Technologies—Musics—Embodiments

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Today recorded music probably accounts for the single largest category of music listening. This essay seeks to re-frame the usual understanding of the role of that type of music. Here the history and phenomenology of instrumentally mediated musics examines pre-historic instruments and their relationship to skilled, embodied performance, to innovations in technologies which produce multistable trajectories which result in different musics. The ancient relationship between the technologies of archery and that of stringed instruments is both historically and phenomenologically examined. This narrative is then paralleled by a similar examination of the history and variations upon recorded and then electronically produced music. The interrelation of music-technologies-and embodiment underlies this interpretation of musical production.

Michel Foucault, in trying to convince us that pre-modernity had a form of knowledge, an episteme, which is now past and no longer makes sense, claims that the symmetry of resemblances which ruled the sixteenth century led to a conclusion that "there are the same number of fishes in the water as there are animals . . . .the same number of beings in the water and the surface of the earth as there are in the sky, the inhabitants of the former corresponding to the latter…"[1]

We laugh or are amused—what sort of claim is this? Is it empirical? But if so, then, theoretically, we could go about confirming or disconfirming it by a count. Yet, what agency—the National Science Foundation, NASA—would support a grant to do such a count? We know from the outset that such agencies would not, although in today's episteme, one might be able to fund a census which would take a count of polar bears over several years to determine if they are entering endangered species levels, or do a census of whales to see if they have recovered their populations enough to be hunted. Foucault's point is that the thinking which relies upon such presumed symmetries simply no longer has any bite; its episteme is dead.

The purpose of this essay is to undertake philosophical reflections upon recorded music, or as I prefer in a parallel to Foucault's epistemes, musics in the plural. I will begin my reflection with an attempt to locate us with respect to the many musics we may experience contemporarily and hint at something like the suggested census noted above. I shall first forefront the listener, the human who hears or listens to musics. But in parallel fashion, I shall also place the listener into a context where the technologies

Janus Head, 10(1), 7-24.

which mediate the musics are also brought under scrutiny. Clearly, there are indefinitely large numbers of such musics which could be listened to: performed musics—chamber, classical, rock, ancient music consorts, street performers and the list expands and expands. Similarly, whatever types of performances might be listened to, such musics could also be recorded and thus listened to in the form of recorded music. Recorded musics are—we usually think—replicated musics. But here one must then also account for the plurality of recording technologies: iPods, Walkman, vinyl, CD, digital tape, Musak, radio, and again an indefinite list of technologies which mediate and present the recorded musics grows.

Yet, with an echo of the difficulty of determining if the number of birds equals the number of fishes, there is difficulty in determining how many listeners hear how many songs in how many ways. Yet there may be clues: Gold records are those which sell 500,000 per run; Platinum records are those which sell 1,000,000 per run. In 2006 in the US, there were 30 gold and 16 platinum runs, thus equaling 31 million records.[2] Now, how many people listened to those 31 million records and how many times was each song heard? And don't forget to count all the downloads which also occurred in the same year from the multiple sources. While we do not know an actual number, we can easily surmise that the number must be very, very large indeed! But, to make it simpler, while yet remaining intuitive, let us imagine only listeners to recorded songs in greater New York on a given day, and then imagine the listeners to all the live music performances of whatever kind on that same day—from the philharmonic in Lincoln Center to the Peruvian flutists in Greenwich Village. I am willing to wager that the number of recorded presentations is simply much larger than the number heard in live performances by a very large magnitude. Here my point is that we philosophers, musicologists, performers and other theorists may be coming to reflect upon recorded music very late. For if it is the case, as I suspect, that on a world-wide basis more listeners listen to recorded music than any other kind of presented music, it is sort of like a very large canary already escaped from its cage and now has grown too big ever to re-enter.

Recorded musics are, of course, technologically mediated musics. And, historically, recorded musics are quite recent arrivals upon the very ancient histories and even pre-histories of other musical presentations. For the moment I shall not discuss scoring, which could be considered a sort of pre-recording technique for preserving some kind of identity between the same piece played in different performances, and which also employs a type

of 'material technology' analogous to print, but as notations on a page. Nor shall I do more than sketch the very rapid history of recorded musics which go back only 130 years, but I do want to point up in bulleted blinks, how fast and how diverse this technological trajectory has been:

- 1877 Thomas Edison produces the first useable cylinder recording, first with tinfoil, later wax cylinders. These were mechanical devices recording sound waves physically, mechanically. Only a few plays are possible before the record deteriorates.
- By 1899 coin-in-box predecessors to juke boxes were already popular.
- By 1902 Caruso began to record, first with cylinders, later with discs, which began to appear in 1903.
- 1904 saw the invention of the diode which made electrical rather than mechanical recording possible, but which did not become practical until 1919.
- By 1923 radio threatened to depress the reproduction industries, first with live, later with recorded presentations.
- The first stereo developments began in 1931 and magnetic tape followed in 1934.
- Vinyl, which reduced surface noise compared to the older discs, began in 1948 and the older '78's began to be replaced by '45's and 33's. Full stereo was available by 1956.
- Cassettes, 1963, digital CDs, 1978, and DAT or digital tapes came on in 1989.
- Then, with the 1990's came the proliferation of online and downloading copies in all the varieties now popular.

