Click::REVU: an optophonic sound installation

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Abstract
If traces of past media remain in contemporary forms of media, how can these traces be appropriated and applied in the creation of a sound-based installation? This paper presents Click::REVU a sound installation developed by the first author. The work blends physical characteristics of an early sonification device, the Optophone – a device that translated optical data to sound - to create an illusory presence through a scanner mechanism from a multifunction printer. The work’s compositional structure reduces the scanner’s image capture ability to an indexical relationship that is expressed as a minimal soundscape of drones and clicks. As a media archaeological sound-based artwork, the ideation of Click::REVU has depicted a form of optophonics through the interpretation of early 20th century Optophones. These forms, as archival sources of knowledge for reinterpretation, have informed the development and realization of this work, one that is expressed through a genealogically related contemporary form of media, the contact image sensor scanner.

Keywords
Sound art, media archaeology, optophonics, Optophone, obsolescence

Introduction
If Benjamin said that history had hitherto been written from the standpoint of the victor, and needed to be written from that of the vanquished, we might add that knowledge must indeed present the fatally rectilinear succession of victory and defeat, but should also address itself to those things which were not embraced by this dynamic, which fell by the wayside - what might be called the waste products and blind spots that have escaped the dialectic. [1]

Bequest, Theodore Adorno

Theodore Adorno’s observations of Benjamin are made within a critique of the modern subject’s dread of backwardness. However, they equally provide an examination of the possibilities of this backwardness as a refuge from modernity where the past can live on in the present. Joel Burges posits that such refuges can harbor historical possibilities which can be excavated “for alternative itineraries to a present in which capitalism has co-opted modernity.” [2] Thus, by engaging in counter historical thinking, the “presence of the past can disrupt this temporal form of linear progress by constellating those temporal elements.” [2]

One perspective as a critique of new media is media archaeology. While some see that the “methodological repertoire of media archaeology has been geared to discourse analysis”, media archaeology allows for the exploration of the material possibilities of obsolete media through an engagement with the physical artefact. [3] Calls for such an engagement with media are not new and have arguably been ever-present in the creation of media archaeological art.

This paper presents Click::REVU, a media archaeological sound-based installation developed by the first author. The work utilizes elements of the Optophone, a device designed to “substitute the ear for the eye” by making optical signals audible, in its ideation and realization. [4] As media archaeological experimentation, the work is informed by a relationship between contact image sensor (CIS) technology prevalent in low-cost multifunction printers and the Optophone via the light sensing technologies developed through the 20th century. As such, the Optophone shares a media genealogy with optical devices developed in the early 20th century as precursors to later developments that include the automated conversion of images into machine-readable text (optical character recognition), image sensors embedded in digital cameras and scanning technologies and the compact disc. This relationship between past and present forms of optical media informs a conceptual and aesthetic approach for the appropriation of one such form of media, the CIS mechanism (Figure 1), in the creation of Click::REVU.

The next section provides a brief introduction to media archaeology as creative practice and a survey of related works. Following this, the paper presents a brief introduction to the Optophone and its development. Next, Click::REVU is presented where a system overview and aesthetic and compositional strategies are described.
A plea for new directions in media archaeological research issued by Andreas Fickers and Annie van den Oever in 2013 specifically called for an experimental approach to media archaeology over discursive enterprises through the historical re-enactment of past media technologies. [3] *New Media Archaeologies* (2019) extends Fickers and van den Oever’s entreaty through a series of essays by highlighting the contribution that experimentation can make to understanding media archaeology. Again, they argue such an approach can “stimulate our imagination of the past” through the “sensual and experiential potential of technical objects, which … has hardly been broached hitherto in technology or media historiography beyond a purely aesthetic consideration.” [5]

