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William Aspray, *Women and Underrepresented Minorities in Computing: A Historical and Social Study*. Springer, 2016. 271 pp. ISBN: 9783319248097.

Review by Roli Varma

There has been almost exponential growth in computing and information technology (CIT) employment opportunities. According to the US Bureau of Labor Statistics, employment in CIT occupations is projected to grow 13 percent from 2016 to 2026, faster than the average for all occupations. People employed in CIT occupations tend to earn higher salaries than in other occupations. For instance, the median annual wage for CIT occupations was $82,860 in 2016, which was higher than the $37,040 median annual wage for all occupations. Furthermore, computing has become ubiquitous in daily life, including social interaction via media. Yet, CIT fields continue to have a major problem with diversity.

Women's share of baccalaureate degrees in computer science (CS) peaked at 15,126 in 1986, dropping to 7,063 by 1995. Since then, the proportion of women in CS has fluctuated. In 2013, women earned a mere 18 percent (9,209) of bachelor's degrees in CS, which is less than what they earned in the mid-80s. Currently, women make up 47 percent of the civilian workforce but only 27 percent of the CIT workforce. Similarly, African Americans, Hispanics, and Native Americans/Alaska Natives make up over 24 percent of the US population, but the number either training or working in CIT occupations is low. For instance, African Americans and Hispanics account for 11 and 15 percent of the civilian workforce, respectively; however, they make up only 7 and 6 percent of the CIT workforce, respectively. These ratios have remained low despite numerous initiatives by government, private companies, and nonprofit organizations to significantly increase women's and minorities' participation in computing. So, what's going on?

The underrepresentation of women and minorities in computing has intrigued scholars, university administrators, policymakers and corporate leaders for some time. Scholars have identified a number of factors that have led to lack of diversity in computing. Typically, studies have focused either on women or on minorities. Aspray's book considers both demographic groups whose representation in computing is much weaker than their representation in the US population as a whole. Instead of focusing on why some groups continue to be underrepresented in computing,

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Aspray provides a social history of activities aimed at increasing the proportion of women and underrepresented minorities in science, technology, engineering and mathematics (STEM) and computing in higher-education institutions. He presents such historical activities within the context of transformations that occurred in American society in the 1960s, including the Civil Rights and Women's Rights movements.

The first part of the book provides an overview of the social science literature on the general issue of women's and minorities' participation in STEM. Aspray appropriately observes that such literature specific to computing, while growing, is still scant in contrast to the literature on STEM. Most of the information provided in the book is historical, discussing various milestones. For women, African Americans, Hispanics, and Native Americans, the author reviews select historical literature on higher education and STEM education with a specific focus on engineering; for African Americans, Hispanic, and Native Americans, the rise of specific institutions devoted to these minorities and funding opportunities to support their careers are reviewed as well. This part provides many references in the literature for the reader; in this sense, it is very informative.

The second part of the book is devoted to case studies about attracting and retaining more women and underrepresented minorities in computing. There is a chapter on the historical evolution of each of the prominent organizations that help women get into STEM disciplines (SWE, AWIS, WEPAN, MentorNet) as well as computing (ABI, CRA-W, ACM-W, NCWIT). Similarly, Aspray summarizes the efforts of various STEM (NSBE, NACME, GEM, SACNAS, MAES, SHPE, AIHEC, AISES) and computing organizations (BDPA, ADMI, CDC, CMD-IT) that have contributed to the broadening of underrepresented minorities' participation in STEM and computing disciplines. Some of the issues facing these organizations as they strive to be more effective are also discussed. This section of the book is very informative regarding how these organizations evolved, including how various projects and programs were initiated and how funding was provided to various academic organizations. The final chapter features successful programs initiated at various academic institutions to attract and retain more female students and underrepresented minorities in computing. These examples show that the underrepresentation of women and minorities in computing is not inevitable but, rather, that interventions have led to some progress in the broadening of these groups' participation in computing.

Aspray's book engages the reader in a social history of STEM and computing disciplines since World War II, and describes the efforts of various organizations and successful programs that offer hope for more diverse participation in computing. This book serves as an excellent resource for academics, researchers, and students in computing, STEM disciplines, and social sciences. I recommend this book not only to readers interested in an account of women's and minorities' participation in computing but to faculty and administrators seeking ways to deal with the challenges in their infrastructural developments so as to address the lack of diversity in computing.

Andrew Nelson, *The Sound of Innovation: Stanford and the Computer Music Revolution.* MIT Press, 2015. 248 pp. ISBN: 9780262028769.

Review by Owen Marshall

Stanford's Center for Computer Research in Music and Acoustics (CCRMA, pronounced "karma") resides in a hilltop Spanish Gothic fortress, known locally as "The Knoll." The impressive accommodations are fitting; CCRMA is one of the world's major centers for computer music research. It is also one of the most well-funded, thanks to its cofounder John Chowning's patent for Frequency Modulation (FM) Synthesis, a technology that largely defined the sound of '80s pop music. In *The Sound of Innovation,* Andrew Nelson provides a concise yet intimate history of CCRMA's occasionally rocky ascent to The Knoll. Drawing on extensive interviews and archival work, Nelson (a professor of management at the University of Oregon who studied at CCRMA as a Stanford undergraduate) guides us from the Center's humble beginnings as a "parasite" of the Stanford Artificial Intelligence Lab (SAIL) to its present diverse portfolio of research and teaching.

