

# The Folk Music of Chance Electronics: Circuit-Bending the Modern Coconut

*Qubais Reed Ghazala*

**T**hey began testing me in grade school. Special tests. “What’s-wrong-with-Reed?” tests. To take them I’d be called out of the class right in the middle of the day’s lesson. Why does Reed look out the window all the time? And what are those things he draws? Those . . . pictures. Or . . . whatever they are. What *is* he drawing?

I was tested and counseled and encouraged and interviewed and on and on and on throughout my school years. Nonetheless, I have always looked at the world outside the school window as my fantastic personal laboratory, a stupendous learning environment all in itself. And it has always been to its flasks and lessons that I have felt most welcome, and within them most fulfilled.

When I was in junior high school I found a rabbit hole in my bedroom, masquerading as my wooden multidrawer desk. In the main drawer was a magic lamp that I knew well, but had not rubbed correctly so as to meet the genie within. It is rare, as Aladdin might agree, to hear the genie before taking sight of it, but this is how the oracle came to me—in an abstract musical apparition.

What happened? Sometime during the psychedelic 1966–1967 “Summer of Love” era, in a rush to find a forgotten item for a lost-in-time project, I closed my desk drawer and the world changed. I had fallen down the hole and heard the genie call in oscillating waves, luring me inside the lamp. Or was it the sirens of Ulysses, I might ponder now, drawing me to dangerous shores?

In my drawer a small battery-powered amplifier’s back had fallen off, exposing the circuit. It was shorting out against something metallic, causing the circuit to act as an audio oscillator. In fact, the pitch was continuously sweeping upward to a peak, over and over again.

Opening the drawer I discovered the amp, my genie lamp. I immediately thought: If this can happen by accident, what can be made to happen purposefully? If this can happen to an amp, not supposed to make a sound on its own, what might happen if one were to short out circuits that already make a sound, such as keyboards and radios and toys?

I was a penniless teenager. I had heard a few synthesizers on recordings, but 14 years old and fundless as I was, owning one was not in my near future. Here, however, in this shorted-out mini amp, I had discovered a sound source within my means for exploring synthesis and experimental music.

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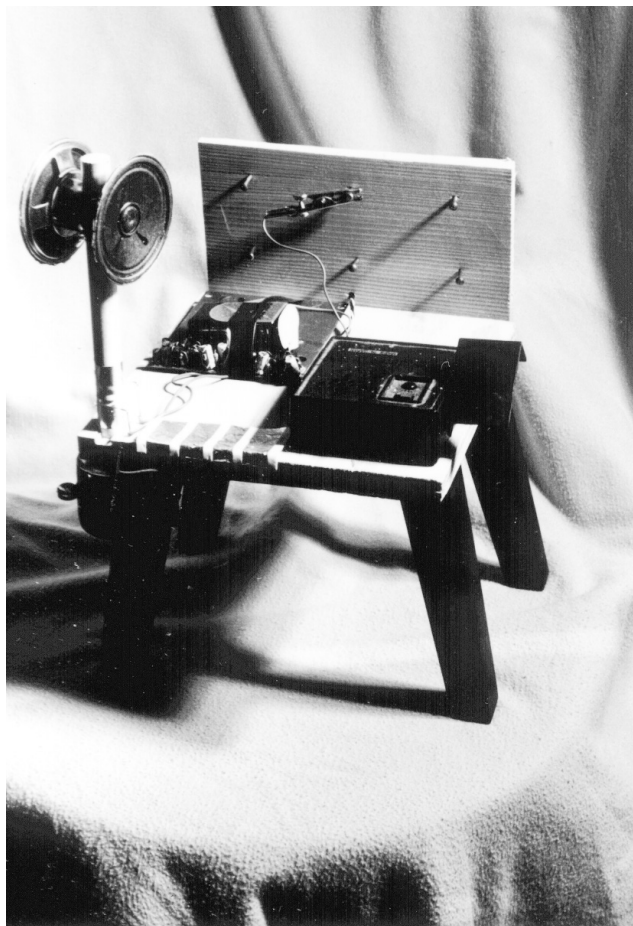
**Frontispiece. Circuit-Bending the Modern Coconut** (© Qubais Reed Ghazala)

I soon modified the amplifier in numerous ways. Placing the circuit within a larger housing, I added ro-

**Fig. 1. Mock-up of first instrument, circuit-bent transistorized 9V amplifier, pressboard platform, nail and alligator-clip patch bay, aluminum foil body contacts, 2-in speakers on spinning dowel driven by slot-car motor and accelerator pedal, ends of wooden table legs, approx. 12 × 10 × 8 in, ca. 1966–1967 (a series of modifications occurred over this period). (© Qubais Reed Ghazala) This instrument provoked an irritable 1960s audience to disrupt a performance by the author and his band, damaging the instrument and forcing a redesign.**

## ABSTRACT

**T**he author describes the philosophy and art of circuit-bending: shorting out conventional electronic devices to reveal unexpected sound and music. Starting from his first foray into chance electronics during his junior high school years, he details both his method of working and the wealth of instruments that have resulted.





