Mapping Sound

Play, Performance, and Analysis in Proteus[1]

ABSTRACT Each playthrough of Ed Key and David Kanaga's *Proteus* (2013) presents players with a new, randomly generated island to explore. This unstructured exploration is accompanied by a procedurally generated ambient soundtrack that incorporates both harmonic textures and melodic motives, and abstract musical representations of environmental sounds. In the absence of clearly defined goals—except to progress through four distinct "seasons" of the game—the player's relationship to the soundtrack becomes a core gameplay element, and a playthrough of *Proteus* becomes, among other things, a kind of improvised performance art.

Viewed from this perspective, *Proteus*'s combination of free exploration and chance strongly evokes ideas from mid-twentieth-century musical modernism, including the graphic scores of Cardew and Cage and the "mobile form" works of Stockhausen and Ligeti. *Proteus* further complicates analysis by concealing the mechanisms that produce particular musical fragments and by eliding the roles of listener and player/performer. This article examines the tensions inherent in the complementary actions of playing/performing *Proteus* and listening to/analyzing it, and argues that the game challenges the distinctions between creator, performer, and observer by vividly embodying the most deeply ingrained metaphors of music analysis.   KEYWORDS *Proteus*, modernism, aleatory music, analysis, indie games

The ancient Greek sea god Proteus (Πρωτεύς), eldest son of Poseidon, could change his shape at will (Figure 1). A gifted oracle, he would give up his secrets only to those who could lure him from his watery lair. As Homer relates in the fourth book of *The Odyssey*, the stranded Menelaus and his men (aided by Proteus's daughter, Eidothea) disguised themselves with seal pelts in order to trap the shapeshifting god. Holding Proteus fast even as the god transformed into elusive animals and birds, into leafy trees, and even into flowing water itself, Menelaus was eventually rewarded: Proteus, exhausted, revealed the secret to escaping his long internment in Egypt, allowing Menelaus and his men finally to sail home.[2]

The computer game *Proteus* (Twisted Tree, 2013) presents the player with an algorithmically generated island to explore. This world rearranges itself anew with each click of the "New Game" button, though certain features (shown in Figure 2) persist across iterations—a dirt path, a pair of gothic towers, an abandoned hut, a circle of mysterious statues. A game of exploration and contemplation, *Proteus* offers impressionistic images

FIGURE 1. The Greek god Proteus, as depicted in Andrea Alciati, *Omnia Andreae Alciati V.C. Emblemata* (Paris: Marnef & Cavellat, 1583), 581, accessed May 20, 2020, https://archive.org/details/omniaandreaeal00alci.

and an interactive, ambient soundscape rather than narrative or conflict.[3] The object is simply to explore and enjoy the environment[4] and, with curiosity and persistence, to learn how to leave it. *Proteus*'s procedural generation helps to preserve the experience of exploration, offering up a fresh landscape each time one loads the game.[5] As a piece of

3. Such games are often referred to as "walking simulators," though music theorist Elizabeth Hambleton has evocatively called them "navigable narratives." Navigable narratives, she writes, "inhabit the uncanny valley between soundwalks and literary computer games . . . at least in part due to the creators' major focus on the sonic and visual artistry." *Proteus* lies closer to the former end of Hambleton's spectrum than the latter. See Hambleton, "Gray Areas: Analyzing Navigable Narratives in the Not-So-Uncanny Valley Between Soundwalks, Video Games, and Literary Computer Games," *Journal of Sound and Music in Games* 1 no. 1 (2020): 21–22, accessed May 20, 2020, https://doi.org/10.1525/jsmg.2020.1.1.20.

4. On the affinity between "soundwalks" and representations of natural environments in videogames, see Kate Galloway, "Soundwalking and the Aurality of Stardew Valley: An Ethnography of Listening to and Interacting with Game Audio," in *Music in the Role-Playing Game: Heroes & Harmonies*, ed. William Gibbons and Steven Reale (London: Routledge, 2020), 166–170.

5. This landscape is shaped only indirectly by the game's designers, who developed the algorithms for creating the island but crafted no geographies themselves. On the pursuit of seemingly "unauthored" experiences of nature in video games, and music's role in particular, see Michiel Kamp and Mark Sweeney, "Musical Landscapes in *Skyrim*," in *Music*

FIGURE 2. Four persistent features in *Proteus*: the hut, the statues, the tower, and the path. (All game screenshots are by the author on Steam, May 18, 2019.)
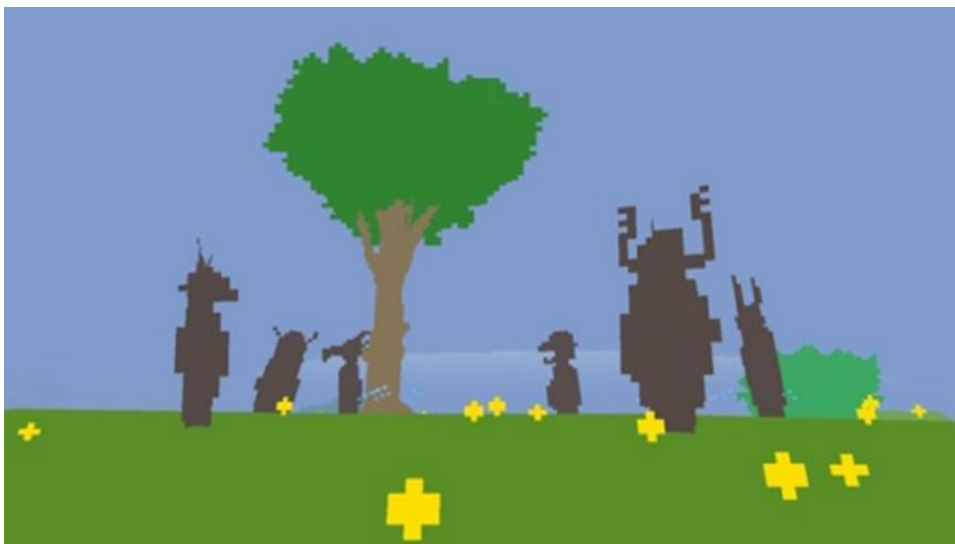

FIGURE 2. continued

audiovisual art, experienced through the first-person perspective common to many video games, *Proteus*—like its namesake god—challenges the player to hold it fast, even as it changes form around them.

One of the most notable features of *Proteus* is its procedurally generated soundtrack: throughout the game, a large vocabulary of short musical gestures and atmospheric

in the Role-Playing Game: Heroes & Harmonies, ed. William Gibbons and Steven Reale (London: Routledge, 2020), 179–181 and 186–194.

FIGURE 2. continued

FIGURE 2. continued

synthesizer textures weave in and out of the soundtrack in rough correspondence with the player's movement through the environment and their proximity to notable landmarks. As Karen Collins has written, procedural music is simply "composition that evolves in real time according to a specific set of rules or control logics . . . . This can take the form of generative composition or transformational composition."[6] In the case of *Proteus*, this procedural

6. Karen Collins, "An Introduction to Procedural Music in Video Games," *Contemporary Music Review* 28, no. 1 (2009): 13, accessed May 20, 2020, https://doi.org/10.1080/07494460802663983.

soundtrack is not merely background texture or an incidental feature, as it is in many games; rather, the music is central to the experience. "*Proteus*," reads the game's advertising copy, "is a game about exploration and immersion in a dream-like island world where the soundtrack to your play is created by your surroundings."[7] According to the game's creators, programmer Ed Key and composer/sound designer David Kanaga, this soundtrack "follows the mood of the world."[8]

In this essay I approach *Proteus* as a piece of interactive audiovisual art that interacts suggestively with several important aspects of mid-twentieth-century musical modernisms, posing fascinating analytical challenges and questioning the status of the text not only in ludomusicology but also in musicology and theory more broadly. In one sense the game is an *aleatory* work—based on chance—the performance of which is different each time. Chance music is often associated with composers like John Cage, Christian Wolff, Karlheinz Stockhausen, György Ligeti, and others. Given its computational nature, however, *Proteus* operates not only as a kind of indeterminate score but as a program that can generate *new* indeterminate scores, randomizing the game's layout each time it is played. Perhaps even more significantly, *Proteus* highlights the paradoxical dual role of the player by allowing them to serve *simultaneously* as performer and listener: as both the producer and consumer of sounds.[9] Such a division of attention is always, to some degree, required of all performers: in order to perform well, one must listen constantly to the music that one is producing. And it is a common configuration in video games, where the player's actions are necessary to drive the audiovisual experience forward. But the recursive hermeneutic of the *listening performer* vs. the *performing listener* is rarely given the kind of attention that a close reading of *Proteus* calls for: at every turn, the game's procedurally generated landscapes and soundscapes both invite and repel closer examination.

The player's dual orientation makes analysis challenging; as the decisions and desires of the performing self intertwine with, reinforce, and contradict the decisions and desires of the observing self, it becomes difficult to mark off where one ends and the other begins. Through its emphasis on a variable sonic environment (the soundtrack) tied to a representation of a spatial environment (the island), *Proteus* also embodies vividly many of the central metaphors that have been used to explore music's cognitive and conceptual underpinnings: the notion of music unfolding in theoretical or conceptual space; the idea that music is perceived by an embodied subject through the lens of their own embodiment; and the domain-crossing use of spatial, static representations to depict temporal, dynamic processes.[10] By looking at both

7. Ed Key and David Kanaga, "About This Game," accessed July 2, 2019, http://store.steampowered.com/app/ 219680/.

8. Key and Kanaga, "About This Game."

9. Kiri Miller has theorized the *Guitar Hero* series and similar games as experiences that destabilize the binary distinction between performing music and listening to it: the "schizophonic" performance of the player is responsible for allowing the music to unfold, even as the player themself serves as the game's primary audience. See *Playing Along: Digital Games, YouTube, and Virtual Performance* (New York: Oxford University Press, 2012), 85–86 and 111–124.

10. On embodied cognition in general, see George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: University of Chicago Press, 1980). On embodiment, image schemas, musical meaning, and metaphorical accounts of musical space, see Candace Brower, "A Cognitive Theory of Musical Meaning,"

technical and musical aspects of *Proteus*, and examining the process of playing, experiencing, and analyzing it, this article will explore a series of questions about musical knowledge and musical experience, determinacy and indeterminacy, and creativity and constraint.

PLAYING *PROTEUS*

As Tim Summers has pointed out, there is no single, authoritative playthrough of any video game—rather like there is no authoritative performance of an indeterminate musical work. Because games require player input, which opens up the possibility of both freedom and failure, every "performance" of a game is unique. "We cannot deal with the abstracted case," Summers argues, "rather, we must accept that the particular, subjective experiences of the player/listener/analyst constitute one of the primary sources of data when analyzing game music."[11] The first portion of this article will chronicle briefly some of my "analytical play" in *Proteus*.[12] I use video examples and musical transcriptions throughout. In the terms used by Nick Collins, this will be a "black box" analysis of *Proteus*, paying attention to the system's output and results with no access to its source code.[13]

As shown in Video Example 1, every iteration of *Proteus* begins with the player afloat in the ocean, their virtual eyes opening to the sound of a single chord: an E♭ chord with no third and an added ninth, as shown in Example 1. The island (Figure 3) is off in the distance, barely visible. After the opening chord, all is silent save for the sounds of gently moving water. There is little to do but move forward, although the player could choose to remain still. When I reach the beach, the music begins in earnest (Video Example 1, 0:27). What follows is an account of one of my own playthroughs; the experience (and thus, the soundtrack) of each player will vary.
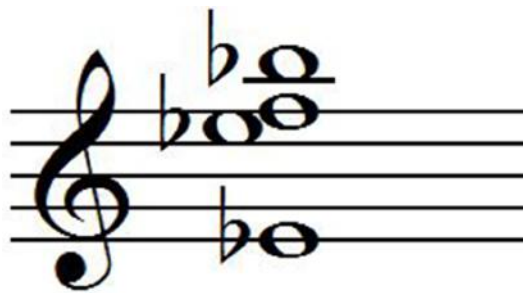
EXAMPLE 1. Opening chord of *Proteus*.