Noting that media archaeology is being executed in artistic ways, Jussi Parikka attempts to articulate a creative methodology for practicing media archaeology that contextualizes artworks as such. He suggests several themes for resurrecting old media in contemporary contexts. Therefore, media archaeological artworks “that visually engage with historical themes” can invoke “alternative histories that offer critical insights into the assumed-natural state of digitality” using obsolete artefacts. [6] These works may “engage with emerging media cultures” by drawing on concrete archives as a means of “working like an historian” to an artistic end. [6] A sensual engagement with the artefact, whether a past or present form of media, is a way of opening technologies to expose the “buried conditions of our media culture.” [6]

### Related Works

A diverse range of artists and many works have been discussed through a media archaeological lens. Such works include those by Paul DeMarinis, Bernie Lubell, Lynn Hershmann and Michael Naimark amongst others that incorporate explicit references to past analogue and mechanical machines in their work. [7] Inspired by Etienne Jules Marey, Lubell’s *Etiology of Innocence* (1999) contains a hand pumped mechanism based on the heart that powers various “bouncing, breathing, beating” mechanisms. [8] DeMarinis’ installations emphasize the “material or mediating experience of specially designed artifacts” by creating *counterfactual artefacts* that “occupy a creative space at the boundary between actual and possible worlds.” [9] Examples within this context include *The Messenger*, a work that presents early telegraph experiments alongside Internet communications. Another are those included in *The Edison Effect* (1989-1996), a series of sound sculptures that play a range of obsolete recorded media using laser beams including wax cylinders, 78 rpm records and a clay cylinder (Figure 2).

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**Figure 1. CIS mechanism**

**Figure 2. Fragments of Jericho, from *The Edison Effect* series**

**Figure 3. Steam Machine Music (2010)**
He writes “the malfunction of machines is a constantly continuing factor for the use and existence of technology”, as evidenced by the “inevitable errors of the machine through the pre-electronic case of mechanical music.” [11] Examples of Cornford’s work include *Binatone Galaxy* (2011), *Migrations* (2014) and *Constant Linear Velocity* (2016). These works consider obsolescence not as an end but an opportunity to reconsider the functional potential of abandoned devices and their movement from production to pollution.

It is not the intent of this paper to cover the range of possibilities for media archaeological sound art. This review has presented several examples of works that exist in a media archaeological context. Even whilst focusing on activities of tactile engagement with media artefacts as an approach to the creation of sound art, the field is increasingly diverse and, at times, difficult to distinguish between what is explicitly intended as media archaeology and those works that exhibit characteristics of such approaches. However, it is within this diversity of possibilities that *Click::REVU* is situated, not only as a sound installation foregrounding the materiality of the physical object, but one explicitly informed by a media archaeological approach to historical media representations. Developed as a part of the first author’s doctorate research, this work has emerged out of an inquiry into unlikely relationships between obsolete and contemporary media and an aesthetic reimagining as a sound-based installation. The work is the last in the portfolio of artworks developed to realize the research’s theoretical framework.

**The Optophone**

One result of the First World War was the need to physiologically reconstruct human bodies. This need produced an increased demand for prosthetic technologies. [12][13] One area of sensory loss was sight. Whilst braille had been available as a tactile substitute for sight since the early 19th century, technological innovation surrounding the war years provided an opportunity for other forms of sensory prosthetic devices to “relieve the disabilities of the blind.” [14] One such device was a little-known invention called the Optophone. As a sonification device, the Optophone translated optical data to sound. Fascinated with the relationship between electricity and light and the conductive properties of selenium, Edmund Edward Fournier d’Albe’s early experiments and research led him to develop a means of providing a “complete electrical substitute for the eye.” [14]

**Background**

First demonstrated in 1912, the exploring Optophone (Figure 4) was a device to aid visually impaired people with orientation in their environment. [15] Fournier d’Albe stated that the blind could navigate around obstacles by listening through an adapted telephone receiver to hear a series of clicks or rasping generated by differences in light intensity. However, the instrument was not without criticism. One critique was of need. “The blind problem is not to find lights and windows but how to earn your living.” [14] With this in mind, Fournier d’Albe presented a redeveloped Optophone in 1914.

