Co-Construction of Users and Technologies*, Inside Technology (Cambridge: MIT Press, 2003), 24; see also Trevor Pinch and Ronald Kline, "Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States," *Technology and Culture* **37**, no. 4 (October 1996): 763-795; Ruth Schwartz Cowan, "The 'Industrial Revolution' in the Home: Household Technology and Social Change in the 20th Century," *Technology and Culture* **17**, no. 1 (January 1976 1976): 1-23; Trevor Pinch and Frank Trocco, *Analog Days : The Invention and Impact of the Moog Synthesizer* (Cambridge, MA: Harvard University Press, 2002).

audiophiles has often focused on their behaviors as consumers, with some scholars emphasizing a desire among community members to build and retain social exclusivity, and others emphasizing "non-technical interventions" or "tweaks" that help users "personalize" the technologies of their hobby.[3] Some researchers have concentrated more specifically on the presence of hi-fi equipment in domestic spaces, and its influences, often gendered, on family interactions.[4]

But behind both patterns of consumption and uses of technology in the audiophile community are particular aesthetic motivations and enthusiasm for technology that also warrant attention. As described in Chapter 1, both aesthetics and technological enthusiasm have been shown by historians and sociologists of technology to influence both the development paths of particular technologies as well as the shape of technological innovation within user communities and in society more broadly.[5] The high-end audio community developed in part around the

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[3] Joseph O'Connell, "The Fine-Tuning of a Golden Ear: High-End Audio and the Evolutionary Model of Technology," *Technology and Culture* **33**, no. 1 (January 1992): 1-37; Marc Perlman, "Consuming Audio: An Introduction to Tweak Theory," in *Music and Technoculture*, ed. Rene T. A. Lysloff and Leslie C. Gay (Middletown: Wesleyan University Press, 2003), 346-357, on 347; Marc Perlman, "Golden Ears and Meter Readers: The Contest for Epistemic Authority in Audiophilia," *Social Studies of Science* **34**, no. 5 (October 2004): 783-807; Roland Gelatt, *The Fabulous Phonograph, 1877-1977*, 2d rev. ed. (New York: Macmillan, 1977); Alexander Magoun, "Shaping the Sound of Music: The Evolution of the Phonograph Record, 1877-1950" (Ph.D. Thesis, University of Maryland, 2000); Jeffrey Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975" (Ph.D. Thesis, University of Pennsylvania, 2004).

[4] Susan Douglas, "Audio Outlaws: Radio and Phonograph Enthusiasts," in *Possible Dreams: Enthusiasm for Technology in America*, ed. John L. Wright (Dearborn: Henry Ford Museum & Greenfield Village, 1992), 44-59; Keir Keightley, "'Turn It Down!' She Shrieked: Gender, Domestic Space, and High Fidelity, 1948-59," *Popular Music* **15**, no. 2 (May 1996): 149-177.

[5] See John F. Kasson, *Civilizing the Machine: Technology and Republican Values in America, 1776-1900*, 1st Hill and Wang pbk. ed. (New York: Hill and Wang, 1999); Joseph J. Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950* (New York: Oxford University Press, 1983); Thomas Parke Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970* (Chicago: University of Chicago Press, 2004); Robert C. Post, *High Performance: The Culture and Technology of Drag Racing, 1950-2000*, Rev. ed., Johns Hopkins Studies in the History of Technology (Baltimore: Johns Hopkins University Press, 2001); David N. Lucsko, *The Business of Speed: The Hot Rod Industry in America, 1915-1990*, Johns Hopkins Studies in the History of Technology (Baltimore: Johns Hopkins University Press, 2008); Immanuel Kant and Werner S. Pluhar, *Critique of Judgment* (Indianapolis: Hackett Pub. Co., 1987); Aden Evens, *Sound Ideas: Music, Machines, and Experience*, Theory out of Bounds V. 27 (Minneapolis: University of Minnesota Press, 2005); Herbert J. Gans, *Popular Culture and High Culture: An Analysis and Evaluation of Taste* (New York,: Basic Books, 1974); Pierre Bourdieu, *Distinction: A Social Critique of the Judgement of Taste* (Cambridge, Mass.: Harvard University Press, 1984).

ultimate goal of "fidelity," or "trueness to the source," in home audio reproduction. But despite general agreement regarding its importance, the details of what constituted fidelity were often the source of significant disagreement within the high-end audio community. Responses to the compact disc in this regard varied significantly, and were governed by what it represented both sonically as well as culturally.

As previous chapters have shown, since the height of the hi-fi hobby in the 1950s and 1960s, audiophiles have engaged in small-scale system-building – an activity often connected with the goal of increasing fidelity in the reproduction of music. The emergence of high-end audio in the 1960s and early 1970s shifted the emphasis in system-building from measurements and technical specifications towards what became known as "subjective" aesthetic goals, while retaining the focus on user intervention and interaction with audio system components. Upon its initial release, the appearance of CD technology as a literal and figurative black box, coupled with the perceived low quality of its sound, made the medium incompatible with the ethos of high-end audio. I argue that an aesthetically-motivated approach to systems-building inspired audiophiles to open this black box in an effort to incorporate the new medium into their systems-building paradigm. Within this paradigm, "system" is understood less as a large-scale, institutional entity possessing "momentum," and more as a small-scale entity where the user is as much a part of the feedback loop as any technical component, and where aesthetic concerns about sound quality and desires for interactivity motivate user action.[6]

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[6] I draw here upon Norbert Wiener's model of "cybernetic" systems – a more detailed description of small-scale systems building can be found in Chapter 1. See also Norbert Wiener, *Cybernetics: Or, Control and Communication in the Animal and the Machine*, 2d ed. (Cambridge: M.I.T. Press, 1965); David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics*, Johns Hopkins Studies in the History of Technology (Baltimore: Johns Hopkins University Press, 2002); see also Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983); Wiebe E. Bijker, Thomas Parke Hughes, and Trevor Pinch, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, Mass.: MIT Press, 1987).

As with the previous chapter's discussion of the "old" vacuum tube and the "new" transistor, the story of the compact disc is also necessarily the story of the analog vinyl LP, which at the time of the CD's debut was the dominant format for home music reproduction. For many audiophiles, their first exposure to digital audio came via digitally mastered analog LPs. And while the compact disc appeared to supplant vinyl records almost completely by the 1990s, some high-end audio enthusiasts continued to insist on the LP's sonic superiority. As with the vacuum tube, analog reproduction also set the standard of sound quality against which digital formats were judged. While a great deal of engineering effort went into improving CD sound, many engineers continued to refine the capabilities of vinyl playback, helping to preserve the medium and its associated technologies to the point that the two now often coexist in many listeners' systems. Further, the advent of digital recording also became an occasion for arguments about science and scientific practice and experimentation, as discussed in Chapter 4. This chapter will therefor include some discussion of state of vinyl LP playback during this period, and describe some of the specific arguments that erupted around digital audio writ large.

I begin with a brief overview of the emergence of high-end audio as an offshoot of the hi-fi hobby, and the particular aesthetic sensibilities that characterized this budding enthusiast community. I then discuss some of the key differences between analog and digital recording that influenced audiophile impressions of the CD medium prior to its formal commercial release. I next show how responses to early CDs and CD players varied within the community, and how perceived weaknesses in the sound of CDs prompted audiophiles to modify the CD system to improve sound quality. Finally, I demonstrate how, following the evolution of CD products from

both large and small firms throughout the 1980s and into the 1990s, efforts to "open" the CD system enabled its acceptance by the high-end audio community.

To best describe the various issues at stake for audiophiles concerning the CD, I draw from materials and sources closest to the high-end audio community: enthusiast magazines and oral history interviews.[7] As previous chapters have shown, debates and discussions about specific technologies, reviews of equipment, reader letters, interviews, and industry analysis have long filled the pages of high-end audio magazines. Oral history interviews with engineers, reviewers, retailers, and users, illustrate the significance of subjective, aesthetic impressions of equipment. In both cases, the voices of audiophiles themselves provide insight into how CD technology was perceived by this community. The purpose of this chapter is not to argue for or against the rationality of audiophile responses to the compact disc, but rather to show how high-end audio enthusiasts' aesthetic and systems-building aims compelled them to open this seemingly closed technology.

From Hi-Fi to High-End

High-end audio emerged from the post-war hi-fi craze that first introduced the term "audiophile" to the American public.[8] Hi-fi enthusiasts were predominantly male, white, and middle- to upper-middle-class.[9] Many built their own equipment from kits, and various companies, large and small, sought to capitalize on consumer interest by introducing numerous

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[7] Oral history interviews were conducted from February, 2007 to the present. Interviewee's names have been changed to ensure their privacy, and male pseudonyms chosen because all interviewees quoted in this paper are men.

[8] Douglas, "Audio Outlaws: Radio and Phonograph Enthusiasts," 44.

[9] Although high-end audio today is more ethnically and gender diverse, the majority of enthusiasts in the US are white men.

music delivery media and technologies for the home. Local audio clubs provided opportunities to form social bonds and share ideas, while specialty publications such as *Stereo Review* and *High Fidelity*, and popular magazines like *Saturday Review*, printed reviews of new equipment and tips for maximizing the quality of home audio systems. These systems were often comprised of four main parts, each of which could be considered a small system: source components, such as record players; a preamplifier, providing source selection, volume, and tone controls; a power amplifier, which amplified the signal to a level that could drive the final component: the loudspeakers.[10] CD players added to the roster of source components in such systems.

The high-end segment of this community coalesced in the mid-1960s and early 1970s, in part out of frustration with two perceived characteristics of contemporary hi-fi culture: a largely marketing- and producer-driven industry, and tendencies among hi-fi enthusiasts to become obsessed with equipment and technical measurements at the expense of the enjoyment of music.[11] Among the progenitors of this new community was J. Gordon Holt, a technical editor at *High Fidelity*, who founded his own publication, *The Stereophile*, in 1962.[12] Holt's approach to hi-fi in *The Stereophile* differed from other audiophile publications in several ways, but most significant was the de-emphasis of bench-test results and technical measurements in favor of descriptions of home audio equipment's "subjective" qualities. These descriptions emphasized emotional responses and aesthetic attributes of the sound based on extended listening in a home

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[10] Another common configuration consists of the preamplifier and power amplifier in a single unit called an "integrated amplifier." Integrated amplifiers with radio tuners are called "receivers." For further detail about audio system components and configurations, see Chapter 2.

[11] Tang argues that in the 1950s, the hi-fi hobby was comprised of two categories of people: music lovers who sought high-quality reproduction in their homes, and "bugs" or "fanatics" who seemed more interested in measuring music with various devices than listening to it. Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975", 165-168.

[12] The "The" in the title of the magazine was dropped in 1977, starting with volume 4, number 1, the 15th anniversary issue.

environment. Holt introduced his reviewing philosophy in the first issue by observing that "components that measure identically do not necessarily sound similar, and... audio equipment is, after all, designed to be used and listened to."[13] This was echoed by Harry Pearson, who founded his own high-end audio publication, *The Absolute Sound*, in 1973. In his inaugural editorial, Pearson wrote, "we have no brief against measurements and numbers. They are sometimes revealing, but, just as often, they are confusing. The ear is an infinitely more subtle and sophisticated measuring device than the entire battery of modern test equipment."[14]

For many, including Holt, the source of enthusiasm for home music reproduction was not the promise of attaining a "perfect" reproduction, but rather the enjoyment derived from efforts to get there. This approach, he acknowledged, had its downsides:

> ...it is difficult to accept the wisdom of [the impossibility of perfection] on an emotional level while we dump ever escalating globs of money into one state-of-the-art component after another... the hard fact of the matter is that perfection, like the end of the rainbow where the pot of gold is stashed, is always just a hilltop away. And as you advance, it recedes, because every subtle improvement in the fidelity of sound is reciprocated by an enhancement of the perfectionist's ability to hear evermore subtle imperfections.[15]

The notion of an ever-expanding ability to hear "subtle imperfections" in audio equipment was coupled with a conviction that the aesthetic effects of those imperfections could be consistently and accurately described, and both Pearson and Holt developed extensive vocabularies for describing the sound of particular parts of a home audio system. While Pearson, Holt, and the high-end audio community at large generally agreed that a high level of fidelity was the primary goal of any high-end audio system, they frequently clashed over precisely what constituted high

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[13] J. Gordon Holt, "*Stereophile* Reports on Equipment," *The Stereophile* **1,** no. 1 (September-October 1962): 12

[14] Harry Pearson, "Viewpoints (Reprinted in 20th Anniversary Issue)," *The Absolute Sound* **17,** no. 86 (March/April 1993): 90-91, 90.

[15] J. Gordon Holt, "Chasing Rainbows," *Stereophile* **5,** no. 2 (1982): 2-3, 30, 3.

fidelity, and how it was best achieved technologically.[16] The compact disc provoked one of the most intense and long-standing of these conflicts.

Analog and Digital Recording

Although the "subjective" approach to home audio, discussed in Chapter 4, emphasized sound quality based on observational listening over measurements and technical specifications, the technical aspects of home audio reproduction remained important to high-end audio enthusiasts. Technical choices affected how components operated together in a system, as with the pairing of loudspeakers and power amplifiers. Indeed, the technical specifications for the CD standard became one of many topics debated within audiophile circles long before CDs were available for purchase in the United States. The digital CD and the Red Book standard differed from the traditional analog LP in ways audiophiles felt were both technically and aesthetically important, and while digital recording offered many advantages over analog recording, it also introduced a variety of new challenges.[17]

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[16] For examples of subjective audio terms, see J. Gordon Holt, *The Audio Glossary* (Peterborough: Amateur Audio Press, 1990).

[17] LPs were not the sole analog medium available for home audio in the late 1970s. The compact cassette tape had been developed by Philips and released in Europe in 1963, and in the United States in 1964. Many audiophiles expressed the opinion that it was cassette tapes, not CDs, that undid the dominance of vinyl LPs before CDs arrived on store shelves. The success of the CD, they argue, came not from its sound quality, but because it offered better sound than cassettes with many of their convenience features. Further, some audiophiles noted that the highest-fidelity medium available both before and after the CD was reel-to-reel analog tape. Bill, a former shop owner, told me that when he was doing demonstrations for customers, he favored analog tape over LPs: "when I wanted to show the potential of a system that I was demonstrating to people, I didn't really use records. I was already well beyond that. I mean, I would thread up my 30 IPS [inches per second] tape machine, and I would basically just destroy my clients, and effectively destroy my competition. Now, the argument one could ask is, 'well, that's great, but what can I play at home?' And my answer to that was, 'that isn't the point. I'm showing you the potential of the system that I'm selling you. . . I'm putting this Ferrari on a track rather than driving it in traffic, and most LPs are driving in traffic.' And I knew that as a recording engineer long before digital came out... That was the norm for me. And I played those tapes to demonstrate the dynamics of whatever system I wanted to show. So the so-called advantages of digital when it first came out weren't relevant to me. You know, I was already beyond that, beyond the limitations of the LP." Interview, 04/20/07.