I want here simply to make two points: first, this 130 year proliferation must appear as a very rapid proliferation which also covers a wide variety of different technologies to record and reproduce musics. Second, it is a history, which while having ups and downs, clearly is one which now pervades an entire global economy, again evidence of our very large escaped canary.

I have now begun with technologies, which in the case of recording technologies mediate musics which in this first pass are heard by listeners. In short, I am relating here a material means of producing musics to experiencing humans who listen to these musical phenomena. Now, however, I want to shift to pre-history and begin now a long-range location for musics. How

long ago humans began to make music remains unknown—but whenever music began, from the earliest human beginnings there were always already present human uses of technologies! This may seem like a strange claim, but only a few years ago there appeared in *Science* an article which refers to the chipped stone tools used by chimpanzees to crack nuts in a hammer/anvil fashion which go back at least 4300 years BP [before present][3] The sample found remains quite identical with contemporary chimp tool formation and use. The surmise of the article is that such simple tool use probably goes back at least to the common ancestor from which chimpanzees and humans split off! By current dating that is over six million years ago. And, for the physical anthropology literate, we are all familiar with tool uses by homo erectus, Neanderthals, and homo sapiens sapiens. Stone Age tools go back at least two plus million years. I would like to suggest that our common image here is one of a limited appreciation of the diversity of technologies by our ancient ancestors—we may think of Acheulean hand axes, or chipping tools, or maybe if we realize that 'soft' technologies such as nets and baskets probably were also used, but all of these, we usually surmise, are for subsistence needs. That is, we tend to evoke a simple and basic existence for our predecessors. This may underestimate our ancestors.

What, then, should we make of a 45,000 BP "bear bone flute" found in a site associated with Neanderthal humans in a cave in Slovenia? *Science* reported this find and the probable conclusion that this artifact was likely a flute as evidenced by the regular symmetrical shaping of the four holes which, under analysis, yield a tuning system for a diatonic scale.[4] And while such a musical instrument is not millions of years old, so as to compete with Acheulean hand axes, it probably does suggest that performed instrumental music occurred long ago in pre-history. In passing, note that we are now shifting the music scene from listeners—although they, too, were likely present—to also include performers. With performers, human embodiment actions come into play. The flute player must learn an embodiment skill which engages, in this case, the disciplined hand and breath motions which are mediated through the flute to produce music. We are now able to recognize a very basic relational ontology of instrument use. The human practicioner plays the flute to produce musical sound—I diagram this as:

Human ⇛ flute ⇛ music

This relational phenomenon is what phenomenologists call 'intentionality.' But in this case, it is an actional intentionality which is directed, mediated through a material instrument—a technology. A deeper analysis would go on to show that in the learning process, the shapes of experience change: first, struggles with playing the flute yield sounds, but they are not refined, gracile, 'musical.' But as skill is acquired, the flute is 'mastered' in that it withdraws or becomes more and more transparent and the player is able to produce the sounds we hear as flute-music. This same process, which we can describe for the movement from novice to virtuouso performance, no doubt also characterized the experience and attainment of the Neanderthal flutist. The 'woodwind,' here 'bonewind,' instrument permits the mediation of the human hand and breathing action into flute music, hearable both by the player and any audience present.

We have now taken a simple look at recent recording technologies and then at a very ancient instrumental technology with musics mediated by different technologies over a very vast historical span. Now I want to risk reader dizziness by reciting what for me was a very formative occasion, a conference on musical improvisation at the University of California, San Diego, in 1981: I had been invited to be a keynote speaker at this conference which appeared to me to be of great interest—an interdisciplinary gathering of musicians, composers, humanities academics and even one other philosopher, Daniel Charles from the university of Paris. I arrived, realizing that I knew not one person from previous experience, although at social events I met folk who had read my *Listening and Voice: A Phenomenology of Sound* which was, of course, the connection to this event and the source which motivated the invitation. But it was the improvisation workshops which turned out to produce the most interesting provocations.