Journal of Music Theory 44, no. 2 (2000): 323–379, accessed May 20, 2020, https://doi.org/10.2307/3090681; Lawrence Zbikowski, *Conceptualizing Music: Cognitive Structure, Theory, and Analysis* (New York: Oxford University Press, 2002); Berthold Hoeckner, "Paths through Dichterliebe," *19th-Century Music* 30, no. 1 (2006): 65–80, accessed May 20, 2020, https://doi.org/10.1525/ncm.2006.30.1.065; and Arnie Cox, *Music and Embodied Cognition* (Bloomington: Indiana University Press, 2016).

11. For an overview of current research techniques in ludomusicology, see Tim Summers, *Understanding Video Game Music* (Cambridge, UK: Cambridge University Press, 2016), 13–53.

12. On analytical play as a research method, see Summers, *Understanding Video Game Music*, 34–35.

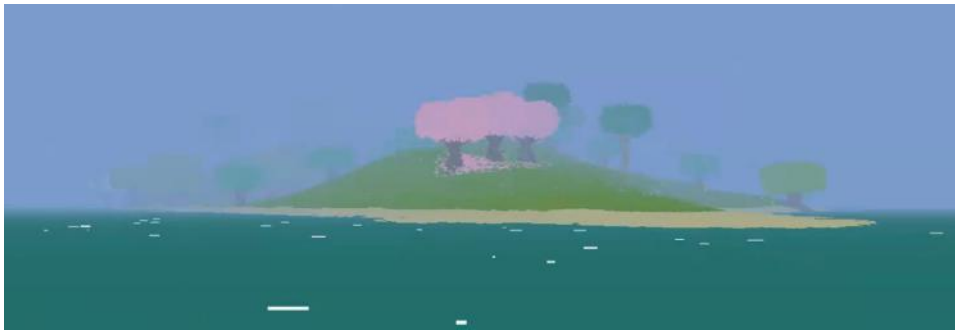13. See Nick Collins, "The Analysis of Generative Music Programs," *Organised Sound* 13, no. 3 (2008): 240–241, accessed May 20, 2020, https://doi.org/10.1017/S1355771808000332.

FIGURE 3. Opening image of *Proteus*.

EXAMPLE 2. Simplified transcription of "Landfall" melody and pink tree "theme"/texture in my playthrough (see Video Example 1, 0:27).

A lazy sequence of tones (shown in Example 2) begins, elaborating upon the opening chord. The music begins on E♭ again but quickly adds the third (G) below, confirming the major tonality. A fourth (A♭) appears as well, along with the dissonant ninth (F) from the opening chord. After cautiously investigating the coastline, I make my first big "move" by approaching the pink trees, which are shedding their leaves gently—an action represented mimetically by the falling, echoing tones that enter the texture. As I approach the trees, a new, high-pitched melody enters (0:48); its theremin-like warbling is timbrally distinct from the warm synthesizer pad of the opening tones. The high-pitched music persists as long as I stay near the trees, further filling out the E♭ major context by emphasizing C. When I back

EXAMPLE 2. continued

EXAMPLE 3. *Proteus*'s central pitch collection.

away from the trees, the new figure fades slowly out of the texture, leaving only something like the original music (1:02).

The reduced score in Example 2 outlines the music that I heard in the opening moments of *Proteus*. Much of *Proteus*'s music in any given playthrough is centered around the characteristic pitch collection shown in Example 3. This collection is based loosely around an E♭ major scale with no leading tone. A♭ and C seem to be somewhat less important than the other tones and are thus indicated with filled noteheads.

The game's music continues in this style, dominated by a middle-register synthesizer and often augmented by new sounds that represent objects encountered within the game. *Proteus* mixes traditional sound effects (waves, wind, insects, birds) with musical imitations of environmental and animal sounds. The creatures that populate the island, for instance, are musical: most of them create tones and melodies in much the same way as the environment. After thoroughly investigating the grove of pink trees, I encounter a flock of birds (chickens, perhaps; see Figure 4 and Video Example 2). They produce sharp, mallet-like tones as they peck the ground, as well as warbling calls. When I make my presence known to them, they scatter in a cascade of xylophonic footfalls.

A series of gravestones encountered several minutes later (see Video Example 3) emit deep bass tones when approached, in accordance with the *Proteus* pitch collection. Slaloming through a line of gravestones produces the bass-register melody shown in Example 4. The gravestone melody fits into the *Proteus* pitch collection noted earlier, centering on B♭ rather than E♭.

In one humorous moment from my playthrough (Video Example 4), I am startled by a new, surprising sound, and I move the mouse reflexively, jerking the camera around nearly

FIGURE 4. *Proteus*'s pixelated chickens.

EXAMPLE 4. Gravestone melody (see Video Example 3).

EXAMPLE 5. Hopping frog melody (see Video Example 4).

180 degrees. The instincts honed by playing other first-person games—which are often violent shooting games—have momentarily taken over. In contrast to Lawrence Kramer's "hermeneutic windows," which invite us into a deeper interpretive experience, unexpected sounds or movements in such games are typically harbingers of danger—but this is not true of *Proteus*.[14] The new sound turns out to be a digital frog, which like the other denizens of *Proteus* is not only harmless but produces a light-hearted tune (Example 5) as it hops away from me.[15]

INDETERMINACY

In the absence of obvious formal goals to pursue, *Proteus*'s players are left to explore the island as they wish.[16] Transient goals arise organically: the player may see a hill and decide to go investigate what lies at the top. From there they may see an intriguing valley, or an oddly colored tree, and explore further. One notable feature of each island is a

14. On the narrative and environmental affordances of the first-person perspective in video games, see Michael Nitsche, *Video Game Spaces* (Cambridge, MA: MIT Press, 2008), 102–108. On hermeneutic windows, see Kramer, *Music as Cultural Practice, 1800–1900* (Berkeley: University of California Press, 1990), 6–16.

15. *Proteus*'s frogs seem to be capable of emitting two different, similarly styled melodies as they jump; this is the one heard in Video Example 4.

16. A formal narrative eventually emerges; this will be discussed in the section "Form and Flux."

winding dirt path; in my video recording, this path proved too tempting to ignore. I made several efforts to follow it and see where it might lead—around the perimeter of the island, perhaps, or back to where I had started, or to new and undiscovered corners. But the island's visual and auditory delights made it difficult to stay on the path. Each tantalizing new distraction by the side of the footpath drew me further from it, making it more and more difficult to find my way back in order to resume the informal task that I had set for myself.

Proteus's emphasis on unstructured exploration also means that its soundtrack is far more prominent than the background underscoring found in most games—games in which the player's attention is often occupied with specific tasks or challenges. Because it is generated by the player's movements within the environment, *Proteus*'s music takes on an equal rather than subordinate role with the game's presentation.[17] While players may choose to explore the island based on its visual aspects, exploring in order to probe *Proteus*'s musical mechanics (or to use those mechanics to create ambient music) is just as valid and likely a choice.[18]

Despite the exploratory freedom granted to the player, they do not have direct control over the music that they produce or hear. Audio in *Proteus* walks a line between two categories of game sound described by Karen Collins: interactive sound, which responds directly to the player's input (e.g., the sound of Mario's jump in *Super Mario Bros.*); and adaptive sound, which reflects changing states of the game that are outside the player's direct control (e.g., changing soundscapes or soundtrack cues to reflect the passage of day into night in *The Legend of Zelda* series).[19] Elements of the game's environment, such as trees, water, gravestones, and birds, produce sounds in characteristic but unpredictable ways. The island and its environmental features act as a kind of indeterminate notation, depicting general shapes and contours. The nature of the objects sometimes gives a clue as to the sounds that will be produced—the mimetic noises made by moving animals, or the deep tones of the dark, imposing gravestones—but the relationship between image and sound is just as often hidden (as is the case with the slow synthesizer melodies that seem to accompany trees).

In an article written on his personal blog shortly before the game's release, *Proteus* composer David Kanaga draws an explicit connection between dynamic musical systems in games and the visually expressive but musically indeterminate notation found in works like

17. In their review of *Proteus* Isaac Schankler notes, "[*Proteus*'s] minimal resemblance to a typical game has caused some to brand it an 'antigame' or not a game at all. This ongoing turf war in the gaming community over what is and isn't afforded that status is a curious echo of old 20th-century arguments about music and art. In fact, *Proteus* could just as easily be called an interactive audiovisual artwork, raising the question: What is the difference, anyway? Does it even matter?" See Schankler, "Games Played: *Proteus*," *New Music Box*, February 5, 2013, accessed October 18, 2019, https://nmbx.newmusicusa.org/games-played-proteus/.

18. In one of three critical vignettes on *Proteus*, Ian Bogost describes using the game as a makeshift ambient sound generator, running in a window while he works on other things; see Bogost, *How to Talk about Videogames* (Minneapolis: University of Minnesota Press, 2015), 127.

19. See Karen Collins, *Game Sound: An Introduction to the History, Theory, and Practice of Video Game Music and Sound Design* (Cambridge, MA: MIT Press, 2008), 4 and 125–126.
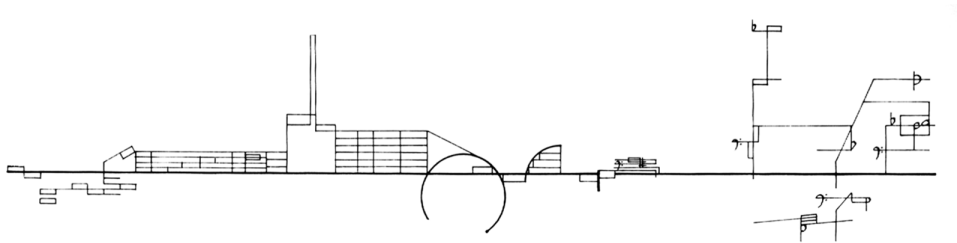
FIGURE 5. Cornelius Cardew's *Treatise*, p. 66, reproduced in Kanaga, "Soundtracks 2."