The reading Optophone was “designed with the object of enabling blind persons to ‘read’ ordinary letter press by means of the ear.” [4] With this development, d’Albe added a musicality to the tones used to represent text as sound. Using a numbered ratio from the musical scale, the reading Optophone produced a series of eight notes; G, C, D, E, G, B, C, E, from which “both concords and discords could be obtained according to the letters exposed.” [4]
In 1920, Fournier d’Albe, along with optical engineers Archibald Barr and William Stroud, were issued a patent for “new and useful improvements in Optophones.” [17] Improvements included a reversal of the action for reading text and a change in the tonal range. The revised device was termed the “black-sounding” Optophone (Figure 5) because, as a form of additive synthesis, it was the letters themselves that produced sound, thus producing no sound in the intervening “white” space. With this, the tonal range was reduced to G, C, D, E, G. [18][19] Arguably, with these harmonized changes, it was easier to hear and learn the different chord variations in relation to the characters. [20]

Figure 5. The Type-reading Optophone

Related Developments

Whilst the development of prosthetic sight-to-sound technologies waned with the emergence of optical character recognition (OCR) technologies and speech synthesis, some research and development after Fournier d’Albe’s original Optophone are worth highlighting. Some notable devices include the Battelle Optophone (1960s), Charles Carle’s Lexiphone (1963) and Mauch Laboratories Visotoner (mid-1960s), a self-contained battery operated Optophone and the Cognodictor (mid-1970s), a recognition reading machine consisting of an optical scanner and a speech synthesis engine. [21] Similarly, various research has been undertaken to develop devices that interpret three dimensional, or distance-to-object information, something increasingly commonplace with advances in image capture and analysis technologies. [22][23]

As a media archaeological exercise, Tiffany Chan et al.’s contemporary rendering of the Optophone is described as a practice-based method of understanding media history through a tactile engagement with the “material particulars of historical mechanisms.” [24] Such an approach provides an understanding of the presence of past media embedded in contemporary culture and technology through a series of overlapping temporal layers. Chan et al.’s remake of the Optophone does not seek to reconstruct an equivalent device nor to replicate previous experiences of the device. Rather it seeks to highlight “what we cannot retrieve, repeat, or translate in the present” to foreground differences and absences as a refrain from “flattening the many versions of optophones into the optophone.” [25][26] Such flattening of perspectives, as noted by Chan, has contributed to an oversimplification and imprecision concerning certain narrative histories of media. As Druckery argues, history is “not merely the accumulation of fact, but an active revisioning, a necessary corrective discourse, and fundamentally an act of interrogation—not just of the facts, but of the displaced, the forgotten, the disregarded.” [27] It is this ‘flattening’ of historical narratives and connecting seemingly unrelated forms of media that has contributed to the ideation and realization of Click::REVU.

Click::REVU

Click::REVU (Figure 6) is an sound-based installation that repurposes and foregrounds the CIS mechanism as the primary visual element for the work. In its intended use, the CIS mechanism is generally concealed within a larger structure, analogous to an organ within a body.

Figure 6. Click::REVU

Removed from the shroud of darkness of its natural habitat and its support structures (e.g., interfaces to image formation, formatting, and engine control) the CIS itself has become visually impaired as it struggles to see in its new environment. The mechanism’s movement is reduced to a series of horizontal gestures, symbolic of its utilitarian and repetitious function. Creatively appropriating and

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1 Click::REVU is currently near its final completion. Full video documentation and further images will be available when a camera-ready version of the paper is required.
interpreting aspects of optophonic media, Click::REVU incorporates the electromechanical material sounds produced from the CIS’s movement with the discordant chaos of notes of Fournier d’Albe’s early white-sounding Optophone. The simultaneity of pitched voices provides textural layers that coexist and clash with each other.