**Fig. 2. Original circuit now re-fitted into permanent housing, circuit-bent transistorized 9V amplifier, cedar box, orange plaid curtain material, almonds and pecans in the shell, 1/8-in patch cords, chrome hemispheres for body contacts, various switches and potentiometers, two 3-in speakers, approx. 11 × 5 (closed) × 8 in, ca. 1968. (© Qubais Reed Ghazala) Armored now against attacks, the instrument settled into this final configuration, surviving to the present day.**

tary switches to the short-circuit paths so that I could run the new circuits through various resistors, capacitors, diodes, photo cells and any other electronic component I could find. Potentiometers and push-buttons were added. I discovered places on the circuit that, if touched, would make the circuit howl! I then added body contacts. Not knowing I was building patch bays, I built patch bays. I even added a tiny spinning speaker system (Fig. 1).

This instrument could synthesize all kinds of interesting sounds—animals, insects, machinery, wind, thunder—and endless abstract, unrecognizable noises could be produced. Turning the rotary switch sequenced these sounds and created rhythms of these unusual voices. Waving a hand over the photo cell gently swept the pitch and animated the sounds. If the body contacts were touched during any of this, the voices could be pitch-shifted downward, until nothing but clicks were heard, or upward until they were out of hearing range.

A chain of people could “play” each other’s bodies using the body contacts. If one broke the chain with one’s partner, one could close the chain again by holding hands, stroking an arm or kissing (or in any way resuming the contact of flesh) to play the instrument.

No one had seen such a thing before at my high school. The box now had a couple dozen controls and a set of cables for the patch bay. There were chrome finger contacts, several dials and speaker

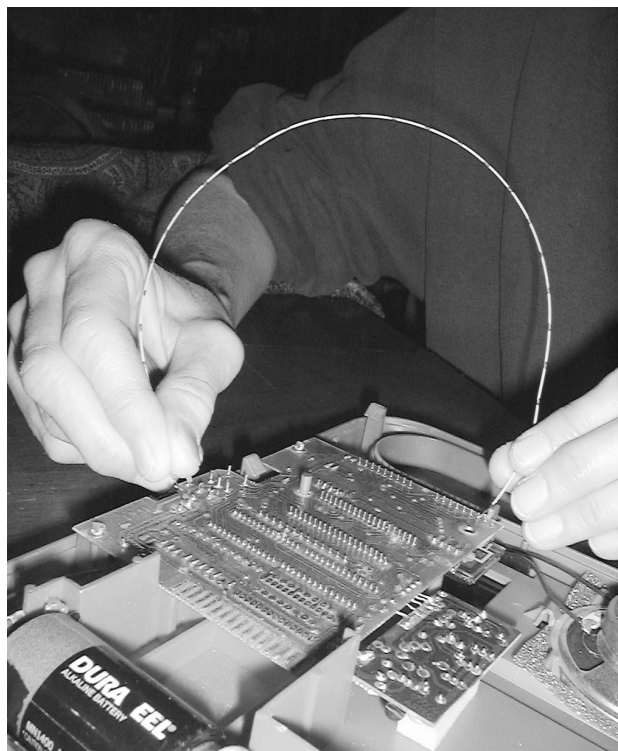
grille cloth cut from my orange plaid bedroom curtains.

At this point the circuit was housed within a small cedar box. Inside the hinged lid I had glued whole nuts, still in their shells. These nuts, hard-shelled almonds and pecans, were used to hold the patch cords, as it was always easy to wrap the cords, in one way or another, around the nuts to keep them at hand but out of the way (Fig. 2). “You made this?” my electronics teacher stammered. (At that point we were making a table lamp out of a bowling pin in his class.)

The circuit and I were a spectacle. Media stereotyping at that time denied members of the “counterculture” mere consciousness, let alone acuity. My instrument and I did not fit this popular myth. Again I was making my teachers uncomfortable. In fact, the circuit and I were often seen in school as a threat.

Truth be told, at home in my basement lab I was learning more about electronics, music and synthesis than my high school could offer at any grade level. I learned endless valuable lessons as this first instrument was built and re-built over those early years and housed and rehoused into different enclosures. Furthermore, as I began to chance-modify other sound circuits, I became aware of what seemed to be a new world of music, intriguing and endless, just a moment away.

I was exploring chance electronics. While simple, the process is explosive in its startling audio output. Fantastic



**Fig. 3. The act of circuit-bending. (© Qubais Reed Ghazala) Here a Texas Instruments Speak & Spell is being explored with a short length of wire. Any interesting sounds found in this way will be charted directly on the circuit board by marking where the wire’s ends were when the sound was produced.**



**Fig. 4. Inverter, circuit-bent toy containing audio samples of human voice and automotive sounds with push-button switches, glass fish eye, potentiometer, paints, approx. 3 × 5.5 × 1.5 in, ca. early 1990s. (© Qubais Reed Ghazala) The Inverter is a “living instrument” whose new wiring creates thermal pressures upon the circuit, changing its voice over time.**

aleatoric music might result, composed of either “real” instruments (samples) or layers of evolving indefinable sounds (new synthesis). Through work with human or animal voice synthesizers, new musical languages might appear. Perhaps less dramatic but no less intriguing are the original tone colors that might result, turning that \$2 discarded keyboard into something one would gladly place in a studio. How? Just do what my desk drawer did: short things out.