Cornelius Cardew's *Treatise* (1963–1967, a page of which is shown in Figure 5). "Graphic scores," writes Kanaga,

> offer new ways of navigating the 2-dimensional plane (page) of musical information, often by being less systematically precise (but more visually evocative), so that object relationships can emerge in play with more fluidity, an important precedent for games/fluid visual systems as movement.
>
> Videogames are musical interfaces. And, being *dynamic*, they're of particular interest, re: fluidity. What was possible at one moment isn't at the next—possibilities shift. The information, and space, we're given at one moment is gone the next. . . .
>
> When a soundtrack is subject to the variability of a game's mechanics, the music itself becomes a mechanic, an instrument—music to be played. And the fluid space that houses this mechanic becomes a space for the play of instruments, a composition—again, music to be played. Spaces hold other spaces which in turn hold others, and so the hierarchical relationship between instrument and composition which says that the former is a component object used in the latter can be dissolved, reversed.[20]

Here Kanaga professes an interest in the musicality of video games—all games, not simply those oriented toward music—and in using interactivity to blur the lines between compositions, instruments, and performers. Graphic scores, according to this view, are an analog way of performing the same effacement of systematic, traditional notation that generative composition strives toward. Thor Magnusson makes a similar argument, positioning graphic scores as an essential antecedent for algorithmic music: "Graphic scores can represent a special form of algorithm . . . . The graphic score opens new dimensions in the ontology of music by rejecting linearity in musical notation, thus paving the way for encoded generative or algorithmic music."[21]

Scores like Cardew's *Treatise* give the performer interpretive freedom to create music that they feel traces out the visual images. The performer (or performers) must decide how

20. See David Kanaga, "Soundtracks 2: Methods: Interface and Dimensionality in Music Spaces," *Wombflash Forest* (blog), September 11, 2012, accessed December 22, 2019, http://wombflashforest.blogspot.com/2012/09/soundtracks-2-methods_11.html, sections 3 and 6.

21. See Thor Magnusson, "Algorithms as Scores: Coding Live Music," *Leonardo Music Journal* 21 (2011), 21, accessed May 20, 2020, https://muse.jhu.edu/article/457976. Magnusson's particular interest moves from this realization, through Iannis Xenakis's UPIC software system as an important early form of computer-mediated graphic composition, and toward the possibility of the composer themselves being involved in the realization of an indeterminate score; all of those elements are central to the contemporary practice of live-coded music.

to interpret graphic elements such as the thick black line running through the center, the boxes of various sizes that cluster on the left side of the page, and the tree-like branching structures to the right, on which several bass clefs and other musical symbols are suspended. Some performers over the years have rigorously prepared and rehearsed their musical responses to Cardew's symbols, while others have used them as the impetus for free improvisation.[22] As Judith Lochhead notes, works like *Treatise* are characterized by a "one-to-infinity" relationship between the notation, and the possible sound structures produced.[23]

Regardless of the performer's approach to *Treatise* (or any other graphic score), a process of translation must occur, from abstract line to musical sound. In the scholarship on experimental music, the result of this process is referred to as a "realization" and can be informal (a set of notes or an outline) or formal (a fully notated score).[24] The same is true of *Proteus*, albeit with a slight difference: the game itself mediates the player's interactions with the environment (taking into account factors like rate of movement and proximity to landmarks) and uses them to produce music according to some set of rules. Those rules are located not within the player-as-performer—as they would be in the realization of an indeterminate work—but rather within the game's code; they have been predetermined by Key and Kanaga and remain mostly inaccessible to us. Thus, the island has elements of an indeterminate or graphic score, as realized in the form of the three-dimensional island.[25] But the player's interpretation of that score is constrained by the game's programming: there is an additional layer standing between the player and the "score." It is this additional estrangement that creates a distinctive listening/performance feedback loop, which structures the experience of the game. One way of looking at this situation is represented in Figure 6, which demonstrates that while gamers do not create a realization of *Proteus* in preparation for performance, their encounter with the game's environment is akin to a performer's encounter with an indeterminate score. Dotted lines in the figure represent the one-to-infinity relationships described by Lochhead: one in the process of realizing an analog indeterminate

22. For accounts of numerous realizations of *Treatise*, see Virginia Anderson, "'Well, It's a Vertebrate . . .': Performer Choice in Cardew's *Treatise*," *Journal of Musicological Research* 25, no. 3–4 (2006): 291–317, accessed May 20, 2020. https://doi.org/10.1080/01411890600840578. Of particular interest are anecdotes involving critic Roger Smalley, who wrote ruefully that Cardew should have included a "Legend" of symbols to aid in interpretation (pp. 297–299); the small group that performed the premiere recording (pp. 307–310); and music theorist and guitarist Kevin Holm Hudson, who used *Treatise* as the basis for solo improvisation in the 1980s but muses about whether the effect of the work is lost when the audience cannot see Cardew's score (p. 314).

23. Judith Lochhead, "Performance Practice in the Indeterminate Works of John Cage," *Performance Practice Review* 7, no. 2 (1994): 234.

24. The most noted and influential practitioner of the latter method is David Tudor, often cited for his meticulous realizations of the indeterminate works of Cage, Feldman, and others, and his resulting influence on the performance practice of experimental music. See, *inter alia*, John Holzapfel, "David Tudor and the Performance of American Experimental Music, 1950–1959" (PhD diss., City University of New York, 1994); Judith Lochhead, "Controlling Liberation: David Tudor and the 'Experimental' Sound Ideal" (paper presented to the Getty Research Institute Symposium, 2001); and David Cline, *The Graph Music of Morton Feldman* (Cambridge, UK: Cambridge University Press, 2016), 264–291.

25. In his analysis of the game *Dyad* (2012, also scored by David Kanaga), Steven Reale raises a related issue: when a transcription was mentioned to him, *Dyad*'s creator Shawn McGrath objected to the idea of representing the game's soundtrack in conventional musical notation, asserting "the notation for *Dyad*'s music . . . is its game." See Reale, "Transcribing Musical Worlds; or, Is *L.A. Noire* a Music Game?" in *Music in Video Games: Studying Play*, ed. K. J. Donnelly, William Gibbons, and Neil Lerner (London: Routledge, 2014), 93.

WRITTEN GRAPHIC SCORE

Performer
creates

Composer
creates → graphic/
indeterminate
score ----> realization → performance

PROTEUS

Player
interacts with

Developer
and composer → source code ----> Island
create (graphic/
indeterminate
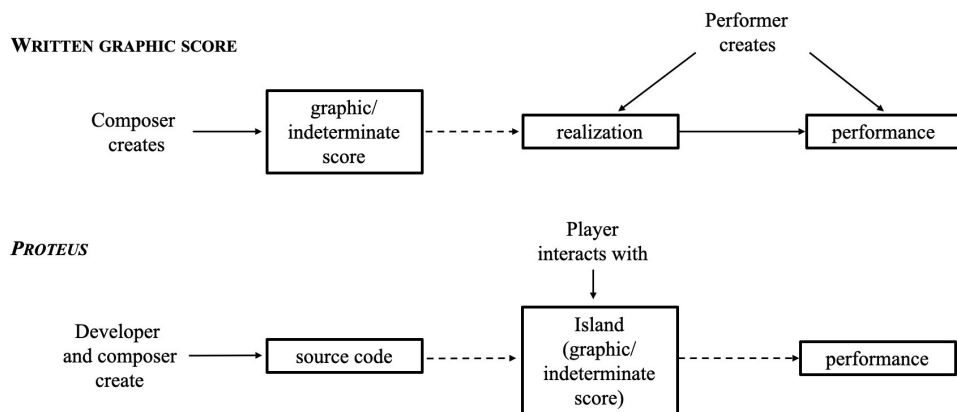score) ----> performance

FIGURE 6. Interactions between composer/developer, graphic score, and performer/player.

score, but two in the process of playing *Proteus*—from the source code to the island, and from the island to each unique playthrough.

The island path, which forms a through-line in *Proteus* in much the same way as the thick horizontal line does in *Treatise*, is perhaps the most vivid illustration of the tension—or as Kanaga might frame it, the fluidity—between the performing self and the listening/observing self in *Proteus*. In my own playthrough, I wanted to see the sights and hear the sounds that the path would lead to, but I was quickly sidetracked, and I never successfully completed a circuit of the island. This failure to circumnavigate *Proteus* is the result of the very hermeneutic process described earlier: I hear a sound or see an object that attracts my attention, but as I walk the path—as I "perform" it—I am quickly distracted by the external feedback that arises from my own performance of *Proteus*. My actions are then influenced by what I hear, and so on, in an infinite loop: as the game progresses and the player becomes more comfortable, the listening/performance hermeneutic speeds up almost to the point of reflex.

In another sense, the experience of playing *Proteus* resembles some processes of improvisation, particularly group improvisation, since the underdetermined nature of the game's interactions means the player is constantly probing in order to provoke a response from the game. Any playthrough or "performance" of *Proteus* is mostly improvised, in that the player follows immediate stimuli in search of feedback, or constructs (and then pursues, or abandons) informal transient goals. Scholars and improvisers often describe group improvisations as the creation and pursuit of a collective intention, or as a *conversation* among friends.[26] In certain ways the many exploratory avenues offered by *Proteus*—to follow the path, to chase the frog, to frolic among the gravestones—mimic the experience of those musical conversations: one band member hears an interesting melodic or rhythmic idea in a bandmate's

26. On collective intention in jazz improvisation, see Garry L. Hagberg, "Ensemble Improvisation, Collective Intention, and Group Attention," in *The Oxford Handbook of Critical Improvisation Studies, Volume I*, ed. George Lewis and Benjamin Piekut (New York: Oxford University Press, 2016), 481–499. On improvisation as conversation, see Paul Berliner, *Thinking in Jazz: The Infinite Art of Improvisation* (Chicago: University of Chicago Press, 1994); Ingrid Monson, *Jazz Improvisation and Interaction* (Chicago: University of Chicago Press, 1996); and Charles Keil and Steven Feld, *Music Grooves* (Chicago: University of Chicago Press, 1994).

improvisation and picks up on it—chases it—in their own playing. The sonic conversation in *Proteus*, however, occurs between the player and the game: the player may pick up on cues that they see or hear in the environment, but that environment responds in kind only to the degree that the programmers have designed it to do. While the non-teleological freedom of the gameplay to some degree allows the player to shape the musical text (as filtered through *Proteus*'s abstract, environmental "notation"), any creativity they perceive in response has been pre-programmed or algorithmically generated.

PROTEUS AS SUBJECT AND OBJECT OF ANALYSIS

Approached primarily as a musical game (with its visual aspects taken, for the time being, as secondary), *Proteus* presents several interesting challenges to listening, analysis, and performance. Bracketing off the possibility of a non-playing observer watching over the player's shoulder, *Proteus* essentially collapses the traditionally opposed roles of performer and listener into one. To listen to *Proteus* requires one simultaneously to perform it; those performative actions are influenced in turn by the sounds and music that the player hears as they play. The playing experience is a feedback loop. In a way, the game is subject to something like the "observer effect" in quantum mechanics: we cannot observe a system without changing the state of that system. No direct intervention is necessary; the mere act of observation, the system's *being seen*, is enough to alter the state of the system under surveillance. As Key and Kanaga write on the game's website, "The primary means of interaction is simply your presence in the world and how you observe it."[27]

In music theoretical terms, the collapse of the performer/listener dichotomy is traumatic: it means the dissolution of the Cartesian subject/object divide that underlies much of Western musical thought. As John Covach writes, we create subject-object divisions "whenever we approach a piece of music as an object in some world 'out there,' as an object distinct from ourselves as perceiving and conceiving subjects."[28] This subject-object distinction is, to some degree at least, a given for traditional models of musical analysis, which assume that the analyst is a subject who makes statements about an object that they perceive in the world—an object that exists completely independently of them and would go on existing regardless of their attention to it. That is to say, this view holds that music exists regardless of whether we play or listen to it, like the proverbial tree falling in the forest. The subject, it follows, exists regardless of their relationship to any particular object. Covach's solution to music theory's ingrained Cartesianism is to invoke Edmund Husserl, whose phenomenology uses the notion of a subject-object division but "transforms [it] in an important way."[29] Husserl's concept of intentionality holds that all consciousness is consciousness *of* something; there are no empty sets in perception, only specific acts of consciousness directed at specific objects. The subject-object relationship, for Husserl, is "richly interdependent": there is no subject without an object to perceive and

27. Key and Kanaga, "About This Game."

28. John Covach, "Destructuring Cartesian Dualism in Musical Analysis," *Music Theory Online* 0, no. 11 (1994), para. 1, accessed May 1, 2020, https://www.mtosmt.org/classic/mto.94.0.11/mto.94.0.11.covach.html.

