Эпистемология и философия науки
2019. Т. 56. № 3. С. 123–137
УДК 167.7

Epistemology & Philosophy of Science
2019, vol. 56, no. 3, pp. 123–137
DOI: 10.5840/eps201956354

FROM TECHNOLOGY STUDIES TO SOUND STUDIES: HOW MATERIALITY MATTERS

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In this paper I put in dialogue two areas of scholarship: Technology Studies and Sound Studies. Within Technology Studies I discuss the influential social construction of technology approach and illustrate it with the history of the moog electronic music synthesizer, the first commercial music synthesizer. I stress the role of standardization of keyboards and the key role played by users in the development of this technology. I examine certain iconic sounds that the moog synthesizer produces and discuss the stabilization of sound. It is argued that just as technologies can be traced as stabilizing over time, sounds also can be traced with certain sounds stabilizing and being taken up by users whilst other sounds fail to stabilize. The technology required to produce a sound, performance practice, and wider cultural concerns such as the naming of sounds are crucial ingredients in the stabilization of sound.

Keywords: technology studies, sound studies, standardization, electronic music, social constructivism

ОТ ИССЛЕДОВАНИЯ ТЕХНОЛОГИЙ К ЗВУКОВЫМ ИССЛЕДОВАНИЯМ: О ЗНАЧЕНИИ МАТЕРИАЛЬНОСТИ

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В статье устанавливается взаимосвязь между двумя предметными областями: исследованием технологий и звуковыми исследованиями. В контексте исследования технологий автор анализирует влиятельный подход к социальному конструированию технологий и иллюстрирует его примерами из истории создания первого коммерческого электронного музыкального синтезатора. Автор уделяет особое внимание значению стандартизации клавиатуры, а также роли пользователей в развитии данной технологии. Автор полагает, что звук, равно как и технологии, утверждаются во времени. Технологии создания звука, практики исполнения и более широкие культурные аспекты (такие как присвоение названий звукам) являются важнейшими составляющими стандартизации звучания.

Ключевые слова: исследования технологий, звуковые исследования, стандартизация, электронная музыка, социальный конструктивизм

Introduction

In this paper I bring together two areas of scholarship, *Technology Studies* and *Sound Studies*. I will try and show how these two endeavors can be put in dialogue with one another and also exemplify the benefits of this dialogue by delving into the early history of the electronic music synthesizer. So I will start big but end small – discussing some very specific sounds which this instrument makes.

What do I mean by technology studies? For me technology studies is the study of technological artefacts and processes which treats technology as integrally a social, cultural, political, and economic phenomenon. It is part of the wider field of Science and Technology Studies (S&TS) [Jasanoff et al., 1994; Hackett et al., 2007]. Many of us who started off in *science* studies in the 1970s eventually moved to studying technology as well. For me it has always been important to explore how both science and technology can be studied within a common analytical framework.[1] The Social Construction of Technology (SCOT) [Pinch & Bijker, 1984] aims to introduce a common framework for the study of both science and technology and to try and also delineate some of the differences between these two activities. For example one obvious difference is the role that users play in science versus technology [Oudshoorn & Pinch, 2003]. Scientific knowledge and techniques are by and large produced by esoteric specialist communities for the use of other esoteric specialist communities. The knowledge produced from, say, a solar-neutrino telescope about neutrino fluxes is of use to fundamental particle physics, leading to the confirmation of neutrino oscillation [Pinch, 1986]. But if we take a piece of technology such as, say, the electronic music synthesizer first developed by Moog and Buchla in the late 1960s, and eventually mass produced in an array of commercial instruments by companies today such as Yamaha, Roland and Korg, one finds many more diverse users for such instruments [Pinch & Trocco, 2002; Holmes, 2012].

