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Source *NJP Reader #6 Reanimating Nam June Paik*, pp.99-105

Publisher Nam June Paik Art Center, Yongin

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Colophon

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Published on 30 December 2016

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NAM JUNE PAIK ART CENTER
백남준아트센터

Precious Error: Nam June Paik at Bell Labs — Zabet Patterson

In an interview with Douglas Davis, Nam June Paik claimed to always be "overwhelmed by my engineering…. I can compose something through technology that is higher than my personality or lower than my personality. In painting, you can compose as much as you want, but de Kooning cannot make anything that is deeper or more profound that what he has, inside himself. But in engineering, there is always the other. The Other, it is not you. I believe that is what Norbert Weiner was talking about in discussing the difference between human time and machine time. Your work is not yourself. Sometimes your work has nothing to do with yourself."[1]

The rhetoric that attends Paik is a mythology of firsts, a spectacle of play and satire, Dada-stylings and childlike absurdity: the first video art, a pioneer of interactive art. Here, I am interested in Paik's technological imaginary – which brings together necessary error, contingency, and the sense of an unknowable Other, operating on a time scale which is subtly and terribly different. Randomness is in dialogue with iteration, rigorous order with generative possibility. Specifically, I want to look at Paik's work at Bell Labs, focusing primarily on a short film that is an example of what he called "precious error." It relies not on the predictability of the computational system, but on interruptions and disruptions occurring somewhere in the space of the feedback loops between peripheral, CPU and user, generative errors that anticipate and reveal a technological subject.

In the winter of 1966, Paik wrote a letter lamenting the lack of attention paid to the radical potential that computers offered the visual arts – and to the attendant potential that artists offered to push industry in new directions. He forwarded copies to Max Mathews, and Michael Noll at Bell Labs, suggesting that "experiments derived from the unorthodox instinct of the artist"[2] were needed to "bring forth some unusual results in the research of pure science and applied technology."

Mathews, a pioneer in electronic music, was then the head of Bell Lab's Acoustical and Behavioral Research Center, where Noll worked. They visited Paik's Canal Street studio, located in an area replete with junk shops and restaurants, and were startled by what they saw – it looked like a television repair shop, full of sets without enclosures, and wires everywhere. Paik moved around them, tinkering, modulating. But he wasn't repairing these sets – he was changing their specifications, distorting the pictures with magnets, and modifying their circuitry. If anything, he saw himself as repairing man's relationship to technology.

Paik would exhibit some of these treated televisions in an exhibition in 1968 at the Galleria Bonino on 57th street. In a review in the *New York Times*, critic John Canaday claimed that Paik's "dozen or so" television sets were each "violated by its own electronic attachment to deform the image beyond anything you can imagine, no matter how bad your reception is." But he went on to state that "in most cases the screen becomes a field of operation for totally abstract images, in motion, composed sometimes of wonderfully organized lines of light, and sometimes of curious hazy, flow shapes."[3]

The television sets Mathews and Noll saw were works of process and change – and works of chance and error. The images that appeared at the interaction of CRT and magnet were unexpected. The audience of the shows was invited to manipulate the sets as Paik did in his studio that day. This error was interactive, dependent on the whims of the human participant. It was famously playful. It gave rise a man-machine synthesis, and an interactive control, with elements of surprise. This play humanized technology, made it into a sloppy, yet comprehensible machine. It was something Paik often claimed to want: "The real issue implied in "Art and Technology" is not to make another scientific toy, but how to humanize the technology and the electronic

1 **Douglas Davis, "Nam June Paik: The Cathode-Ray Canvas," in *Art and the Future: A History/Prophecy of the Collaboration between Science, Technology and Art* (New York: Praeger Publishers, 1973), 152.**

2 **Quoted in *Nam June Paik, Videa 'n Videology*, exhibition catalogue (New York: Everson Museum of Art, 1974), n.p.**

3 **John Canaday, "Art: Serene Squares and Tortured TV," *New York Times*, April 4 1968.**

medium."[4] Yet at Bell Labs Paik would find himself confronted with an apparatus he found impossible to humanize.