29. Covach, "Destructuring Cartesian Dualism," para. 2.

there is no object, as such, without a perceiving subject to surveil it.[30] For Husserl, things being apprehended in this manner are imbued with intentional content (or *noema*), which represents their significance to the observer. By necessity they are perceived to a large degree by the significance they hold for the perceiver. The cup of coffee on my desk is never perceived as merely a cup; rather it is imbued with significance toward me, the perceiver: it is, for example, "too hot to drink," or "just right," or perhaps it is "just out of reach," or even "in danger of being spilled on a stack of library books."[31] In other words, "It is an object *for me* and towards which my consciousness is directed."[32]

Another significant model for an anti-Cartesian mode of musical analysis comes from David Lewin. Although Lewin invokes Husserl in his 1986 essay "Music Theory, Phenomenology, and Modes of Perception," arriving at the beginnings of a theory of musical-action-as-perception, another work of Lewin's directly and radically challenges music theory's Cartesian outlook: 1987's *Generalized Musical Intervals and Transformations* (often abbreviated *GMIT*). "We tend to imagine ourselves in the position of *observers* when we theorize about musical space," writes Lewin:

> The space is "out there," away from our dancing bodies or singing voices. "The interval from s to t" is thereby conceived as a relation of extension, observed in that space external to ourselves; we "see" it out there just as we see distances between holes in a flute, or points along a stretched string . . . . In contrast, the transformational attitude is much less Cartesian. Given locations s and t . . . [it] does not ask for some observed measure of extension between reified "points"; rather, it asks "if I am *at* s and wish to get to t, what characteristic gesture . . . should I perform in order to arrive there?" This attitude is by and large of someone inside the music, as idealized dancer and/or singer. No external observer is needed.[33]

Henry Klumpenhouwer reads Lewin's turn from intervallic to transformational thinking in *GMIT*'s seventh chapter as an indictment of music theory's dualism and as a proposed way forward.[34] For Klumpenhouwer, who considers Lewin's anti-Cartesianism in the context of his father's writings on Descartes and psychoanalysis, the transformational attitude renders the subject/object collapse as a kind of therapeutic breakthrough rather than a methodological trauma.[35] Lewin's music theorizing from that point forward is often concerned with ways to unify the concerns of music theory with hermeneutics and criticism, performance practice, and even creative composition.[36]

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30. Covach, "Destructuring Cartesian Dualism," para 2.

31. For a brief introduction to Husserl's intentionality, see Smith, 2007, 56–59 and 206–210.

32. Covach, "Destructuing Cartesian Dualism," para 2.

33. David Lewin, *Generalized Musical Intervals and Transformations* (New York: Oxford University Press, 2007), 159.

34. See Henry Klumpenhouwer, "In Order to Stay Asleep as Observers: The Nature and Origins of Anti-Cartesianism in Lewin's *Generalized Musical Intervals and Transformations*," *Music Theory Spectrum* 28, no. 2 (2006): 277–280. Klumpenhouwer refers to Lewin, *Generalized Musical Intervals and Transformations*, 157–174.

35. On David Lewin's father, Bertram Lewin (1896–1971), see Klumpenhouwer, "In Order to Stay Asleep as Observers," 280–285.

36. Numerous latter-day review-essays have sought to characterize larger trajectories within Lewin's body of work. See, for instance, Steven Rings, "Review of *Generalized Intervals and Transformations, Musical Form and*

As Steven Reale has argued, video games are uniquely positioned to express the first-person perspective called for by Lewin, allowing players to traverse and interact with musical spaces in a vivid and (virtually) embodied manner.[37] The interdependence of subject and object allows for a suitably recursive view of perception and performance in *Proteus*. Far from being some Cartesian object we can hold at arm's length, the island exists primarily as something virtual, a potentiality. Because players have limited time on the island (about forty-five minutes, as we will explore later) and an extremely limited point of view, they cannot hold the environment at arm's length in order to fully surveil and rationalize it; it can only be observed *while* they are traversing it, never from a distance. There is thus no meaningful subject/object division: the island collapses both into one, existing only as an intentional object *for* the performing-and-observing subject. They are, as Husserl put it in the passage quoted earlier, "richly interdependent." The music being heard and the environment being seen are both strong influences on the course of the music being produced. The player is presented with any number of visual, musical, and environmental cues to follow: objects to investigate, paths to follow, hills that enticingly shroud the player's view at a certain distance, practically begging to be explored. At the beginning of the game, the possibilities for exploration are wide open. Once the player makes landfall, they can literally move anywhere and follow any path. Each choice made, however—to approach this or that object, or move in this or that direction—has direct, audible consequences in the soundtrack and often has the effect of closing off certain other possibilities, thus shaping each "performance" of the game.

While this unified perceiving-receiving subject is rare in traditional media—music, film, literature—it is common in video games, even constitutive. Although I have chosen to metaphorize *Proteus* as a form of musical performance, the player-game interaction is often conceptualized in literary terms. As Michael Nitsche puts it, "The player in a video game is both reader (of the computer's output) and producer (via input) of events. For video game spaces, this means the player not only enters game worlds but also changes them and their ingredients."[38] Espen Aarseth calls games "ergodic literature"—forms of art that require the input of their audience. "In ergodic literature," writes Aarseth, "nontrivial effort is required to allow the reader to traverse the text." Effort, that is, that goes beyond "eye movement and the periodic or arbitrary turning of pages," as would be found in film or literature.[39]

Transformation, and *Studies in Music with Text*," *Journal of Music Theory* 50, no. 1 (2006): 111–127, accessed May 20, 2020, https://doi.org/10.1215/00222909-2008-010; Julian Hook, "David Lewin and the Complexity of the Beautiful," *Intégral* 21 (2007): 155–190; and William O'Hara, "Review of *David Lewin's Morgengruß*," *Music Theory and Analysis* 5, no. 1 (2018): 104–114.

37. Steven Reale, "A Musical Atlas of Hyrule: Video Games and Spatial Listening" (paper presented at the annual meeting of the Society for Music Theory, October 31, 2015).

38. Michael Nitsche, *Video Game Spaces* (Cambridge, MA: MIT Press, 2008), 31. The text-based "interactive fiction" games of the 1970s and '80s offered literary scholars a way into video game studies, and perhaps as a consequence literature has remained a more popular metaphor in academic game studies than, for example, film, which might be more robust due to its use of both sound and image. See, *inter alia*, Nick Montfort, *Twisty Little Passages: An Approach to Interactive Fiction* (Cambridge, MA: MIT Press, 2005).

39. Espen Aarseth, *Cybertext: Perspectives on Ergodic Literature* (Baltimore: Johns Hopkins University Press, 1997), 1–2. In making this assertion, Aarseth pushes his argument past theorizations of traditional literature as a medium that is made interactive by its demands for active engagement and interpretation from readers. Such influential theorizations

Proteus's lack of a narrative structure, however, is unusual among games, as is its relative dearth of clear goals. Most game spaces and narratives are structured by particular objectives, which may be conceived abstractly (progress from point A to point B, score as many points as possible, defeat the other players) or in terms of a diegetic narrative (save the princess, win a battle or war, and so forth). For game theorists like Nitsche, the elements of narrative are in fact the *sine qua non* of space- and place-making in games, as the particular form of the environment (such as a [race]track, an arena, or a labyrinth) tends to dictate what the player must do.[40] *Proteus*, in Nitsche's reckoning, would be classified as a "playground" or "sandbox" game: a space for the kind of unstructured creativity that is most commonly associated with children's play.[41] In terms introduced to academic discourse by Roger Caillois, such unstructured play is referred to as *paidia*, which is opposed to *ludus* (structured, rule-governed play).[42] As we will see, although *Proteus* contains what game theorist Jesper Juul calls a "completable goal," a large-scale structure with an overarching objective, the actual experience of playing *Proteus* is characterized by the player's ability to define their own agenda, largely unrestricted by external direction and free to explore the "turbulence" and "improvisation" that characterize *paidiac* play.[43] Juul calls such player-defined goals *transient goals*, for their tendency to arise and dissipate organically. In the next section, we will begin to explore how *Proteus*'s transient gameplay allows it to bring to mind musical metaphors of performance and improvisation.

FORM AND FLUX IN *PROTEUS*

Systematically analyzing *Proteus* requires us to account for two levels of form, and the experiences of playing/observing that accompany each. We will look first at the large-scale form of the game and then at the task of mapping and analyzing what happens from moment to moment.

While *Proteus* focuses on free exploration, it is not without a large-scale structure. The game begins in springtime and cycles through the four seasons, presenting the player with a distinct yet functionally identical environment each time. By default, players spend one

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include Umberto Eco's idea of the "open work" (*opera aperta*); see Eco, *The Open Work*, trans. Anna Cancogni (Cambridge, MA: Harvard University Press, 1989); and Wolfgang Iser's reader-response theory; see Iser, *The Implied Reader: Patterns of Communication in Prose Fiction from Bunyan to Beckett* (Baltimore: Johns Hopkins University Press, 1974), and *The Act of Reading: A Theory of Aesthetic Response* (Baltimore: Johns Hopkins University Press, 1978).

40. See Nitsche, *Video Game Spaces*, 171–189.

41. Nitsche, *Video Game Spaces*, 171–172.

42. See Roger Caillois, *Man, Play, and Games* (1959), trans. Meyer Barash (Urbana: University of Illinois Press, 2001), 13. It is worth noting also that Caillois diagnoses a general tendency to turn *paidia* into *ludus* through repetition and standardization (see pp. 27–28). For an application of Caillois's ideas to music, including his more famous taxonomy of types of play (*agon, alea, mimicry,* and *ilynx*), see Roger Moseley, *Keys to Play* (Oakland: University of California Press, 2016), 26–33.