The fundamental difference between analog and digital is often described in the following way: analog is *continuous*, while digital is *discrete*. For example, consider a thermometer designed to record changes in temperature throughout the day on a drum of paper that rotates at a constant speed. The thermometer includes a coil of metal wire that expands and contracts with temperature. One end of the coil is fixed, and the other is attached to a small pen. As the temperature changes, the expansion and contraction of the coil is recorded by the pen on the drum of paper, producing an image of temperature changes over time. This continuous representation on the paper is "analogous" to the changes in temperature. A digital recording of temperature changes would be made by measuring the temperature at a specific time interval, such as once per second, and then storing the value of each measurement. These measurements can then be used to produce a similar graph of the changes in temperature displayed by the analog system. It is important to note that although we often associate digital information with computers, a recording made with a pencil and paper could still be considered digital if it involved these kinds of discrete measurements.

In the audio world, the same abstract descriptions of analog and digital still apply, although with a variety of extra variables. With both analog and digital audio, audio recording involves converting sound waves, or fluctuations in sound pressure through the air, into electrical signals, or analogous fluctuations in voltage over time. Microphones are used to convert the acoustic energy of sound waves into electrical energy by means of a small diaphragm that vibrates inside a magnetic field, creating a small electrical signal.[18] With analog recording, this

[18] The production of an electrical signal by varying a magnetic field is known as electromagnetic induction. A device used to convert one type of energy to another is known as a transducer. Audio systems can consist of different types of transducers, the most common being the voice coils in loudspeakers that convert the current signal from the amplifier into acoustic energy, and phono cartridges that convert the mechanical grooves in a vinyl LP into an electrical signal that can be amplified. See Chapter 2 for further explanation.

electrical signal can be recorded onto physical media magnetically, as with audio tape, or mechanically, as with vinyl records.[19] In both cases, the fluctuating electrical signal creates an analogous arrangement of metal particles in a tape or grooves in a record via direct contact between the recording implement and the medium itself.

With both analog and digital recording, recording engineers must make decisions about microphone placement for instruments, how many tracks to devote to a particular instrument, what effects (such as artificial reverb) to use, and perform a "mixdown," which involves taking multiple instrument tracks and mixing them to a right and left channel stereo track. Although a variety of factors affect the resulting sound in an analog tape recording, the fidelity depends in large part on the amount of tape surface used for a particular track in terms of both space (the amount of the tape's overall width devoted to the track) and time (the speed at which the tape passes over the recording head, usually measured in inches per second, or IPS). All else being equal, the more tape surface that is used during the recording, the higher the fidelity of that recording.[20]

Digital audio recording differs from analog recording in a number of ways, but the most basic is how the analog electrical signal generated by fluctuations in sound pressure is stored. With digital recording, the amplitude (in volts) of the electrical signal is measured periodically, and the value of each measurement is stored as a binary number that corresponds with the amplitude of the signal. The many steps in this process are known collectively as "analog-to-

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[19] The vinyl record had itself been the subject of standards fights in the late 1940s and early 1950s. For discussions of the evolution of analog recording and standards for playback, see Magoun, "Shaping the Sound of Music: The Evolution of the Phonograph Record, 1877-1950" ; Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham: Duke University Press, 2003); Tang, "Sound Decisions: Systems, Standards, and Consumers in American Audio Technology, 1945-1975" .

[20] Additionally, the composition of the tape surface, the electronics in the tape deck and mixing console, microphone quality, and a host of other factors all play a role in the final product of any recording session.

digital conversion," and the converted digital signal can be stored to digital magnetic tape, a hard disk, or other digital media. In order to reproduce sound from this digital signal, the binary numbers must be converted back into an analog electrical signal. This process is known as "digital-to-analog conversion."

Although there are different types of analog-to-digital and digital-to-analog conversion, the most well-known (largely due to its use in the Red Book CD standard) is called "pulse code modulation," or PCM. With PCM, the amplitude of the electrical signal is measured or "sampled" at a given time interval, and stored as a binary value of a specific size in bits – a process known as "quantization". Sampling rates are measured in kilohertz (kHz), or samples per second, and bit depths refer to the possible range of values for the measured amplitude of each sample. In a digital recording session, recording engineers can choose values for each of these attributes according to their available hardware, and the fidelity they and the performer hope to achieve for the recording.[21] For example, the engineer may choose to set the sampling rate to 96 kHz and the bit depth to 24 bits in order to make a high-fidelity digital recording.[22] This would mean that 96,000 times per second, the analog-to-digital converter measures the amplitude of the incoming electrical signal from the microphone, and stores that measurement as

[21] Most modern professional digital studios are equipped to record at a variety of sampling rates, some up to 192 kHz. However, the hardware necessary to processes this volume of information is expensive, so other studios or home studios are often limited to lower sampling rates. In most situations, professional or not, bit rates tend to be less diverse, usually either set to 16 or 24 bits per sample. At the time of the CD's release, a variety of digital recording systems were available, most operating at or below 16 bits and 44 kHz.

[22] Although multi-track digital and analog recordings both require a mixdown, an additional step is required for a digital recording if the final medium is a CD, which is to reduce the sampling and bit rates to the Red Book standard values of 44.1 kHz and 16 bits. High-resolution digital formats use higher sampling and bit depths for greater fidelity, but require special hardware to play back (Sony's high-resolution Super Audio CD, or SACD, format also uses a different analog-to-digital and digital-to-analog conversion process called Direct Stream Digital, or DSD).

a binary number with a possible value between 0 and 16,777,216.[23] The fidelity of a digital recording is affected primarily by these two attributes of PCM digital recording.[24] Sampling rates are associated with the "resolution" or level of fine detail of the resulting sound, and bit depths with the dynamic range, or levels of difference between the softest and loudest parts of the sound. To make a visual analogy, the sampling rate is akin to dots per inch, or DPI, in a digital image (such as 72 DPI for images on the web, 300 DPI or greater for print, etc), and bit depth corresponds to the range of possible colors each dot can be. The higher the DPI, the finer the details of the image. The greater the number of colors, the more difference between one shade and another will be visible. Both values contribute to the overall fidelity, or likeness to the original source, of the image, as sampling rates and bit depths contribute to the fidelity of the recorded sound.

When digital recorders first became commercially available in the 1970s, the advantages of a digital recording over an analog recording were numerous and significant. In an introduction to PCM digital recording in the April 1982 issue of *Stereo Review*, recording engineer and Boston Audio Society member E. Brad Meyer noted that these advantages included extremely low distortion and noise, the virtual elimination of "flutter", or minute, rapid variations in playback speed, and the absence of tape "print-through", or the effect of layers of tightly-wound magnetized tape causing ghost-like "echoes" on adjacent layers. In addition, the "error-free" storage and retrieval of digital data meant that exact copies of an original digital master

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[23] For example, with Red Book PCM, a 16 bit number gives $2^{16} = 65,536$ different possibilities. A 24 bit number gives $2^{24} = 16,777,216$ possibilities. The greater the bit depth, the more possible amplitudes can be represented per sample, and the more finely detailed the dynamics of the resulting sound.

[24] Sometimes "bit rate" and "bit depth" are used interchangeably, but "depth" is a more accurate description because it relates directly to the amplitude and dynamics of the sound that is reproduced when the binary numbers are converted back to analog electrical signals.

recording could be made for reproduction, unlike analog reproductions, which were frequently copies of copies and thus suffered from generational degradation.[25] But this description, he noted, was "what one might call the chamber of commerce version of digital recording."[26] In reality, digital recording introduced a variety of new distortions and new problems quite different from analog recording, and not nearly as well understood. Meyer noted that the low distortion figures for digital recording were only relevant at high signal levels, which was where the most distortion in analog recording systems occurred. Digital systems, by contrast, had their worst distortion at low signal levels. "Distortion in a digital system arises from the fact that the 'ruler' used to measure the signal has gradations of finite size, and the lower the signal level, the larger these gradations are relative to the signal," he observed. "Near the bottom of its dynamic range a digital recorder can add a harsh, gritty distortion to the signal which is known as granulation noise. The subjective effect of this noise is much more unpleasant than ordinary [analog] tape hiss."[27] PCM also generated distortion at frequencies that were equal to "the difference between the sampling rate and three times the signal" – a phenomenon "too complicated to go into" in his article, but also absent from analog recording.[28] Meyer further described another characteristic of PCM digital recording that many audiophiles later suggested was the cause of poor sound quality of early CDs: the "hard" clipping of digital recorders pushed beyond their maximum recording levels. "At the upper end of its dynamic range," he wrote,

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[25] E. Brad Meyer, "Digital: A Not Unbiased Examination of Some of the Pros and Cons of the New Recording and Playback Process That Is About to Revolutionize Our Listening Lives," *Stereo Review* **47**, no. 4 (April 1982): 56-59, 57.

[26] Ibid., 58

[27] Ibid.

[28] Ibid.

> an analog recorder, when presented with a signal too loud to be recorded without distortion, limits the amplitude of the signal gradually, rounding off the tops of the waveform in a way that makes the subjective effect relatively mild. A digital system, however, reaches its upper limit abruptly, and anything above that limit is clipped hard, with sharp corners where the waveform flattens. This hard clipping is much more objectionable than the soft clipping of the analog system, so the recording level on the digital machine must be set a few decibels farther below the maximum for safety. This effectively reduces the usable dynamic range of the digital machine from what the specification might lead one to believe.[29]

These new constraints and features of digital recorders, and the new medium of the CD, were not well understood in the music industry at the time of the CD's release. While some mastering engineers had record cutting machines in their studios, the mastering and duplication of CDs were beyond the means of independent studios, and were done at separate facilities.

Digital Vinyl

These "closed" aspects of digital recording and mastering, in concert with the functional behavior of CD players for home audio, led many audiophiles to view both digital audio and the CD system with a degree of suspicion. At the same time, high-end long-playing vinyl record, or "LP," playback had reached what one interviewee described to me as a "high level of refinement."[30] LP playback involved a variety of user-controlled variables, such as the downward force of the stylus against the record groove, that had noticeable effects on the sound from LPs. Turntable systems were also very open, with key parts such as the platter, tonearm, cartridge, and sometimes the motor, visible and accessible to users. Although not all audiophiles relished the work involved in setting up turntable systems and LPs to achieve the best sound, the diversity of products available and potential for improved sound through user manipulations kept many audiophiles interested in the hobby.

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[29] Ibid. This type of clipping was also one of the characteristics that distinguished tube amplification, which tended towards a rounded, analog clipping, and transistors, which clipped hard.

[30] Interview, 03/11/07.

For some audiophiles, the rituals involved in tweaking the performance of the record player and caring for their record collection were important aspects of their enjoyment of the hobby. For others, these procedures were considered a nuisance. Vinyl LPs were also limited in the amount of music that could be stored on a single side, which meant many trips back and forth to the turntable to flip over or change records, particularly for classical and orchestral pieces that tended to be longer than rock and pop songs. In addition, certain sonic issues with vinyl playback – the familiar pops and clicks generated by static electric interference and/or dust particles encountered by the stylus on the surface of the LP, along with various distortions and the noise characteristic of the medium – were a frustration for some music lovers. Jim, a former equipment reviewer, described it this way:

> It's surprising [vinyl LPs] sound as good as they do, given the intrinsic, primitive nature of dragging a stylus through this torture test of grooves, which, as they get closer to the center of the record, get compressed, and they pinch the stylus, and all kinds of horrible distortions occur that you can hear!... There's no way you're going to get around, if you've got a highly modulated pipe organ recording or piano recording with big peaks... or an orchestral recording, as you get towards the inner grooves... and unfortunately, that's the way a lot of classical music is, and solo piano works, that they build to a tremendous...a big crescendo, as you near the center of the record. And those distortions are... my knuckles used to turn white as I knew that...I thought, "oh God," you know, I'm gripping the chair because I know, as good as my cartridge is at tracking, it's going to mistrack, probably.[31]

While some of Jim's complaints were related to attributes inherent in vinyl playback, engineers began trying to resolve some distortion issues and limitations of the analog recording process prior to the advent of CDs by combining analog and digital recording techniques. By the late 1970s, while many recordings were still made with and mastered on analog tape, others were recorded with early digital recording equipment, and digital master tapes were used for cutting the lacquer masters used to produce vinyl records. Although the expense and complexity of early

[31] Interview with author, 05/07/07. Mistracking distortion is caused by the stylus jumping out of the groove of an LP during heavily modulated passages.

digital systems limited them to professional rather than home use, this did not prevent the technologies from sparking debate and discussion among audiophiles, and many had their first encounters digital audio through digitally mastered analog LPs. The sound of these LPs, and the proposed standards for digital recording, thus became fodder for broader debates about digital versus analog sound.

Jim recalled his first experience hearing a digitally mastered vinyl LP:

> There was a period when digital recording was developed by Soundstream that Telarc records were releasing. They made digital masters, and they mastered them to analog vinyl. This was before the compact disc. The first time I ever heard a Soundstream recording, a Soundstream recorder, was a revelation to me. And likewise, at an AES chapter meeting in Toronto, when I heard a first digital recording of solo piano, I said, "that is the way piano's supposed to sound! There's no flutter. It's solid. Sustained."... [Digitally mastered records,] cut to vinyl, and then played back on my direct drive turntable, there was no audible flutter... In fact, I can even tell you of the recording. I think it was... an American pianist, Malcolm Frager, playing Chopin, and it was a great recording. Lots of dynamic peaks and stuff. And when it was mastered to vinyl, it was a real test for phono cartridges at the time because many of them wouldn't track the peak levels on it. But, it was [the] combination of an original digital recording, mastered to vinyl, played back on a direct drive turntable, where I could not detect flutter.[32]

Phillip also remembered the first digitally-mastered vinyl LP he heard, but had a very different reaction:

> The first digital rock recording was announced. It was Ry Cooder's "Bop till you Drop". I ran down and bought it, because the magazines were saying "look, this is a new world. There's gonna be no noise, no distortion, no wow and flutter, no tape hiss. I mean, it's gonna be huge dynamic range, I mean, it's just gonna be so much better than what you're used to." So I had been a Ry Cooder fan, I had all his records up to that point, and I went out and I bought that record... And I get home, and I put this record on, and my expectations were all positive... I went into this with only the highest of expectations. And I put this record on, and it was like something so wrong with it, and what was wrong with it wasn't even... it wasn't even the sound that was wrong. It was how it made me feel... it made me feel... it made me feel bad. And I mean, it was like when a beat happens... what makes music good is that you get in the zone, and then the beat repeats itself, and you get in the zone and you get relaxed... but the opposite happened. With each beat, it was like a pile driver pushing me further down into the ground and made me feel worse and worse and worse until two or three minutes in, I couldn't listen anymore. I didn't recognize what I was hearing. It didn't sound like music, it didn't... It was so weird. I'll never forget that experience.[33]

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[32] Interview with author, 05/07/07.

[33] Interview with author, 05/29/07.

While there are a variety of variables in these two experiences, including how the Frager and Cooder recordings were produced, they show that digitally-mastered analog LPs were a source of serious disagreement among audiophiles, and illustrate the different approaches that different audiophiles took to analyzing recordings. While Phillip cited concerns for accuracy and fidelity during our interview, his description of his experience was primarily emotional, and his approach to home audio was like that of the "observational listeners" described in Chapter 4. Jim, on the other hand, was in the "double-blind listeners" camp, and his description addressed the absence of characteristic distortions in analog-mastered recordings (while making an argument about how a piano "should" sound). Phillip's response also pointed to one of the many questions about early digital recordings that persisted long after the CD's release: the psychological effects of digital recordings.