In 1967, Mathews invited Paik to come to Bell Labs as a "resident visitor" to work on the "computer picture" problem. Paik began going there in 1967. He had already learned the rudiments of FORTRAN in a series of lectures by James Tenney. At Bell Labs, Noll took on the task of teaching Paik programming. He created an account for him, and Paik went off on his own, working with a mainframe, FORTRAN, and a strange machine called the Stromberg Carlson 4020.

Bell Labs was home to some of the most significant breakthroughs in science and engineering from the 1920s to the 1980s. Transistors, lasers, satellites, cellular telephony, information theory – the list is long, and the story has been told many times.[5] Less well known is that, in the 1960s, Bell Labs became a crucial site in an epochal intersection between modern art, science, and technology as important as anything since the Bauhaus of the 1920s – and that a seemingly peripheral device, the S-C 4020 microfilm recorder, was at the very heart of that intersection.

In the 1960s and 70s, mainframes dominated computing. These enormous machines were not so much object as architecture. Their image in popular culture was of switches and blinking lights, emphasizing that, first and foremost, they were calculation machines – with no necessary relationship to optical media. In the era of the mainframe, the output of text and image was quite literally peripheral. Companies made a range of special-purpose devices to supplement mainframe computers that didn't necessarily ship with screens or printers. One of these was the Stromberg-Carlson microfilm recorder.

This machine was a special purpose peripheral that could be attached to mainframes such as the IBM 7090, 7094, 360, and the GE 600 to present and preserve images and image sequences in ways that then-contemporary interactive computer screens simply couldn't. It was a metal box the size of a small room that combined televisual, cinematic and computational technologies – a strikingly hybrid apparatus that was used to produce the majority of computer graphics over the course of the late 1950s and early 1960s. There was a tape drive for accepting instructions, a controlling buffer, a Charactron screen sealed in a light-tight compartment with a film camera and a photographic camera, and development equipment for these images. The Charactron screen was a unique little beast: a shaped beam tube that deflected electrons through a mask of alphanumeric characters, transferring these characters to the viewing area at very high resolution with a display rate of 10,000 characters per second.

The S-C 4020 understood a limited range of instructions, but this narrow range of instructions was nevertheless able to produce complex images. The process, though, was arduous. As Stan VanDerBeek described making movies with this system for *Art in America* in 1970 first, a computer program is written "in this special language, and put on punched cards; the punched cards are then fed into the computer; the computer tabulates and accepts the instruction on the cards, calculating the explicit details of each implied picture of the movie and putting the results on tape."[6] The tape was then run on the S-C 4020. In its sealed box, each sequenced frame lit up the screen in turn, as the camera clicked forward in controlled increments. Programmed variations of the letters and numbers of the Charactron built up an image. VanDerBeek was candid about the effort involved, and the potential for time consuming mistakes: "after much trial and error – during which time the computer informs you that you have not written your instructions properly – you have a black and white movie."[7]

Stromberg Carlson advertised the S-C 4020 as offering the easy production of tabular data, graph plotting and design drawings, grid projections and drawing of

4 **Quoted in Gene Youngblood, *Expanded Cinema* (New York: E.P. Dutton, 1970), 308**

5 **For a lively account of this history, see Jon Gertner, *The Idea Factory: Bell Labs and the Great Age of American Innovation* (New York: Penguin, 2012). See also Peter L. Bernstein, *Three Degrees above Zero: Bell Labs in the Information Age* (New York: Scribner, 1984).**

6 **Stan VanDerBeek, "New Talent – the Computer," *Art in America* 58 (1970): 86**