Obtain a low-voltage battery-powered sound circuit such as a toy musical keyboard instrument or a talking toy such as the Speak & Spell game. To make one’s most important circuit-bending tool, simply cut a 12-inch piece of insulated multistrand wire, strip a little insulation off each end and “tin” the ends with solder to make them solid and firm. With the circuit making a sound, touch one end of the wire to a circuit point and the other end of the wire to another circuit point. If this results in an interesting sound, mark the circuit to show where the ends of the wire were placed to create that new sound (Fig. 3).

While keeping one end of the wire stationary on the initial spot, touch the other end of the wire—let us call it the traveling end—to another arbitrary spot. If a new sound is created, mark the circuit board again. If the entire circuit is

searched in this way and the searcher is not yet content with the found sounds, start all over again, but with the stationary end of the wire on a new spot. The traveling end repeats its tour.

When satisfied with the collection of discovered circuit paths, finally “hard-wire” them into place. This is done by wiring each new circuit through its own switch, a toggle switch that is mounted on the instrument’s case.

Using the switches, one can now actuate the effects discovered with the traveling wire. One can in addition combine these effects by turning several switches on at once. I should also note that once the unit’s original tiny speaker is bypassed this new “line output” will usually produce fine frequency range and fidelity when amplified.

We have now entered a world where music no longer adheres to human presumption in theory, circuit design and composition. Thus, great new sounds and musical realities can occur as one sits with one’s out-of-theory instrument, a truly alien instrument, and listens to its metamorphosed output. After all, now in hand is an instrument that exists nowhere else in the universe and that presents sounds no one else has yet heard.

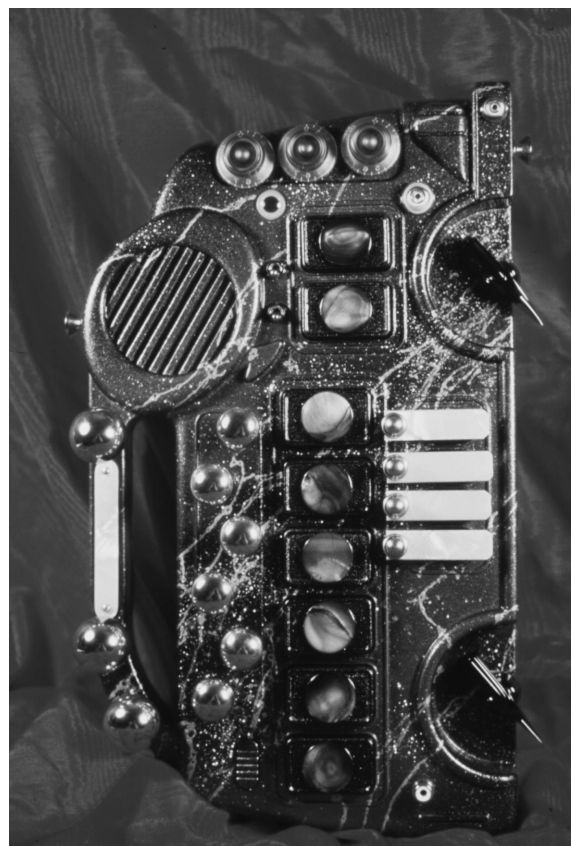
This is not to say that I do not appreciate the music lab’s environs or even

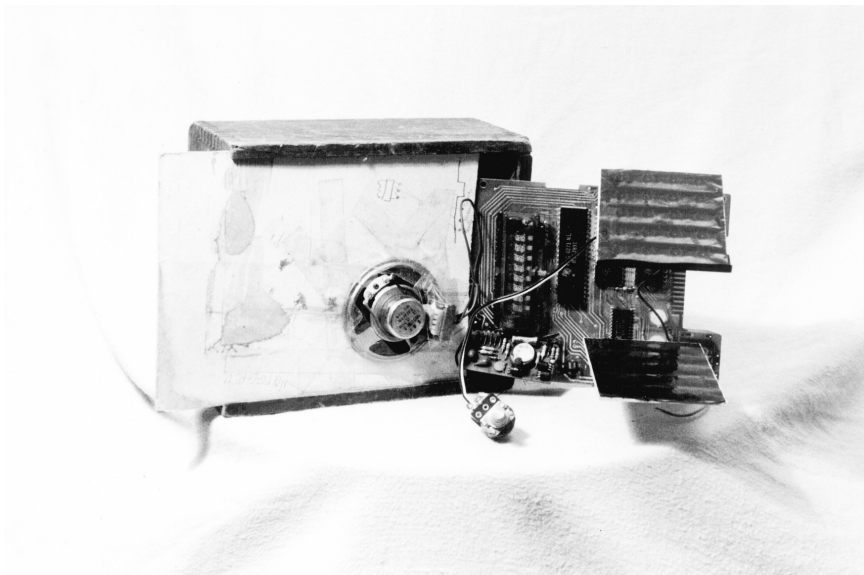
adore a good system or module. I do! Nor am I uninspired with the results of the theory-true synthesizers I design from scratch, such as my Vox Insectas and human voice generators. Appreciated as well are the complex polyphonic instruments I have built from kits or schematics adhering strictly to design (and music) as we know it. Still, I have personally found more truly new sounds to listen to, to ponder and to work with by week’s end, through chance electronics. “As we know it” . . . changes.