The Psychology of Digital

In 1980, psychologist John Diamond gave a presentation at the Audio Engineering Society convention in Los Angeles, demonstrating part of his larger research efforts into the negative psychological effects of digitally-encoded sound. Diamond's experiment involved stress tests, where muscle strength in a subject's arms was measured during playback of analog recordings and playback of digital recordings. He claimed that during the playback of digital recordings, test subjects exhibited weaker muscle response than when analog recordings were played. In a letter to *The Absolute Sound*, Nelson Morgan of the Electronics Research Laboratory at the University of California at Berkeley suggested that Diamond's presentation proved nothing beyond his failure to apply proper scientific controls to his research. "While [Dr. Diamond] did provide an interesting show (in which volunteers had their arms pushed down

more easily by the speaker during the digitally recorded passages)," Morgan wrote, "he failed to use even the most elementary precautions to ensure the significance of the results."

> Specifically, the following deficiencies were noted:
>
> 1. the test was not double or even single blind, that is, the experimenter was aware of which was which in his repertoire, and frequently stated out loud the character of each recording.
>
> 2. the demo did not employ selections that were identical except for the factor under test (digitization); pair elements were only chosen to be similar.
>
> 3. the stress criterion used was a highly subjective one (performed by the experimenter), and not one shown to be correlated with any more conventional measures of stress, such as GSR (galvanic skin response) or EEG (electroencephalograph) measurements.

"Scientific method is not a frail or a fetish," he said in closing. "It is a necessary minimum to achieve meaningful results."[34]

Diamond, whose response to Morgan was published in the same issue, acknowledged the lack of double-blind conditions, but said that under the constraints of a 20 minute presentation, there wasn't time to conduct a proper double-blind test (although he claimed that over 200 double-blind experiments had been conducted as part of his larger research project). The real issue with his presentation, he suggested, was not the absence of scientific controls so much as it was the money at stake in the push towards digital recording and distribution in the audio industry – an argument that would be repeated by high-end audio enthusiasts dissatisfied with the CD's performance. "I was warned on several occasions before I presented my paper," he said,

> that "the big manufacturers are out to get you." And I understand from the program chairman that attempts were made, predominately by Mr. [Bart] Locanthi of Pioneer development labs, to have my paper moved from the general session to the digital session, where it would not be heard by the majority of the membership. I was told by more than one member of the AES that the manufacturers "took a bath" with quadriphonic [sic] sound and that they were going to make very sure that no one "rocked the boat" with digital because of the billions of dollars involved.[35]

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[34] Nelson Morgan and John Diamond, "Controversy 1 – Debates: A Scientific Truth of Dr. John Diamond's Attack on Digital," *The Absolute Sound* **5**, no. 20 (December 1980): 391-395, 391.

[35] Ibid., 392.

In defense of his experimental methodology, Diamond asserted that his research had been "precise and accurate," and had demonstrated a repeatable difference in muscle response with analog versus digital playback. But he further criticized Morgan and others both for their narrow view of science, suggesting that "true science does not start with taking measurements," and questioned the value of scientific approaches to audio and music reproduction.

> The banner of science is raised against my "fetish." And yet, in the long run, should not your own house be put in order before criticism is made of me? After all these years of scientific research, we still do not really have a good loudspeaker. It seems that we still cannot even agree on tubes versus transistors or on which class of amplifier. We cannot agree on microphone placement, or even on matching microphone types to specific instruments. And, of course, all the scientific measures are quite unable to approach the measurement of the artistic worth of the music and the performer. All of the scientific equipment seemed somehow to have been at best of limited value. And this is why there has been, in the consumer's mind, so little respect paid to the "aboveground" reviews of equipment, with all the measurements neatly displayed. Instead, there is tremendous interest and respect for the underground magazines, which have concentrated on the subjective, on the listening effects. They have stated for years that the measurements are not what matters. There is something else. And that is the human response. And the human response somehow is more subtle and more valid when used correctly and in its appropriate place than all the millions of dollars worth of so-called scientific equipment.[36]

Diamond's argument clearly aligned with Pearson's reviewing philosophy for *The Absolute Sound*, and his criticisms of the measurement-oriented approaches used by the more mainstream hi-fi magazines.[37] But Diamond's experiments were also discussed in the pages of the leading audio magazine in the United States, *Stereo Review*, which had traditionally been a measurement and double-blind listening-oriented publication. In E. Brad Meyer's April, 1982 article about PCM recording, he referenced Diamond's research with skepticism, suggesting that better designed experiments had called Diamond's findings into question, and noted Diamond's references to "dark tales of conspiracy" among manufacturers of digital equipment who, Diamond claimed, had refused his requests to participate in his demonstration.[38] Diamond

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[36] Ibid., 394.

[37] This philosophy is explored in-depth in Chapter 4.

[38] Meyer, "Digital: A Not Unbiased Examination," 59.

responded to Meyer's comments in the July issue of *Stereo Review* by suggesting that Meyer, like Morgan, was conflating his AES presentation, which was a "demonstration" rather than an "experiment," with his controlled research. He invited *Stereo Review* readers to write to him for a copy of his full research findings and decide for themselves whether his experiments were conducted properly, and what, if any, significance his findings had for digital recording.[39] In response, Meyer wrote that his own request to Diamond for the full findings had thus far gone unfulfilled, but mentioned that the experiment had been repeated by the Detroit chapter of the Audio Engineering Society, and their results matched those of Diamond. "However," he said, "they then made one small change: the experiments were repeated, but made 'double-blind,' so that neither subject nor tester could know which selection was playing. All correlation between digital sound and the strength of the subject's deltoid muscles disappeared."[40] But Meyer observed that despite a lack of sufficient proof of digital audio's psychologically damaging properties, the "controversy rage[d] on," and questions about the psychological effects of digital recordings continued to inform research well into the 1990s.[41]

Debates about the negative effects of digital recording also went beyond psychological effects in listeners to physical and mechanical effects in audio components. In 1985, Dr. Judith Reilly, a physics and mathematics teacher in Massachusetts, claimed that ultrasonic signals generated by digitally-mastered LPs were inducing microscopic cracks in turntable bearings,

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[39] John Diamond and E. Brad Meyer, "Digital Dissent," *Stereo Review* **47,** no. 7 (July 1982): 6.

[40] Ibid.

[41] In the January 2000 issue of Stereophile, Markus Sauer described the research of psychologist Jurgen Ackermann in Germany, who conducted listening tests with analog and digital equipment, and asked listeners questions about their emotional states. His findings suggested that listeners felt more at ease, less nervous, and were more likely to tap their feet or sing along during analog playback than with digital playback, although Sauer acknowledges that Ackermann's study was too complex to describe in detail, and that he had not yet completed his statistical analysis of the results. Markus Sauer, "God Is in the Nuances," *Stereophile* 23, no. 1 (2000), http://www.stereophile.com/features/203/index.html.

causing variations in platter speed that resulted in a distorted, unpleasant reproduction of music. Her research was first described in print by Neil Levenson, the resident equipment reviewer at the classical music review magazine, *Fanfare*. Beginning in the spring of 1984, Levenson published a series of articles based on Reilly's research, including oscilloscope traces and photographs of bearing micro-cracks.[42]

After seeing Levenson's article and the accompanying photos from Reilly's lab, J. Gordon Holt wrote about Reilly's claims in *Stereophile* with a degree of skepticism. While acknowledging that "hard evidence is hard evidence, and Prof. Reilly appears to have more than enough to support her claim that something narsty is afoot," Holt nonetheless found her research findings hard to accept. For one, he observed that her claims of damage went beyond turntable bearings, and included a preamplifier made by Mark Levinson Audio Systems, which she told Holt she had returned to the factory for repair "after it had been 'damaged' by receiving input from digitally mastered analog records." Holt called MLAS and was told that the repair was a fairly routine updating, but that Reilly had insisted that "no digital recordings be played even in the same room where her component was being 'repaired.'" To Holt, this suggested an anti-digital bias that undermined Reilly's claims to objectivity. Holt was also at a loss to explain how enough ultrasonic energy could be generated during playback of a digitally mastered LP to induce micro-cracking when the relative amounts of energy in a turntable system were so small.

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[42] Levenson's first article appeared in the May/June 1984 issue of *Fanfare*, including oscilloscope traces. Micro-crack photos appeared in the November/December 1985 issue. Neil Levenson, "New for Audiophiles," *Fanfare* **7**, no. 5 (May/June 1984): 88-93; Neil Levenson, "New for Audiophiles," *Fanfare* **9**, no. 2 (November/ December 1985): 325-335. Levenson was no fan of the CD during its early years, sounding much like Harry Pearson in his observations about the medium's unpleasant sound. Describing a listening session at a friend's house in the September/October 1983 issue, Levenson said that "not a single instrument survived with its tone structure intact," and that a sudden noticeable improvement in the sound was achieved only when his friend turned the CD player off and switched over to FM radio. Neil Levenson, "New for Audiophiles," *Fanfare* **7**, no. 1 (October 1983): 23-31, 24.

"How do we explain Prof. Reilly's findings?" he asked. "We don't. And I have a strong suspicion we won't have to, because, very frankly, I find this business just a little bit fishy."[43]

In the following issue, Reilly responded angrily to the way Holt and *Stereophile* publisher Larry Archibald had presented her research, saying that the low-quality graphs she had sent them had not been intended for publication, and would both confuse readers and make her appear less credible. She also included a more thorough description of her hypothesis:

> To account for the observed speed variations [in turntables], I have postulated that, once the micro crack is generated, moving dislocations pile up against it, thus storing energy in its immediate vicinity. Here thermal energy is of primary importance... As the dislocations collect (established in electron microscope micrographs), the area adjacent to the micro crack becomes elastically deformed. When the energy builds up sufficiently, it is suddenly released in the form of little shockwaves called acoustic emission (AE). AE is typically a high frequency phenomenon of 50 kHz or more.... the hypothesis is, given the high density of micro cracks, AE bursts are continually emitted, causing minute tremors in the bearing. Cumulatively these tremors lead to speed variations and the attendant musical smear.[44]

In addition, she defended her experimental practice by suggesting that "the correlations existing between the many experiments and the theoretical postulations are of such a magnitude as to warrant further investigation, not immediate, out of hand dismissal," and turned her response to Holt's skepticism into a lesson in the scientific method:

> Correlation is the very nature of original research into areas heretofore unexamined. From experimental data certain relationships emerge. Hypotheses developed to explain these observed relationships lead to predictions which are then tested in the laboratory – and so it repeats. Such is the manner in which the study has proceeded. The recurring marked consistencies between laboratory results in my theoretical predictions are currently grounds for further research.[45]

Holt was unsatisfied, citing numerous references in her response to "experts" who went otherwise unidentified, and several missing details he considered critical to accepting her claims, such as how she explained where the "digital spuriae" in digitally-mastered LPs came from since

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[43]J. Gordon Holt, "Stop Digital Madness!," *Stereophile* **8,** no. 8 (1985): 5-12, 10.

[44] J. Gordon Holt and Judith Reilly, "Professor Reilly Responds – with Spirit!," *Stereophile* **9,** no. 1 (January 1986): 47-59, 50.

[45] Ibid., 54.

the process of D-to-A conversion turned sampling pulses back into a relatively steady analog signal before the lacquer master disk was cut.[46] In an addendum to Reilly and Holt's back-and-forth, Archibald admitted some discomfort with the idea of publishing Reilly's findings in the first place, but discovered that many in the high-end audio community already knew about it, and most appeared to side with Holt or were otherwise suspicious of Reilly's findings. The Scottish turntable manufacturer Linn had also conducted its own tests and found no correlation with Reilly's findings, as had John Atkinson who, at the time, was editor of *Hi-Fi News and Record Review* in the United Kingdom.[47] Holt's suspicion of her claims may have, in part, been a byproduct of his general frustration with the anti-digital rhetoric in high-end audio, or defensiveness of his own support for digital. Reilly's claims were ultimately dismissed due to lack of repeatable results among other researchers.

As these examples show, debates about the quality of digital audio arose before the CD was commercially available, and those about digitally mastered analog LPs persisted after the CD was released. Some audiophiles believed that the issues related to digital audio would be solved once a digital medium for home reproduction was available, not unlike audiophile attitudes about solid-state electronics in 1960s and early 1970s. In other words, a digital medium such as CD would solve many of the sonic issues with digitally mastered analog recordings much as a solid-state amplifier could resolve the issues heard in systems that combined solid-

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[46] Ibid., 56.

[47] Clark Johnsen, "Digital Madness and *Fanfare*," *Stereophile* **9,** no. 8 (December 1986): 17-23. Johnsen had originally sent his article, a refutation of Reilly's hypothesis, to *Fanfare* for publication, but it was rejected. *Stereophile* then agreed to publish it.

state preamplification with tube power amplification.[48] In the meantime, the technical details of the forthcoming CD, and PCM, continued to be hot topics in the pages of both subjective and objective audio magazines.

The "Black Box"

At the time of the compact disc's introduction, some audiophiles felt that high-end audio had become increasingly marginalized relative to the mainstream electronics industry, and that non-audiophiles simply didn't care about quality sound. "So far as the general public was concerned," Holt lamented in 1982, "the high fidelity movement was probably a lost cause from the start."

> It was simply a fad, and went over for all of the wrong reasons – status (all the rich people have it!), snob appeal (all the cultured people have it!) and the herd instinct (everybody else is getting it!). But without any real understanding of what it was all about – better sound, rather than different sound...[49]

Earlier that year, Holt half-jokingly noted that each time a new medium for home music reproduction was introduced, regardless of improvements it may have offered over existing media, music lovers would "denounce" it as "unmusical."[50] Although characteristically irreverent, Holt presented the high-end audio community as having concerns about new home audio technologies that were not, in his estimation, uniformly reasonable.

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[48] Holt suggested in response to a reader letter concerning digital sound that having an "intervening analog disc" introduced distortions that were not audible in digital recordings where no such disc was present. J. Gordon Holt, "Digital Revenge – Response," *Stereophile* **5,** no. 9 (November 1982): 40-42, 42. Douglas Sax took the opposite view – that once CDs were available (often referred to prior to their public availability as "digital audio discs" or DADs) the problems of digital audio would be revealed to have nothing to do with issues related to transferring digital tapes to analog vinyl LPs. "As the DADs become available," he wrote in a Stereophile editorial, "you will ultimately come to one of two conclusions: either all the recording engineers have gone bad, or there is something rotten in the state of Denmark." Douglas Sax, "The Flip Side of Digital," *Stereophile* **5,** no. 9 (November 1982): 3-4, 36, 36.

[49] J. Gordon Holt, "The Revolution That Never Was," *Stereophile* **5,** no. 4 (1982): 2-3, 3.

[50] J. Gordon Holt, "Where We Are and How We Got Here," *Stereophile* **5,** no. 3 (1982): 2-3, 18-19, 2.