43. Jesper Juul describes three kinds of goals that tend to control not only digital games but formal and informal modes of analog play: *completable goals*, such as getting to the end of a level or winning a game; *improvement goals*, such as besting one's own high score or personal record time; and *transient goals*, which he applies in part to creative "sandbox" or simulation games, in which a player might strive to build a city of a certain type or size in the *SimCity* series. Transient goals are informal and may be completed or revised many times in the course of a play session or a longer-term engagement with the game. And clearly the three categories are not mutually exclusive. See Juul, *The Art of Failure: An Essay on the Pain of Playing Video Games* (Cambridge, MA: MIT Press, 2013), 83–90.

full day (approximately ten minutes of real time) in each season. Each nightfall, a strange light appears somewhere on the map, visible from far away. Although the player is free to continue exploring, nighttime will not end until the player approaches the light source, where they will find a single large tree, surrounded by a swirling stream of smaller white lights (Figure 7). A large circle of lights is traced out on the ground nearby. Within this circle, time passes quickly, as in a time-lapse film: clouds stream by and the sun rises, races across the sky, and disappears once again, repeatedly. Players can exit the circle at any time of day, effectively giving them the option to repeat an entire day or some portion thereof.

If a player does not wish to turn back time, they may enter a smaller concentric circle nearer the center. Upon entering this circle, the player is overtaken with light. The screen goes white for a moment, and the player reappears in the midst of the next season. Thus, *Proteus*'s form looks something like Figure 8: a linear progression through four distinct seasons, with the option to live only a single day within each or to repeat multiple days. The duration of the final season, however, is fixed: once winter begins, the end of the game is imminent. Winter ends not with the "time circle" featured in the previous three seasons but rather with the player's ascension into the sky, which begins gradually at some point during the night and proceeds slowly over the course of several minutes. During this ascension the player is free to "walk" in all directions—in midair—but is powerless to stop the upward motion.[44] When night falls over winter, the game is effectively over. *Proteus*'s reliance on a metaphor taken from nature—the four seasons—positions its overall form as a linear

FIGURE 7. An upward stream of lights (top center), indicating the location of the "time circle."

44. Unlike in many first-person games, the player's avatar in *Proteus* is never visually accessible—the player never holds any objects, never sees their own arms interacting with the world, cannot look down to see their own feet, and so forth. Therefore the problem of "walking" in thin air is never addressed. Ian Bogost explores the ludic implications of this disembodiment in *How to Talk about Videogames* (Minneapolis: University of Minnesota Press, 2015), 117–120.
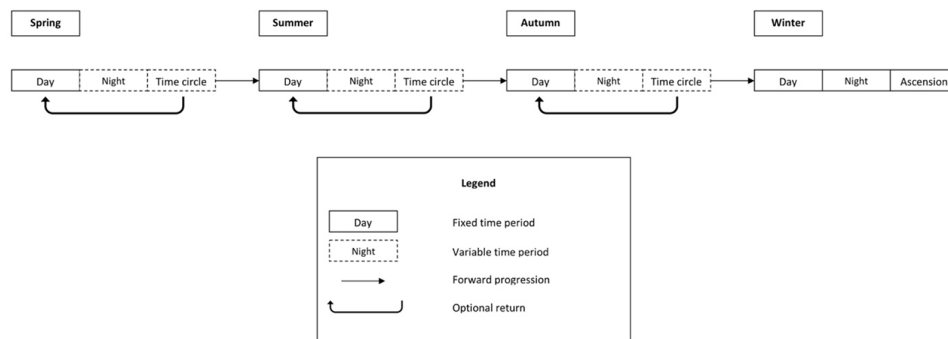
FIGURE 8. Fixed and variable form in *Proteus*.

progression: movement through the four seasons may be delayed (even indefinitely) but not stopped, and *never* reversed. While the structure of each island persists through the seasons, each season presents a distinct soundscape—the percussive flowers of summer bounce up and down, dancing to their own chimes as if in a Disney movie; rainy autumn is awash in gentle dissonances; the hush of winter arrives with almost physical force, replacing the bell-like timbres of earlier seasons with an eerie whistle.

Having established an overall form for the game, we may now revisit David Kanaga's writings and his interest in graphic scores. Elsewhere on his website, Kanaga draws a more explicit parallel between his own work on *Proteus* and Cardew's *Treatise*. He provides the image reproduced in Figure 9, which he calls a "walking score."[45]

Many familiar aspects of *Proteus* appear in Kanaga's score. There are environmental features, such as the hut, the gothic tower, and the gravestones. There are visual references to the four seasons, such as a sapling for spring at #4, a bright sunny scene for summer in #5, and a stark, leafless winter scene in #13. And there are references to *Proteus*'s limited narrative elements: the dots in the center of #12 might signify the swirling lights of *Proteus*'s transition sequences, while #15 seems to be a reference to the player's ascension into the sky at the end of the game. Elements of music notation are present as well, strengthening the notion that *Proteus* is in some sense a musical composition, or a digital instrument on which compositions may be created.[46] These musical symbols are often incomplete (#15) or somehow distorted (#2) and thus represent music only in an abstract way.

The name "walking score" casts this image as a visual depiction of one player's journey through *Proteus*. Intriguingly this visual diagram brings Kanaga's compositional aesthetic, discussed in the previous section, around in a full circle: he is enthusiastic about the capacity for video games to create music that fulfills the indeterminacy and fluidity toward which fixed graphic scores of the mid-twentieth century could merely strive, but at the same time he chooses to create just such a static graphic score as a representation of his random and infinitely replayable game. With this transcription between media, *Proteus*'s relationship to

45. See https://davidkanaga.bandcamp.com/merch/artifact-edition.
46. Here we should recall, from the blog entry quoted previously, Kanaga's desire to efface the distinction between an instrument and a composition.
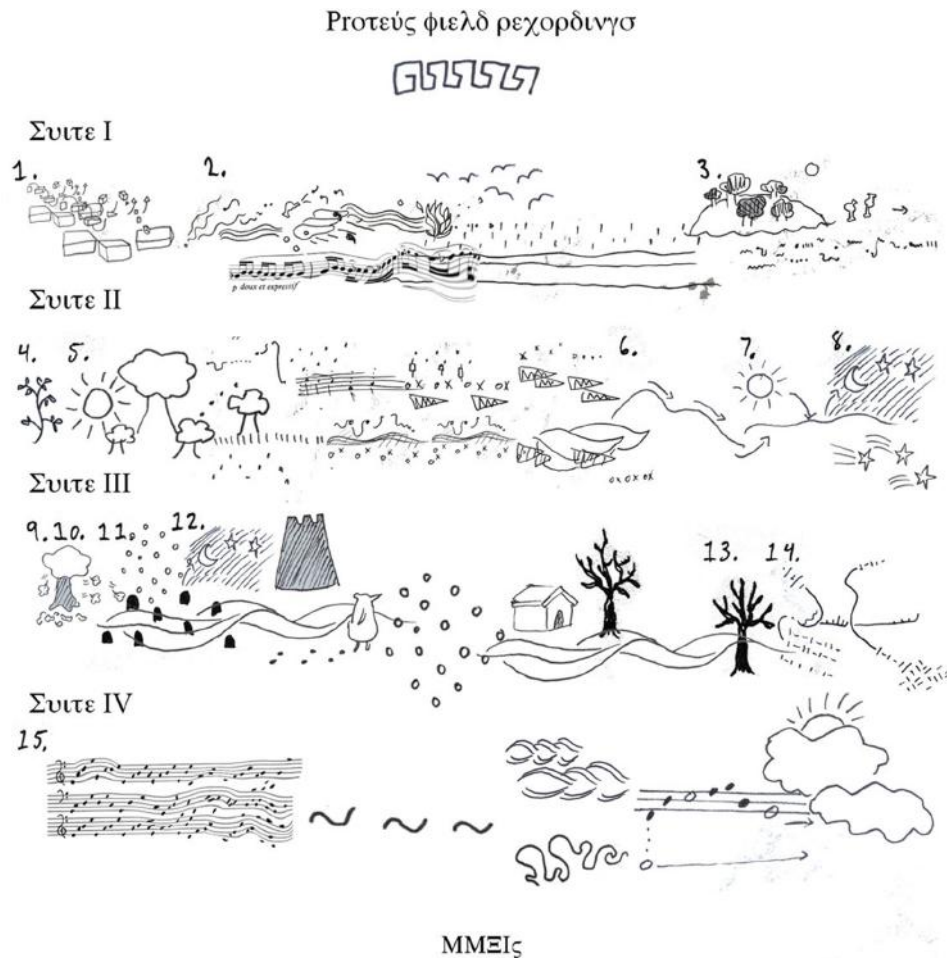
FIGURE 9. David Kanaga's "walking score" for *Proteus*.

avant-garde aesthetics and techniques becomes even clearer. Kanaga eagerly takes advantage of the ability to generate the island—and thus the "score" of *Proteus*—anew with each play-through, and to create an "instrument" on which players can realize his highly abstract "graphic score" of trees and birds and stones. But he is also interested in casting his digital game in the visual language of its mid-century antecedents, and he creates a single graphic score that loosely represents only one among millions of possible score configurations for *Proteus*.

TIME, SPACE, AND THE ROAD NOT TAKEN: MAPPING *PROTEUS*

Having explored the game's large-scale form, and begun to draw out the connections between contemporary game and sound design and the experiments of the twentieth-century avant-garde, we will now turn our attention to the player's moment-to-moment experience of *Proteus*, and to how the realization of the game's environment as a score might be represented as a process of moving through space. Many first-person video games include a

mapping function, which indicates the player's location within the world, offers an outline of where they have been, and in some cases even indicates their goals in advance (although areas that have not yet been visited are often omitted from in-game maps). Commercial games have also often been subject to mapping by fans, who share their insights with their online communities, or in the form of official "strategy guides" sold commercially.[47]

Proteus lacks any such mapping function, leaving players with no reliable way to orient themselves within its always-new environment. When the game was first released, its official website (www.visitproteus.com) featured a discussion forum where players could share stories of their explorations, ask questions, and speculate about the meaning of the game and the intentions of its creators. On this forum, one fan calling themselves "Koala" posted an in-depth guide to mapping the game, detailing a method of systematic exploration. But under the caption "Fair Warning," they write:

> What you'll be doing, if you follow this guide, is creating a map of your individual island. Each island is different but usually contains the same basic landmarks and important areas. So much of the fun and mystery of *Proteus* is the complete absorption and immersion one can experience. FOLLOWING THIS GUIDE WILL 'KILL' YOUR IS-LAND. Before you say "that sounds awful" and close your [web browser], hear me out. When I say kill, I mean deviate from the original intent of *Proteus*. You will have to approach this game as if you were a paid explorer, and an actual mapmaker. It will take times, patience, tools, and willpower. You will not be giggling at jumping frogs or gaping at a meteor shower. You'll be scratching your head and getting frustrated. But it's worth it. YOU WILL BE CHALLENGED, BUT IT CAN BE LOADS OF FUN. . . . If you're someone who feels glee when solving a problem, you'll love orienteering your island. Also, you don't lose the fun of exploring. The exploration will become more in-depth than wandering, and learning your island will make you feel almost "at home" there.[48]

There is much to unpack in Koala's caveat. Many of their ideas resonate strongly for music analysis, as do their anxieties. For Koala, exploring the island thoroughly and systematically will "kill" the island by ignoring the intentions of the game designers—that players relax and wander, that they "giggle at jumping frogs" and "gape at meteor showers." This fear recalls an idea from nineteenth-century musical aesthetics, which often described pieces of music as organic wholes, and fretted that *analyzing* them (from the Greek root *analusis*, to tear apart) inevitably meant metaphorically killing them, as if pieces of music themselves were living organisms and music analysis a form of autopsy.[49]

47. For an overview of mapping and strategy-sharing practices among video game fans, see Mia Consalvo, "*Zelda 64* and Video Game Fans: A Walkthrough of Games, Intertextuality, and Narrative," *Television and New Media* 4, no. 3 (2003): 321–334, accessed May 20, 2020. https://doi.org/10.1177%2F1527476403253993.