I am surrounded by instruments—every catastrophe in my house sounds musical. My total collection nears 500, including many unusual instruments of the world, antique through modern. I am fond of everything in the planet’s instrumentarium (I play Chinese *er hu* as often as electronic instruments). It is because of this, perhaps, that I recognize the difference. Chance-wired instruments take us to a new place.

In struggling with this difference, I have developed language to help people understand the technical process as well as the tenets of the art movement that has resulted. I saw the need to invent a nomenclature for my article series introducing my original discovery process to the readers of Bart Hopkin’s *Experimental Musical Instruments* (EMI) magazine. In 1992, in EMI, I first published my term

**Fig. 5. Species Device, circuit-bent animals-on-bus toy with antique back-lit “sleepy” doll eyes (pilot lights, red for envelope peak and blue for power; these eyes slowly close their lids as the instrument is laid down to play in the horizontal position), photosensitive glass fish eye (for shadow vibrato), five potentiometers with antique black Bakelite and gold Gibson electric guitar knobs, 13 brass drawer knobs wired as body contacts, purple mother-of-pearl finger buttons, antique celluloid finger keys, switches, paints, holographic dusts, approx. 8 × 12 × 3 in, ca. mid-1990s. (© Qubais Reed Ghazala) A deep BEAsape instrument, the Species Device integrates the player seamlessly into the circuit when one touches the brass contacts while the mechanical keys and buttons are played.**





**Fig. 6. Incantor prototype, Speak & Spell circuit, antique elementary school wooden chalk box (for resonator), cardboard (speaker baffle), approx.  $6 \times 4 \times 4$  in, ca. 1978. (© Qubais Reed Ghazala) The first Speak & Spell released to the public used a mechanical push-button interface arranged in side-by-side panels (foreground). Another unique feature was the three-wire speaker system allowing the circuit-bender to split the signal into a stereo pair.**

*circuit-bending* to describe the procedure above [1].

Many new terms were to follow, such as *immediate canvas*, *clear illogic*, *threshold of invention*, *living instrument* and *BEAsape*, along with various instrument names that now mark the movement's emergence.

The concept of an immediate canvas is very important. Until now, the assumed hurdles of electronic design have instilled a sense of apprehension in laypersons. Even if one does not electrocute oneself, a slow and tedious entry is expected via a stack of daunting, equation-bound texts. Circuit-bending changes all this, as it transforms the circuit into a friendly and "immediate" canvas like the painter's canvas: immediately there for anyone at all with brush in hand. Just walk up to it and paint.

One of the reasons the modern painter's canvas is immediate is that painters today rarely wildcraft their pigments. Stretch a canvas (if that!), squeeze tube, paint—that is pretty immediate.

Similarly, a parallel can be seen between circuit-bending's circuit board-as-canvas and ready-made pigments in the form of the traveling wire mentioned above. Just as personal understanding of the *science* of pigment is not as needed by painters today as it once was, upon circuit-bending's immediate canvas a similar thing now occurs: The science of the electron is no longer needed to advance the creative moment. Finally, in electronics, one can just walk up and paint.

The painting process here, circuit-bending's chance approach, is an act of clear illogic. As opposed to fuzzy logic, a seeking of norm within chaos, clear illogic seeks chaos within the norm. It is through this chaos, a powerful creative



**Fig. 7. Modern Incantor, circuit-bent Speak & Read, electric eye in antique brass and milk glass lens, switches, potentiometer, LEDs, paints, holographic dusts, approx.  $7 \times 10.5 \times 2$  in, ca. late 1980s. (© Qubais Reed Ghazala) The looping system consists of the four controls to the upper right; the streaming switches are centrally located; the pitch dial and body contacts are further to the left. Its reset button, a simple power-supply interrupter, is to the lower right.**

force, that the instruments are allowed to behave beyond the theoretical intentions (and limitations) of the designer.

Let us place this concept on more familiar ground. Earthlings *musicalize* things. An instrument will be made from a coconut washed up on the shore, eventually. The coconut could become the ball of a rattle (idiophone) or, halved, the shell of a drum (membranophone). A hole could be poked and blown over (aerophone). The coconut might be used as a resonator for a stringed instrument (chordophone). It depends on how one sees the coconut (see *Fronispiece*).