I arrived at a workshop, a studio in which there was a grand piano, various traditional instruments, and a collection of distinctly non-traditional instruments. I tried to be unobtrusive and found a seat in a corner, self-consciously aware that my only performance abilities were abandoned long ago from high school to early undergraduate trombone playing days. But observer status was not an option—I was handed a "water horn" and commanded to participate. The water horn was a stainless steel container, partially filled with water, to which had been brazed a series of brass rods of different lengths around the perimeter of the vessel. I was handed a violin bow, and by now cacophony had already begun. Some players were hitting the open piano wires with hammers; others were turning anything in sight into a

percussion instrument; virtually nothing was being played in a standard or traditional way and so, in the spirit of the event—which was simultaneously being recorded for posterity—I began to bow the rods on my water horn, and later to shake the instrument to get a gurgling sound. Extreme improvisation indeed, but this event took in my experience and memory as I realized that any instrument whatsoever had multistable possibilities just as I had earlier noted belonged to various other perceptual phenomena. This event, 1981, occurred not long after my first book on the philosophy of technology (*Technics and Praxis*, 1979) in which I had initiated a long term interest in the role of instruments as the material means for producing scientific knowledge. And, I claim, there is a parallel between scientific and musical instruments with respect to the already noted role of intentionality. The human action undertaken is mediated through the instrument to produce its result. If, in one case, it is the greater knowledge Galileo obtained through his telescope—of the craters of the Moon, the satellites of Jupiter, the phases of Venus, in the other case it is the transformed sounds produced through the playing of the instrument, sounds which are as different from ordinary human vocal sounds as the sights through the telescope differ from those of naked eye observation. And to attain each production, in both cases, there is an acquisition of a skill which must be acquired to have a refined and high quality result. I shall return to this parallelism later for added analysis, but for now I want to return once again to an ancient pre-historical example of technologies which turn out to display a remarkable set of multistabilities which I find surprising.

My example is that of ancient archery: with few exceptions [Australian Aboriginals who developed boomerang technologies and some southern hemisphere groups who developed blow gun technologies] virtually every ancient culture developed archery, variations upon bows and arrows. But the style of use, the technical composition of the material artifacts, and the cultural contexts into which these technologies fit, display an amazing set of multistable patterns:

- The English longbow, constructed of yew or ash, long (2 M.+) with long arrows, could be taught simply for use for the yeoman and fired with rapidity from a standing position. The firing technique called for the bow to be held at arm's length before the bowman, with the bowstring then pulled back and the arrow placed between the first and second fingers for release. Its effectiveness was demonstrated in the historical

battle of Agincourt, where this type of archery overcame the crossbow archery of the enemy.

- From the East came the radically re-curved, short (1.2-3 M) and composite bow used by Mongol horsemen who repeatedly invaded eastern Europe. Clearly a bow of longbow length could not work on a galloping horse, and the composite of bone, wood, skin and glue, radically recurved, allowed a smaller weapon similar power. But the firing technique was also different. Here the bowstring is held close to the face and bow pushed rapidly away with another form of quick fire, timed exactly to the gallop of the horse.
- A third 'artillary' style of archery arose in China, in this case a long (2M+), recurved bow called for the highest pull power in antiquity (matched only today with the compound pulley powered bows now popular). Here the firing technique included simultaneous push and pull, plus the use of a thumb ring to prevent injury to the thumb by the string. I was delighted to discover some of the terra cotta warriors in the XiAn complex cast in exactly this posture on my first visit to China in 2004!

The examples above illustrate what I call multistability in the sense that the 'same' technology takes quite different shapes in different contexts. In each case, the tensioned, strung bow can propel the arrow over distance with striking power, but the human skills take different shapes and patterns in using the also technically different artifacts. Does this seeming excursus have anything to do with music? My answer is 'yes' and I shall try to open this line of inquiry by returning to the improvisation event with its playful exploration of performance variations upon traditional and non-traditional instruments.

Every archer could hear the bow string 'twang' when fired. Could it then be 'played?' We have already noted at least three styles of firing an arrow: bow extended and held still; string held still and bow pushed out; and double push and pull. Each of these variations, however, serve the same purpose, to fire an arrow. But in a new context if one holds the bow in a horizontal position instead, and 'plucks' the bowstring—we are transforming the bow from its usual use, into a new use, as a sort of stringed instrument!