**System Overview**

Click::REVU employs electronics and software to control functions such as motor drive, data acquisition and audio output. These components include a Teensy 4.1 microcontroller, an audio shield connected to the Teensy and a Pololu 8833 motor driver board. A system overview is shown in Figure 7.

![Figure 7. High level system overview](image)

The microcontroller programatically controls all functions of Click::REVU with a custom-developed software program (sketch). The sketch performs three primary functions: the acquisition and control of data from the CIS, CIS motion control via the motor driver and audio synthesis and output via the Teensy audio shield. A custom-designed circuit board (see Figure 8 for a circuit diagram) contains the necessary circuitry and components for motion drive and control, programmatic control, data capture, and voltage regulation.

**Audio Synthesis**

Fournier d’Albe did not describe the type of waveform that generated the device’s frequencies, instead variously describing the sounds as musical notes “embracing an octave” capable of producing chordal qualities and being “particularly pure and free from overtones.” [14] These descriptions being pure and free from overtones suggest a sinusoidal waveform for the Optophone’s audio output. However, the technical drawings suggest the output waveform more likely to be a modified square wave. Applying aspects of both the fanciful and technical descriptions of the Optophone’s sound producing qualities to produce a modulated effect provides the basis for

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Click::REVU’s audio synthesis approach. Using sine tones as the carrier tones and square waves as modulation signals of each waveform, the data collected is mapped to parameters of each waveform as a method of introducing elements of change to the otherwise static waveforms. A high-level overview of the audio signal chain is shown in Figure 9.

![Figure 9. High level audio synthesis overview](image)

**Aesthetic Approach**

Click::REVU exposes the CIS mechanism (Figure 10) as an audio-visual element of the work, foregrounding the cyclic rhythm of the mechanism’s movement whilst incorporating its sounds as a part of the work. In this way the inherent electroacoustic and electromechanical characteristics are integrated as audio-visual elements of the work. The CIS’s materiality is heard as an amalgam of subtle electromagnetic pulses energizing coils, a worm drive twisting, cogs meshing, rollers squeaking and rattling and, at boundary limits, switches clicking. From the repeated gestures and the minimal electroacoustic sounds emerge gradual changes to the audio-visual rhythm.
Compounding this difference, the construction and assembly of the structural elements of the work produces subtle nuances in the rhythm of the mechanism. The glass platen which the CIS originally sat upon, as a window for it to see through, is reversed to face the audience. This aligns the work nearer to the purpose of the Optophone as a visual aid for the sight impaired. To this, the illusory body of the Optophone emerges through the CIS as it enables the vocalization of variations of light and dark.

Click::REVU interweaves elements of the Optophone by adopting Fournier d’Albe’s concept of interpreting type based on bands of light, each keyed to a different frequency. Fournier d’Albe’s incorporation of musical elements for the Optophone can be considered an aesthetic attempt to make the auditory output more attractive to listen to after the roaring noise and buzzing tones of the earlier exploring Optophone. This aestheticization of sound is represented in Click::REVU through the use of modulated sine tones using frequencies in relation to musical scales.

**Compositional Strategy**

Click::REVU’s sonic presence combines the ‘musicality’ of Fournier d’Albe’s reading Optophone with the electroacoustic materiality produced by the movement of the CIS mechanism described in the previous section. The scanner mechanism’s repetitive gestures and the fixed frequencies of the sine tones appear homogenous. However, each movement exhibits moments of difference in its return and repetition.

Click::REVU uses the notes G C, D, E, G, B, C, E associated with the white-sounding Optophone. The representation of Fournier d’Albe’s early reading Optophone, as the composition *White*, reads a data value from within the programmed strata range and applies it to affect a specific tone function. This begins with a wavering drone comprising a chaos of notes. As the data values are read, tones change at different intervals. Interfering with the drone’s rhythmic texture by the imposition of small movements in the individual frequencies is a way of introducing rhythmic difference. By disrupting the continuous, or linear, repetition of each sine tone, the drone’s rhythm becomes cyclic, as return and difference, through the variations introduced in the process of return and renewal.