Our society's electronic discards, like coconuts fallen to the sea, collect at the high-tide lines of garage sales and flea markets, secondhand shops and garbage bins. Circuit-benders see these circuits as the island native saw the coconut. These circuits *are* coconuts of our island. Adapt the coconut, adapt the circuit.

Circuit-bending, seen as art, was inevitable. I say inevitable due to a principle I call the threshold of invention. This threshold comes into being as we encounter the leading currents of our time. Because the modern moment occurs before us as if on a stage, and we, the audience, bear witness, there will be the possibility of a common reaction. Often

this reaction appears as a wave of invention. With discarded circuits on the stage and artists as audience, the threshold of invention suggests that what I discovered back in the 1960s was due.

Conceptually, a living instrument is somewhat more difficult. You and I are living instruments. We accept that our voices will change, becoming deeper over time, quieter in the end, and some day failing. We accept that our friends and lovers will change as they age. However, can we accept this in our musical instruments?

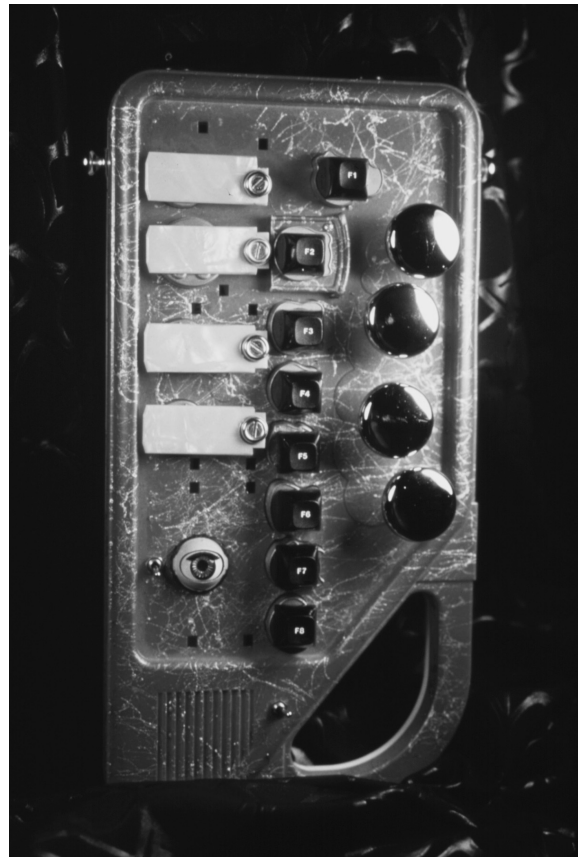
The why and why not of this issue could fill pages with ink and halls with people in argument. Let me just say that not all circuit-bent instruments are living instruments—that is, instruments that burn themselves out slowly, but faster than usual due to the bending process. The great majority of my own bent instruments are not living instruments (at least not in this regard; but it can easily be argued that all the instruments we know, acoustic and electronic, are living instruments). None that I routinely offer to the public are.

However, some bent instruments do age and sound different as time passes, as they consume their accelerated life-spans. The instrument grows a little older, moves a little closer to early demise, every time it is turned on (Fig. 4). Don't play it to save it? Play it to let it sing? Not your father's Farfisa, for sure.

**Fig. 8. Trigon Incantor, circuit-bent Touch & Tell, 2-in diameter steel balls, switches, LEDs, potentiometer, paints, holographic dusts, 13 × 10 × 3.5 in, ca. 1996. (© Qubais Reed Ghazala)** Along the left-hand edge are the series of streaming switches that, if actuated while the machine is speaking, transform the output into various compositions of chance music. The switches are divided into two response sets: language, wherein the new audio consists mainly of unusually arranged allophones, and instrumental, bringing about phases of aleatoric pitch and timbre sequences.



**Fig. 9. Morpheum, circuit-bent animals-on-a-train toy, back-lit antique sleepy doll eye (blue pilot light), chrome drawer knobs (body contacts), computer keys, antique celluloid keys, switches, potentiometers, antique Bakelite knobs, paints, approx. 7 × 10 × 2.5 in, ca. late 1980s. (© Qubais Reed Ghazala)** A simpler instrument than the related Species Device, the Morpheum is the more standard BEAsape instrument.



Body-contacting was one of the very first things I found possible within the bending process. From the start I had the feeling that I was transformed in some way when body-contacting an instru-

ment, myself becoming a part of the circuitry as surely as any capacitor soldered in place.

I felt that a new, albeit temporary, creature was created when a musician played a body-contact instrument—in this moment when the electricity of both bodies intertwines, the same essential electricity that if interrupted would cause each body to die. I was changed and the circuit was changed, and I had trouble deciding where each of us began and ended. I simply concluded that we were something new, and we were one.