7 **Ibid., 91.**

axes and vectors, as well as automatic forms projection, as well as permanent storage on microfilm. But as Gene Youngblood points out, it rapidly became the "the most commonly used output system for computer movies."[8] As Youngblood also notes, many of these films weren't made by artists or filmmakers – "They are made by scientists, engineers, and educators to facilitate visualization and rapid assimilation of complex analytic and abstract concepts."[9] He states that these films are not "aesthetically motivated" – which seems strikingly incorrect. These films were fundamentally motivated by aesthetics – just an earlier conception of it, which has to do with the organization of sensory perception – how we see and how we know. These films were transforming our ideas of received visual knowledge. This strange machine made all kinds of previously invisible objects and processes suddenly, startlingly visible – and made previously impossible visualizations remarkably possible. E. E. Zajac made the first computer film, simulating the motion of a communications satellite around the earth. Béla Julesz and A. Michael Noll made astonishing leaps in understanding depth perception in human vision by writing routines that created random-noise stereographs to answer questions about seeing that had gone unanswered since 1838. Kenneth Knowlton developed innovative techniques for scanning photographs, creating work collected by the Museum of Modern Art (MoMA) in New York. Stan VanDerBeek and Lillian Schwartz used Fortran-based computer languages to produce experimental cybernetic films generally regarded as crucial early works of computer art.

Paik made a limited number of works at Bell Labs. Two of them, *Confused Rain* (1967) and *Etude 1* (1967), made an unusual use of the microfilm recorder: its ability to make hard-copy prints. It had a mirror split beam system that could output to thermally processed gelatin silver paper. *Confused Rain* is a snip of paper, with the letters that spell confuse cascading down the page. It is an experiment with chance and randomness, pointing towards the Surrealists. In contrast, *Etude 1*, recently re-discovered at the Smithsonian, is rigorously ordered. It is a print of concentric circles, each comprised of individual letters of the alphabet. God. Dog. Love. Hate. Each lay claim to a circle. The print is accompanied by another print, this one of a FORTRAN program used to create the image, dated October 24, 1967. Though it exists as a singular image, it seems likely that the program was intended to produce a film as well, due to the sequential exposure characteristic of the S-C 4020. Regardless, each of these works takes advantage of the key capability of the S-C 4020 – the clean cut letters delivered by the Charactron screen. Significantly, the one extant film from Paik's work at Bell Labs does not explicitly make use of this capability. What it does make extensive use of is the ability of the mainframe to program repetitive machinic randomness. Paik saw randomness and repetition as the crucial elements that computation offered for the artist. But he is fascinated by the potential for the machine to produce error – error that arises in part because of a certain autonomy of the machine, which he understands as operating in a technical time separate from human time. This was why he worked on programming his work himself while at Bell Labs. He stated that "if I give an order to an engineer, and if I don't go through all the experiments myself (that is, the complicated process of trial and error) I will lose all these precious errors, I will only get what I want and miss all the disappointment and surprises. I have found that the by-product is often more valuable than the first envisioned aim."[10]

Compared to much of Paik's work, the film *Digital Experiment at Bell Labs* (1966-67) plays out in a minor key. The title casts this work as provisional, a procedure to verify or refute. A test: precise, repeatable, controlled. The title is descriptive rather than evocative, but nevertheless invokes the futurity of the feedback loop – a result that allows for repetition with a difference. The title suggests that there were more

8 **Youngblood, *Expanded Cinema*, 196.**

9 **Ibid.**

10 **Quoted in Johnathan Price, *Video Visions: A Medium Discovers Itself* (New York: New American Library, 1972), 134.**

experiments to come – but the film is singular. While a number of the films that artists made with the S-C 4020 worked with excess and overload – the films of both Vanderbeek and Schwartz come to mind – Paik's film is austere. Visually, it is closer to the neutral aesthetics of Noll, Julesz and Edward Zajec – and the latter two producing under the auspices of science rather than experimental film or art.

As it begins, there is just a single dot, moving on a diagonal. At 14 seconds in, there is a graphic flash – HEAD, upside down. This graphic would have indicated the beginning of the film strip as it was printed out by the S-C 4020, and its incidence in the film 14 seconds in makes it clear that Paik edited the film strip after it was produced by the apparatus. It also makes it clear that he was as invested in the errors and artifacts of the computational apparatus as the elements that he had deliberately programmed – which were, nevertheless, intended to produce a machinic randomness. There are layers of "precious error" here – both intentional and artifactual.