Sound studies can be defined as an emerging interdisciplinary area that studies the material production and consumption of music, sound, noise, and silence, and how these have changed throughout history and within different societies" [Pinch & Bijsterveld, 2004, p. 636]. Sound Studies has become a vibrant new interdisciplinary field with many different, yet often overlapping strands [Bull & Back, 2004; Sterne, 2006, 2012a]. Among the areas involved are acoustic ecology, sound and soundscape design, anthropology of the senses, environmental history, cultural geography, urban studies, auditory culture, media studies, musicology, ethnomusicology, literary studies as well as of course Science and Technology Studies.

[1] For a similar approach see Latour (1987).

The Oxford Handbook of Sound Studies [Pinch & Bijsterveld, 2012] is a collection of essays on sound which makes the case for input from science and technology studies. Science of course intersects with sound through the classic work of Helmholtz in understanding tones. Specific bodies of scientific knowledge also get applied to sonic contexts, such as physicist Wilhelm Weber's efforts to standardize pitch [Jackson, 2006]. Physiology as well has many connections (e.g. the research of Robert Brain (2008), and Mara Mills (2012)). The sonification of scientific data is also a growing topic [e.g. Feder, 2012]. New sonic technologies are being developed continually and impact societies in unexpected ways.

I think the special contribution which S&TS can make to sound studies is our focus upon the materiality of sound (and bodies) and the technical devices used for making, transmitting, and storing sound. Sound over time becomes more thing-like – a commodity to be bought and sold on iTunes, a thing to be worn, as with personal stereos. Sound itself becomes a new way to sell and market goods. Sound cannot only be listened to but measured, regulated, and controlled [Thompson, 2002; Bijsterveld, 2008]. From my experiences in multidisciplinary collaborations and gatherings around sound materiality and technology are the aspects which sound scholars find hardest to deal with. Many academic areas have sophisticated ways of describing sound, but they are less good at treating how sounds gets embedded, and entangled with, and mediated by material and technological devices or how specific listening practices and other bodily practices co-evolve with these new sorts of sonic technologies.

Science, technology, and medicine are one of the keys to unlock these new worlds of sound. Science, technology and medicine do not only – intentionally or unintentionally – create new sources of sound but they also provide us with new tools, methods and theories about sound [Helmreich, 2007; Roosth, 2009]. Which sounds have been produced, captured, stored and transferred by science, technology and medicine? By which means? How have society and culture appropriated these sounds and means, and how have scientists, engineers and doctors themselves listened to the objects, machines and bodies they study – with or without the help of sonic equipment?

Electronic Music Synthesizers

In this paper I describe three early synthesizers: the Modular Moog synthesizer (1964–1970); the Buchla Modular system developed over roughly the same time period; and last, but by no means least, the minimoog synthesizer developed in 1970. I have written in detail about all these synthesizers in our book *Analog Days* [Pinch & Trocco, 2002]. One of the central ideas in the book is to conceptualize musical instruments using the tools of S&TS. In other words it is argued that musical instruments are themselves pieces of technology and can hence be treated within the remit of S&TS. A reminder of the technological roots of instruments comes from Robert Moog himself:

> Musical instrument design is one of the most sophisticated and specialized technologies that we humans have developed. [Pinch & Trocco, 2002, p. v]

What does it mean to think of musical instruments, such as synthesizers, within the frameworks of S&TS? It means that one can start to talk about synthesizers as nodes in a socio-technical assemblage – that these instruments are integrally part of society, culture, economics, and politics. One methodological way to investigate these instruments is to "follow the instruments" and to study their usage. The "meaning of something comes from its use" is a Wittgensteinian maxim of which I am fond. I try not to assume one musical or sonic usage but follow how synthesizers get used at different times and in different contexts.

Following the Instruments

This approach to musical instruments is very different from the traditional approach of organology. Following the early synthesizers takes us not only to the concert hall and recording studio, but also to new contexts such as the advertising industry (where the synthesizer was used for coffee and beer ads [Taylor, 2012]); the radio studio (where it was used to make sound jingles); Hollywood sound stages and editing suites (the first movie to use all synthesizers for special effects was Star Wars in 1977), TV studios (Miami Vice in 1984 was one of first US TV shows to use synthesizers for mood music); and retail music stores and musical instrument trade shows (the minimoog was the first synthesizer to be sold in retail music stores in 1970). Listening is also part of the story, but "listening" with the ears does not capture everything [Ihde, 1976]. Experiencing electronic music through dancing is very different to listening on headphones alone in a bedroom or through speakers in a recording studio or in a car stuck in traffic on the highway.