48. "Map Making Guide: Another Look at Proteus (Pseudo-Spoilers)" by user "Koala," *Proteus* forums. (Original URL, accessed May 9, 2015: http://www.visitproteus.com/forum/index.php?topic=230.0). As of 2019, a note from the creators indicates that the forum has been "retired" and taken offline. While the forum's structure is still accessible via the Wayback Machine (www.archive.org/web), individual threads seem to have been generated server-side and are not preserved. Much like the Greek god Proteus and the game named after him, the internet constantly changes its form, obscuring its past like footsteps buried under new snow.

49. On this topic, see Daniel K. L. Chua, *Absolute Music and the Construction of Meaning* (Cambridge, UK: Cambridge University Press, 1999), 199–208.

A rudimentary map of my own playthrough, sketched on graph paper, is reproduced in Figure 10. It represents the virtual space where my earlier narration unfolded: the beginning of the game at sea, the movement onto land, the encounter with the pink trees and the musical chickens, and so forth. While the map depicts the locations of these events, it does not represent the order of their progression nor the sounds that resulted from each. Instead it offers a representation of the virtual—and in *Proteus*, sonic—space where my model playthrough unfolded, and where any number of alternate paths might have come to be.
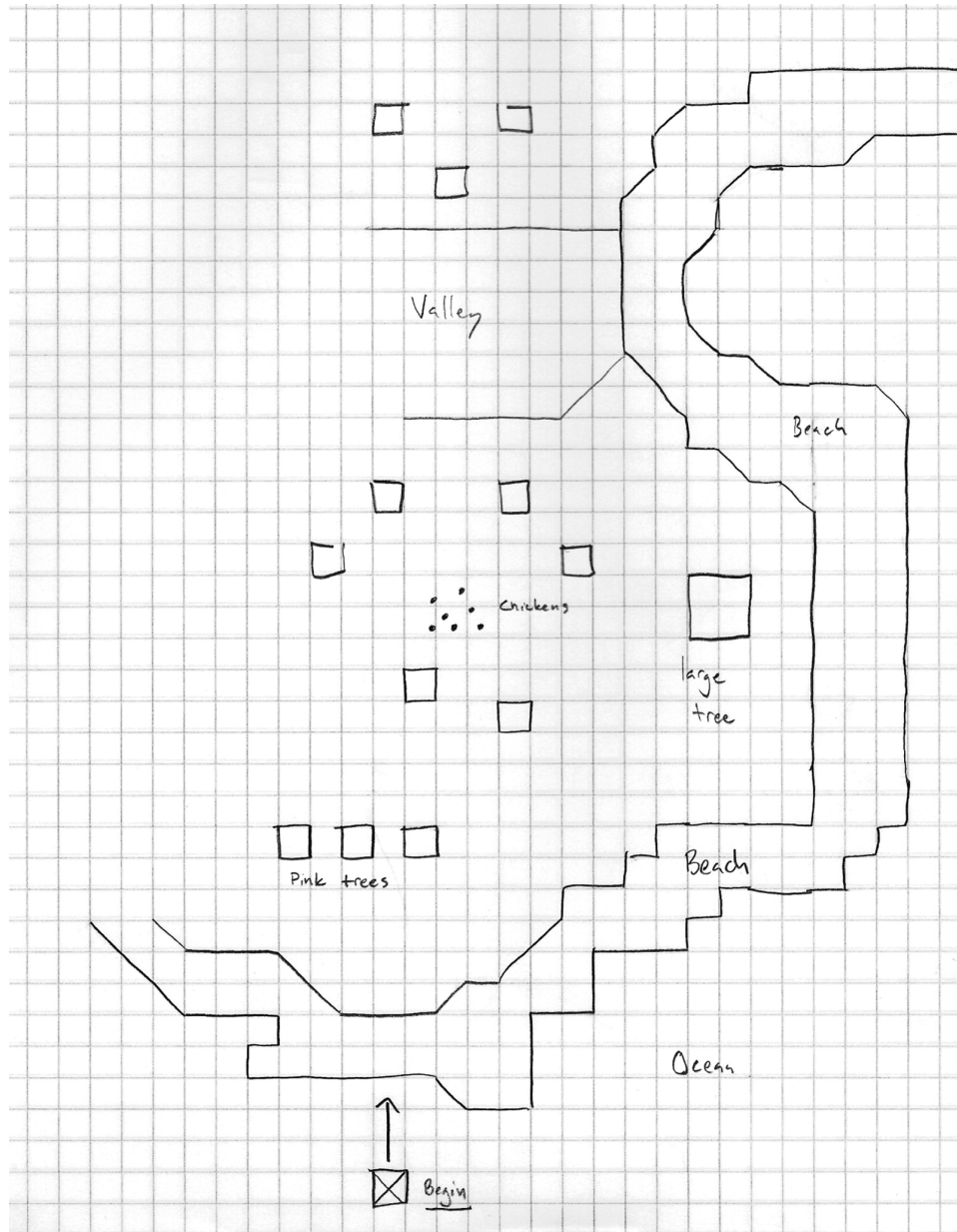

FIGURE 10. Rudimentary map of *Proteus*, opening.

It is no coincidence that the best way to get one's head around *Proteus*'s world is to map it, for as Mark Evan Bonds has shown, the map is the prevailing metaphor of modern music analysis. This has not always been the case; Bonds argues that early descriptions of form by theorists like Johann Mattheson and Heinrich Christoph Koch were *temporal* in design. Their accounts were essentially recipes, sets of directions that presented form as a series of events that happen one after another.[50] Bonds credits Antoine Reicha with creating the first *visual* diagram of musical form, with his famous *grand coupe binaire* (Figure 11a) from 1825.[51] Reicha's early map of sonata form works in much the same way as an old-fashioned temporal list, telling the composer what to do next. But rather than a sequential list of sections (as in the work of, say, Koch), Reicha's diagram uses a series of boxes moving left to right and down the page, each of which represents a different harmonic or thematic area. These visual boxes evoke a spatial metaphor, conceiving of thematic areas (such as the principal thematic [or "mother"] idea, the "bridge" or transition, the second thematic idea, and so forth) as orderly containers into which musical ideas are placed. It is possible to trace the process of composing or listening through the diagram, implying that the process of listening to a piece is

Pour que la grande coupe binaire se grave mieux dans la mémoire des élèves, nous la figurerons ici sur trois lignes:

Première partie, ou exposition des idées.

MOTIF	PONT	SECONDE IDEE MÈRE	IDÉES ACCESSOIRES
ou première idée mère.	ou passage d'une idée à l'autre.	dans la nouvelle tonique.	et conclusion de la première partie.

Première section de la seconde partie.

DÉVELOPPEMENT principal,	ARRÊT
en modulant sans cesse.	sur la dominante primitive.

Seconde section.

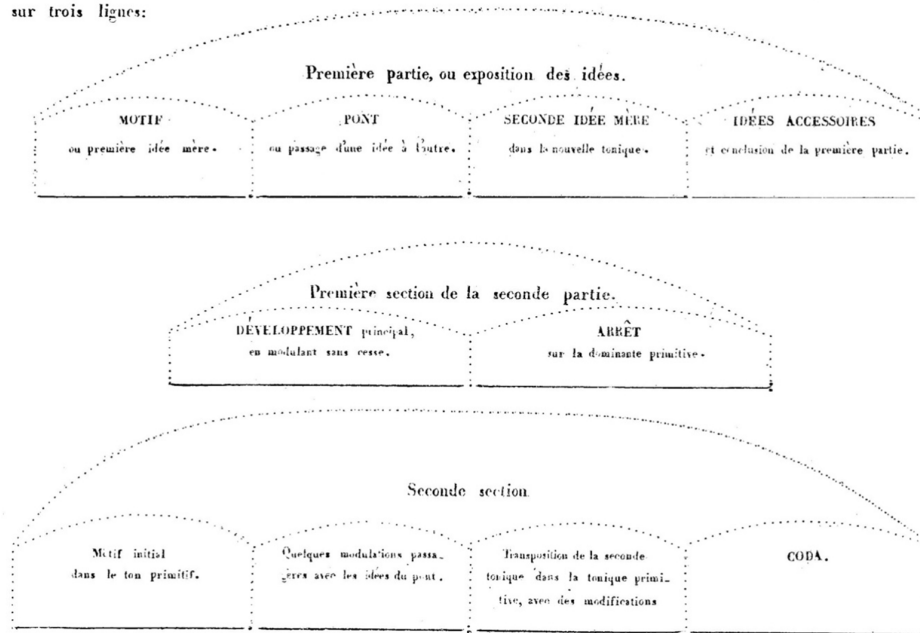| Motif initial	Quelques modulations passa	Transposition de la seconde	CODA.
dans le ton primitif.	gères avec les idées du pont.	tonique dans la tonique primitive, avec des modifications	

FIGURE 11A. Reicha's *grande coupe binaire* (1825; reproduced in Bonds, 2010, p. 267).

50. Mark Evan Bonds, "The Spatial Representation of Musical Form," *Journal of Musicology* 27, no. 3 (2010): 270–276, accessed May 20, 2020, https://doi.org/10.1525/jm.2010.27.3.265.

