The mid-1960s was an exciting period in the application of digital computer animation to artistic purposes. The early 1960s saw mostly scientific and engineering animation, with computer animation at Bell Telephone Laboratories, Inc. (aka Bell Labs), in 1962 by Joseph B. Kruskal, Jr., and in 1963 by Edward E. Zajac. In the artistic domain, starting in 1966, John Whitney, Sr., worked as a visiting artist at an IBM research facility in Los Angeles, where Jack P. Citron created programs for Whitney to use [1]. I saw Whitney's 1966 movie *per-mu-ta-tion* [2] at the time and was impressed by its dancing circular abstract patterns, nicely timed with the music, and how its development created a story. The movie was originally black and white and later colorized into two colors. Patterns enter from the sides into what seems to be a circular stage. It all builds to a visual climax in synchrony with percussive music [3]. Even today, I am impressed by what Whitney created.

In the same timeframe, but independently, artist-filmmaker Stan VanDerBeek came to Bell Labs and collaborated with programmer-scientist Kenneth Knowlton on the use of computer animation for artistic purposes. This paper describes that collaboration and some of the artistic movies that resulted. The movies that VanDerBeek and Knowlton created are examples of the state of the art of computer animation in the 1960s. I hope this article increases interest in and study of this topic, including the artistic evolution of the series of movies.

Stan VanDerBeek, Kenneth C. Knowlton

Stan VanDerBeek was an artist and experimental film animator. He received a Certificate of Art from Cooper Union in 1952 and worked with modern dance, including with Merce Cunningham and Yvonne Rainer [4]. He experimented with technology for artistic purposes, such as his Movie Drome, inside which he projected images [5]. As Knowlton remembers, "Stan was impetuously energetic, and technically savvy, from the start. Calling himself a tech-art 'fruitpicker' he later went on to visit numerous educational and industrial computer-rich laboratories to pick the 'low-hanging fruit' " [6]. Kenneth C. Knowlton came to Bell Labs in 1962 after receiving a PhD from the Massachusetts Institute of Technology. He was assigned to the research area in a department that worked in computing techniques in the computing science research center.

In late 1962, Knowlton proposed a programming language and system for the creation of computer-animated movies for "education in science and technology" [7]. In 1963, he developed the BEFLIX (for Bell flicks) programming language and wrote a Technical Memorandum describing BEFLIX [8]. BEFLIX was written in macro FAP (Fortran Assembly Program) and was used to produce imagery in raster mosaic graphics on the Stromberg-Carlson SC-4020 CRT-based microfilm plotter at Bell Labs [9]. BEFLIX was used initially in programs written in FAP but was later expanded into new versions for use in Fortran programs [10].

In early 1964, Knowlton used BEFLIX to program a film about BEFLIX being used for a computer-animated movie.
When VanDerBeek first came to Bell Labs, Knowlton programmed computer-animated sequences that he gave to VanDerBeek, who took the sequences away and edited and colored them to create final experimental art movies. VanDerBeek created the poetic words used in the computer animations and also obtained and added music to the final movies. During this initial period, VanDerBeek did not do programming—although they discussed together the computer imagery that Knowlton programmed. Their mutual appearance in the 1968 documentary *Incredible Machine* shows that they both enjoyed the collaboration, and each energized the other [14]. In her 1974 book, McCauley quotes VanDerBeek: "Gradually, with the help of Carol Bosche and Ken Knowlton, I was tutored in programming and began to work in the area of computer animation" [15].

After their initial work together, Knowlton created a programming package (called TARPS and written from BEFLIX as macros) so that VanDerBeek could do programming himself. TARPS (Two-dimensional Alphanumeric Raster Programming System) enabled VanDerBeek to program words to move through various paths and change their sizes, geometries and motion sequences. Together Knowlton and VanDerBeek debugged and tweaked the programs, in a true collaboration. Recalling it, Knowlton wrote in 2010, "Stan's mental and physical energy raced ahead of both of us. . . . The Knowlton approach to things was methodical. . . . The Van-DerBeek approach was try just about anything to see what happened" [16].

Knowlton gave thought to his collaboration with VanDerBeek and wrote in 1972:

The first few months of interaction with Vanderbeek were mutually frustrating. . . . After a few months, Vanderbeek became quite proficient with TARPS; in due time he was programming almost completely on his own, while I served essentially as a debugging consultant [18].