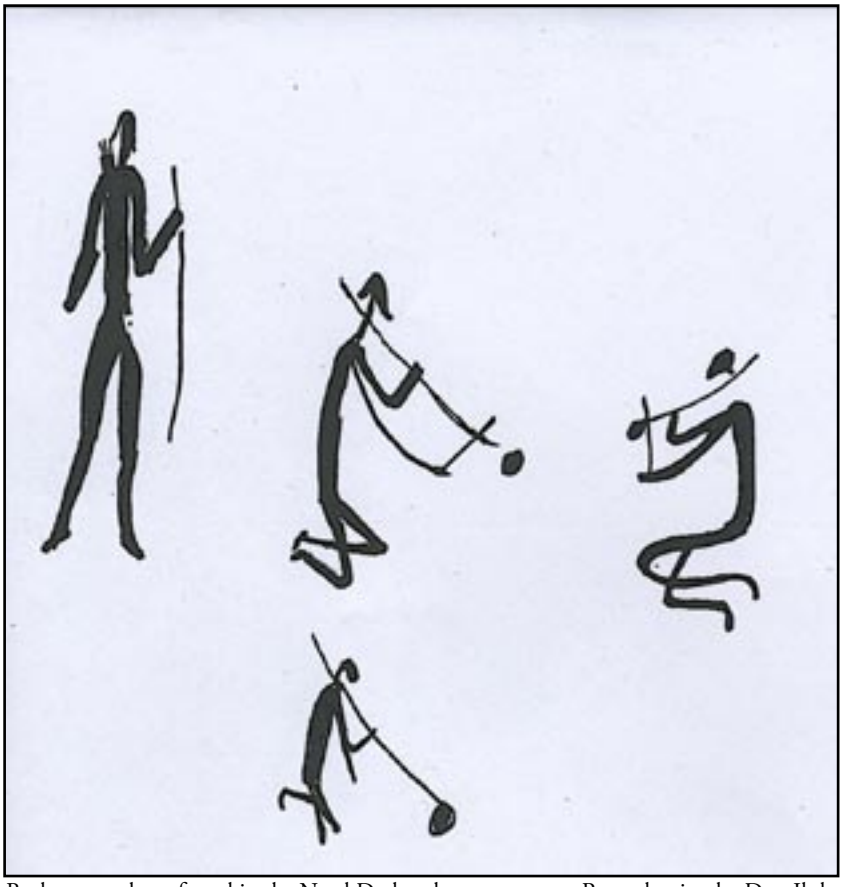
Anyone familiar with a history of instruments, or ethnomusicologists would know that there have been a wide variety of single-string instruments in many cultures. But I suspect not many know that there is also a tradition

of actually using an archery bow as a stringed instrument. Apparently such uses are common in Africa. According to even such a common source as the Encyclopedia Britannica, "…The San of the Kalahari often convert their hunting bows to musical use."[5] So, we are now off on a new technological trajectory or line of development. To produce a more interesting music, why not a moving fret? And, we notice, that the simple 'twang' is not very loud or powerful, so why not add a resonator?

Again, just as with the hunting bow, there are a variety of types: "There are three types: bows with a separate resonator; bows with attached resonators; and mouth bows [all] evolved from the hunting bow."[6] In short, what I am doing with this set of cultural variations, is to show how an improviser creates a new stability or performance practice, using either a regular archery bow, or by adding very minor features and thus opening the way to developing stringed instruments. In my actual, original speculations—phenomenological fantasy variations—I did not yet know about what I cited above, but followed what I knew to be an exploration of different ways in which the human-technology actions could be possible as in the improvisation event. But as it turns out, this trajectory had already been followed. The above illustrations are of sub-Saharan African practices. But such practices apparently are not only contemporary practices. Another source, archeologist, J.D. Lewis-Williams points out in the *South African Archeological Society Newsletter*:

> …Bushmen recognize two kinds of music, vocal music and instrumental music. . . .the more personal instrumental music …is played …sometimes while walking in the veld, sometimes while relaxing in the camp. One of the most characteristic Bushman instruments is the musical bow, which is, in fact, an ordinary hunting bow. It can be played with the performer using his mouth as a resonator. When so used, the bow is more or less horizontal but can also be played with the stave vertical or semi-vertical. Then some performers like to use a calabash or other object as a resonator to produce more varied sounds as they tap the string with a stick.[7]