The S&TS framing of the history of musical instruments can help start answer a question which has long puzzled me. Why do new musical instruments come along so infrequently? Why even do improvements to classical instruments make such little headway [Bijsterveld & Schulp, 2004]? Many new instruments are invented but few become true innovations. If by new instruments we mean ones that have enough impact to be sold in retail music stores, we find very few new instruments. In that synthesizers today can be purchased in music stores they count as one of the few new genuine classes of instruments to be developed. Looking back over the twentieth century one finds the electric organ, electric guitar, but before that one has to go back to the saxophone invented by Adolphe Saxe in 1841. The saxophone only took off commercially with jazz in the 1930s. This provides a clue to the success of the synthesizer. More has to be going on than the material production of a new instrument – also crucial are developments in the wider culture including music and its social arrangements. The story of the success of the synthesizer can also be traced to new genres of popular music such as psychedelic, and later progressive rock which enabled this instrument to flourish. Thus to follow the synthesizer one must trace its roots in the 60s counterculture. The same argument has been made by historians studying the emergence of computing in Silicon Valley [Turner, 2012]. Indeed some of the same venues (e.g. the San Francisco Trips Festival where the Buchla made its first public appearance) and personnel (e.g. Stewart Brand) feature in both histories.

The uptake of the synthesizer in retail music stores is not the simplistic one of music stores suddenly stocking synthesizers when the new instruments became available. Successful instruments have to be affordable, desirable and saleable. The selling and marketing of instruments turns out to be important. Interviews with the salesmen at the time [Pinch, 2003b] reveal not only what works but also blind alleys, including an infamous tie-up between Moog and Taco Bell founder Glen Bell (Taco Bell was expanding into the South West of the US at the same time as the Moog was taking off). The plan was to have demonstrations of Moog synthesizers at schools handing out free coupons to dine at Taco Bell where a Moog musician would play live. Tacos for a while in St Petersburg Florida, where this experiment started, have never tasted so good!

Synthesizers Enter Retail Music Stores

Just consider one tiny aspect of the problems faced in persuading a retail music store to stock a new instrument. The minimoog although considerably cheaper than its big brother, the Moog modular system, was barely affordable (at the time it was the price of a rock group's van), and with its 43 knobs and switches it was hard to play.

The sales technique for synthesizers involved tracking down musicians in clubs who already played keyboards (e.g. Fender Rhodes or Hammond organ); lending then a minimoog for rehearsal and live performance; teaching them how to make rudimentary sounds (a process which involved the salesman attaching colored tape to the instrument's knobs and switches to mark the different sounds – e.g. the red sound); persuading the musician that the sonic energy and monophonic soloing capability of the new instrument would add star power on a par with the electric guitar (including its gendering [Waksman, 2001]); setting up the necessary financial loan arrangements (usually the deal was closed around the only person with any money – invariably the girlfriend or mother of the musician!); and then taking the musician to the retail store and "demonstrating" to the store owner that there was a new customer and persuading the store owner to take a risk and stock more instruments. Presence (with sales booths and clinics) at musical instrument trade shows such as NAMM (instead of the Audio Engineering Society which Moog as an engineer had previously attended) became crucial, as did setting up a network of dealers which eventually became a global network. The success of the new instrument also depended upon demonstrations of its potency for live and recorded music (the salesmen would ply store owners with copied Moog LPs). As touring rock bands started to use minimoogs, sales increased (the sales people at Moog measured their success by orders coming in from towns where Emerson, Lake and Palmer last played). At some point the sounds of the new instrument became ubiquitous and its presence accepted as just something you popped out to the store to buy or go online and purchase.