The collaboration that resulted in the VanDerBeek/Knowlton movies clearly was mutually beneficial. Upon seeing what visual effects VanDerBeek wished to create, Knowlton expanded on the programming packages, creating TARPS and other language packages that followed.

Since VanDerBeek was not an employee of Bell Labs, the Labs’ legal division drafted a one-page agreement between Knowlton and VanDerBeek, dated 4 June 1968, which VanDerBeek signed 18 September 1968. The terms of the agreement specified that the movies be cocredited to VanDerBeek and Knowlton, "in approximately the following form: 'Realized by Stanley Vanderbeek with Kenneth C. Knowlton.'" VanDerBeek was allowed to copyright the films in his name.

**THE VANDEBERECK-KNOWLTON COLLABORATION**

Peter G. Neumann was a researcher at Bell Labs who knew Knowlton and who also knew artists in New York City because of his involvement with Charlotte Moorman’s Avant Garde Festival. Neumann introduced VanDerBeek to Knowlton and thus initiated a collaboration that resulted in about ten computer-animated experimental art movies, starting in 1965 and lasting to the beginning of 1969.
and Knowlton was licensed by VanDerBeek to exhibit the films, but not “on television, or other place charging admission.” The agreement permitted VanDerBeek to use the facilities of Bell Labs and to receive the originals of the films.

POEMFIELDS

VanDerBeek and Knowlton are credited with collaborating on ten movies between 1965 and 1969. A series of eight movies, called PoemFields, was made, employing poetic text in fantastic computer animation, along with other imagery. The Film-Makers’ Coop describes the PoemFields movies:

All of these films explore variations of poems, computer graphics, and in some cases combine live action images and animation collage; all are geometric and fast moving and in color. There are eight films in the computer animated art series. As samples of the art of the future all the films explore variations of abstract geometric forms and words. In effect these works could be compared to the illuminated manuscripts of an earlier age [19].

In his 1971 book, Gene Youngblood described the PoemFields:

Whereas most other digital computer films are characterized by linear trajectory figures moving dynamically in simulated three-dimensional space, the VanDerBeek-Knowlton PoemFields are complex, syncretistic two-dimensional tapestries of geometrical configurations in mosaic patterns. . . . Variations on the mosaic field became more complex with successive experiments, until simulated three-dimensional depth was achieved in the form of infinitely repeated modular units in perspective. . . . The PoemFields are filmed in black-and-white, with color added later through a special optical process that permits color gradations and increments almost as complex as the forms themselves [20].

The following is a list of the VanDerBeek-Knowlton movies, based on material at the AT&T Tech Channel, the Film-Makers’ Coop, the Estate of Stan VanDerBeek and a biography of VanDerBeek [21]:

PoemField No. 1 (1965 or 1967)
PoemField No. 2 (1966) (with a jazz soundtrack by Paul Motian)
PoemField No. 3 (1967)
PoemField No. 4 (no date)
PoemField No. 5 (1968) (computer-generated soundtrack)
PoemField No. 6 (no date)
PoemField No. 7 (1967–1968) (with a soundtrack by John Cage)
PoemField No. 8 (no date)
Collide-Oscope (1966) (VanDerBeek, Knowlton and Bosche) [22]
Man and His World (1967; shown at Expo ’67)

However, Knowlton does not recall the movie Collide-Oscope, and it is thus possible that VanDerBeek worked solely with Bosche on this movie. Knowlton recalls that VanDerBeek was working on PoemField No. 9 and No. 10 [23].

The VanDerBeek-Knowlton movie PoemField No. 2 (1966) is posted on the AT&T Tech Channel [24]. There is much use of a flashing effect, as images and sequences flash on the screen. There are colors, added optically by filmmakers Robert Brown and Frank Olvey, presumably in collaboration with VanDerBeek or under his instructions [25]. The words “LIFE LIKE” appear, the phrase superimposed upon itself but shifted, creating an almost three-dimensional effect (Fig. 2a). There are also various words that morph into patterns, including a computer-animated “THE END” at the very end, along with computer-animated credits to VanDerBeek and Knowlton (Fig. 2b). Patterns and words shift and move across the screen. Multiple colors are used in many of the sequences (Fig. 2c). Zabet Patterson describes PoemField No. 2 in some detail in her book [26].