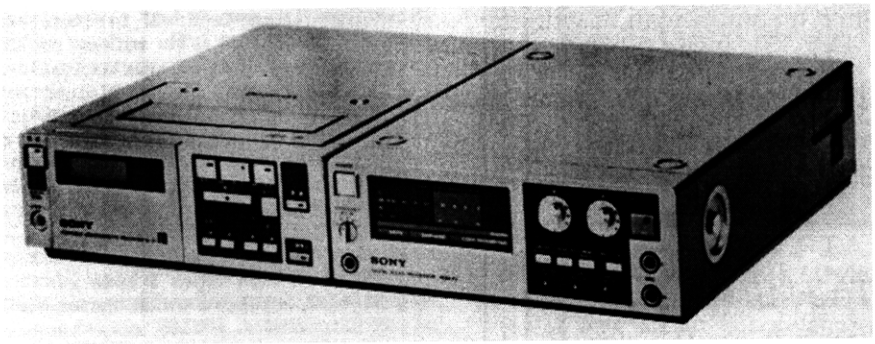

Figure 6.1 - The Sony PCM-F1 (r) and SL-200 BetaMax video recorder (from Stereophile 5, no. 7, pg. 5).

Although many audiophiles first encountered digital audio in the form of digitally mastered analog LPs, there were hints of, and much discussion about, digital audio standards for the forthcoming CD in the years prior to its availability in the United States. The Red Book standard for the CD established a sampling rate of 44,100 samples per second (44.1 kilohertz, or kHz), and a "bit depth" of 16 bits of information per sample. Standardizing these values was an essential part of Sony's and Philips' plans to license the Red Book specifications to other manufacturers, and ensure compatibility with properly-manufactured CDs.[51] But prior to the formalizing of the Red Book standard, Sony provided a preview of what digital home audio might be like with the release of the PCM-1 in 1977. The PCM-1 and its updated version, the PCM-F1, were digital-to-analog converters, or DACs, that allowed the recording and playback of digital audio via video cassette tapes, and were aimed at amateur recording hobbyists. The first review of the PCM-1 appeared in *Stereophile* in 1979, and while Holt made only a few recordings with it, he was left with a very favorable impression of its sound.[52] Others raised doubts about the PCM process immediately.

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[51] The Red Book standard's sampling rate was based on the Nyquist-Shannon sampling theorem, which posits that in order to reconstitute a continuous, analog signal from a discrete, digital signal, the sampling rate of the digital signal must be at least twice the frequency bandwidth of the original source. 44.1kHz was selected because it was just over twice the audible frequency range of human hearing, which extends roughly from 20 Hz to 20 kHz, and because of compatibility requirements with U-Matic tape machines used for CD mastering. 16 bits was chosen because it was felt to provide sufficient dynamic range, and because of constraints in the processing power of available digital-to-analog converters. For more thorough explanations of digital audio, see Pohlmann, *The Compact Disc Handbook* and Robert Harley, *The Complete Guide to High-End Audio*, 3rd ed. (Tijeras: Acapella Pub., 2004).

[52] J. Gordon Holt, "Sony Pcm-1 Digital Recording System," *Stereophile* **4,** no. 4 (1979): 14-23. The cost of the PCM-1, excluding the video tape recorder, was $4500 ($12,700 in 2007 dollars).

Peter B. Fellgett, head of the Department of Cybernetics at the University of Reading in England, observed that,

> ... we simply do not have the knowledge to decide how many bits are really needed, but such estimates as can be made suggest at least 18 and probably 20, several lines of argument converging about this figure. Even this is likely to prove conservative, since the history of audio is a story of each generation underestimating the powers of the human ear and the standard of quality it demands before it is really satisfied.[53]

Some readers feared that the hardware developers would standardize on a sampling rate that was too low to provide sufficient fidelity. "The problem here is that, once the digital standards are established, the sonic fidelity of digital equipment will be frozen, probably forever," wrote one *Stereophile* reader in 1980.

> Analog recording is open-ended, so to speak, in that the existing standards allow for limitless improvement as the technology advances. The very nature of digital audio mitigates against any future improvements, because any digital recording that uses a higher sampling rate or greater quantization than the standards dictate, in order to increase the fidelity of the recording, will be completely unplayable on any "standard" digital player.[54]

Holt responded by observing that past standards for analog recording and playback had not been as flexible as the reader suggested, and while he agreed that digital standards might be "frozen," they would offer higher fidelity than contemporary LP technology. He further speculated that,

> If it is found that there are sonic imperfections in digital audio due to limitations imposed by the digital standards, then improved digital systems using different "standards" and costing more money will be made available to those who can pay the price. If they go over, the new "standards" will become established standards.[55]

Holt's confidence in both the standardization process and the flexibility of the high-end audio industry set him apart from much of the community, as did his claims about the quality of digital audio. "As the only 'underground' editor who has had anything nice to say about digital," he wrote in 1982, "I wish to make it very clear that I do not, nor have I ever, asserted that digital

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[53] Peter Fellgett, "The Digital Dilemma," *The Absolute Sound* **7**, no. 27 (1982): 13-19, 17.

[54] Ted Kiley and J. Gordon Holt, "Digital Dead End," *Stereophile* **4**, no. 6 (1980): 65.

[55] Ibid.

reproduction is perfect. What I have said, and still say, it is that it is a hell of a lot more nearly perfect than any analog [record/play] system."[56]

Digital's nay-sayers included publishers and editors of other high-end audio journals, one of whom Holt observed at the 1982 Consumer Electronics Show wearing a t-shirt that read, "Stop Digital Madness."[57] Also included were some of *Stereophile's* own staff writers, who expressed concern not only about the CD, but also about the perceived Japanese dominance of the electronics industry, and its ability to create "de facto standards" for electronic communication through a combination of manufacturing prowess and a lack of initiative on the part of U.S. regulatory organizations.[58] Among the most vehement skeptics in the audio press was Harry Pearson. In 1983, Pearson blasted CD technology as "a 30 year step backward in recorded sound," and lamented the industry's choice of "one of, if not the most primitive" standards for the new medium.

> The real tragedy, and I think it's going to amount to that, is that the recorded heritage of an entire generation of artists – popular and classical – is going to be lost while our technocrats iron out the bugs of current digital technology (subsidized by, guess who?). It is interesting to see that we at *The Absolute Sound* are still managing to uncover layers of detailing and nuance from recordings made in the late 50s and early 60s, detailing and nuance that will never be recoverable from contemporary digital productions, which now, on a good system, will sound as "good" as they are ever going to.

"We must, then, reluctantly call for boycott, pure and simple, of the compact disc," he concluded. "Join us, for the sake of music."[59]

Mainstream hi-fi publications, particularly *Stereo Review*, were more consistently enthusiastic about the forthcoming medium, demonstrating little patience with many of the anti-

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[56] J. Gordon Holt, "Digital Revenge," *Stereophile* **5,** no. 6 (August 1982): 3-4, 31-32, 3.

[57] The editor was *International Audio Review's* Peter Moncrieff. Ibid.

[58] Editorial Staff, "Miscellany – De Facto Standards," *Stereophile* **5,** no. 9 (1982): 30-32, 32

[59] Harry Pearson, "Editorial," *The Absolute Sound* **8,** no. 29 (1983): 7-8, 7.

digital arguments emanating from the high-end audio community. Referring to high-end enthusiasts as "golden ears," recording engineer E. Brad Meyer warned *Stereo Review* readers to ignore the negative commentary about digital, and to rely instead on their own impressions once CD systems became available. "Most of the people who have been offering opinions about digital sound have not yet listened to a digital playback of anything," he wrote. "They are commenting on the sound of an analog disk made from a digital tape. This does not constitute a valid test of the digital encoding process." Further, he suggested that resistance to digital audio stemmed from negative impressions about the *idea* of quantization more than its actual application.

> There is, evidently, something about the very process [of quantization] that some audio purists find offensive. Such adjectives as "gritty," "harsh," "granular," and "hard," as well as complaints that the top end of the spectrum is irritating, that ambience isn't reproduced properly, or that instruments don't have the correct timbre, all tend to flow from the idea that one simply can't just chop up a musical signal into little bitty pieces and then expect to reconstitute it successfully.

"Once you have made steak into hamburger, goes the reasoning," he wrote, "it can never taste like steak again."[60]

The different publications were somewhat more united in their suspicion of how CDs were being marketed. "Even though the technology deals with the 'yes no,' 'one or zero' properties of encoded digital audio signals," wrote David Ranada, *Stereo Review's* resident digital expert in the early 1980s, "the advantages of a compact disc system are not so black and white. Overzealous claims for the system... might be heard from a poorly informed audio salesman seeking to impress someone hearing compact disc playback for the first time. Take

[60] Meyer, "Digital: A Not Unbiased Examination," 58.

them with a grain of salt."[61] In *The Absolute Sound*, Peter Fellgett cited an earlier technology transition in the home audio world, arguing that

> ... the trouble is that "digital" is being sold to the public not for what it is but for the name, like hotpants or shocking pink. If the actual merit matches the name, no harm is done, but otherwise the industry is setting a snare for its own foot... A lesson ought to have been learnt from the fate of "transistor sound" following the premature introduction of solid-state power amplifiers before there was sufficient knowledge of how to design them properly.[62]

These marketing efforts were also viewed as directed not at high-end enthusiasts, but at a general public whose standards for sound quality were much lower. Reporting from the 1983 Las Vegas Winter Consumer Electronics Show, reviewer Anthony Cordesman wrote in *The Absolute Sound* that the large Japanese and European electronics firms pushing CD players were aiming at what he and other writers referred to disparagingly as "mid-fi" – a euphemism for low-quality, mass-produced home audio components. "This emphasis on mid-fi may make sense in economic terms," he wrote, "but it has had a number of side effects."

> One is that the players are generally shown rather than demonstrated. They are being sold on the basis of creating a major new market, high profits, and the glamour of their technology – not on the basis of a superior musical sound. They are being pushed by professional marketing groups, which have little, if any, understanding of either the technology or of sound. They are being pushed with a total disregard for the truth. These things are far from perfect devices.[63]

First Impressions

Advertisements for CDs and CD players began to appear with greater frequency and marketing hyperbole in the months leading up to the CD's release in the United States. The March 1983 issue of the British classical music magazine *Gramophone* featured a primer on CD

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[61] David Ranada, "Hands on the Digital Disc: Things You Need to Know before and after You Buy a CD System," *Stereo Review* **48,** no. 4 (April 1983): 61-63, 61.

[62] Fellgett, "The Digital Dilemma," 13.

[63] Anthony Cordesman, "The Last Las Vegas Ces: Last, That Is, before the Compact Digital Disc Assault," *The Absolute Sound* **8,** no. 29 (1983): 180-195, 183.

technology, reviews of forthcoming CDs, and several CD player advertisements. An ad from Hitachi stated that the company had "crossed the threshold of an audiophile's dream," and that "audio perfection is now a reality."[64] A Sony advertisement in the same issue somewhat awkwardly claimed that the CD system "has about as much in common with a record deck as Concorde has with a Tiger Moth," and included the soon-to-be-infamous tag-line, "perfect sound that lasts forever."[65] In the following issue, Philips raised the rhetorical bar by stating, "quite purely and simply a Philips Compact Disc player reproduces music precisely as the performer intended. Giving you pure, perfect sound that will last for ever. (We mean eternally.)"[66]

For the most part, correspondence throughout 1983 from *Gramophone*'s international readership was positive about CD sound. But the CD's formal release in the United States did little to alleviate audiophile concerns. Readers of *The Absolute Sound* were almost uniformly dismissive of CDs both before and after they became available in the United States. One early adopter wrote an apologetic letter to Pearson, noting that listening to a CD and LP copy of the same performance of Strauss's "Also Sprach Zarathustra" had revealed that "the vinyl was sweet and airy, the CD harsh and constricted. Harry, you were right, the dynamics are merely noise. There is no musicality, just sound."[67] Other readers expressed anti-corporate sentiments, refuted the claimed superiority of digital audio on Hegelian/Marxist grounds, or suggested that digital

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[64] Hitachi, *Gramophone* **60,** no. 718 (March 1983): 1007-1008.

[65] Sony, *Gramophone* **60,** no. 718 (March 1983): 1016-1017.

[66] Philips, *Gramophone* **61,** no. 719 (April 1983): 1219. By the second half of 1984, "perfect sound forever" had been dropped from Sony and Philips advertisements in the magazine.

[67] Gregory Mareski, "The Compact Disc Scandal," *The Absolute Sound* **8,** no. 30 (1983): 15.

audio was a tool of Satan.[68] *Stereophile* subscribers tended to be less melodramatic in their criticisms, but many took Holt to task for his support of the CD, including one who wrote that the only reason he was renewing his subscription was for the opportunity to see Holt eventually "eat his words."[69] Phillip, a 55-year-old reviewer, described to me his first encounter with the CD system:

> I had a Japanese pressing of Roxy Music's "Avalon," which is one of my favorite records. And so I go to this [Audio Engineering Society] meeting, and they announce the first CD they were going to ever play... And they just happened to have Roxy Music's "Avalon." That's what they transferred. And I go, "okay,"... And they played it, and... it was the worst, flat, compressed-sounding, bright, no detail, everything smeared, no transients... I mean, it just sounded like shit. I could've played a cassette, it would sound better. Okay, it's a new thing, is just coming out, it's the first demonstration. When it's over, people are going to say, "you know, this technology's sexy, but it doesn't sound very good." But no. When it was over, people went, "whoa, did you hear that? Oh my god, that's the greatest thing I ever heard, whoa!"... And that's when I said, "we're fucked. We're *fucked*." And I went out the next day, and I went to a bumper sticker store, and I made bumper stickers that said, "Compact Discs Sound Terrible."[70]

Other audiophiles noticed inconsistencies in the sound quality from CDs. Bob, a 47-year-old former audio salesman, remembered his early experience with CD sound:

> The first two CDs that I ever heard were the Scorpions' "Love at first sting," and Michael Jackson's "Thriller." Now, Michael Jackson's "Thriller" is actually a good recording, if you listen to it on vinyl, or on a good CD player now, a modern CD player, it's pretty amazing. But the Scorpions was terrible... it was like fingers on a chalkboard bad. It was egregious... I would never play CDs for a demonstration... the sound that I heard was like the wind blowing through the trees with a metallic glare. That's the best way I can describe it to you.[71]

Carl, a 45-year-old professional engineer and high-end audio enthusiast, had a similar experience:

> I remember the very first CD I bought was Quincy Jones' "The Dude." At that time, you couldn't hardly get a CD. There was hardly any of them around. And I bought that just 'cause it was the only thing I could find. And it was a wonderful sounding recording. And

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[68] David Mann, "Boycotting the Compact Disc," *The Absolute Sound* **8,** no. 30 (1983): 15-16; Judy Spotheim, "The Bible on Digital," *The Absolute Sound* **10,** no. 37 (1983): 10; Israel Blumenkrantz, "Hegel, Marx, and the Compact Disc," *The Absolute Sound* **10,** no. 38 (1985): 22.

[69] Thomas Dawson, "The Taste of Digital," *Stereophile* **4,** no. 6 (1980): 64-65, 64.

[70] Interview, 05/29/07.

[71] Interview, 04/27/07.