Therefore, with the rush to discover and name new species so pressing in the circles of biology, cautiously I introduce the BEAsape (pronounced “be a,” as in “be a sport”; “sape,” rhymes with grape). BEAsape is an acronym for BioElectronicAudiosapian. Instrument/animal, mutant or hybrid, both musically and zoologically the BEAsape pushes boundaries (Fig. 5).

The human body, able to conduct electricity, becomes a part of the circuit when the circuit is touched. Any number of connections and new sounds are possible here as the player's flesh becomes the equivalent of a potentiometer, adjusting electrical flow between circuit points. The electro-human BEAsape, equally of circuit board and blood, is literally a living instrument, one whose voices are as

varied as the endless circuits available to this technique.

During my 35 years of experiment and design, I have created countless circuit-bent instruments. A few of these instruments are now well known within the circuit-bending movement. Best known is the circuit-bent Speak & Spell. Originally a spelling game, this series of human voice synthesizers was manufactured by Texas Instruments decades ago. While I immediately circuit-bent the first model released to the public, I did not publish my work until many years later. In 1993, in *EMI*, I introduced the Incantor (Incantor as in incantation—odd chants and streams of mystic-sounding vocalizations result from circuit-bending's rearrangement of the Speak & Spell programs meant to construct speech) [2] (Fig. 6).

I will describe the primary circuit-bent functions of an Incantor to set an example of results found not only in Incantors but in many other bendable circuits as well.

Through the standard techniques of circuit-bending I discovered six systems that I now routinely build into Incantors: looping, streaming, master pitch, body-contact vibrato, reset and pilot lights for power and audio peak. Many more modifications are possible (Fig. 7).

Looping: Musically, the most familiar territory on an Incantor is accessed through the looping system. Here also is where a bottomless pit is found, filled

with more sound-forms than there will ever be time to hear. An Incantor looping system actually presents itself as two system interfaces. The first initiates a sound loop when a push-button switch is pressed; each time the button is pressed, a new loop is set. In this way one can test loops to find one to work with. Throwing a nearby toggle switch then locks this loop into play. The second part of the system is optical: By means of shadows falling across a photo cell, loops are incremented forward into new forms as a hand is waved over the instrument.

In practice, the player starts the Incantor, which, through the voice synthesis method of linear predictive coding, ties allophones together and begins to speak, somewhat fluently, in a human language (depending on the country it was designed to be sold in). If the looping function is actuated mid-word, one suddenly finds oneself listening to a sequence of varied sounds instead of the sustained noise of vowel or consonant one might expect. These might be segments of speech, abstract unrecognizable sounds or both. They might be overtly musical, almost musical or not musical at all—perhaps just faint hissing that rises in volume once in a while.

A full range of dynamics—tiny sounds, great sounds—might evolve within a single loop: surprising sounds of nameless instruments. Pushing the button again creates a new loop, a completely new loop perhaps, and so on, forever.

Streaming: The streaming system consists of three switches, each capable of rearranging the digital speech programs in various ways. Instead of looping, these switches transform the audio into endless streams of aleatoric music.

Pitch: Any output can be tuned with the pitch dial over a very wide range, all the way down to deep subharmonics.

Body Contacts: Similarly, the body contacts affect pitch, although not to so great a degree. Touching the contacts decreases pitch only a little, but just the right amount for real-time vibrato.

After having worked with numerous random and pseudo-random machines, written code and bent code and built complex, processor-controlled synthesizers to explore chance in music, I cannot deny the Incantor its simple elegance of interface and certainly not its stupendous, in fact fathomless, output. As a chance music box the Incantor is a truly remarkable machine.

Briefly, I will touch on a few more key circuit-bending instruments.

The Trigon Incantor (Fig. 8), another human voice synthesizer, enlarges the chance interface via three large steel balls that roll around on the pressure-sensitive stage to actuate the aleatoric responses.

This Incantor originated from a device marketed as the Touch & Tell. Once it is bent, the synthetic human voices are transposed into streams of chance music taking the form of either musical vocal-like languages or more abstract tonal sequences.

Morpheums (Fig. 9) are multichannel BEAsape instruments combining animal cries with mechanical sounds, drastically pitch-shifted by means of the body contacts. New voices result.

Aleatrons are circuit-bent keyboards (I could write an entire book on the fantastic output of circuit-bent digital keyboards; the range of new responses, tonal as well as aleatoric, can be mind-boggling).

Great examples of the Aleatron are the circuit-bent Casio SK-1 sampler and the Casio SA2 mini-keyboard. While the SK1 Aleatron self-composes outrageous tonal sweeps and percussive oddities as the keyboard is played, the SA2 Aleatron, upon the tapping of the added “chance” button, responds with realistic instruments (i.e. piano, bass and snare drum) but in meter and composition far removed from anything familiar.