Nelson structures his analysis of CCRMA's history around the concepts of radical interdisciplinarity and multivocality. Radical interdisciplinarity denotes "a partnership in which seemingly diverse disciplines come together on equal footing and in which the participants from these disciplines are forever changed as a result of the interaction."[1] Multivocality, a term borrowed from sociologist Woody Powell, describes "the ability to perform multiple activities with a variety of constituents."[1] These concepts, Nelson suggests, help explain CCRMA's track record of innovation.

The story begins in 1946, with the founding of Stanford's music department and the hiring of Vannevar Bush protégé Frederick Terman as the dean of engineering. Terman presided over Stanford's entrée into the emerging Cold War military-industrial-academic complex, vigorously promoting industrial and interdisciplinary collaboration. Nelson argues that this interdisciplinarity became "radical" in the 1960s, when the campus antiwar movement occasioned a shift away from military funding sources and toward increased involvement of social science and humanities perspectives. CCRMA was largely the product of this auspicious institutional milieu.

Nelson insists that CCRMA's innovation history is best understood as deriving from primarily musical aims. He figuratively situates compositional goals as the "cantus firmus," or fixed and pre-existing melody, of CCRMA's polyphonic history. He might alternatively have opted for the metaphor of "pedal point," or a sustained tone against which occasionally dissonant motifs are played. Dissonances between CCRMA's institutional ideology and its complex history make up some of the books most compelling moments. The claim of compositional aims as the enduring motivational priority, for example, strikes an odd interval with Chowning's recounting that "I didn't write any music after '66."[1]

The same could be said for radical interdisciplinarity and multivocality: these concepts clearly reflect CCRMA's collective self-conception, but they occasionally falter as general explanations of its actual practices. For example, one interesting dissonance in the broader theme of radical interdisciplinarity concerns the center's complex and shifting stance toward its own relation to defense funding sources. In her ethnography of CCRMA's Parisian sister organization IRCAM, Georgina Born suggested that CCRMA's 1979 "divorce" with SAIL was due to Chowning's political objection to the AI lab's military funding sources.[2] In Nelson's account we learn instead that the split was in fact initiated by SAIL itself, much to Chowning's surprise, when the computer science department failed to make room for CCRMA in its new facilities. This apparent complication of CCRMA's political mythology goes tantalizingly undiscussed.

Stanford's music department, not sure what to make of Chowning's computer music, denied him tenure in 1973. They changed their minds, however, once the NSF, the NEA, and Yamaha showed up bearing grants and licensing deals with Chowning's name on them. Here Nelson points out that multivocality proved a liability for Chowning, if also the source of his eventual redemption. The particulars of this episode, especially with respect to Chowning's famed encounter with FM synthesis, raise some key questions regarding the role of interdisciplinary boundary-work in the construction of discovery accounts. As at least one other reviewer has noted, Nelson's claim that Chowning was the first to discover a musical application for FM synthesis needs some qualification.[3] Chowning pioneered a computational method for FM sound, but by that point FM modules were already being used by synthesizer pioneers like Bob Moog and Don Buchla. Rather than a penchant for multivocality, it was arguably Chowning's self-described ignorance of Moog and Buchla's techniques (as he explains in an interview about his FM breakthrough, "I had no experience in the world of analog synthesizers") that conditioned his discovery of FM on behalf of academic computer music.[4]

The FM synthesis patent is almost as significant an event in the history of university technology licensing as it is in the history of computer music. Much of the book's latter half follows the negotiations over intellectual property that FM occasioned, as well as the ambivalent relationship between scholarly openness and industrial propriety that continues to structure the work done at CCRMA. Most intriguing here is to see how CCRMA's radical and multivocal ethics have come into tension with the manifestly monopolistic (not to say "monovocal") regimes of patent protection that marked the shift from military Keynesianism and the countercultural interlude of the late 1960s to late 1970s neoliberal privatization.

A greater emphasis on sources from outside of CCRMA proper might have helped to weave these local dissonances into a broader counterpoint, situating it more fully within the world of postwar electronic and computer music. That said, any qualms about *The Sound of Innovation*'s internal focus are balanced by the publication's open and technologically ambitious publication approach. A free and open access HTML version of the book contains in-text links to scans of numerous primary source documents, and a companion virtual archive (thesoundofinnovation.com) provides researchers with a diverse and well-organized collection of textual, visual, and audio materials. This archive alone is a valuable resource for the field of computer music history. Nelson's work informs and invites a continuing scholarly conversation concerning CCRMA—an institution whose story is still far from over.

REFERENCES

1. A.J. Nelson, *The Sound of Innovation—Stanford and the Computer Music Revolution*, MIT Press, 2015.
2. G. Born, *Rationalizing Culture: IRCAM, Boulez, and the Institutionalization of the Musical Avant-Garde*, Univ. California Press, 1995.
3. R. Feller, "Andrew J. Nelson: The Sound of Innovation—Stanford and the Computer Music Revolution (Book Review)," *Computer Music J.*, vol. 40, no. 1, 2016, pp. 73–75.
4. J. Chowning and H. Herndon, "Technosphärenklänge # 2, Talk by John Chowning and Holly Herndon," SoundCloud, 2017; https://soundcloud.com/hkw/technospharenklange-2-talk-by-john-chowning-and-holly-herndon.

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