> the next CD I bought was... it was the ABC Band, "Lexicon of Love," the old new-wave days, you know? And it sounded terrible. And I just remember being quite confused about what the heck was going on here, you know? And this was about the time you started seeing some things show up in the high-end [magazines] talking about, "you know, this CD stuff isn't sounding that great. There's something that's not quite right." And on that album, I could definitely... it just did not sound good.[72]

Among equipment manufacturers, some felt that the poor sound from CDs obscured the differences between system components that would otherwise be audible with high-quality analog sources. Matthew, a 65-year-old loudspeaker designer, put it this way:

> We were in the business of making speakers at higher and higher resolution and greater and greater realism. And when CDs first came out, it was such a big step down in quality, such a huge step down, and it was almost like, why would anybody bother buying our speakers at all? Because not only does the source then not even have the subtleties there that only we can reproduce, but our speakers make them even sound worse because they're recorded so badly... it really hurt us, and I think it hurt the high-end industry in general, because it made it almost impossible to distinguish your product.[73]

In the retail sector, high-end audio dealers faced similar difficulties. "From the time I opened my shop," Paul, a 64-year-old high-end audio dealer, told me,

> 'till about... I would say 1983, 1984, maybe even '85, things were heading in the right direction. Tube preamps and amps were getting better, solid-state preamps and amps were getting better, turntables, tonearms and cartridges were getting better... Enter the CD player, and that was the great leveler, in a negative sense... CD players come in, and what happens? If you play it over a CD player, *everything* sounds like shit.[74]

Some retailers noted that the popularity of the new medium brought customers into their shops, but the poor quality of the sound available during the CDs first years obliged them to demonstrate its limitations to customers. Frank, a former retailer, would run demonstrations for customers with both CDs and LPs to illustrate the differences in their sound, and discuss with them his impressions of the CD's limitations:

> We would just tell people, "look, here's what CD is. This is what it offers. It's probably the wave of the future. It sounds like crap." We would just tell people that. And, like, "you know, here's a CD player, it's this price or whatever, here's a turntable. If you're really into the CD thing, you may just want to make sure you have a turntable as well. Plus, you've probably got a huge record collection." So we didn't have any problem

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[72] Interview, 09/24/07.

[73] Interview, 01/08/08.

[74] Interview, 05/31/07.

> communicating to people... I mean people would come in all excited about it, and we'd be like, "look, here's the reality." And we just did that, and it worked really well. And I think people appreciate the honesty, and I think it's also a lot easier to establish your credibility as a salesperson when you're being honest.[75]

Despite heated responses from some audiophiles, Holt continued to challenge blanket rejections of digital audio, arguing that while digital recording and playback sounded fundamentally different from analog, they were, in his view, more "accurate" representations of live music.[76] His willingness to accept the CD also put him in closer alignment with the music-consuming public, who flocked to the medium as more discs and players became available. Many of these consumers were not the careless "mid-fi" consumers so disparaged in the high-end audio press, but sophisticated music lovers who demonstrated different priorities than the typical audiophile. Bill, the owner of a high-end audio shop during the period when CDs were first available, offered the following observation:

> There's no doubting that the idea that hitting a button, the lid opens up, the tray comes out, and inserting the five-inch piece of plastic in it and then pushing play, and then sitting down for the next hour... that was a very gratifying thing... it made the idea of listening to music, and particularly to people who might have a serious intention of taking the process further, it made it immediately accessible to those kinds of people... [if] you sit them down in front of a hi-fi system with an LP versus a digital player... those people, nine out of 10,

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[75] Interview with author, 06/28/07.

[76] J. Gordon Holt, "The Absolute Sound of What?," *Stereophile* **8,** no. 2 (1985): 5-10, 5.

> are going to take the CD player. Why? Because it makes the access to music easy, in their terms, and enjoyable. Sans the neurosis of the turntable.[77]

Marcus, a 56-year-old salesman, agreed:

> You know, [human beings are] neurologically predisposed to want things to be simpler, or easier... access has always been a motivating factor. Believe me, the only reason that CDs stayed popular when they first came out was not because they sounded good. It was because A) they were marketed "perfect sound forever," and B) people were able to listen to their music easily. No noise, no pops, no scratches, no ritual cleansing and, you know, religious washings of the records. You could play an entire album without getting up. It can play completely and end without getting up. It was access that made it popular. And that's been the continuous trend. It's all about access.[78]

Other audiophiles observed the importance of accessibility, but Bill acknowledged that this did not occur to him when CDs were first available, and argued that his and other audiophiles' negative approach to the CD in its early days had a damaging effect on high-end audio as a whole. When CDs first came out, he and others in what he described as the "high-end audio establishment" began "screaming foul" and arguing, as Pearson and many others did in print, that CDs would take the life out of music reproduction. This attitude, he said, created a "schism" between high-end audio and music lovers, where music lovers were "demeaned for their embracing" of the CD.

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[77] Interview with the author, 04/24/07. Many audiophiles interviewed for this project shared these impressions. This was not the only example in the CD's history of a non-technical issue determining the path of the technology and the development of the standard. The total playing time was the subject of some disagreement between Sony and Philips, and for many years the determining factor was said to be the longest recording of Beethoven's 9th Symphony in the PolyGram catalog – a mono recording from 1951 that was 74 minutes long – because this piece was a favorite of the wife of Sony Vice President Norio Ohga. The Philips Corporation had an article posted to their website, "Optical Recording Beethoven's Ninth Symphony of greater importance than technology," describing the influence of Beethoven's Ninth (http://www.research.philips.com/newscenter/dossier/optrec/beethoven.html, accessed 8/12/07). But in the December 2007 issue of the IEEE Information Society Newsletter, Kees A. Schouhamer Immink, a researcher at Philips from 1968 until 1998, wrote that the real reason for the CD's length constraints had nothing to do with Mrs. Ohga's musical preferences, and more to do with competition between Sony and Philips, and the constraints of Sony's U-Matic video tape recording technology, which at the time was the only device available for PCM mastering. See Kees A. Schouhamer Immick, "Shannon, Beethoven, and the Compact Disc," *IEEE Information Society Newsletter* **57,** no. 4 (December 2007): 42-46; see also Randy Alfred, "Dec. 16, 1770: Beethoven's Birth in Bonn Leads to Longer Cds," *Wired*(2008), http://www.wired.com/science/discoveries/news/2008/12/dayintech_1216. (accessed 3/30/09) (Alfred and Immick both acknolwedge the aforementioned article on the Philips website, and Alfred notes that as of his writing, which was originally posted to the *Wired* website on December 18, 2008, the website had been taken down).

[78] Interview with author, 05/02/07.

> And in my view, this created the beginnings of a schism, because up until that divide I... it was my job, and I think for a lot of high-end people, our job was to try to do everything we could to court the music lover to come into our camp. When we then threw up this barrier where a technology came that appeared to them to allow easier access to it, and we said, "no no no, you can't go there," I think we then created a block. And in a way, they won. Digital technology became accepted. It is indeed the norm of today... we, sort of, in its seminal days, threw up this objection, and we were right in doing it on one level, because it wasn't as good as it could be. But I think we were too categorical in our condemnation of it. We refused to acknowledge the appeal that its benefits would have to music lovers, and we created this, as I say, this schism. And I think that we have never really recovered from that. Even to this day.[79]

CD player reviews began to appear in the high-end and hi-fi magazines in 1983. Julian Hirsch, equipment reviewer for *Stereo Review*, published measurements of 11 new CD players in the July, 1983 issue – a first for the magazine. While Hirsch generally did not write about the sound of electronics, relying instead on measured results and descriptions of usability features, his exposure to the new medium nonetheless inspired some commentary on the sound.

> ...digitally mastered discs had an incredible bass (they can go down to nearly 0 Hz) that could often be sensed through speakers that we never suspected of having exceptional low bass capability. I was often able to feel the bass, even at low levels, in selections that I would not have chosen to demonstrate bass reproduction. Moreover, the CD medium is free from all the kinds of modulation noise and distortion that are inherent in analog tape and disk recording and reproduction. CDs have nonlinear distortion (both harmonic and intermodulation) several orders of magnitude below the levels typical of the best analog media -- which is to say, essentially none. Finally, the medium has no wow and flutter or any of the complex frequency modulation effects that can result from these fluctuations.[80]

The first CD player review appeared in *Stereophile* towards the end of 1983 with the Sony CDP-101, the first player Sony released in the United States. Holt wryly observed that "audiophiles will... be dismayed to note that there is nothing on it to adjust; there isn't even a knob to diddle."[81] The player was expensive at $1000 ($2080 in 2007 dollars), and the selection of discs was limited, but he was impressed:

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[79] Interview with author, 04/20/07.

[80] Julian Hirsch, "*Stereo Review* Tests 11 Digital Compact Disc Players," *Stereo Review* **48,** no. 7 (July 1983): 44-56, 56. Typical of pre-CD writing about home audio, the word "disk" most often referred to vinyl records. CDs were sometimes referred to as "discs" later.

[81] J. Gordon Holt, "The Sony CDP-101 CD Player," *Stereophile* **5,** no. 10 (1983): 6-11, 6.

Figure 6.2 - The Sony CDP-101 CD player (from *Stereophile* **5**, no. 10, pg 7).

> ... the sound was so opulently gorgeous it almost defied belief! It was a total incarnation of the perfectionist's wildest dreams: Rich, velvety, airy, awesome, liquid, yet incredibly detailed. There were none of the analog disc's problems. No marginal mistracking, no subtle [vertical tracking angle]-error distortions, no disc resonance smearing, no feedback induced low-end boom or mud, no ticks or pops or pressing grumbles even at the highest listening levels. And there was no analog tape flutter or modulation noise or transient rounding or print through or hiss.[82]

The first CD players did not receive such generous feedback in *The Absolute Sound*, and reviews became occasions for further observations about the business interests behind the CD. Anthony Cordesman suggested that "manufacturers are committed to producing unreliable developmental players" to be sold by "dishonest or incompetent mid-fi dealers" who "desperately need something new to push to overcome the effects of the recession and the competition from computer sales." "They are counting… on sales," he wrote, "because there are enough truly stupid techno freaks to make anything new sell regardless of what it does to the music."[83] Pearson offered his observations of the CDP-101 that Holt found so impressive, and did not mince his words:

> ... the Sony compact disc player overloaded the high-level section of every preamp in the house ... the sound was excruciatingly metallic and hard. The strings on orchestral digital recordings sounded like they had been fashioned from razor blades... Lew Johnson [of the electronics manufacturer Conrad Johnson] theorizes that the Sony player was generating considerable bass garbage and thus overloading the preamps... I found the Sony unlistenable. Horrid.[84]

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[82] Ibid., 8.

[83] Anthony Cordesman and Harry Pearson, "The Denon Dcd-2000 Compact Disc Player," *The Absolute Sound* **8,** no. 29 (1983): 48-52, 51.

[84] Ibid.

Soon, other large Japanese and European manufacturers began exporting CD players to the United States, including Kyocera, Yamaha, Denon, Hitachi, and Philips.[85] Holt continued writing most of the CD player reviews for *Stereophile*, and in 1985 discussed the aftermath of his review of the CDP-101, making a significant observation about his assumptions regarding the Red Book standard:

> My faith was unshaken, partly because I knew how good digital audio could be, and partly because I assumed that Sony's first CD player would use D/A conversion and audio circuitry that was at least as good as that in their PCM processors. But I must admit that I expected, along with the audio "establishment," that all CD players would sound essentially, if not exactly, the same.
>
> I shoulda known better.[86]

Holt and a number of other audiophiles discovered that while the Red Book standard allowed for consistency and compatibility in certain areas, the non-standardized components appeared to be contributing to the quality of the sound the players produced. Differences from one player to the next were, to audiophile ears, often substantial, and this was seen by many as a positive sign. In a review of three Japanese CD players, *The Absolute Sound* reviewer John Cooledge wrote,

> I'm downright encouraged by the fact that these three CD players sound so distinctly different from one another... my most optimistic guess is that these players are in fact not carefully designed, at least not to the standards which we've come to expect in true audiophile quality equipment. In other words, the sound engraved in some CDs just may be a lot better than CD players have so far been designed to extract.[87]

That two different Red Book-compliant CD players could sound different from one another playing the same program material led high-end audio engineers and users to two questions: where were the points in the player's architecture that affected the sound quality, and what could be done to improve them?

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[85] Philips players were sold under the Magnavox brand name in the United States.

[86] J. Gordon Holt, "Yamaha CD-2 CD Player," *Stereophile* **8,** no. 2 (1985): 54-56, 54.

[87] John Cooledge, "Three Compact Disc Players: The Yamaha, Nec and Onkyo," *The Absolute Sound* **9,** no. 35 (1984): 39-41, 41.

"The most important feature of digital is analog."

"Adcom made a CD player that [had a high-bit DAC]," Marcus told me.

> And then, all the Japanese players started, you know, they started to make them, they started to say, "ooo, there's a market here. Let's make more." And then bits became the thing. So 16 bit, 18 bit, slowly started creeping up. And the Adcom players just kept sounding better... for several years, this stupid player sounded better than anything else... So turns out that eventually we realized that it was the analog stage they used in the CD player... And if you had a good analog section, you had a good CD player. And if you didn't, you didn't. The Japanese stuff didn't... it became possible to get better and better sound out of a CD... because of the surrounding componentry.[88]

While the basic attributes of the Red Book standard for digital audio were understood (though not accepted) by the high-end audio community, CD players, with their laser tracking components and microprocessors for digital-to-analog conversion, represented a much higher level of technical complexity than LP systems. This complexity rendered many components involved in CD playback both physically inaccessible and technically imposing to audiophiles.[89] Desires for improved sound and greater interaction led some audiophiles to try, as Harry Pearson later described it, "a veritable flood of hoodoo products" meant to manipulate the discs themselves, "from Armor All, with hilarious results, to green marker pens, to every sort of rubber damper, short of the condom, known to mankind."[90] While such "tweak" products offered questionable sonic results, they did provide a hands-on way of interacting with early CD systems.

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[88] Interview, 05/02/07. Adcom is a British electronics firm.

[89] When first released, CD players contained the "densest and most complex integrated circuit ever employed in a consumer-electronics product." Robert Harley, "You've Come a Long Way, Baby: The Compact Disc Turns 25," *The Absolute Sound* no. 174 (September 2007): 42-56, 45.

[90] Harry Pearson, "State-of-the-Art in Digital: 1994 – 6 Compact Disc Turntables," *The Absolute Sound* **19,** no. 93 (Late Winter 1994): 48-64, 48. In the mid-1980s, Armor-All was thought to improve CD sound until it was found to damage disc surfaces. In this article and others at the time, Pearson referred to CD transports as "CD turntables." For an overview of various CD tweak products, see Robert Harley, "Compact Disc: Jitter, Errors, and Magic: Robert Harley Examines Whether Devices to Improve CD Sound Have Any Effect on Error Rates or the Level of Jitter and the Digital Datastream," *Stereophile* **13,** no. 4 (April 1990): 70-90.

Figure 6.3 - The Meridian MCD CD player (from *Stereophile* **8**, no. 2, pg. 56).