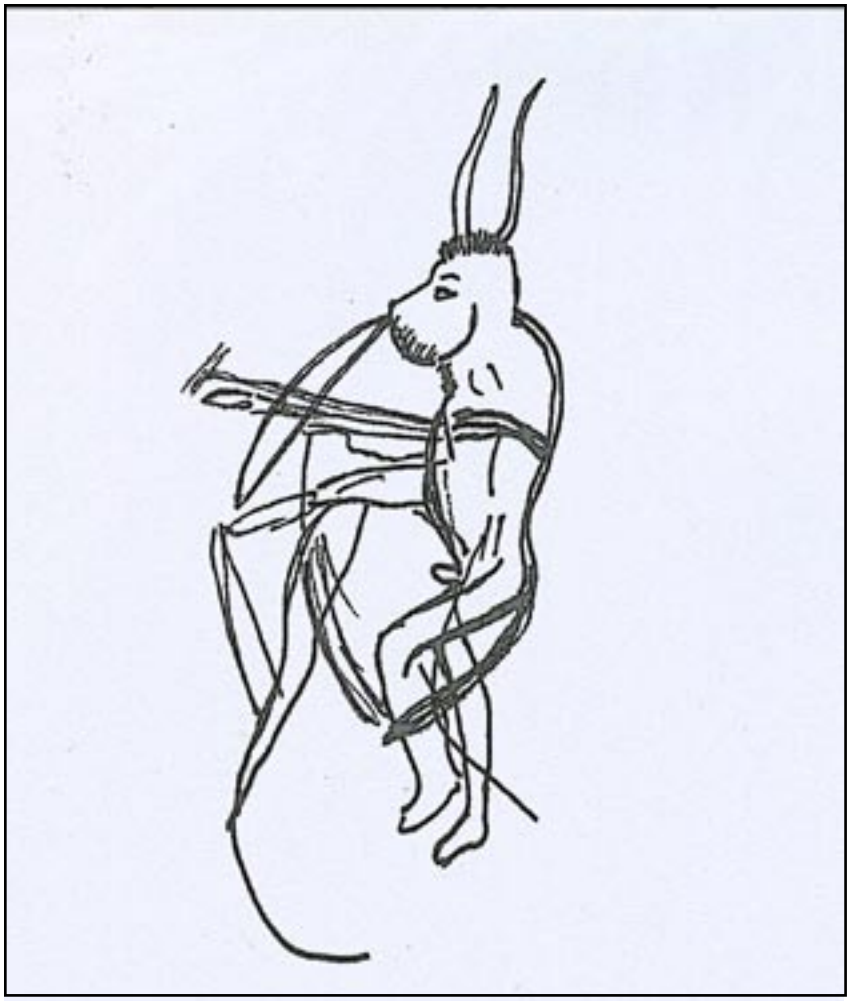
Then, to clinch the case, these modes of playing the bow have recently also been found to be depicted in the traditional Bushman rock art found in the Natal Drakensberg area by Paul den Hoed and Justin Clarke:



Bushman rock art found in the Natal Drakensberg Reproduction by Don Ihde

This rock art dates back to 2500 BP. (I visited this area and saw some of this rock art in 1982 but did not see this particular depiction.). And, if this is not enough, note that a shaman depicted in the Trois Freres cave in Southern France with a dating of 15,000 BP is shown, as now commonly interpreted as playing a bow in this same position (see next page).

With bows played in this way, both multistable variations appear, and in each different types of musics are produced. "Apart from adapted shooting bows, more specialized types of musical bows are widespread. Most are sounded by plucking or striking the string, but the Xhosa uubhu is bowed with a friction stick…"[8] Thus the 'same technology'—a bow—apparently fits two radically different trajectories, one of them musical. And this set of different trajectories is apparently also very ancient.



Bow playing Shaman, Trois Freres Cave, France Reproduction by Don Ihde

On the surface, it may seem that this detour into pre-history with glimpses of ancient 'bearwind'/woodwind instruments, or of stringed weapons/stringed instruments may seem very far from the focus upon recorded music. But my point here is that, in human-techology interrelations, there may be found a set of multistable variations, and, from these, suggestions for trajectories or further and different developments. To fortify both points permit one more set of variations, this time those which may be found in a similar comparison between scientific and musical instruments.

It is probably not coincidental that the European Renaissance and Early Modern Science both marked a period in which instrumentation began to proliferate in both art and science practice.[9] In music, this is a period which instruments are more and more used, compared to older a cappella and plainsong sacred music, to the increased use and experimentation with a variety of stringed, brass, woodwind and percussion instruments. Indeed, our current orchestral instruments such as violins, violas, horns, timpani and the like, can all trace their development to this period. Musical instruments, however, produce sounds but many other Renaissance and early modern instruments were more related to optics and visualizations. Galileo, often taken as the paradigmatic figure for early modern science, developed both telescopes and microscopes utilizing compound lenses to magnify both the macroscopic and the microscopic phenomena of interest. I have referred above to several of his observations of previously unseen celestial phenomena—and these could only become visible by first, recognizing the optical possibility of magnification, and then gradually developing the optical technology which both allowed greater resolution and greater magnification. Indeed, Galileo, hearing of Lippershey's 3X telescope, went on to produce nearly a hundred of his own telescopes, up to approximately 30X, which turns out to be the limit for lenses without encountering chromatic distortion.[10] Thus, the limit Galileo reached was one which allowed him to recognize the "protuberances" of Saturn, but not resolve them into the rings with which we are now familiar. The trajectory, of course, is the line of development which recognizes in the material possibilities of optics, the possibility of greater and greater magnification and resolution, suggested in the very use of the instrument. The same following of a trajectory is, of course, also possible with musical instruments. Changes of material for stringed instruments, for example from gut to hair to wire or polymer strings, all allow different tonalities for the produced sounds. Nor should we forget that the human actions in 'playing' or tuning both scientific and musical instruments also plays a crucial role in the output. Galileo insisted that in order to see what he saw, he needed to train the novice telescope user, not unlike the training which must go into producing a good tone and sound from any musical instrument.