The simultaneity and diversity of sine tones create moments of harmony and discord, as diverse rhythms interact to maintain a metastable equilibrium between them. An arrhythmic presence exists as a dysfunctional interrelation of rhythms experienced by introducing discontinuity to the sine tones through the irregular presence and absence of sound. At a macro level, the work’s rhythms are modulated by the mechanism’s electromechanical and programmatic movement. This relationship, modulated by slow changes in environment light, does not interrupt the rhythms but modifies them through the light’s diurnal cycles. This interaction between the mechanical and organic elements, experienced by the creation and discovery of new rhythms through repetition and difference, presents a novel interpretation of an optophonic work in Click::REVU.

These variations, translated into a presence and absence of sound, interferes with the discordant drone by imposing discontinuous moments within the individual sine tone frequencies. In addition, a by-product of this discontinuity is embraced as a part of the resulting sound. Heard as clicks, these are an artifact of the disruption to the sine tone as it is turned off and on at varying points in each waveform’s amplitude. This granulation of an already fragmented ability to see adds a further textural layer to the soundscape.

**A Media Archaeological REVU**

Utilizing an experimental form of media archaeology as a speculative approach to explore the artistic potential of media can be one way of creating intriguing parallels and connections between past and present media. Such connections have been used to inform the ideation and realization of an idiosyncratic optophonic creation. Such non-discursive insights into the past can also stimulate our imagination, allowing one to “reflect critically on the hidden or non-verbalized, sensorial, corporal, and tacit knowledge” through an engagement with these artefacts. [5] [28]

Click::REVU has focused on the material elements of the Optophone to create a presence of the artefact through the body of a contemporary mediatic form. The work does not reveal the working of the Optophone through itself. Instead, it was interested in the temporality ascribed to such devices as sensorial traces of past articulations, their intriguing noises, functionality, and physical construction.

The work constructs a form of expression based on the practical realization of Fournier d’Albe’s prosthesis by utilizing elements of his Optophone. These elements are reimagined through a form of contemporary media, not as a device tightly coupled to sight and sound but as an interpretive sound-based installation. Utilizing a form of contemporary media technology to interpret past media
creates an awareness of characteristics of them as traces of the past in the present.

**Conclusion**

This paper has presented Click::REVU, a sound-based installation. As media archaeological research, Click::REVU is a part of a portfolio of works that have, by employing different media archaeological approaches, have reinterpreted obsolete and contemporary media as sound-based installations. The previous works, Click::TWEET and Click::RAND have been presented respectively at ISEA2020 and NIME2021. [29][30] Media archaeology, as an approach to inquiry, can be a way of seeing the possibilities of alternative historical narratives between the past and present through the convergence of obsolete and contemporary media technologies. Making such connections and representing familiar things in unfamiliar ways through artistic methods may impart a sensation of things as they are perceived and not as they are known. Approaching the conceptualization and realization of the work through media archaeology, Click::REVU imagines an optophonic form that is an interpretation of Fournier d’Albe’s early 20th century research and development. Blending physical characteristics of the reading Optophone’s sound, the work’s composition reduces the sense of light and dark to an indexical structure that is expressed as a minimal soundscape of drones and clicks. The combination of rhythms produces continual moments of arrhythmic disruption. As such, this reinterpretation of archival knowledge informs the creation of Click::REVU, expressed through a distantly related but contemporary form of media, the contact image sensor scanner. Reimagining the past through the present, the work reconfigures the existence of the Optophone within a broader history of optical technology and sensory prosthetics. Just as the Optophone was developed as a visual aid for the sight impaired, media archaeology as a form of creative practice, can provide alternative perspectives in which to see the world.

**References**