51. See Bonds, "Spatial Representation of Musical Form," 266–267. Bonds notes that despite the 1826 publication date found on Reicha's treatise and often cited for the diagram, the second volume of the *Traité de haute composition musicale* actually appeared in 1825.

analogous to moving through a conceptual space.[52] The diagram also visually conveys a sense of hierarchy: individual themes are grouped into three large parts—the lines of the *grande coupe*—which are in turn divided into two parts, which mirror the double bar lines of a sonata form movement: the "exposition of ideas" in the first part and *développement* and recapitulation on the other. The metaphor of "spaces" that can be filled with thematic content and that bear both temporal and hierarchical relationships to one another has persisted in music theory, exemplified most recently by Hepokoski and Darcy's *Elements of Sonata Theory*.[53]

In geographic terms, the *grand coupe binaire* is something like the street map of Cambridge, Massachusetts, shown in Figure 11b, which conveys visually the steps necessary to walk between two locations of a small coffee shop chain in Cambridge: turn left as you leave
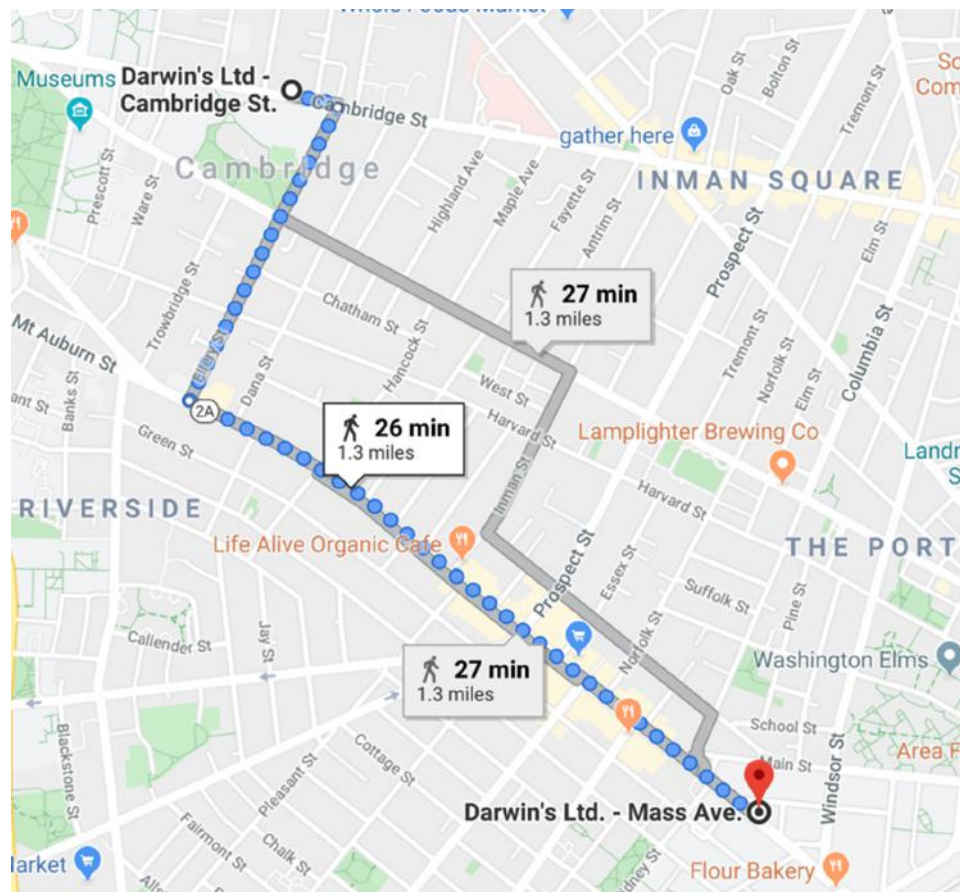

FIGURE 11B. Walking directions between two Darwin's Ltd. coffee shop locations, Cambridge, Massachusetts. (Screenshot by the author from Google Maps, December 28, 2019)

52. This spatial metaphor draws on a basic CONTAINER schema, as described by Lakoff and Johnson, *Metaphors We Live By*, 29–32. For more on image schemas in music theory, see Zbikowski, *Coneptualizing Music*, 65–77.
53. See Hepokoski and Darcy, *Elements of Sonata Theory*, 14–22.

the shop, turn right onto Ellery Street, then left onto Massachusetts Avenue.[54] In online mapping software, such a visual representation is often accompanied by verbal directions (which will be spoken aloud if the traveler is navigating with an app), akin to the landmark-based directions that people often give to one another. Extraneous information is omitted in both: not every shop front is represented, not every street is named. Both this map and Reicha's *grande coupe binaire* are essentially visual recipes, hinting at a certain pragmatism shared between eighteenth- and early-nineteenth-century music theory treatises (which teach their readers to compose rather than providing tools for analysis) and videogame walk-throughs, which tell a player how to complete a game.

Maps, however, have another function I have already alluded to: they can show *all* the possibilities of a given space, all the options and potentialities that may or may not be realized. A second map, shown in Figure 12a, functions very differently from the first. It gives a synoptic overview of one portion of Cambridge, showing the many different ways by which one could move among the area's many coffee shops. Rather than simply showing directions, it gives the lay of the land, conveying far more information. Synoptic maps can be used not only for performance but for what we might metaphorically think of as analysis and composition, applied to real-life spaces: they allow us to learn something new about a given location, or to create any number of new paths rather than delineating a single fixed route. Figure 12a's map of local coffee shops could be used to answer simple questions ("What is the nearest coffee shop to me?" or "Which coffee shops are between my home
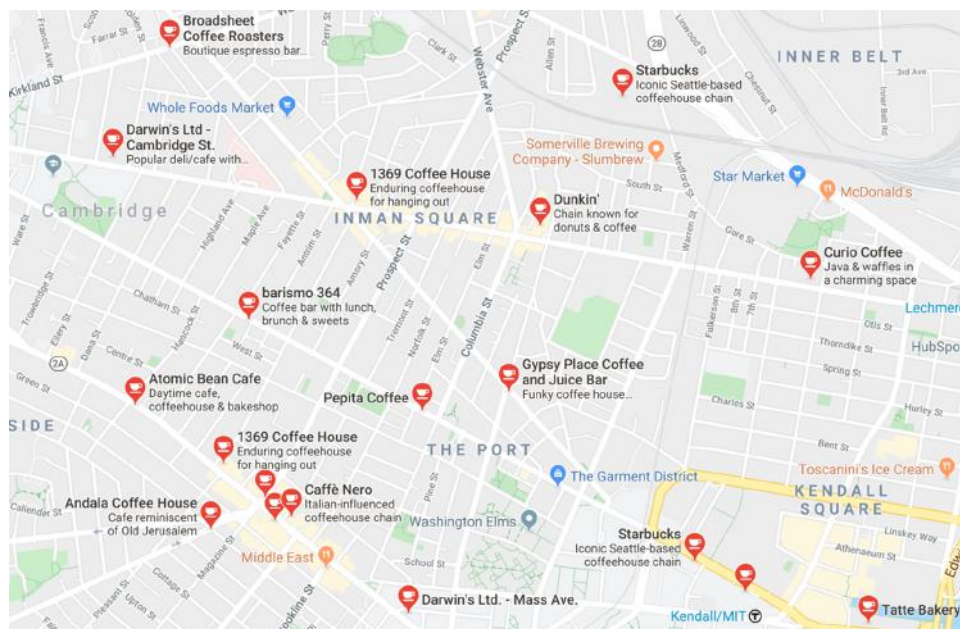

FIGURE 12A. Coffee shops in and around Central Square, Cambridge, Massachusetts. (Screenshot by the author from Google Maps, December 28, 2019)

54. See Bonds, "Spatial Representation of Musical Form," 273.

and my workplace?") or, overlaid with other data, might be used to study subtler issues ("How do the locations of coffee shops in Cambridge correlate with demographic distribution, neighborhood density, property values, and/or household income?").

One musical equivalent of this second type of map—a synoptic, spatial overview of possibilities—would be any of the many diagrams of tonal space made famous by music theorists of the late nineteenth century and revived in the late twentieth. On Hugo Riemann's famous *Tonnetz* (a modern adaptation is shown in Figure 12b), for example, a theorist or composer can chart out any number of pieces of music as movements through a single musical space, consisting of all twenty-four major (+) and minor (-) triads. Or they might use such a diagram to locate parsimoniously related chords for compositional purposes. Alternate visualizations of this space can present the same topography while highlighting different connections within the same field, emphasizing or de-emphasizing certain relationships.[55]

But how can a map help us understand *Proteus*? The diagram I have given of the game's larger structure (the four seasons, in Figure 7) falls into the first category of map: it shows us
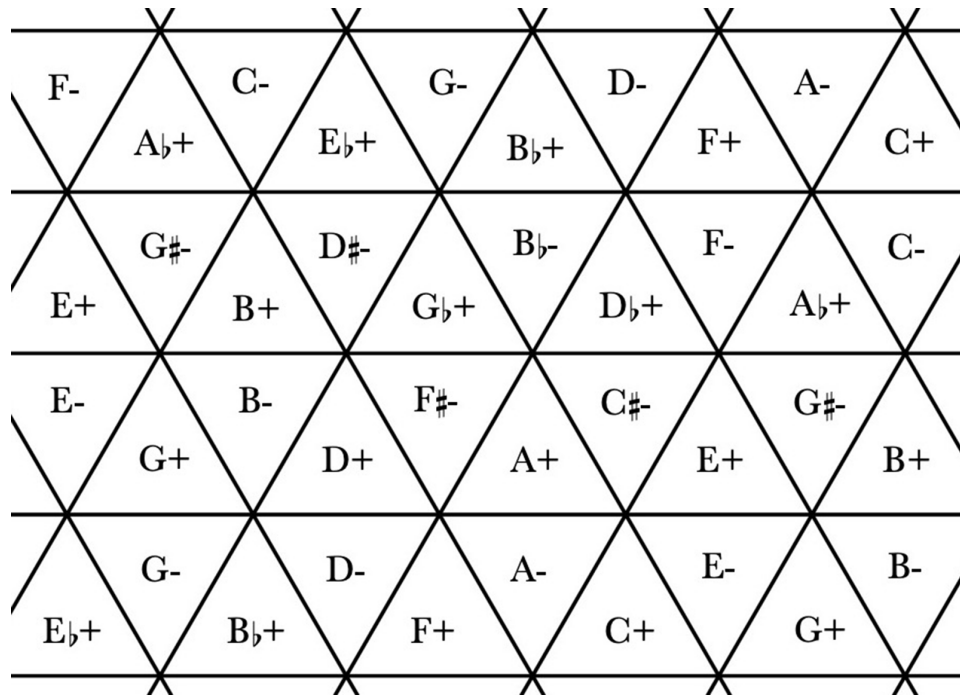

FIGURE 12B. One section of the Neo-Riemannian *Tonnetz*.

55. Figure 12b shows a modern, "Neo-Riemannian" adaptation that assumes enharmonic equivalence; nineteenth- and early-twentieth-century diagrams by Riemann and others did not. Examples of alternate visualizations include the *Tonnetz*'s geometric dual, the "chicken-wire torus," or "Cube Dance," an arrangement that emphasizes two of the canonical Neo-Riemannian operations at the expense of the third; on both of these, see Jack Douthett and Peter Steinbach, "Parsimonious Graphs: A Study in Parsimony, Contextual Transformations, and Modes of Limited Transposition," *Journal of Music Theory* 42, no. 2 (1998): 247–48 and 253–54.

how the phases of the game are ordered, but it gives no further detail about the characteristics of each season nor the topography of each unique island. The rough sketch of my island's opening area (Figure 10) approximates the spatial overview of the second type of map, conveying the exploratory and musical possibilities that were open to me in the first few minutes of a single iteration of the game. Attempting to map the entire game as I go along, however, seems to fall into some ineffective middle category. Certainly one could tirelessly map every corner of the island, as Koala recommends. But what would be gained? The implication behind making any map—whether ludic, musical, or both—is that, once it is made, the map can serve as a guide to some *other* activity that would otherwise be impossible. But as cartographers of this pixelated Eden, what have we accomplished if we create, through tireless and systematic exploration, a diagram that simply lets us . . . explore more? As in Jorge Luis Borges's parable of overzealous geographers who create a one-to-one scale map of their kingdom, playing *Proteus* in order to map it is in some ways indistinguishable from simply playing it, albeit in a more systematic way than its developers probably intended.[56]

This is where the analogy of *Proteus* to most musical works might break down. Notated music can be analyzed, to some degree at least, without ever being realized in sound: examination of its notated *form* can tell us something about its separate sonorous *content*. Such analysis could be in the service of system building, in the service of greater knowledge of music in general, or it could, as David Lewin puts it, seek to prompt us to new musical experiences, as in a famous series of graphs from his *Generalized Musical Intervals and Transformations*, shown in Figure 13: "Hey," such analyses say, "next time you hear *Das Rheingold*, try listening like *this*."[57] What is more, as Lewin writes elsewhere, musical analyses can serve as "goads to musical *action*, ways of suggesting what might be done, beyond regarding what has been done."[58] In the case of *Proteus*, which so thoroughly conflates the notions of form and content, the analysis we do is *already* performance. There is no difference in kind, no distinction between form and content, no Cartesian division between our selves and our play. With apologies to T. S. Eliot: we are the game while the game lasts.[59] So what does this say about the notion of analysis itself? How does analyzing this very musical game differ from the act of analyzing a piece of music, or any given performance of a piece, and can this help us reflect backward on the practice of musical analysis?[60]

56. See Jorge Luis Borges, "On Exactitude in Science," in *Collected Fictions*, trans. Andrew Hurley (New York: Viking, 1998), 325.