But CD players also had circuitry for processing the analog signal once it had been converted, as well as power supplies and mechanical parts that were similar to other audio components. It was in these areas that the earliest CD player modifications were made by small high-end audio engineering firms. The first CD player considered high-end by the audiophile community was built in 1984 by the British firm Boothroyd-Stuart under the brand name Meridian. In a 1985 review of the Meridian CD player, called the MCD, Holt explained that Boothroyd-Stuart obtained complete CD players from Philips, replaced all of the analog audio circuitry, installed a more robust power supply, and even modified the laser tracking system to improve its response time.[91] Boothroyd-Stuart designer and cofounder Bob Stuart also discovered that it was not just the electronics in most mass-produced CD players that were problematic, but the mechanical parts as well. Stuart

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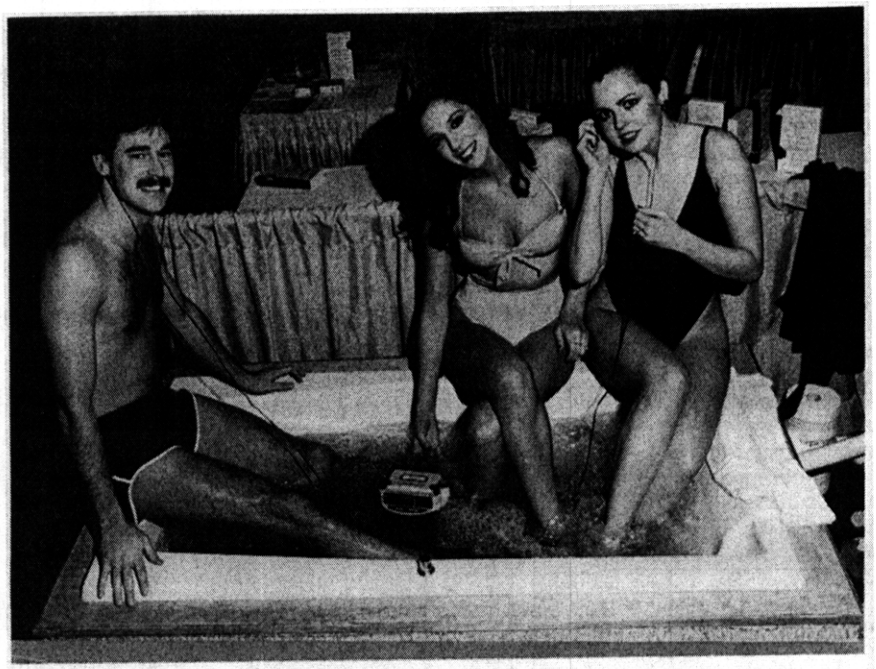
[91] J. Gordon Holt, "Meridian MCD CD Player," *Stereophile* **8,** no. 2 (1985): 56-59, 57. Boothroyd-Stuart's use of Philips technology was an important, if not entirely technical, part of early efforts to modify and improve CD playback. Philips made their players available for purchase by small companies seeking to design their own cases and interfaces as part of an overall effort to spread the technology, while Sony did not. Sony and Philips also had different approaches to digital-to-analog conversion that affected the sound of the firms' players. In the CD's early years, the vast majority of players from smaller firms were thus based on Philips technology. The so-called "brickwall" filters used in Sony CD players were low-pass filters designed to cut off any frequencies about 22 kHz, or slightly less than half the sampling rate for the Red Book standard. Although higher frequencies would not necessarily be audible since human hearing extends to around 20 kHz, additional frequency information could overload the amplification circuitry in a CD player and cause intermodulation distortion in the audible frequency range. The sonic characteristics of brickwall filters were cited by many audiophiles as partially responsible for the poor sound quality of early Sony CD players, but were not associated with the Red Book standard. The differences between how the progenitors of the Red Book standard chose to design their own CD players further shows how the standard itself enabled various innovations among firms. John Atkinson, "Zen and the Art of D/A Conversion," *Stereophile* **9,** no. 6 (September 1986): 47-51, 51. See also Pohlmann, *The Compact Disc Handbook*, 121-132.

noticed that when CDs were physically stabilized in the player, the sound improved. He surmised that stabilizing eliminated errors in the decoded digital signal that were introduced by vibration of the disc in the player. In an interview several years later, Stuart noted that this manipulation of CDs "got us into a lot of trouble." "There was a whole sector of the audio community who are not audiophiles and who understood completely that compact disc and all digital audio was destined to be [the] future," he said. "They were very scared that audiophile tweaking of this 'perfect' medium was being encouraged."[92] While Holt was uncertain which of the many modifications in the Meridian MCD made the "perfect" medium sound better, he was convinced they were "doing something right."[93]

The MCD began unifying some of the subjective impressions of writers for *Stereophile* and *The Absolute Sound.* Reviewer Thomas Miiller noted that the MCD represented the first real challenge to anti-digital sentiments in the community. "Science," he



A floating CD player from Sony: We all know what else floats.

Figure 6.4 - A photo from *The Absolute Sound*'s 1985 Winter CES report, with original caption, suggesting the magazine's lingering feelings about CDs (from *The Absolute Sound*, Spring 1985, pg. 30).

[92] Robert Harley, "The Increasing Importance of the Smaller Difference: Meridian's Bob Stuart Talks to Robert Harley About Digital, Dither, and the D6000," *Stereophile* **14,** no. 9 (September 1991): 86-101, 87.

[93] Holt, "Meridian MCD CD Player," 57.

wrote,

> has given us a new technology of enormous potential and we at *The Absolute Sound* (and all other publications) have a responsibility to set and apply the highest standards to this new technology. In that vein, the Meridian CD player is the first (but not final) payment on the promise. It, at least, belongs in these pages.[94]

The success of the MCD among audiophiles marked the beginning of a trend of modification and experimentation by a variety of high-end firms, in which the analog electronics remained the primary focus.[95] As Anthony Cordesman put it in 1987, "the most important feature of digital is analog."

> As a further irony, the most audible and pure gold differences which most subjective reviewers find between the technical features of well-made CD players do not emerge in the digital or "high tech" part of the player, but rather in that most humble and mundane of areas: the analog gain stage. While the better sounding designs differ over the proper amounts of feedback and all the other technical details that preamplifier designers argue over, there is a very clear correlation between high sound quality and those few companies which have focused heavily on improving the analog stages.[96]

Larger firms were also experimenting with different DAC and filtering technologies, and shifting from multi-bit DACs to 1-bit or low-bit DACs as new and more powerful digital signal processing (DSP) chips were becoming available.[97] While the high-end press acknowledged that the larger firms were making improvements in their players that resulted in better sound quality, the impetuous for and source of the changes were most often attributed to the smaller firms.

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[94] Thomas Miiller, "First Impressions: The Meridian CD Player," *The Absolute Sound* **9,** no. 36 (1985): 99-100, 100. Miiller's name was in fact spelled with two "i's" in the magazine.

[95] Many power supply and filtering innovations came from Colorado-based firm PS Audio. See J. Gordon Holt, "PS Audio CD-1 CD Player," *Stereophile* **9,** no. 6 (1986): 117-119, 117.

[96] Anthony Cordesman, "Compact Disc Players: The Never-Ending Survey," *Stereophile* **10,** no. 1 (1987): 124-139, 130. For several years Cordesman wrote reviews for both *Stereophile* and *The Absolute Sound.*

[97] Ken Pohlmann argues that there were three evolutionary steps in CD player design in the decade following the CD's release: players began with multi-bit DACs and analog brickwall filtering, then brickwall filters were replaced by digital oversampling filters, and finally the multi-bit DACs with were supplanted by low-bit DACs. As powerful DSP chips became available to smaller firms, they, too, began experimenting with different DAC designs. For a discussion of the differences between different DAC technologies, see Pohlmann, *The Compact Disc Handbook*, 132-140.

Some engineers' experiments with the analog electronics of CD players also involved the use of vacuum tubes. Among the first commercial available CD players with vacuum tube electronics was the California Audio Labs Tempest, which John Atkinson reviewed for *Stereophile* in 1986. While a strange amalgam of advanced and antiquated technologies that was "guaranteed to turn heads," Atkinson observed that the Tempest used top-quality parts, and clever substitutions of components in the analog stage of the player to achieve a qualitatively different type of sound than typical CD players. "[CD players'] DACs produce a current output which has to be converted to a more conventional voltage form," Atkinson explained in his technical description of the Tempest. "Normally, solid-state op-amp circuitry performs this task, but in the Tempest, the current-to-voltage conversion is performed by triodes running in Class-A!"[98] California Audio Labs also used tubes in place of solid-state devices elsewhere in the circuit for distortion filtering. The Tempest's analog stage, along with its other high-quality parts, left Atkinson impressed. Like Holt, Atkinson had some experience making recordings, and was himself a musician. Playing a recording he'd made of a Chopin waltz for solo piano with the Tempest, Atkinson stated that "the sound of the CAL Tempest… gets

Figure 6.5 - The California Audio Labs Tempest vacuum tube CD player (from *Stereophile* **9**, no. 6, pg. 187).

[98] John Atkinson, "California Audio Labs Tempest CD Player," *Stereophile* **9,** no. 6 (September 1986): 120-124, 121. "Op-amp" stands for "operational amplifier," an integrated circuit that acts as an amplifier, much like a discrete transistor, but in an even smaller package. Although advantageous given their small size and power consumption characteristics, op-amps were often thought to seriously compromise the sound in early CD players and in other mass-market audio components.

closer than any CD player I have heard in remaining true to what I had originally intended!" Although noting in the conclusion that he still ultimately preferred the sound of LPs (and acknowledging the Tempest's $1895 price tag, $3585 in 2007 dollars), Atkinson nonetheless wrote that "the Tempest gets closer to the spirit of the music."[99] Although not mentioned in the review, using vacuum tubes in the CD player's electronics also opened possibilities from a systems standpoint: users interested in swapping in different brands of tubes, known as "tube rolling," could conceivably change the sound of the Tempest without needing to manipulate or know anything about its digital components.[100]

By the second half of the 1980s, the sound of high-end CD players was beginning to turn some early opponents of the medium around. Despite his initial, vehement opposition, in 1986 Harry Pearson observed that "the best of the new CD players reveal felicities on the best digital recordings that indeed justify the potential and promise of the new medium."[101]

> The good news for the people who love music is that the high-end players prove that digital is not so bad as we thought, they can be made to sound quite presentable, even easy on the ears. Those of us, including this writer, who foresaw a future of harsh, metallic, headache and fatigue inducing recordings must now reassess our positions. What the new players make evident is that such recordings, while still in the majority, aren't a necessary adjunct of the digits themselves. They come from bad playback machines and bad recording techniques, and, perhaps, from bad compact discs... all one can say is that we're closing in on the truth about digital sound recording.[102]

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[99] Ibid., 123.

[100] While CAL was among the only firms during this period using tubes in CD players, others, such as VTL and Stax, built external DACs with tubes, and some recent CD player designs use tubes, including players from Prima Luna and Shaling. "I find it more than a little ironic that in 1990 the only two digital to analog converters to employ a new state-of-the-art DAC also use vacuum tubes," Harley wrote in 1990 of the VTL and Stax DACs. "Many in the audio community consider tubes and anachronism, and find it surprising and humorous that they are still used in newly designed audio products. The fact remains, however, that these two tubed digital processors achieve the best digital playback currently available -- and by a wide margin." Robert Harley, "Vacuum Tube Logic Digital to Analog Converter," *Stereophile* **13,** no. 12 (December 1990): 164-171, 164. For added detail on tube rolling, see Chapter 5.

[101] Harry Pearson, "High-End Compact Disc Players and the Sound of Digital," *The Absolute Sound* **11,** no. 44 (1986): 46-61, 47.

[102] Ibid., 46.

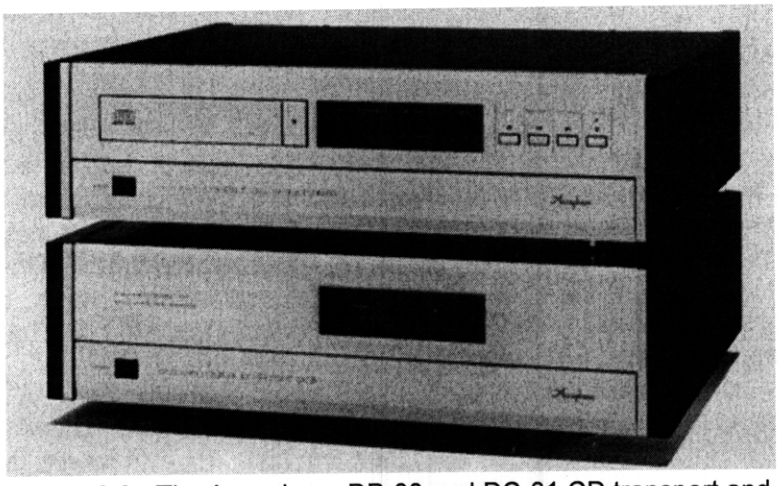

Figure 6.6 - The Accuphase DP-80 and DC-81 CD transport and DAC (from *The Absolute Sound* **11**, no. 44, pg. 51).

Among the catalysts for Pearson's change in attitude was a CD player from a small Japanese company, Accuphase. While the Accuphase player had robust analog electronics and power supply circuitry like other high-end players at the time, it also featured an outboard DAC, and a "transport" that spun the CDs and extracted the data, each in a separate chassis. The separation of the transport and the DAC became an area of significant experimentation and innovation among high-end audio firms, while offering a new level of interactivity and systems-building options for audiophiles.

Transports, DACs, and Interfaces

"The two companies that first started doing anything of any significance [were] Wadia and Theta – outboard [DACs]," Paul, the shop owner, told me.

> And believe it or not, the other guy, the company that was doing it was a Japanese company, Accuphase. Accuphase came out with a really, really, really good CD player... about '86. $11,000 CD player. And everybody laughed because CDs were perfect, and we cleaned up with those 'cause it made everything else sound horrible. The original Wadia 64X [DAC]... I mean, that thing was like $9,000. But what it did to the digital output of a CD player was nothing short of phenomenal. So here this whole add-on thing becomes the meat and potatoes of high-end dealers trying to prevent the sound that they're trying to create from crumbling before their ears.[103]

Although Pearson was impressed with the Accuphase player, among the first firms to release a separate DAC was Sony. In 1986, Sony released the CDP-650 ESD CD player and its partner,

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[103] Interview, 05/31/07. In 2007 dollars, the Accuphase system would have cost $20,800, and the Wadia DAC around $13,000.

the DAS-703 ES outboard DAC. The CDP-650 also had a built-in DAC, but users could now get a digital signal from the player and use the external converter to generate the analog signal that was fed to the preamplifier. Holt had some difficulty describing what exactly was different between the CD player's internal DAC circuitry and the outboard converter, but noted that, "it can be readily compared with what happens when you replace a good 100 watt amplifier with a superb 200 watter. One experiences something akin to relief, as though a nagging worry has been banished."[104] Of equal and perhaps greater importance to Holt, however, was what separating the transport from the DAC meant from a systems standpoint. "Just two years ago," he wrote,

> some of CD's most vociferous critics complained that the system was so cut and dried that it would never allow for the innovation and tweakery that has made high-end audio such a challenging field. They argued that there weren't enough bits, the sampling rate was too low, and that linear encoding denied the fact that sounds die out exponentially, not in a linear fashion. And since everything about CD was unequivocally spelled out in hard, cold, immutable numbers, it would "freeze" sound reproduction at its present level of (rotten) quality. CD would, they opined, take all the fun out of audio.
>
> We now know how wrong they were.[105]

Enabling users to "mix and match" components at this level, he argued, would open the door to creating a "no holds barred" CD playback system, preserving the ability to select different components to work together in an optimal way that was a core part of the high-end audio hobby. Providing digital output from the transport also gave high-end audio engineers another level on which to experiment with manipulating the sound of CDs. Soon, a variety of outboard DACs were available from small, high-end audio firms.[106]

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[104] J. Gordon Holt, "Sony CDP-650 Esd CD Player/Das-703 D/A Converter," *Stereophile* **9,** no. 8 (1986): 94-97, 95.