Noll said of the film that:

> "The FORTRAN program to create this movie would have been quite short. A subroutine would be used to give a random number within a specified range. A fixed number would be added and the result used as the X and Y coordinates of the point to be plotted. All this would be repeated within a couple of DO loops, with each frame sent to the Stromberg-Carlson SC-4020 microfilm plotter to create the movie."[11]

Paik would have been fascinated by how the machine, equipped with a limited program, could create unexpected results within the parameters. But again, he goes out of his way to include elements which are outside the parameters of the program. The HEAD graphic flashes again a minute and seven seconds into the film, and then shortly after, the screen flares white, a glare which lasts for three seconds – a brief flicker in time, but a startling break in the internal consistency of the film. After the white, there is a brief flare of something which looks like static – a graphic that might seem to invoke Béla Julesz's random dot diagrams and stereograms. But looked at closely, it blurs. The graphic does not have the sharpness of pixels and blocks, and in fact, it only partially covers the screen – a jagged edge, suggesting this is a torn piece of paper, stretches across the top. After this flashing interlude, the screen remains dark for 24 full seconds – nearly 1/9th of the film. Then the small dot appears again, moving randomly along the diagonal, left and right, right and left. These are the constraints programmed into the computer. This is how the image was to move. There is a banded flicker at 4:15, and then the HEAD graphic flashes again. The diagonal moves from upper left to lower right in mostly straight lines for almost the first three minutes. Then it shifts, moving from upper right to lower left. This indicates the particular constraints that were programmed into the computer. Noll's comments on the program are instructive, and informed; he made works using a similar structure.

But it is telling that Noll's work plotted straight lines, just as it was telling that Paik's *Confused Rain* and *Etude 1* used letters. This was what the S-C 4020 and the Charactron screen were good at – straight lines, crisp alphanumeric characters. The bulk of Paik's film is just a simple dot, moving erratically. The film moves the viewer to think not about presence, but about absence. The movement seems to outline a diagram that isn't there, a shape that never appears. It draws a constellation, not seen as once, but seen serially, point by point. This is, at base, how the microfilm plotter made movies – it built up the lines point by point. But this wasn't seen, because the shutter was controlled by the computer – it was held open until lines and pictures and full

11 **A. Michael Noll, "Flashback: The Story behind Nam June Paik's 'Digital Experiment' at Bell Labs," October 30, 2014, online at http://asiasociety.org/blog/asia/flashback-story-behind-nam-june-paiks-digital-experiment-bell-labs (accessed August 15, 2016).**

frames were exposed. But Paik's film closes the shutter after each dot appears. We watch the machine do its work, in a kind of real time.

At the end of the film, there is a short blur of activity – a flickering line of numbers and letters, and characters appears in the middle of the screen. After the meditative stillness of the slowly moving dot, they flicker rapidly from one to another. The contrast is jangling, adrenal. Noll stated of the film that "There is text that appears at the end, but that most likely is some sort of data dump from the computer and was not programmed by Paik."[12]

Noll positions this as error – and on some level it was. But Paik clearly edited the film, and he chose to include this "data dump." It is a gorgeous blur of the straight lines, the numbers, letters, and symbols the Charactron screen was intended to produce. The shutter stays open and the information appears in a fluid rush. This "data dump" is of all of the affordances of the apparatus that Paik chose not to utilize in building his film. Yet they remain at the end – a haunting sequence that registers as error, but a uniquely machinic error – the flare of the machine doing something unintentional, at a speed too fast for the human to read or assimilate it. A registration of what Paik called "machine time" drawing on Norbert Weiner. According to Paik, Weiner was the theorist par excellence of the "micro-form," the "technical interior of the electronic age" attuned to the "delicate but horrible difference of Machine Time and Human Time."[13]