The VanDerBeek Estate allowed me to view privately many of the PoemField movies other than PoemField No. 2. My descriptions of PoemField No. 5 and No. 7 follow, but to be fully appreciated the movies really need to be seen.

PoemField No. 5 (1968) animates the words “FREE FALL” and superimposes shadowy human shapes skydiving in space and spheres upon computer-animated sequences, all in color (mostly strong reds and blues) with computer-generated ascending and descending tones (Fig. 3). The visual effect is almost three dimensional and is quite exciting artistically, in my opinion, developing to visual climaxes. There seems to be less flashing than in PoemField No. 2 and more expanding textures and patterns of words and shapes. PoemField No. 5 seems more sophisticated than PoemField No. 2. “THE END” is computer animated and extends as if the movie does not want to end.

PoemField No. 7 (1967–1968) opens with an image that looks like a large plus sign and the words “LOVES OR.” Patterns expand (Fig. 4), with one eating away and dissolving into another, sometimes with different colors for the expanding edges. The patterns are quite geometric, in contrast to the more fluid imagery in PoemField No. 5. Multiple colors of red, blue and green appear, one color morphing into another. A nice afterimage effect occurs at one segment.

It is fascinating to view PoemField No. 5 with the ChromaDepth® glasses. ChromaDepth glasses (manufactured by American Paper Optics) shift colors spatially, thereby creating a 3D stereoscopic effect [27]. These glasses utilize flat film prisms that translate colors, thereby giving the stereo parallax shifts that the brain transforms into the perception of stereoscopic depth. Richard A. Steenblik invented and patented the idea for this stereoscopic viewing in the early 1990s [28].

Viewed through ChromaDepth glasses, the colors in PoemField No. 5 are transformed into three-dimensional depth, sometimes consisting of more than one plane. This becomes an analytical technique to help understand how VanDerBeek created the movie by superimposing separate portions each on top of the other. It is not known whether VanDerBeek was interested in actually creating 3D when he made the movies.
Fig. 2. (a) The words “Life Like” are shadowed in an almost 3D effect in this frame from PoemField No. 2. (Frame taken from AT&T Tech Channel—Courtesy of AT&T Archives and History Center. With permission of Estate of Stan VanDerBeek.) (b) The ending credits to PoemField No. 2 include a nicely animated sequence. The frame here is the credit to “Ken Knowlton.” (Frame taken from AT&T Tech Channel—Courtesy of AT&T Archives and History Center. With permission of Estate of Stan VanDerBeek.) (c) Random patterns appear in PoemField No. 2 as words disintegrate into patterns, as in this example. (Frame taken from AT&T Tech Channel—Courtesy of AT&T Archives and History Center. With permission of Estate of Stan VanDerBeek.)

Fig. 3. (a) Frame from PoemField No. 5 showing computer-animated image superimposed on shadowy skydiver and globe. (Courtesy Estate of Stan VanDerBeek and Andrea Rosen Gallery. © VanDerBeek Estate.) (b) Frame from PoemField No. 5 showing computer-animated numbers 123456. (Courtesy Estate of Stan VanDerBeek and Andrea Rosen Gallery. © VanDerBeek Estate.)

Fig. 4. Frame from PoemField No. 7 showing a geometric pattern that expands with its outer edge in color against the different color of the background. (Courtesy Estate of Stan VanDerBeek and Andrea Rosen Gallery. © VanDerBeek Estate.)
All the PoemField movies have an impressive flow and development and seem to tell a story from beginning to end, sometimes reaching a climax in the middle section. Perhaps the use of words helped to focus the flow and development, but so too did VanDerBeek’s prior experience as a filmmaker.

I compared the animation programmed by VanDerBeek with what Knowlton had earlier created, to see if what VanDerBeek did was different from what Knowlton had earlier programmed. The words “THE END” evolve at the very end of Knowlton’s 1964 computer-animated movie into an almost three-dimensional shadow form. This type of animation is later expanded and developed in the animation done for the VanDerBeek-Knowlton movies. I also notice a progression of computer-animation style from Knowlton’s 1964 computer-animated film to the animations initially done for the VanDerBeek-Knowlton movies. There is also a similarity, possibly present because all the animation utilized raster graphics and animated textures. The later PoemFields seem to have a more sophisticated artistic computer animation, probably because VanDerBeek was by then doing his own programming using TARPS.