[105] Ibid., 96.

[106] Sony and Philips developed a standard for carrying compressed digital audio information directly off the CD (known as S/PDIF, or Sony/Philips Digital Interface Format), but the connectors themselves were not standardized. A variety of different connector and cable types have been developed over the years following the S/PDIF standard (including TosLink, XLR, BNC and RCA).

In addition to the systems-building advantages, high-end audio engineers also found that separating the transport and DAC offered additional ways of eliminating some of the CD's characteristic distortions, particularly "jitter." Jitter refers to timing errors between the data on a CD and a player's internal clock that can cause audible clicks or gaps in the audio signal, and what is commonly described as a "smearing" of the music's higher frequencies as samples are overlapped or dropped. In separate transport and DAC systems, the digital signal sent by the transport to the DAC also includes a clocking signal to synchronize the incoming digital information with the DAC's processors. If the clock signal from the transport contained errors, those errors generated distortion in the DAC's analog output.[107] The interface between the transport and DAC could therefore have a significant effect on the quality of the resulting sound, and by separating them, engineers had greater freedom to explore possible solutions for jitter reduction. While large firms were aware of jitter problems in early CD players, smaller firms were the first to make their elimination a priority. Once again, Boothroyd-Stuart was in the lead among these firms, introducing advanced jitter-reduction technology in their Meridian 207 Pro CD transport and DAC system in 1988, which *Stereophile* reviewer Thomas Norton said "almost" eliminated the need for the typical reviewer caveat that analog reproduction for home audio was still superior to CD.[108]

Numerous reviews of separate DAC and transport products from Theta, Wadia, Mark Levinson Audio Systems, PS Audio, and other small firms followed in the next few years in both *Stereophile* and *The Absolute Sound*, validating Holt's prediction that separating the transport and

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[107] Rémy Fourré, "Jitter and the Digital Interface: Rémy Fourré Offers a Primer on Jitter in Digital Audio," *Stereophile* **16,** no. 10 (October 1993): 80-97, 87.

[108] Thomas Norton, "Meridian 207 Pro Compact Disc Player," *Stereophile* **11,** no. 11 (1988): 122-123, 122. For a detailed explanation of jitter, see Harley, *The Complete Guide to High End Audio*, 2004, chapter 8.

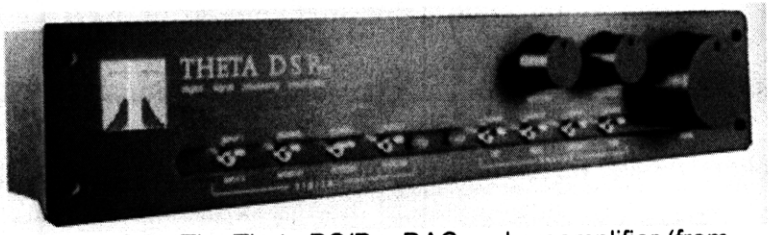

Figure 6.7 - The Theta DS/Pre DAC and preamplifier (from *Stereophile* **12**, no. 3, pg 104).

the DAC would open the CD system in the ways audiophiles had been waiting for. Not surprisingly, as more products became available, the potential and shortcomings of both specific products and the integration of those products in audio systems were revealed. *Stereophile* reviewer Lewis Lipnick discovered that a solid-state DAC from Theta provided heretofore unknown levels of quality from his CDs, but also suffered from radio frequency interference problems largely absent from CD players with internal DACs.[109] Reviewer Martin Colloms was impressed with the Wadia 1000 Decoding Computer DAC, but also noticed radio frequency interference issues, as well as some sonic imperfections, specifically a "hint of mid[range] 'glare' and treble brightness, plus a touch of 'chromium plating' – the sound being just a shade brighter and shinier than necessary."[110]

Colloms also suggested that different CD transports affected the sound from the Wadia 1000. After trying it with multiple transports, he suggested that

> the Philips-Marantz [transport] provid[ed] the best results for both clarity and rhythm. Interestingly, the Sony transport showed good treble clarity but was more subdued in terms of dynamics and rhythm. Different digital coupling cables affected the sound in more subtle ways, while a symmetrical buffer... significantly improved the sound using the Philips and Marantz models.[111]

Sonic differences between different transports and digital cables were noticed by other reviewers, including Robert Harley, who wrote in 1991 that the Wadia WT-3200 transport "had the ability to

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[109] Lewis Lipnick, "Theta D/A Preamplifier," *Stereophile* **12,** no. 3 (March 1989): 104-109, 106. The RF interference issues were resolved by the manufacturer who sent Lipnick a new unit for review.

[110] Martin Colloms, "Wadia Digital 1000 Decoding Computer," *Stereophile* **12,** no. 9 (September 1989): 109-115, 112.

[111] Ibid., 113.

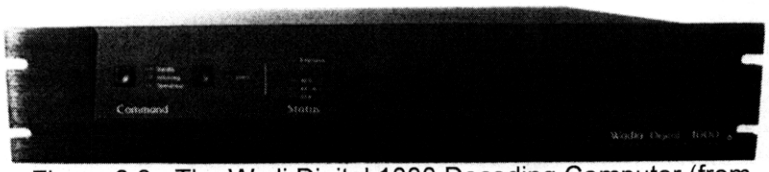

Figure 6.8 - The Wadi Digital 1000 Decoding Computer (from *Stereophile* **12**, no. 9, pg. 109).

open the window on the music and reveal nuance and subtlety not heard through lesser transports. Fine detail and low-level information – so important in holding the listener's attention – were presented with exceptional resolution." He further noted that among the WT-3200's various digital interfaces, the fiber optic or "glass" interface had the best sound.[112] While the idea that a digital signal could vary from one transport to the next, or be affected by cables, was incompatible with the perception of digital as closed, finite and predictable, many audiophiles found that different digital decoding and filtering mechanisms in the transports, and various jitter reduction techniques in the interface between the transport and DAC, could greatly improve the sound from CDs.[113] In a 1993 *Stereophile* article, Rémy Fourré, then vice-president of the California-based DSP chip maker UltraAnalog, offered the explanation that jitter originated in the interface between the transport and the DAC. He noted that the digital signal sent by the transport to the DAC included the clocking signal the DAC used to convert the digital signal to an analog signal. If the incoming clock signal from the transport was affected by jitter, the analog output of the DAC would be distorted.[114] Separating the transport from the DAC, was felt to reduce the jitter problems that had first gained attention with Boothroyd-Stuart's original Meridian MCD, and the various interfaces offered different levels of jitter reduction.

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[112] Robert Harley, "Wadia Wt-3200 CD Transport," *Stereophile* **14,** no. 6 (June 1991): 190-194, 193.

[113] Ken Pohlmann illustrates the processing of the digital signal from a CD prior to reaching the DAC in Pohlmann, *The Compact Disc Handbook*, 143.

[114] Fourré, "Jitter and the Digital Interface: Rémy Fourré Offers a Primer on Jitter in Digital Audio," 87

Other firms sought to deal with jitter and other CD distortions differently by focusing on the discs themselves. Robert Harley noted that by 1990, there had been "a veritable explosion of interest in all manner of CD tweaks, opening a digital Pandora's box."

> An avalanche of CD tweak products (and the audiophile's embrace of them) has suddenly appeared in the past few months.... most of these tweaks would appear to border on voodoo, with no basis in scientific fact. Green marking pens, and automobile interior protectant, and an "optical impedance matching" fluid are just some of the products touted as producing musical nirvana.[115]

Harley set out to test a variety of these tweak products, including the green marking pen known as the "CD Stoplight," which could be used to coat the outside edge of a CD with green ink, supposedly absorbing some of the infrared laser light reflected off the CD surface when it is being played. He measured the results using a sophisticated testing device – the Design Science CD Analyzer – which was able to produce a variety of measurements from both "treated" and "untreated" CDs. An engineer by training, Harley had worked in the CD duplication industry prior to joining the *Stereophile* staff, and brought to these tests a sophisticated knowledge of the details of CD technology. But he was also an avid audiophile, with strong beliefs about the validity of a user's

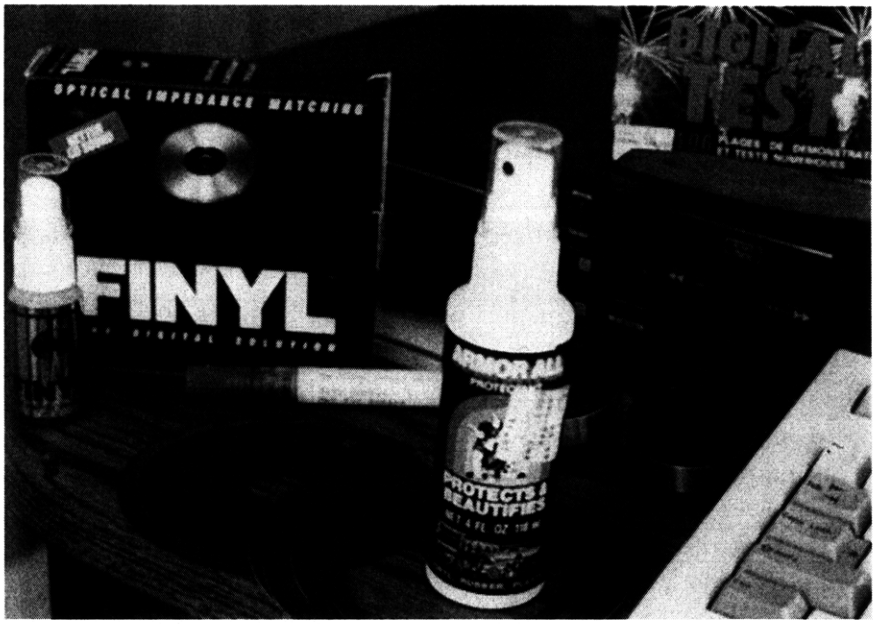

Figure 6.9 - Various CD tweak products (from *Stereophile* **13**, no. 5, May 1990, pg 73).

[115] The "automotive interior protectant" to which Harley refers was Armor-All, which in the mid-1980s was considered an easy and cheap way to improve CD sound until it was discovered to damage disc surfaces. Harley, "Compact Disc: Jitter, Errors, and Magic," 70.

subjective impressions of audio equipment performance, and his analysis of the various tweak products included technical measurements as well as subjective listening tests.[116]. In conclusion, he noted that, "from my measurements, it is apparent that none of the CD tweaks have any affect on a player's error correction ability or on the amount of jitter in the [high-frequency] signal." But, he continued,"it is beyond doubt that they increase the musicality of CDs."

> Just as in analog audio, there are things going on in digital audio that have not been identified, but influence sonic characteristics. There is a real need to explore these questions through empirical measurement and by listening. I am convinced that undiscovered optical phenomenon in CD playback affects sound quality. Only by combining critical listening with the scientific method can these mysteries be solved.[117]

Despite Harley's contention that some CD tweaks made positive and audible differences, by the mid-1990s, many tweak products had fallen out of favor. Although some continued to be manufactured and sold, it was in the area of hardware that most high-end developments were taking place.[118] Harry Pearson, reflecting in 1994 on the changes in digital audio and CD playback during the previous 10 years, divided CD performance into four phases. The first phase was the CD's original release, "representing, lest we forget one of the biggest commercial lies of our time, perfect sound forever."[119] The sound of CDs and CD players at this point were "horrid sounding to the point of scatological putrescence," and revealed a whole new array of distortions that left many in the high-end community "hardly able to articulate what was so bad, much less

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[116] Harley was among the most passionate advocates of observational listening during the height of the "Great Debate," covered in Chapter 4.

[117] Harley, "Compact Disc: Jitter, Errors and Magic," 90.

[118] Some tweak products continued to be reviewed, including the "CD Upgrade" and "CD Greenbacks" reviewed by Jack English in the February 1992 issue of *Stereophile*. CD Greenbacks took the CD Stoplight concept further by covering a larger area of the disc and thereby reducing, it was claimed, the amount of reflected light from the laser and improving the sound. CD Upgrade was a clear mat that could be laid across the top of CDs to improve stability and reduce vibration-induced distortion. English was particularly impressed with the CD Greenbacks, suggesting that "with the greenback in place, the music sounded as if a layer of noise had been removed; low-level information became much more obvious." Jack English, "Digital Aid," *Stereophile* **16,** no. 2 (February 1992): 174-176, 175.

[119] Pearson, "State-of-the-art in Digital," 48.

provide any insight into why the sound was egregious."[120] The second phase included "patchwork" remedies, including many of the tweak products Harley reviewed for *Stereophile*. But this was also the era that saw the first separate DACs and transports (or "CD turntables," as Pearson called them), with high-end audio engineers applying their knowledge of "advanced electronics circuitry to the inner workings of the CD playback system."

Phase three in Pearson's list was sparked by the $14,950 Mark Levinson No. 30 DAC ($20,916 in 2007 dollars), "one of the most audacious and successful products put on the high-end market since the original Levinson JC-2 [preamplifier]."[121] The No. 30, in Pearson's estimation, was a "modern-day technological shot heard round the world" that set the standard by which all other DACs were judged, and sparked the creation of less costly DACs from Wadia, Theta, and others.[122] Indeed, Anthony Cordesman at *TAS* and John Atkinson at *Stereophile* both considered the No. 30 a state-of-the-art DAC, and Atkinson bought his review sample after the review was complete. In the same issue as Pearson's article, Cordesman reviewed several less-expensive DACs, including the $1695 Counterpoint DA-10 ($2371 in 2007 dollars), which allowed users to swap in and out different DAC chipsets to achieve different sounds, and three more expensive models, including the Levinson No. 30, the $14,000 Krell Reference 64 and $5000 Theta DS Pro III ($19,586 and $6995 in 2007 dollars, respectively). Cordesman remarked that "this wouldn't be *TAS* if I did not try to put the digital/analog debate into an updated perspective," and suggested that while digital had advanced far beyond what he and other

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[120] In case *TAS* readers didn't catch Pearson's true meaning behind this phrase, in a footnote he added, "It was that shitty." Ibid.

[121] For a description of the impact of the JC-2 according to *TAS*, see Chapter 5. Ibid., 50.

[122] Ibid.

reviewers had observed in the CD's early days, digital and analog reproduction were both imperfect representations of the "real thing."

> In broad terms, the Krell reference 64, the Mark Levinson, and the Theta all demonstrate that CD can equal analog in terms of overall sound quality and often surpass it. This does not mean, however, the digital sound now has all the potential merits of analog. We are comparing two differently flawed reproduction systems. When you read my comparisons of the sound of the Krell, Mark Levinson, and Theta, you need to bear in mind that surprisingly little has been done to study the subjective differences between listening to CDs and analog, and I will be focusing on how digital sound compares to my understanding of the live musical experience, not on how digital compares with analog.[123]

While other reviewers, including Holt, had long acknowledged that the sound of live music was the benchmark for all evaluations of music reproduction systems, digital or not, Cordesman's position nonetheless reflected that, in some way, the CD had finally achieved the potential in the high-end audio community that Sony, Philips, and other manufacturers had claimed it had in the beginning.