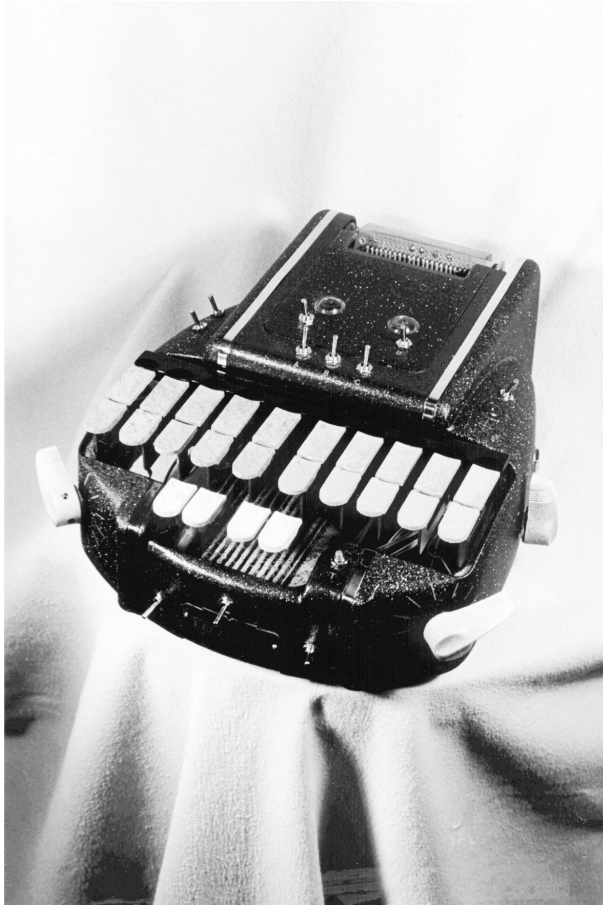
Examples of instruments I design myself entirely from scratch (and then circuit-bend) are my Photon Clarinets (Fig. 10), the Vox Insecta and Video Octavox.

Hands are waved in space over the Photon Clarinet's dual sensors, as with a

**Fig. 10. Photon Clarinet, antique ice crusher case, antique pilot lens, turned wooden ellipses, turned bases, glass domes, photo cells, switches, potentiometer, antique Bakelite knob, paints, holographic dusts, original circuit, approx. 9 × 12 × 7 in, ca. 1996. (© Qubais Reed Ghazala)** In this configuration with remote sensors (as opposed to smaller models with sensors built-in) the Photon Clarinet is the most versatile and easiest to play. The speaker is behind the square aperture toward the top, the opening that ice had been fed through for years prior.



**Fig. 11. Vox Insecta, antique Stenograph machine (with refitted mechanics), antique glass telephone pole jewels (reflectors retrofitted with orange peak envelope LEDs), mercury switch, toggle switches, potentiometers, antique Bakelite knobs, exposed photo transistor, paints, holographic dusts, original circuit, approx. 7 × 5 × 9 in, ca. mid-1980s. (© Qubais Reed Ghazala) Instead of striking an ink ribbon, the keys now actuate a series of hand-made miniature switches closing various insect-sound circuits.**



theremin. However, as opposed to the theremin's, the Photon Clarinet's sensors are light-sensitive. While one sensor smoothly sweeps the pitch, as with a theremin, the other steps the pitch through arbitrary scales, presenting a very unusual voice system.

The Vox Insecta (Fig. 11) is a complex insect voice synthesizer capable of reproducing, as well, choirs and orchestral textures. The Vox Insecta was used in its many modes on my *threnody* CD [3] to express musically the tragedy of Hiroshima.

With the Video Octavox (Fig. 12) any video recording becomes the experimental music counterpart of the player piano roll: a program medium. Here the instrument's light sensors attach to the video screen, activating a "string" section of violins, violas and cellos (filtered voltage controlled oscillators) as well as a built-in Photon Clarinet.

A visit to my web site <<http://www.anti-theory.com>> will reveal dozens more instruments, as well as sound files and much descriptive text. There can be found the Feylith and four-channel Dworkian Register, instruments meant to create a surround-sound environment for other instruments to perform within. There is the Particle Bay, another chance steel ball instrument, this one based on audio samples; the Sound Poem Tank (a

phonics machine); the Audiowave Detonator (a sample smasher); and many, many more circuit-bent designs.

Despite the heterodoxy of these instruments, I prefer to not let bent-circuit mu-

sical composition become a thorny subject. I am satisfied with the realization that every sound, like every color, elicits an emotion. That is enough for me even when composing with aleatoric elements (although this subject is both fascinating and endless, having been debated with me by designers, musicians and the general public since I built my first instrument).

I suppose the greatest value I see in circuit-bending, beyond the new palette, is how the art encourages fresh musical thought. It is these two aspects, the art's sound and its ideas, that have kept me at the bench and in the studio for decades.

Some artists gravitate to this art due to its anti-establishment aspects, taking a political stance setting themselves against the conventional music industry (instrument manufacturers as well as music purveyors). While conscious of the political subterfuge that this art might engender, I do not see this as either unusual or particularly important—it is how our machine works: part again of the threshold of invention, an unstoppable force.