The above all helped in building the new market for the instrument. But notice how thin the phrase "building a new market" is. The detailed socio-technical and sonic practices tell us how this new market was created, thickening our economic understanding of markets [Callon, 1998].

The Social Construction of the Synthesizer

At the core of the Social Construction of Technology approach which I have followed in studying the early history of the synthesizer is the intertwining of the social with the technical. Just how does the social get embedded within synthesizer technology?

I argue that there were two radically different designs of analog modular synthesizer, produced at the same time in 1964–70 within two different "technological frames" [Bijker, 1995]. On the East Coast was Robert Moog, with his pen protector, fifties engineering values, and his designs for patched modular voltage-controlled synthesizers with keyboards that could be played by a variety of musicians. Moog synthesizers were commercially produced to be robust, and easy to use and repair. On the West Coast was Don Buchla located in the middle of Haight Ashbury, who was friends with the Grateful Dead, and Influenced by John Cage. Buchla too built voltage-controlled patched modular synthesizers, but had a very different vision for the synthesizer. It was a vision which appealed to experimental musicians, artists and the avant garde. Buchla rejected standard keyboards arguing that with a new source of sound why apply controllers and interfaces from conventional musical instruments? He designed arrays of pads to interact with his instrument and also came up with an innovative way of doing musique concrète electronically – a device we today know as a sequencer. Within the social construction of technology approach we talk about these two radically different meanings as the "interpretive flexibility" of the synthesizer [Pinch & Bijker, 1984]. This moment of openness typically vanishes from the history of technology and closure around one dominant design occurs. It was the Moog keyboard-based synthesizer which was to become the dominant design.

Standards played a significant role in this history as they have played in many technologies. Moog built his system around a volt-per-octave standard which meant that a one volt change of input into, say, a voltage controlled oscillator produced an octave change of pitch. Since Buchla rejected conventional keyboards he could not define octaves and the volt-per-octave standard had no meaning for him. His technological frame was artistic production, so why build a standard instrument at all? For him that device would be a "machine" rather than an instrument. He compared himself to skilled artisans such as violin makers – each instrument was different. Moog's standardization around keyboards and a volt-per-octave is a key moment. Other synthesizer manufacturers, such as ARP in Boston and EMS in London all used a version of the volt-per-octave standard.

The move made by S&TS framings compared to older approaches in the sociology of technology is not only to ask how technology impacts society but also how society and culture impact technology. How exactly does society and culture get embedded in technology? The social construction of the synthesizer is clearest at the moment of standardization. Musical culture does not have to be organized around octaves, but it is these which get embedded within the technology. The black-boxing of science and technology [Pinch, 1986; Latour, 1987] becomes in effect a powerful carrier of culture. Social struggles become frozen into hardware, a process which Gaston Bachelard calls *phenomenotechnique*. In this case an almost invisible culture is taken forward with the minimoog synthesizer which has even more standardization as it is hard-wired (rather than the flexibility of patch wires between different modules) with a built in keyboard. Indeed the minimoog (although still "analog" in terms of its sources of sounds), and with the aid of "sound charts" to stabilize certain sounds, becomes in effect the template for all later "digital" synthesizers.[2]

2 The scare quotes around the words digital and analog symbolize the valence these terms carry. Analog was a term only applied to synthesizers after digital synthesizers came along, and furthermore on some definitions of digital (binary compiling code) the player piano is a digital instrument.

But history does not have to be this way as Buchla reminds us. There is not only an aesthetics of technology at work here but also a politics of technology. Buchla with his radical artistic stand rejects the capitalist logic of mass production.