Focusing on the transport and DAC separately became one way that high-end audio firms could attempt to eliminate jitter and other issues with CD playback, while also making the CD system more hobbyist-oriented, allowing users to mix and match transports and DACs, experiment with cables, and engage in the types of system-building activities they had with turntables. While some believed CD "tweak" products provided audible improvements, most audiophiles felt the qualitative differences, and improvements, came from the separation of the transport and DAC, and the potential for integration of the CD into their audio systems that this separation made possible.

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[123] Anthony Cordesman, "Three Top D-to-a Converters Surveyed: Comparing the Krell Reference 64, Mark Levinson Model 30, and the Theta Balanced Ds Pro Generation Iii," *The Absolute Sound* **19,** no. 93 (Late Winter 1994): 86-100, 92.

Conclusion

In 1989, John Atkinson reviewed the updated version of the Accuphase CD transport and DAC system that had so impressed Harry Pearson. Atkinson wrote that the Accuphase system had none of the problems often identified by high-end audio enthusiasts with CD playback, and the "open quality" of the sound made it easy to listen to CDs for hours – an experience he characterized as more often associated with vinyl LPs. "The difference between the Accuphase and ordinary CD players," he wrote, "is the difference between a painting and a print made of that painting."[124]

But it was in the review's introduction that he made his key observations about the player. By this point, the price of the two units together had risen to $13,000 ($21,000 in 2007 dollars). Possibly anticipating letters from readers indignant that the magazine would positively review a component so far out of reach for most audiophiles, Atkinson began with an analogy, oft-made by audiophiles, to driving a luxury car – in this case, a used Ferrari recently purchased by a friend who had let him take a turn behind the wheel. "Yes, you could buy a lot of Hyundai Excels for the price of such a car," he observed, "But I'm here to say that it is not the same experience."

> With a thoroughbred like that Ferrari, driver and car take on a symbiotic relationship, the tires become the extension of your nerve endings. The car both is responsive to your wishes and feeds back all you need to know about the road and your relationship with it; it is almost as if you need only to think about what line you want the car to take, and the deed is done. That Ferrari redefined my attitude to driving. No, I will never be able to afford one myself, but I am glad to know that it exists.

"The only possible justification for high price," he continued, "is that you get more, not only than you expected but also than you knew existed. That is the only standard by which to

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[124] John Atkinson, "Accuphase Dp-80l CD Player/Dc-81l Digital Processor," *Stereophile* **12,** no. 3 (March 1989): 109-117, 110.

judge human artifacts designed without compromise."[125] Beyond the obvious connection between the high prices of both the Ferrari and the Accuphase CD player, Atkinson's focus on "feedback" emphasized the importance of the systems approach to home audio in the high-end community, and how products like the Accuphase CD player helped to enable that approach.

As J. Gordon Holt observed in the period leading up to the CD's release, high-end audio hobby is in many ways defined by the *pursuit* of perfection rather than its realization. Despite some shared aesthetic values, this pursuit continues to engender disagreements over which audio technologies provide the highest fidelity and most aesthetically satisfying reproduction of music in the home. Holt, Pearson, and virtually all of my interviewees agree that CD sound has improved immensely since the days of "perfect sound forever." But as Paul, the shop owner, told me, referring to what he believed was a particularly excellent CD playback system, "it will take a CD and make it sound better than any other CD player in the world. It's still not as good as a turntable, tonearm, and cartridge, for half the price. End of story."[126] These disagreements – in many ways an ongoing source of liveliness for the community as a whole – are likely to continue.

Despite its "black box" characteristics in the CD's early years, desires for both improved sound quality and greater interactivity with the technology sparked innovation among high-end audio engineers, gradually making the CD system more accessible and more aesthetically satisfying to the community as a whole. With efforts to improve the analog electronics, separating the DAC and transport, and through other modifications to increase sound quality and interactivity, users were able to include the CD in their audio systems without losing the

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[125] Ibid., 116.

[126] Interview, 05/31/07.

feedback possibilities that had made high-end audio exciting and enjoyable in the years before the CD's debut. The story of the compact disc in the high-end audio community reinforces the argument of Oudshoorn and Pinch that users and technology are in fact "two sides of the same problem" rather than "separate objects."[127] More importantly, audiophiles' treatment of the CD demonstrates that aesthetic concerns and small-scale system building activities are among the ways in which users and technology are connected.

[127] Oudshoorn and Pinch, *How Users Matter: The Co-Construction of Users and Technologies*, 2-3.

Chapter 7 – Conclusion

Today, high-end audio finds itself at yet another crossroads. As in the past, this crossroads brings together technological, social, and, especially recently, economic change and upheaval. The debates of the past three decades have culminated in significant attitudinal shifts among some of high-end audio's progenitors, including, most notably, J. Gordon Holt and Harry Pearson. In a 2007 exchange with *Stereophile's* editor-in-chief, John Atkinson, Holt offered dire predictions for the future of high-end audio. When asked by Atkinson if he felt that high-end audio had "lost its way," as Holt had suggested in 1992, Holt replied, "Not in the same manner; there's no hope now."

> Audio actually used to have a goal: perfect reproduction of the sound of real music performed in a real space. That was found difficult to achieve, and it was abandoned when most music lovers, who almost never heard anything except amplified music anyway, forgot what "the real thing" had sounded like. Today, "good" sound is whatever one likes... since the only measure of sound quality is that the listener likes it, that has pretty well put an end to audio advancement, because different people rarely agree about sound quality. Abandoning the acoustical-instrument standard, and the mindless acceptance of voodoo science, were *not* parts of my original vision.[1]

Holt went on to chastise the high-end audio community for "flatly refus[ing] to submit to the kind of basic honesty controls (double-blind testing, for example) that had legitimized every other serious scientific endeavor since Pascal," leading to "endless derisive amusement among rational people" and "perpetual embarrassment for me, because I am associated by so many people with the mess my disciples made of spreading my gospel." "I never, ever claimed that measurements don't matter," he wrote. "What I said (and very often, at that) was, they don't always tell the whole story. Not quite the same thing." The exchange ended with Holt lamenting that his motivations for pushing subjective testing – "a love for the sound of live classical music"

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[1] John Atkinson, "45 Years of Stereophile," *Stereophile* **30,** no. 11 (November 2007): 3, emphasis in original. For details on Holt's 1992 remarks, see Chapter 4.

– lost relevance in the United States in the wake of "time, history, and the most spoiled generation of irresponsible brats the world has ever seen. (I refer, of course, to the Boomers)."[2]

Pearson has appeared less obviously frustrated in print, but has also expressed a shift in his thinking with regard to what can be expected from high-end audio equipment. In a 2006 panel discussion with *The Absolute Sound's* senior editorial staff, Pearson remarked that "as we proceed into the future,"

> which I think we're going to do in several ways, by lower noise floors and by multichannel and by technologies yet to be discovered – we're going to find that we keep removing the sense of the mechanical sounds of reproduction, but that that's not going to necessarily make the reproduction more real. It may, in fact, and this would be my concluding point almost, lead us to an art form which, I'm sad to say, is not going to be *the* absolute sound but *an* absolute sound.[3]

In the course of the discussion, the editors (including Robert Harley, Wayne Garcia, Neil Gader, and Jonathan Valin) reminisce about being "fooled" by the sound of equipment such as early Magnepan planar magnetic loudspeakers and electrostatic loudspeakers from Quad, also wondering aloud if somewhere along the line the high-end took a "wrong turn," and where things were likely to go from here. Pearson wrapped up their discussion with an impression of the future of high-end audio that might have pleased Jean Baudrillard.[4] "We're not going to achieve the absolute sound," he said.

> What we are going to do with multichannel and lowered noise and all the new strategies at our disposal, however, is we are going to create an illusion of the absolute that is completely convincing on its own terms. Remember that we're not recording reality; it cannot be recorded naturally. So all recording is basically artifice, and it is all an illusion. What we're gonna do is we're going to transport ourself into the recording site, but we're not going to transport it into us. We're going to create a separate parallel universe, a parallel reality. I don't think we'll ever do the absolute sound. It's nice to have it as a standard so we can judge things like dynamics and micro dynamics, and we won't

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[2] Ibid.

[3] Robert Harley et al., "Roundtable: Sonic Realism," *The Absolute Sound* no. 162 (June/July 2006): 106-112, on 106.

[4] See Jean Baudrillard, *Simulations*, Foreign Agents Series (New York City, N.Y., U.S.A.: Semiotext(e), Inc., 1983).

> abandon the standard, but that's not where we're going. Where we're going is toward a totally enveloping albeit artificial experience.[5]

The idea of *an* absolute sound rather than *the* absolute sound, and Holt's sense of anger and defeat, leaves present-day high-end audio in an interesting conundrum. While the experience of becoming an audiophile, particularly the realization associated with hearing a high-end audio system for the first time, continues to attract music lovers, the ambitions that informed the ethos of this community from the 1970s through the 1990s may no longer provide the energy to propel the community in the same way. Events beyond the bounds of the community further erode this ethos. What has been dubbed the music industry's "loudness war," and the popularity of MP3s, cut to the heart of what constitutes high fidelity in much the same ways as early compact discs.[6] The manipulation of music during the recording and mastering process, particularly dynamic compression, with the goal of making recordings sound better (i.e. louder) on low-quality reproduction equipment, leaves many audiophiles feeling that the music industry has abandoned any interests it may have once had to increase the quality, resolution, and fidelity of recorded music. During the 1990s, home theater shifted the focus of many high-end manufacturing firms and retail establishments, and many audiophiles feel that two-channel, stereo music reproduction suffered greatly as a result. Given these challenges, that the absolute sound is unattainable and that there is no hope for fidelity in the face of the dominance of personal sonic preferences, what happens to high-end audio?

Despite the challenges of the social and technological changes the community faces, not everyone is as concerned. Many audiophiles – for example, Michael Fremer of *Stereophile* –

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[5] Ibid., 112.

[6] For a brief explanation and example of the "loudness war" see http://www.youtube.com/watch?v=3Gmex_4hreQ (accessed 04/04/09). Dynamic compression used to increase loudness in recordings has been in use for decades, but many audiophiles feel that it has been severely overused on many popular recordings. See John Atkinson, "As We See It," *Stereophile* **22,** no. 12 (December 1999): 3.

point to increasing sales of vinyl records in recent years as a sign of enduring interest on the part of consumers for high-quality music. Paul, a shop owner, told me during our interview that in the last few years, he has noticed a significant increase in the number of young people coming into his shop, and that they are frequently asking for turntables. He attributed this, in part, to a resurgent interest in music related to the social, political, and economic challenges of the last decade. "People get into music more and more when they're involved with social upheaval," he told me. "That's something that seems to happen."

> Remember the 60s? Okay. So what was wrong with the 80s? There wasn't any social upheaval. I mean, there was no interest in society. The only thing... in the mid 80s to the mid-90s, the only thing people were concerned with was money. Money money money. So what happens? The music industry continued to suffer dramatically during that whole period of time right into 2000. All of a sudden, we're involved in, especially in this country, but worldwide, we're involved in major social upheavals. There are big questions being asked. There's literally culture wars going on. There are marches... good god, marches! Wow! When was the last time I saw one of those? 1972, right? I think that that sort of social upheaval, for some reason, seems to bring along a need, a need to respond with music. It's one way that we express ourselves, and it's also one way that we relieve our tension in an empathetic way as opposed to a passive way. So that's where I think it's coming from.[7]

Although many audiophiles, particularly those in high-end audio retail, cited the Internet as opening the door to problems with online sellers undercutting retail prices on equipment, in other ways the Internet has undoubtedly helped audiophiles connect with one another, and expanded the very active used market for high-end equipment that keeps components circulating, and makes system building more accessible for new audiophiles. Several online review publications have also developed solid reputations in the high-end audio community, particularly

[7] Interview, 05/31/07.

SoundStage!, 6Moons, and TONE Audio.[8] While the digital downloading of music has caused significant problems for the music industry with MP3s, some smaller labels have begun issuing high-resolution downloads of their catalogs that are playable through digital music servers. High-resolution downloads and music servers represent a new opportunity for technological innovation and system building, and many high-end audio firms have begun releasing music server products and DACs that have the Ethernet and/or USB jacks that are commonly seen on computers. As computers become more entrenched in home entertainment, many firms are exploring how they can use these new technologies while preserving the emphasis on high fidelity.

It remains to be seen how these developments will affect the social structure, ethos, and technologies of high-end audio. As I have shown throughout this dissertation, technological and social changes have repeatedly and variously presented both challenges and opportunities for audiophiles, but the focus on aesthetics, fidelity, and system building have remained consistent. The ways high-end audio manufacturers and engineers respond to and take advantage of digital technologies will very likely determine how the community looks in the years to come. For the time being, however, the older technologies of vinyl LPs and vacuum tubes beloved by many do not appear to be going away any time soon.

In this dissertation, I have shown that enthusiastic users introduce aesthetic variation into the process of technological innovation, and into the technologies that emerge from that process.

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[8] See http://www.soundstage.com; http://www.6moons.com; http://www.tonepublications.com. SoundStage! is among the earliest online review publications to garner the respect of the largest of the high-end manufacturers, and is distinguished from other sites by their inclusion of measurements in addition to subjective evaluations. Jeff Dorgay of TONE Audio took a different approach with his publication by making it a free PDF download rather than a website (although TONE Audio also has a website), and has greatly expanded the coverage of both equipment and music since it began publication in 2005. In the interest of full disclosure, I have published two short articles in TONE Audio. See Kieran Downes, "Becoming an Audiophile, Part 1," *TONE Audio* no. 13 (December 2007): 128-131; ———, "What Makes Us Tick, Part 2," *TONE Audio* no. 16 (June 2008): 67-71.

The basis for these aesthetic variations comes from users' love of music, their enthusiasm for technology and for small-scale systems building, and their process of becoming audiophiles. I have shown that the experience of becoming an audiophile occurs in four stages: demonstration, realization, acquisition, and mentorship. Audiophiles continue to cycle through these stages after becoming a part of the high-end audio community, discovering new products and forming new relationships that keep the community vibrant and interesting for its members. I have also shown that, from the late 1960s and early 1970s through the 1990s, the high-end audio community has engaged in heated debates with regard to the roles of subjectivity, objectivity, quantification, and science in the assessment of both the powerful but elusive idea of fidelity, and the abilities of certain technologies to reproduce music with fidelity. Regarding particular technologies for home music reproduction, I have shown that the combination of aesthetic sensibilities, technological enthusiasm, and small-scale systems building practices has not only preserved seemingly antiquated technologies such as vacuum tubes and vinyl records, but kept these technologies on the "cutting edge" of high-end audio technology. I have further shown that, in the case of the compact disc, the acceptance or rejection of new audio technologies in this community has hinged on the openness of that technology to user intervention and system building practices – activities that audiophiles believe can enhance their experience of music in the home.

In other words, what the high-end audio community shows us is an example of enthusiasm becoming practice – a practice that resonates in harmony with the broader human experience with technology, and with music.

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