Weiner argued in "Some Moral and Technical Consequences of Automation" that "machines can and do transcend some of the limitations of their designers, and that in doing so they may be both effective and dangerous."[14] One way of understanding this would be to turn to explanations like William Gibson's catchphrase for technological development: ""The street finds its own uses for things." You invent the telephone pager never knowing that you're altering forever the geography of urban drug dealing."[15] This is a view centered on the human user. But Weiner, in this article, speaks in a more eschatological vein. This is not about human users coming up with unexpected uses for technology – this is about well-intentioned human users who fail to anticipate that the machine could take their best-laid programs into realms of accident and error. He argues that "We have seen that one of the chief causes of the danger of disastrous consequences ⋯ is that man and machine operate on two distinct time scales, so that the machine is much faster than man and the two do not gear together without serious difficulty."[16]

Looking at the materiality of media – a 'new materialism' for a new media – is an important gesture. Examining at the material process of programming the mainframe and the S-C 4020 is a way of attending to our machines, and the complicated ecosystems – political, economic, social, and technological – that they inhabit. It is a way of examining, as John Durham Peters puts it, "the small fulcrums on which large levers swing." It is a way of looking at how humans and machines do and do not "gear together."[17]

But this film operates in a way that seems contrary to that materialism. It reveals, seemingly, everything – the shutter gate falls after each character, showing us a singular dot rather than flashing lines. The "head" graphic, meant merely as a marker is not excised. The "memory dump", as Noll would have it, is left intact at the end. The dump insists on the computer as a numbers machine. It is a tool, not of sound and image, but of information, rendered in points, numbers, letters and symbols.

Nevertheless, what seems to be at stake here is precisely that cannot be materialized. Watching it, one is insistently directed towards what cannot be seen – the levels of the electrons that compute the film, which generate what we see, but which

12 **Ibid.**

13 **Nam June Paik, "Norbert Wiener and Marshall McLuhan," in *Nam June Paik, Videa 'n Videology*, n. p.**

14 **Norbert Wiener, "Some Moral and Technical Consequences of Automation," *Science*, New Series, vol. 131, no. 3410 (May 6, 1960), 1355.**

15 **Matt Rosoff, "William Gibson talks about 'The Peripheral,' the power of Twitter, and his next book set in today's Silicon Valley," *Business Insider*, August 13, 2016, online at http://www.businessinsider.com/william-gibson-the-peripheral-interview-business-insider-2016-8 (Accessed August 15, 2016).**

16 **Wiener, "Some Moral and Technical Consequences of Automation," 1357.**

17 **John Durham Peters, *The Marvelous Clouds, Toward a Philosophy of Elemental Media* (Chicago, IL: University of Chicago Press, 2015), 11**

remain invisible. Paik's inclusion of both machinic randomness and error directs us towards the ways in which the machine operates outside of our control, on a different time scale altogether. It points us towards what we can't see – and what we can't think. The points could just be punctuations in time – but humans long too intensely for pattern and meaning. Watching, the points seem to articulate something that hovers just out of sight. If only we were able to hold them firmly in mind. If only our time scale were different. If only we could instantiate a persistence of vision: a small blur.

As computers would develop ever further into transparency and interactivity, it is useful to ponder practices which actively resist this logic. *Digital Experiment at Bell Labs* points us towards seeing the machine as something that remains troublingly opaque to us, with active capacities of its own. The computational machine, for Paik, is obscure, unruly and wayward. Its operations are most interesting for him when they operate on a different timescale, outside of direct control. The symbolic operations of computation operate in material, but they operate on an essentially inhuman sensory scale.

What we find in Paik's film is silence, space and darkness. Paik points us towards an apparatus that cannot be seen, whose manipulations are fundamentally invisible. We see effect rather than process: Precious Error, and a time that is not ours.

Zabet Patterson, Associate Professor, Art History & Criticism at New York's Stony Brook University, specializes in the intersection of contemporary art and computational media in the postwar period. Her book, *Peripheral Vision: Bell Labs, the S-C 4020, and the Origins of Computer Art*, was published by MIT Press in 2015. It received the Anne Friedberg Award for Innovative Scholarship from the Society for Cinema and Media Studies. Her work has been published in journals including *Grey Room*, *Animation* and *Media-N*, and in a number of anthologies. She was awarded the Warhol Foundation / Arts Writers Grant in support of her forthcoming book, *Metamorphose Yourselves: USCO, Techno-Utopia and Technocracy*.