Users

Part of the story of the history of the synthesizer is the role played by users. Moog and Buchla when they developed their first instruments had no idea who the customers for such instruments might be. Moog was part of the audio-engineering culture and saw synthesizers as being akin to high-end audio gear. Although he did eventually employ a New York salesman and two on the West Coast he made no initial efforts to appeal to retail sales (and since the modular Moog cost the price of a small house, retail sales were unlikely anyway). Moog's second ever customer, Eric Siday, ordered a custom-built Moog for use in making advertisements (Siday was famous for making the Maxwell House coffee ad [Taylor, 2012]). Moog learnt from his early customers as to how to improve the instrument. Most of his customers were based in New York City and he would deliver the synthesizer personally to them (taking them down from Ithaca on a Greyhound bus!), help set up the instrument, and watch how it was used. Added technical refinements came from customers, such as the idea of portamento (gliding between notes) on the keyboard suggested by composer Wendy Carlos. It wasn't that Moog had a Harvard Business School plan to learn from his users. It was just the way he liked to do things:

> All the people I did business with in the early days have remained collaborators and friends and customers throughout the years… They've been very valuable to me both as personal friendships and as guidance in refining synthesizer components – Bob Moog quoted in [Pinch & Trocco, 2002].

Moog also employed studio musicians, such as composer David Borden, in his factory studio to help "idiot proof" the synthesizer. The understanding he reached was that Borden could use the instrument for free late at night but if anything went wrong (detecting the smell of fried electronic components was a sensory skill these musicians soon developed), he must leave everything set up exactly the same. In the morning the engineers would figure out what had gone wrong. Moog realized musicians with no technical familiarity might abuse the instrument in every way possible (plugging inputs into outputs and so on). As a result Moog synthesizers had a reputation for reliability. Musicians who visited his factory were offered free tuition on the synthesizer depending on the amount of gear they bought. This provided further opportunities for Moog to learn what the musicians wanted. He sometimes gave away a free instrument (this is how Sun Ra – an early visitor – acquired his minimoog model B). Moog also realized that the field of electronic music was starting to grow and he encouraged it by launching his own electronic music magazine (*Electronic Music Review*) from his factory – this was a way of encouraging and promoting the wider field of electronic music with record reviews, technical tit bits, concert reviews and so on (it was a precursor to *Keyboard* magazine).

Place is the Space

The story of the Moog and Buchla production facilities (small workshops and garages mainly) is also a story about place and pharmacology: the geography of sound and where and how it is produced and consumed. Moog was located in rural upstate New York, Buchla in Haight Ashbury. Moog attended pot parties but "never inhaled". Buchla was friends with Ken Kesey, the Merry Pranksters, and the Grateful Dead and designed some of his synthesizers when tripping on LSD. Moog employed rural women whose quilting skills were ideal to "stuff circuit boards". Buchla employed his friends, artists, and Zen Buddhists whom he apparently instructed to work in complete silence!

Keyboards

Part of the history is also about the role of keyboards which Buchla famously rejected. Interfaces, which provide the direct human bodily link to machines, are key things to study. The story of the QWERTY keyboard's adaptation to the computer from the typewriter is well known (e.g. Bardini, 2000) and one can tell a similar story about the keyboard's move from organ to synthesizer. Interestingly Moog had earlier built hobbyist theremins which allowed for continuous interactive control and sweeps of sound. He thus had a ribbon controller on his synthesizer which allowed the performer to run his or her finger down the controller making a sweeping gesture. Moog also discovered early on that academic electronic music studios and composers were ideologically opposed to keyboards. Vladimir Ussachevsky had bought three identical Buchla synthesizers for the Columbia Princeton studios. Moog faced a dilemma. It was his salesmen, however, who urged him to keep with the keyboards and over time the keyboard became more and more prominent. Although monophonic (one note at a time), it was a familiar way that musicians could interact with the instrument. In many of the early publicity shots of the synthesizer a keyboard is prominently displayed. We asked Moog about these photographs and he told us:

> The keyboards were always there, and whenever someone wanted to take a picture, for some reason or other it looks good if you're playing a keyboard. People understand that then you're making music. You know [without it] you could be tuning in Russia – Bob Moog quoted in [Pinch & Trocco, 2002]

Over time and with the success of keyboard music realized on the synthesizer, such as Wendy Carlos's "Switched on Bach", the instrument started to become defined as a keyboard instrument. With the keyboard built into the minimoog it established what might be called the "path dependence" for keyboards that exists to this day [Pinch, 2001].