57. As Lewin famously wrote: "The task of the analyst is 'merely' to point out things in the piece that strike him as characteristic and important (where by 'things' one includes complex relationships), and to arrange his presentation in a way that will stimulate the musical imagination of his audience." See Lewin, "Behind the Beyond: A Response to Edward T. Cone," *Perspectives of New Music* 7, no. 2 (1969): 63.

58. Lewin, *Studies in Music with Text*, 96.

59. T. S. Eliot, "The Dry Salvages," in *Four Quartets* (New York: Harcourt, 1943), 27.

60. Citing the ambiguous geography of another of Lewin's networks—how they inconsistently or nonlinearly suggest movement through (Cartesian) time and space—Steven Reale has pointed out that a ludic conception of non-Cartesian movement through space might aid in interpreting them; see Reale, "A Musical Atlas of Hyrule."
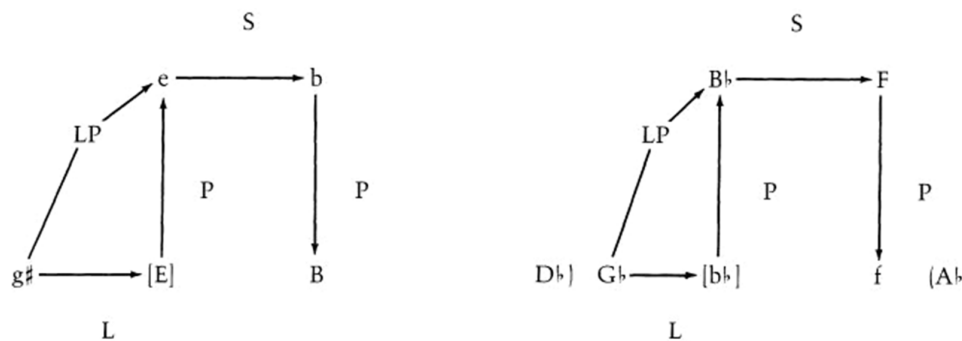
FIGURE 13. Two transformational network analyses from David Lewin (2007, xiii).

PROTEUS AND MOBILE FORM

I would like to close this essay with one possible answer to those questions by reflecting further on the mid-century musical avant-garde, a repertoire (or more accurately, a collection of repertoires) notoriously resistant to theoretical attention. *Proteus* is not only in dialogue with crucial ideas about graphic scores and performative spaces; it can actually help us to think about musical form in ways *unavailable* to notated music, advancing ideas that pen and paper cannot touch.

As I argued earlier, *Proteus* strongly resembles the chance-based music of the mid twentieth century by giving the player a kind of indeterminate score and letting them realize it as they wish. Paul Griffiths describes three forms of chance-based music: aleatory composition, mobile form, and indeterminate notation.[61] In aleatory composition, a fixed score is created according to some chance-based parameter. John Cage's famous "Music of Changes," composed according to guidelines that he derived from the *I Ching*, is a prominent example.[62] The second type of aleatory work is mobile form, which describes works that can be realized in new and different ways each time they are performed, such as Pierre Boulez's Third Piano Sonata, which asks the performer to rearrange the movements. Finally, Griffiths describes indeterminate notation, which encompasses both indeterminate versions of traditional notation (such as stemless or unpitched noteheads, as in Morton Feldman's *Intermission 6* [1953]), as well as graphic or textual notation (such as Cardew's *Treatise*, pictured above, or John Cage's "A Dip in the Lake: Ten Quicksteps, Sixty-One Waltzes, and Fifty-Six Marches for Chicago and Vicinity" [1978]). In aleatory composition, the randomness occurs only on the composer's side of things, whereas the latter two categories call for performers to impose chance in their realization of a performance, based on a fixed image or document that a composer produced quite intentionally.

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61. See Paul Griffiths, *Modern Music and After*, 3rd ed. (New York: Oxford University Press, 2001), 31–33 and 107–113.

62. On Cage's chance-based music, see Constance Lewallen, "Cage and the Structure of Chance," in *Writings through John Cage's Music, Poetry, and Art*, eds. David W. Bernstein and Christopher Hatch (Chicago: University of Chicago Press, 2001), 234–243; and Jonathan Piekut, "Chance and Certainty: John Cage's Politics of Nature," *Cultural Critique* 84 (2013): 134–163.

We have already explored how *Proteus* can be viewed as an extremely sophisticated graphic score, generated anew with each playthrough according to algorithmic guidelines and a fixed vocabulary of environmental and musical objects. But the game can also be read as an example of mobile form, another important stylistic feature of the midcentury avant-garde. As Elizabeth Medina-Gray has shown, the techniques of modular composition often employed in twentieth-century mobile-form works constitute an important antecedent for interactive game soundtracks; studying them can offer important models for analyzing indeterminate game scores.[63] *Proteus*, for instance, finds an extremely close analogue in works like Karlheinz Stockhausen's *Klavierstücke XI* (1957), which consists of nineteen musical fragments arranged across a single large sheet of paper. In his performance directions for the piece, Stockhausen writes:

> The performer looks at random at the sheet music and begins with any group, the first that catches his eye . . . At the end of the first group, he . . . looks at random to any other group, which he then plays . . . Each group can thus be joined to any of the other 18 . . . When a group is arrived at for the third time, one possible realization of the piece is completed. This being so, it may come about that certain groups are played once only or not at all.[64]

Thus, Stockhausen does not leave the form to the player's discretion but instead orders them to navigate by random glances. There is a direct corollary to *Proteus* here: as described earlier, even the player's best-laid plans (to follow the footpath, for example) are in constant danger of being disrupted or abandoned. Stockhausen's criteria for the ending of the piece fit the temporal domain of *Proteus*'s form as well: whereas the player can choose either to skip through or linger in the first three seasons, the fourth imposes a hard ending constraint, just like Stockhausen's instruction about reaching a group for the third time. When winter begins, then, "one possible realization of the piece is completed."

While Stockhausen makes the form of his piece as random as possible, its content is still thoroughly human-generated. *Proteus*, however, takes chance a step further, allowing the score itself—the physical layout of the island, or the "content," in terms of mobile form—to be algorithmically generated. *Proteus*'s algorithms proliferate randomly because they create an indeterminate "score"—an island that encodes a random assemblage of possible soundtracks rather than, say, an imitation of a Bach fugue.[65] *Proteus* thus seems like one example of the closest thing we can get to an indeterminate music that remains random on *both* levels: the composition of the score *and* the realization of that score. It offers the *player* the same kinds of choices as a midcentury mobile-form work—to perform/hear any number of elements, in any order—yet adds an additional layer of chance by making mutable the score from which

63. Medina-Gray offers close readings of Pierre Boulez's *Third Piano Sonata* (1956–57), Earle Brown's *Twentyfive Pages* (1953), and John Cage's *Music of Changes* (1951). See Medina-Gray, "Modularity in Video Game Music," in *Ludomusicology: Approaches to Video Game Music*, ed. Michiel Kamp, Tim Summers, and Mark Sweeney (Sheffield, UK: Equinox, 2016), 57–60.

64. Karlheinz Stockhausen, *Klavierstücke XI* (London: Universal Edition, 1957), "Performance Directions."

65. On computer imitations of tonal composition, particularly Bach, see David Cope, *Experiments in Musical Intelligence* (Madison, WI: A-R Editions, 1996).

the player constructs their explorations. It is as if Stockhausen's *Klavierstücke XI* were *re-printed* for each performance, its musical elements re-created or redistributed in new ways so as to inspire new paths through its mobile form.

In *Proteus*, then, there is an extra layer of indeterminacy placed between the composer/designer and the performer/listener. One way to interpret this estrangement between the player and the sounds produced might be to regard *Proteus* not as a work in itself but as a kind of interface. In many ways, the game bears a functional resemblance to Iannis Xenakis's UPIC (Unité Polyagogique Informatique CEMAMu) system, created and updated through several versions from 1977 up to the 1990s.[66] UPIC's interface consists of a large graphic tablet (often covered with paper to allow for traditional sketching as well as digital input) on which a composer can draw with an electronic stylus. These graphical inputs are interpreted by a mainframe and rendered as sound along conventional axes of pitch (vertical) and time (horizontal).

Proteus vividly demonstrates the potential of digital games to realize vividly certain aspects of the midcentury avant-garde that have fascinated human composers for decades. By combining elements of aleatory performance (as in mobile-form works like Stockhausen's *Klavierstücke XI*) with aleatory composition (by generating random island "scores" at will, as in John Cage's *Music of Changes*) and filtering both through a layer of abstraction by way of the "indeterminate notation" of the game's environment (as programmer Ed Key does by burying David Kanaga's compositional components inside the environment of *Proteus*), the game forges a deeper level of chance, enabling Key and Kanaga to craft a work that is highly random and almost infinitely repeatable and that preserves the element of chance on the part of *both* the creator and the performer-listener. The game thus contributes to continuing discourses in music and computer science about how technology can help realize some of the aesthetic goals of the modernist project, such as achieving truly random outcomes with minimal human intervention.[67]

At the same time, even though *Proteus* unifies many elements of indeterminate music in a single package, there are aspects of musical experience that it fails to replicate. Its feeling of free improvisation is in many ways an illusion, due to the game's inability to respond to the player's spontaneity as a live bandmate might. And the realization of the island-as-score into sound is constrained by the game's code, restricting the broad interpretive freedom that is central to a realization of, say, *Treatise*. Exploring *Proteus* as a work of musical art with distinct successes and shortcomings, however, highlights the way in which many of the central issues and concepts that circulated in the middle of the last century remain both musically and computationally relevant today, and how exploring those issues in both analog and digital forms can yield new insights into the musical problems of the present, past, and future. ◾

66. For a short history of UPIC (the development of which can be traced to Xenakis's interest in graphic notation as early as 1954's *Metastasis*), see Gérard Marino, Marie-Hélène Serra, and Jean-Michel Raczinski, "The UPIC System: Origins and Innovations," *Perspectives of New Music* 31, no. 1 (1993): 258–269.

67. On computational realizations of indeterminate music, see Lindsay Vickery, "Mobile Scores and Click-Tracks: Teaching Old Dogs," in *Proceedings of the Australasian Computer Music Conference* (Canberra: Australian National University, 2010), 63–70; see also Magnusson, "Algorithms as Scores," 20–21.

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