There is, however, a crucial difference which may illustrate a quite different sub-cultural contrast between the history of scientific, compared to musical instrumentation. Once again, I revert to a somewhat imaginative variation for illustration: I ask—could you imagine a serious 21st century

astronomer directing the graduate students in astronomy to try to make a new discovery of some astronomical phenomenon by picking up and re-using one of Galileo's telescopes? Yet, especially when I visit Europe, I have often been delighted to attend concerts given by groups who pick up and use ancient or early instruments to perform a chamber piece! And, even today, what violinist would turn down the opportunity to play a concerto using a Stradivarius or Guaneri violin? I am suggesting that there is lurking here a strong contrast between the instrumental traditions of much science and of much music culture. In general, I am claiming that there is an inbuilt progressivism in the adaptation to new instrumentation associated with science practice, but there can be an equally inbuilt romanticism which sometimes results in a preferred traditionalism associated with some music culture. This may also be evidenced by historical examples.

For example, Trevor Pinch and Karin Bijsterveld have long been interested in the way in which new technologies have been received within historical musical culture, and they have discovered what I shall call "Heideggerian moments." They note in "Breaches and Boundaries in the Reception of New Technology in Music," that technological innovations are frequently first decried, "For instance, the introduction of the piano forte was seen by some as an unwarranted intrusion of a mechanical device into a musical culture which revered the harpsichord."[11] And, again, when in the 19th century, "…key mechanisms and valves (such as found on today's woodwind instruments) were introduced to replace the traditional means of controlling pitch by the use of fingers over the individual holes. The new valves and keys were found to be easy to operate and facilitated the production of much more uniform and cleaner tones for individual notes [such a change met opposition from one, Heinrich Grenser, who complained that improving tone…by the use of keys was] …Neither complex nor art…the real art of flute construction was to build flutes which would enable flutists to play whatever they wanted without the use of keys."[12] I call this a "Heideggerian moment" because the objection to mechanical valves and keys parallels Heidegger's famous rejection of typewriters in favor of the pen:

> Human beings "act" through the hand; for the hand is, like the word, a distinguishing characteristic of humans. Only a being, such as the human, that "has" the word can and must "have hands." . . . the hand contains the essence of the human being because the word, as the essential region of the hand, is the essential ground of being human.

> [After which Heidegger goes on to discredit the typewriter]…It is not by chance that modern man writes "with" the typewriter and "dictates…into" the machine. This "history of the kinds of writing is at the same time one of the major reaons for the increasing destruction of the word. The word no longer passes through the hand as it writes and acts authentically but through the mechanized pressure of the hand. The typewriter snatches script from the essential realm of the hand—and this means the hand is removed from the essential realm of the word. {13}

One can easily substitute hand harp playing for keyboard piano playing and one can see the equivalence to the "Heidegger moment" in the resistance to changes in music technologies.

This resistance is perhaps understandable in the following sense. I have noted above that with any musical instrument which entails human bodily action and the acquistion of skills, presupposes long practice and development which the introduction of a new technology may disrupt. Moreover, any new technological development also enhances and simultaneously reduces some quality to the produced sounds which also thus changes the music. Yet, at the same time, new skills can be acquired and a new virtuosity may be attained. To those who complained about the 'mechanical' output of the piano forte, who today would think of Ashkenaszy or Ash as producing 'mechanical' sounds from the piano? It would be very hard for one who had spent years of hours of skill acquisition to simply abandon such skills for every new modification in instrumentation.

Only now am I ready to return to the focal topic of recorded music. Take note of the implicit trajectory in the short history of recorded music: the earliest cylinder records had very poor fidelity, could play only very short pieces, and could replay them only a few times. In spite of this early listeners often gasped at how "realistic" the voices sounded. Yet, in the interplay of designers and listeners to this recorded music, it could be immediately clear that, if it was possible to improve fidelity, lengthen playing time, and increase repeatability, one should do so. and the re-examination of the noted history shows that this aim was followed:

- Most of the early cylinders allowed only 2.5 to 3 minutes of playing time; this led to matching the musical piece to the recording time

capacity and 'popular' tunes of segments of arias prevailed.
- By 1903 discs had begun to prevail, but still playing time was short thus HMV Italiana's release of Verdi's "Emani" took 40 discs.
- The leap from mechanical to electrical recording, 1877 to 1919, was irreversible, but background noise still posed a fidelity problem.
- Stereo, initiated in 1931, added depth to recordings and vinyl, 1948, combined to produce much higher quality recordings.
- The switch from analog to digital and the invention of the CD, paralleled by the amplifier tube to transister technologies produced changes in sound qualities which found loyalists who divided between listeners who preferred the richer tonalities of vinyl and tape recordings over the background noiseless, but crisper digital sounds.