The computer animations made before 1968 were programmed on an IBM 7094 computer and plotted on a Stromberg-Carlson SC-4020 microfilm plotter. Computer animations after 1968 were made on a Stromberg-DataGraphix SD-4360 plotter, which had replaced the 4020 at Bell Labs [29].

WHAT DEFINED A COMPUTER ARTIST IN THE 1960s?

What made someone a computer artist in the 1960s? Clearly the artist who learned and knew how to program and used a digital computer to create visual imagery was a “computer artist.” There was discussion about whether “patterns” created with a computer were art, and also whether the person programming the patterns was an artist. These definitions were further complicated in the case of collaboration between an artist and a programmer where the artist used material made by the programmer. Today, artists use computers as a medium and do not, themselves, necessarily program.

If someone photographs an oil painting and then manipulates the image digitally, that person does not become an oil painter. Hence if an artist simply used material made by a programmer, the artist was not a computer artist—but the programmer was an artist in creating the visual imagery.

Knowlton was reluctant to consider his computer animation to be art and felt he therefore had to collaborate with an artist. But in my opinion, without Knowlton, VanDerBeek would not have had any access to the computer at Bell Labs, or any computer animation to edit and color. VanDerBeek needed Knowlton—but Knowlton needed VanDerBeek for his editing and coloring and turning the computer-animated sequences into final artistic movies. After seeing what visual effects VanDerBeek wished to create, Knowlton expanded on the programming packages, creating TARPS and other language packages that followed. This clearly was a true collaboration and mutually beneficial.

In the world of art and sculpture, a master sometimes instructs apprentices on what to create—and the master takes all the credit. In other cases, an artist might instruct a technician on what to do. This opens the question of whether VanDerBeek was instructing Knowlton on what to program—in which case VanDerBeek was the master and Knowlton a mere technician programmer. However, it seems clear that what began as a collaboration developed over time until VanDerBeek became his own programmer with direct control over what he wanted in the final animations. Furthermore, in the initial stages of the collaboration, Knowlton showed creativity in his computer-animated sequences that he programmed and created; he was far more than just a technician.

In the end, VanDerBeek and Knowlton were both artists, collaborating and working together. They learned from each other. Knowlton expanded his artistic judgment; VanDerBeek expanded on his editing and learned how to program. Their relationship was truly collaborative, with credit to both.

DISCUSSION AND OPINION

I believe that there is artistic creativity and innovation in the computer animation that Knowlton himself programmed, starting with his early 1964 movie and the sequences he later initially programmed for VanDerBeek. The computer animation style that emerges is that of Knowlton as a computer artist, in addition to his status as a computer technologist. This does not diminish the artistic contributions of editing and coloring that VanDerBeek made to the final movies in their initial collaborations.

Later, VanDerBeek’s computer animations advanced, as he too became a computer animator and a computer artist as defined in the 1960s. The editing and coloring performed by artist-filmmaker VanDerBeek, who was something of a technologist, also developed in sophistication over time. The distinction between artist and technologist clearly was blurred and blended for VanDerBeek and Knowlton.

The PoemField movies created a half-century ago are, in my opinion, amazing, even by today’s standards.
References and Notes
This article is based on discussions with Knowlton and has been reviewed by Knowlton for accuracy and completeness. Chelsea Spengemann of the VanDerBeek Estate contributed comments. However, the final authorship and responsibility for the article is Noll’s alone.

1 William Moritz, “Digital Harmony: The Life of John Whitney, Computer Animation Pioneer”: www.awn.com/mag/issue2.5/2.5pages/2.5moritzwhitney.html


4 Wikipedia entry for Stan VanDerBeek and VanDerBeek website (www.stanvanderbeek.com).


6 Email from Knowlton, dated 26 April 2016.


20 Gene Youngblood, Expanded Cinema (Toronto and Vancouver: Clarke Irwin, 1971) pp. 246 and 249.

21 The VanDerBeek biography is at http://stanvanderbeek.com/_PDF/SVbio42008.pdf.

22 The AT&T Tech Channel credits this movie to VanDerBeek, Knowlton and Bosche. However, Knowlton does not recall it (February 2016 interview).

23 Telephone conversation with Knowlton (28 April 2016).


29 Interview of Jerry White (who was the SC-4020 operator at Bell Labs) conducted 25 July 2015 in Stirling, NJ.

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