I should mention that in this exploration of anti-theory I do not abandon theory, as many people presume. I only question it in the way that scientists always question prevailing concepts. I cannot think theory without anti-theory, a devil's advocate, alongside. Theory has been my friend for a very long time. I have found, however, that it is not the only way to think, and clearly not the only way to create. Rather than parallel and

**Fig. 12. Video Octavox, antique telephone amplifier case, glass fish eye, coil cords with photo-sensors, painted wooden model of the sun, miniature footlights for the sun, antique faceted glass lenses, LEDs, nine potentiometers, eight antique brown Bakelite knobs (on back), eight line outputs (on back), original circuit, approx. 9 × 5 × 4 in, ca. late 1980s. (© Qubais Reed Ghazala) This instrument is designed to use a videotape or a DVD as a score; it can also use random events (e.g. via video camera) to produce an aleatoric "string ensemble" response.**



compare this art and its output to known models, I, in teaching it as the entity that impressed me as a young artist, have chosen to focus on the history of my original discovery process, which was original in that, as noted, I was uninfluenced by outside teaching or example. I was too young, too isolated perhaps.

My aim, therefore, has been to welcome everyone by removing technical as well as academic hurdles as they were removed for me (14-year-olds rarely have college music labs to work in, classically the alternate and more usual birthplace of experimental music and instruments). However, for more specifics I will refer the reader to my 20-article series in *EMI* [4], where I more closely detail the evolution of circuit-bending as well as its placement within the context and history of electronic and experimental music.

As to this odd art's influence, circuit-bending's instrumentarium is exploding worldwide. The Internet is active nonstop, with various galleries and artists presenting their discoveries (when I launched my web site, it was the only place on-line to see circuit-bent instruments; it was also the first instructional site). Now hundreds of new instruments are being built every day, as an Internet keyword search on "circuit-bending" will reveal.

There are innumerable students of circuit-bending—millions, I am told. The truth, however, is that they are not my students. They and I, in fact, have the same teacher—a mind-altering addictive art that reveals itself in examples of composition that, while too alien to recognize, are *too musical to ignore*.

Still, my course has not been smooth [5]. At one low point in the late 1960s an

audience tried its best to hospitalize me and my band and destroy my first instrument. Undaunted, I continued to explore the art. I never feared for its place in the world. I was sure a space would evolve.

Transistors, now tribal, are chanting rhymes. A tempest of new song is swirling within these hidden camps. Circuit-benders are, in a sense, ethnomusicologists exploring villages ringing with electronic folk music, indigenous in this case to circuit and time rather than people and time. They feel as I have always felt (and continue for the same reason): that there is a rich new world of music at hand.

#### References and Notes

1. Qubais Reed Ghazala, "Circuit-Bending and Living Instruments," *Experimental Musical Instruments* 8, No. 1 (September 1992).
2. Qubais Reed Ghazala, "Incantors," *Experimental Musical Instruments* 8, No. 4 (June 1993).
3. Qubais Reed Ghazala, *Threnody for the New Victims of Hiroshima*, Realization CD RZD-022 (1995).
4. See Ghazala [1] and [2]. Additional articles in the series included Qubais Reed Ghazala, "Circuit-Bending and Living Instruments: The Odor Box," *Experimental Musical Instruments* 8, No. 2 (December 1992); "Circuit-Bending and Living Instruments: The Photon Clarinet," *Experimental Musical Instruments* 8, No. 3 (March 1993); "Circuit-Bending and Living Instruments: Vox Insecta," *Experimental Musical Instruments* 9, No. 1 (September 1993); "Circuit-Bending and Living Instruments: The Sound Dungeon," *Experimental Musical Instruments* 9, No. 2 (December 1993); "Circuit-Bending and Living Instruments: Inverters," *Experimental Musical Instruments* 9, No. 3 (March 1994); "Circuit-Bending and Living Instruments: The Video Octavox," *Experimental Musical Instruments* 9, No. 4 (June 1994); "The Morpheum and Strange Earth Voices," *Experimental Musical Instruments* 10, No. 2 (December 1994); "The Flame Componium and Reflections on the Pyrophone," *Experimental Musical Instruments* 10, No. 3 (March 1995); "Circuit-Bending and Living Instruments: The Trigon Incantor," *Experimental Musical Instruments* 10, No. 4 (June 1995); "Perceptual Instruments and Re-

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A book with audio CD containing an article about and a musical track by Ghazala was published by EMI. See Bart Hopkin, ed., *Gravikords, Whirlies and Pyrophones* (Roslyn, NY: Ellipsis Arts, 1996). *Experimental Musical Instruments*, edited by Bart Hopkin, was published from 1985-1999; back issues are available at <<http://www.windworld.com/emi/>>.

5. Additional details about the author's early background and events that led to his work with circuit-bending is included in an earlier version of this article, available at <<http://www.anti-theory.com/texts/lmj>>.

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