This history, shorter than that of early modern optics, displays the same trajectory desires, here for greater sound fidelity parallel to the visual desire for greater magnification and resolution. In the process, however, something else also happens: the technologies for producing these results become much more complex and compounded and with this evolution there arises the possibility of greater manipulability. In order to return to recorded music technologies with a new perspective, I will here return to the music parallel and my final science instrument examples.

Early modern astronomy experimented with compound lens telescopes, all of the refracting sort (tubes with lenses and a focusing device), but, as mentioned, by the time one reaches 30X the fact that white light is made up of a spectrum of colors which refract at slightly different wave frequencies, meant that resolution would be poor and a chromatic distortion sets in. Newton, a century after Galileo, discovered this and reasoned that if one could use a parabolic mirror to re-focus the different wave lengths, one could overcome the chromatic distortion—thus the reflecting telescope which combines lenses and mirrors. Then also, as multistable variants were tried with optics—prisms instead of lenses producing spectra, twin slits producing wave imaging—more and more compound devices produced more and more previously unknown phenomena. A truly revolutionary step was taken, however, only with the discovery of digital processing utilizing computers in the 20th century, which made possible many of the images now familiar within astronomy. Computer tomography makes possible the various manipulations which today show us everything from extra-solar planets to spinning pulsars.[14] Indeed, I have a close astronomer friend who claims

that a telescope is no longer even considered an instrument; it is merely a light gathering device to which are attached the variety of 'instruments' such as spectrometers, interferometers, etc.

I am now finally ready to return to recorded music and its technologies, but with a new framework for understanding, a framework which is no longer bound to taking recorded music as simply copies of, or re-presentations of previous or simply performed music! Rather—and this is the crucial shift—the new combinations of technologies in a complex gestalt could themselves be considered to be a different instrument or instrument set. In my simplest examples above, such as adding a gourd resonator to a hunting bow, one changes and makes the instrument both more complex and yet more 'resonant' for the musical sound produced. Admittedly, the much later addition of electronic amplification is a more dramatic change but one would not deny that the electric guitars played by rock musicians are simply different instruments—indeed one can hardly imagine a rock concert without extensive systems of amplification. And more subtle forms of amplification, often subtly 'hidden' now, are part of the musics of opera, Broadway shows, and other performances.

In this re-framing of the understanding of how musics are technologically mediated, add once again a possible improvisation trajectory to what seems to be recorded music. Here I now take note of transforming what is initially recorded music in a 'performed' or constructed music direction:

- Perhaps the simplest and most direct transformation of recording technologies into instrumental performance ones is the "D.J." use of records being played, which are then, hands-on, manipulated by the DJ thus changing the sounds. In this case the 'same' technology which produced a music for 'passive' listening, is changed into a transformed music.
- Second, and drawing from the above history of recording technologies, a more deliberate and creative transformation comes from a 20th century example—the music of Gyorgi Legeti. Here, he utilized a cut and paste, or bricollage construction of a composition is made from previously recorded sound bits to produce entirely new and different music. The end result is nothing like the previous musics which were recorded, but is a new music with its own gestalt sonic character.
- In both the previous examples, the musics mediated by recording technologies are produced by rearrangements and reconstructions.

A third transformation with deeper implications relates to the initial production of recorded musics. The emergence of the sound studio which bears a direct parallelism with a science laboratory, provides the possibility for further manipulation and transformation of sounds. The sound studio technician—like the lab technician—tunes and tweaks the sounds on the way to being recorded. My point here is that one needs to envision here the much more 'corporate' or team involved in music production. It is not simply the individual or group playing which makes the music; it is rather the whole complex of processes, persons and technologies which produce the music.

- Then, as previously noted from our recording technology history, this growing aggregation of parts from which music is produced, is largely a 20th century phenomenon with all of the above getting as far as a movement from mechanical to electronic mediating technologies. With the late 20th-into-21st century development we reach the level of digital and computer assisted sound producing technologies. This development signals a final break from the implicit 'copy' or 're-produce' model of sound production and shifts to synthesized, generated sound which is no longer necessarily based upon copied or recorded sounds—digital-computerized music does not need an 'original,' but is itself an 'original.' Today, of course, there are many examples of such musics, ranging from techno, to electronic synthesized, to totally transformed musics mediated by computerized-digital technologies. One innovative example comes from the work of Felix Hess, a physicist-turned-artist. His book, *Light as Air*, containing of course a CD of his produced musics, takes recording into a different style of construction. Admittedly, he often draws from 'natural' sounds in the sense that one piece uses sensors which use the window panes of apartment complexes as speaker diaphragms. The panes vibrate when sound is produced within the room and the sensors pick up this sound and 'record' it. But then the sounds thus collected over possibly days, is computer tomographically time compressed so that a 24 hour period is reduced to 8 minutes of played sound, a new music.[15]