Generic Sounds?

Thus far I have told this story without much reference to sound. In our book [Pinch & Trocco, 2002] we wrote "sound is the biggest silence". There were, however, many clues as to how to deal with sound. We were repeatedly told, for example, that the sound of the Buchla and the sound of the Moog were very different and over time I too came to recognize this difference. But it is hard to describe sonically exactly where these differences reside. Is it in the technology (the early Moog unlike the Buchla used a filter), is it in the quality of the wave forms being produced (the Buchla was alleged to have purer" sine waves), or is it in the controllers (Buchla with his sequencer and array of touch pads and Moog with his keyboards and ribbon controllers)? And anyhow how does one compare sounds of instruments independently from performance and genre?

In revisiting the history of the synthesizer for this paper I would like to suggest one way of integrating sound into the story. The alignment of repeatable bodily practices (what Marcel Mauss might call "body technique") with particular aspects of the technology enables the repeatable performance of certain "generic" sounds. What is a generic sound? It is hard to be precise because linguistic usage, the material performance under particular circumstances, and listening skills are all involved. But one way to think about it is to ask about sound captured in devices that emulate the sound of instruments [Pinch, 2003a]. For instance, most digital synthesizers and software suites of effects have menus of sounds including something labeled a "moog sound". Synthesizers, although they are capable of producing many sorts of sounds (including emulations of acoustic instruments and earlier synthesizers) paradoxically often get associated with one type of sound and this can be thought of as a generic sound.

Another way of describing a generic sound is to ask musicians about the type of sound they themselves recognize as being typical of the instrument and which they are able to reproduce. Well known Moog musicians Paul Beaver and Bernie Krause were often hired as session musicians by bands in the late 1960s who wanted the”moog sound”. They became expert at articulating the precise sorts of sound being sought. and how to reproduce them. These generic sounds emerge over time as instruments, performers, and listeners start to stabilize the sonic elements they desire.

At first with a new instrument there is what might be called an “overflow” [Callon, 1998] of sounds. For example, here is a description of Paul Beaver working on a Doors session for their LP “Strange Days”:

Paul Beaver began plugging in a bewildering array of patch cords. He’d hit the keyboard and bizarre, Karlheinz Stockhausen-like sound would emerge. “Actually that sound you had about three sounds back was very usable. Could you go back to that?”… “That Crystalline sound” Jim Morrison joined in. “I liked the sound of broken glass falling from the void into creation.” Which sound was that?” said Paul Beaver. Ray Manzarek – Keyboard Player of The Doors. Quoted in [Pinch & Trocco, 2002].

The problematic linguistic element and lack of stabilization is evident here – what could be the sound “of broken glass falling from the void into creation” which Jim Morrison heard? We will probably never know! But over time generic sounds started to emerge. One such sound for the Moog was its legendary bass sound, a sound reproducible by the minimoog and often taken as part of the defining genre of hip hop. In terms of the technology of the Moog the crucial module technically is the low-pass filter. This is known as the “ladder filter” after the ladder of transistors in its circuit and was the only device on the synthesizer which was patented. It is a way of removing higher harmonics from sounds. The Moog also contained a means of giving “shape” to any musical note in terms of its amplitude in time – known technically as the envelope shaper – a note’s attack, sustain, decay and release (which Ussachevsky first suggested to Moog and became known as the ASDR). In the bass range the type of plucked sound obtained was one that had resonances of a bass guitar but was a much fuller flatulent sound that had an extended sustain.

Moog himself told us a story about this sound as he experienced it at a Paul Simon recording session. In the early days Moog himself would sometimes be invited to recording sessions to play his synthesizer:

> Paul Simon was doing “Bookends” and I brought it in – you know they paid me well for this- they just wanted it there for a couple of days… I sat around watching the session… at that point I could get sounds pretty fast. I knew the equipment. But one sound I remember distinctly was a plucked

> string, like a bass sound. Bump, bump, bump. How did this go Bump bah-hhhm. Then it would slide down – it was something you could not do on an acoustic bass or electric bass. And John Simon [the producer] finally did it with a pedal. And I can remember, while John was fooling around and getting this sound and sort of playing it, a couple of session musicians came through. One guy was playing a bass and he stops and he listens and he listens. He turned as white as a sheet. – Interview with Robert Moog

The value of this new sound is indicated by its potential for actually putting musicians out of work to which Moog alludes. The sound Moog to which refers can be heard at the start of the Simon and Garfunkel track. "Save the Life of a Child". The way of controlling the Moog here seems to have been via a pedal which allows for more control of the ASDR. Malcolm Cecil, another prominent Moog musician who made most of Stevie Wonder's early Moog sounds, told us that he used the ribbon controller through the low-pass filter to get the: "barruuump" bass sound on the track "Boogie on Reggae Woman". Note the difficulty here in using words and letters to capture the sound!

Describing generic sounds is rather tricky. Clearly the material arrangements such as the technology involved – the low pass filter in particular – is what enables the sound to be produced, but it also must be aligned with specific controllers and performance practices. Furthermore the same generic sound can be heard differently depending on the context of performance and musical genre. The sound Moog heard live in the New York recording studio through, one imagines, a very high-end amplifier and set of speakers, is not necessarily the same sound reproduced in an MP3 compressed version of the recorded song which we might listen to today [Sterne, 2012]. Furthermore the musical genre makes a huge difference – hearing the bass sound in the context of a Simon and Garfunkel song is different from experiencing it in the context of a Stevie Wonder song and hearing that Stevie Wonder song in a club in Manchester on the dance floor is different from hearing it at a Harvard seminar, and so on.

It is clearly too simplistic to equate a particular sound with a piece of technology or with a set of material arrangements and certainly not with a piece of musical notation. More, much more, is going on. One last example can be used to demonstrate this. A generic sound much sought after with the minimoog is a monophonic "yawling" Moog filtered keyboard sound, typical of progressive rock in the early to mid 1970s. The solo cuts through in the way a lead guitar does. The use of keyboard controls such as portamento over several octaves and the pitch bending of individual notes (the pitch wheel was invented for the minimoog and is one of the new controllers which made the instrument such a success – it is found on nearly all subsequent synthesizers) adds to the solo's effectiveness. But the genre, visual aesthetics, and virtuosity of performance are also important here. For instance, a virtuoso performer such as Keith

Emerson kitted out in all his pomp rock finery in live concert often exaggerated his pitch bending gestures visually with raised arm motions enabling the audience to see how bodily gesture and sonic effect were aligned. Changing the resonance of the filter during a solo by manipulating the “Frequency Cut Off” control on the minimoog also enriches the sonic quality of the sound. Perhaps rather than talking about generic sounds it makes more sense here to talk about “generic performance practices”.

A nice example of this is a minimooog solo performed by a guitarist in the band Heart on their 1976 song “Magic Man”. Within the genre of rock this is a typical generic type of minimoog sound and performance practice (note that the guitarist has his guitar casually slung over his back as he plays the minimoog solo).

Conclusion

Teasing out how sounds, technology, and performance practices work together in different contexts is one way of moving sound studies and technology studies into new directions. It is a way of addressing the materiality of sound. Obviously there are many types of sounds and many types of technology. There are also many ways into sound and many ways into technology. The approach I advocate here is to locate moments of stability both in the socially constructed technology and the socially constructed sound and to then unpack performance practice as a further way of tying the two elements together. This method into the issue avoids postulating particular affective states or a particular ontology of sound as some scholars have argued [Labelle, 2010]. Both these latter components could be added to the analysis. A particular genre of music, for example, might evoke, say, particular pleasurable states and one might associate, say, particular sonic vibrations with that state and then elicit how the technology in interaction with humans produces particular vibrations. I leave it to others to push on in those directions. Ultimately “hearing modernity” must mean bringing forth the social, cultural, economic, political and affective stakes involved in sonic technologies and these are still early days in that project.

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