What I am suggesting is that the boundaries between recorded music and a new, complex and technologically developing music production are blurred. It is here that I can return to my opening with a Foucault-like episteme. What I discern in the histories I have traced, is that musics which include

instrumental technologies, may now be re-conceived and understood in many ways as parallel to what has happened in science instrumentation. The old image or episteme of early modern science was one which romanticized the genius individual—Galileo, Leewenhoek—each producing his own instruments, telescopes and microscopes, and bravely discovering through newly mediated observation, the new phenomena which made early modern science what it was. This is surely not the episteme of late modern, or possibly postmodern science. Rather, the new instruments are the large, complex colliders and particle collectors, which are 'played' and tuned by many, many scientists and technicians in the Big Science of today.

Music, in a different but often parallel fashion, and perhaps most clearly seen under my image of the large escaped canary of recording technologies, shows precisely the same kind of shift. But we have rarely recognized that instruments can be not only simple, relatively small and perhaps individually played, as with my gourd bow example, but they can also be large, complex, high tech and communal in the production of new musics.

This, in turn, casts a different perspective upon recorded music. Much recorded music today is a sort of doubled reproduction. Recorded results of studio produced and manipulated musics, are pretty much what books are to textual productions. They are the 'calcified, materialized' artifacts which we can pick up and read or re-read at will and leisure. I could have begun with the book metaphor, of course, but ending with it perhaps helps with understanding some of the ambivalence so many music theorists feel about recorded musics. When reframed by a book metaphor, while there remains vestigially something of 'copy' notions of an original, such'copy' and 'reproduction' notions become weaker. No one expects readers of books to regret not having an original hand written manuscript instead of a nicely printed book. And such a reframing also should weaken any elitism which often gets expressed in disdain for recorded music from music theorists. In parallel, from a humanities perspective, I doubt most humanists would ever think of decrying the world of books as texts in the way in which some music theorists decry their auditory counterparts, recorded music. Neither the book, nor the record is dead. And both are only variants in the wide, wide world of language and musics.

Notes

[1] Michel Foucault, *The Order of Things: An Archeology of the Human Sciences* (New York: Vintage Books, 1973). Foucault is citing T. Camenella *RealisPhilosophia* 1623, p. 98.

[2] I am here following the numbers of the US standard; those of the UK are on a smaller scale.

[3] Mercater, et. al., *Science*, Vol. 216, No. 5572, 24 May 2002, p. 1380.

[4] *Science*, Vol. 291, No. 5501, 5 January 2001, pp. 52-53.

[5] "African Music,"Encyclopedia Britannica. 2007. *Enclyclopedia Britannica Online* 11, URL: http:.. www. Britannica.com/eb/article. 57074

[6] ibid. 57074.

[7] J. D. Williams, "The Art of Music," S*outh African Archeological Soceity Newsletter*, 1981, p. 8.

[8] *Encyclopedia*, op. cite. 57074.

[9] There has been a five year project located within the Free University of Berlin which has been investigating the parallel history of instruments in both science and art. My contribution to this project has appeared as, Don Ihde, "Die Kunst kommt der Wissenschaft zuvor. Oder: Provozierte de Camera obscura die Entwicklung der modnernen Wissenschaft?" *Instrumente in Kunst und Wissenschaft,* eds. H. Schramm, L. Schwarte, J. Lazardzig (Berlin: Walter de Gruyter, 2006), pp.417-430 [An English version is forthcoming.]

[10] Still following a long interest in instrumentation, a number of works are now beginning to be published. See, Don Ihde, "Models, Models Everywhere," *Simulation: Pragmatic Construction of Reality, Sociology of the Sciences Yearbook 25*, eds. J. Lenhard, G. Kuppers, T. Shinn (Dordrecht: Springer, 2006),pp. 79-86.

[11] Trevor Pinch and Karin Bijsterveld, "Breaches and Boundaries in the Reception of New Technologies in Music," *Technology and Culture*, 44.3 (2003), p. 538.

[12] ibid., p. 540.

[13] Martin Heidegger, "On the Hand," cited in Michael Heim, *Electric Language: A Philosophical Study of Word Processing* (New Haven: Yale University Press, 1999), pp. 210-211.

[14] Felix Hess, *Light as Air* (Heidelburg: Kehrer Verlag, 2001).