

# IMAGING DIRECTLY ON THE RETINA

## A PROGRESS REPORT

*By Elizabeth Goldring*

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**M**y intention is to keep my highly damaged visual sense alive by using the Scanning Laser Ophthalmoscope (SLO) as a seeing device to foster visual poetry as well as communication over the Internet. In 1979 I wrote:

*Things are disappearing  
Branches from trees  
Pieces of words  
Lines in faces<sup>1</sup>*

As I began to lose my eyesight I developed an increasing appetite for technology including cameras, lenses and any available “seeing machine”. I used this technology both to bolster my fading eyesight and to create new kinds of visual sensations that I could use to express myself.

At this time I was exceedingly lucky to be a Fellow at MIT’s Center for Advanced Visual Studies. CAVS was founded by Gyorgy Kepes in 1967 as a workshop where artists could encounter scientists and engineers. It was at the forefront of a global awakening to art-science-technology as a movement. Its purposes were as humanist as the traditional values of art rather than military or industrial. New tools were being evolved that were replacing “oils” and “the violin”; transmittability of images was becoming at least as important as expression. Artists worked in groups on large-scale installations as well as pursuing individual projects. With MIT as a candy store and the large collaborative artistic projects encouraged by its longtime director Otto Piene as venues, CAVS artists working in diverse media were pioneering new genres of Art and Technology, e.g. Harriet Casdin-Silver’s solar tracked daylight holograms; Eric Begleiter’s holographic candy; Jennifer Hall’s virtual reality glove; Piotr Kowalski’s Time Machines; Shawn Brixey/Laura Knott’s Photon Voice (light and sound responsive particles levitated in a flask interacted with the movement of a dancer). It was an environment charged with new materials, experimentation, poetry, magic where, among other things, artists were attempting to render the invisible visible. We shared work and ideas at bimonthly Fellows meetings. It was here that I first saw some video synthesis techniques employed by Vin Grabill<sup>2</sup>, then a graduate student in the Master of Science in Visual Studies Program at CAVS. In the ensuing months we began a collaboration that has continued for 10 years.



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Terrified and mesmerized by what I saw “from the inside out “as my eyesight worsened, I was observing something remarkably akin to Grabill’s video synthesis techniques of light edged shapes, streaked and pointillist light surfaces and loose green jello movement.

Adapting his video techniques, Grabill and I produced “The Inner Eye: From the Inside Out” (1989, 21 minutes). It is my story of vision loss due to proliferative retinopathy and repeated vitreous hemorrhaging. My Eye Journals, drawings, watercolors, audio tapes and poems provide the basis for the video. In exploring my disintegrating vision as interference patterns of light and color, my poetry, photography and multi media installations also expose interferences among words, images and sounds in tightly serrated space. “The space is locked inside my head...it doesn’t even get so far out as your slit lamp lens...it is from the inside out”<sup>3</sup> Grabill and I also collaborated on interactive media installations and environments designed to heighten the viewer/participants’ understanding of vision loss.<sup>4</sup>

Grabill accompanied me to medical examinations and therapeutic attempts to save my remaining sight. Physicians at Joslin Clinic’s William Beetham Eye Institute and research scientists at the Schepens Eye Research Institute in Boston, supported our project because they felt it might help health care professionals to better understand the psycho-physical condition of vision loss. They opened up their laboratories and research facilities to our cameras and became important consultants to the project.<sup>5</sup>

Ongoing efforts to preserve and augment my remaining sight riveted me in front of two laser propelled devices. I recognized that each offered unique explosive artistic potential. Using a direct feed video link we were able to shoot live footage of my laser treatment or photocoagulation therapy sessions. We also aimed the video camera directly at the laser itself, thus discovering that we could achieve abstract electronic rendering of my subjective impression of laser treatment. These images haunted my remaining vision and are central to the fabric of “The Inner Eye: From the Inside Out”.

While we were compiling the video, I was also introduced to the Scanning Laser Ophthalmoscope (SLO), a diagnostic tool used by physicians to visualize the retina (the back of the eye) in order to evaluate it. During one such examination of my retina, the SLO operators asked me to identify a stick figure. The SLO scanned the image with laser projecting it onto my retina, past the hemorrhages on the front of the eye that contributed to my blindness (at the same time my physician could observe an enlarged image of my retina on a monitor).

I was delighted that I could see that stick figure and I asked the SLO operators if they could project a word - the word “sun” - it was the first word I had been able to read for many months. Working with researchers at the Schepens Eye Research Institute, Grabill and I experimented with hand scrawled letters and a camera. These initial experiments using the SLO appear in

“The Inner Eye: From the Inside Out” as harbingers of my concept for “retinal poetry”.

Enthusiastic about the prospects of the Scanning Laser Ophthalmoscope for non-medical applications I contacted its inventor, Robert Webb, Senior Scientist at SERI. He was intrigued by a possible new use for his invention. Since 1989, my collaboration with Robert Webb has led to several experiments in visual poetry seen through the SLO, the genesis of a visible language for the Blind and a test of communication over the Internet using the Scanning Laser Ophthalmoscope.

Frightened by my own experiences, I was determined to keep the Blind and visually challenged from sinking into a state of deep Blindness where, according to John Hall in *Touching the Rock: An Experience of Blindness* (Pantheon Books, 1991), the memory of images disappears altogether, and the visual sense, it would seem, atrophies from disuse. The noted neurologist and author, Oliver Sacks, says of John Hall’s account:

*There has never been, to my knowledge, so minute and fascinating (and frightening) an account of how not only the outer eye but the “inner eye” gradually vanishes with blindness, or steady loss of visual memory, visual imagery, visual orientation, visual concepts (at one time he cannot remember whether the number three points backward or forward); of the steady advance or journey (which for him takes five years) into the state which he calls “deep blindness”.<sup>6</sup>*

I became determined to fight isolation (including my own) by creating an electronic palette of tools for visual communication. Existing seeing machines don’t work well - it’s partly the technology, mostly it’s the lack of software. The visually challenged are still expected to be able to peruse tomes like *War and Peace* although the torturous reading of every line of every letter in every word and the ensuing nausea from looking at dense texts on closed circuit monitors often tasks the most persistent attempts. It’s no wonder that visually challenged people (myself at certain points included) may be prematurely ready to close their eyes to the dimension of sight.

In my quest for “retinal poetry” and the poetics of a visible language for the Blind I knew I must provide formally simple images that could be transmitted onto the peripheral areas of damaged retinas like my own. In 1991, for “Experiments in Visual Language Seen Through the SLO”, Webb and I collaborated with CAVS artists to transmit images onto my retina via the SLO. These images, live camera poems, fires, faces and brushed calligraphy evinced qualities of strong, visceral artworks. During the performance, the audience at CAVS could see a wall size image of my scarred retina watching as Piene’s word FIRE written in fire faded to embers and as Keiko Prince seemed to caress my retina with her brush strokes. I was also researching ancient and contemporary pictorial languages as well as international signs and symbols as background material for a visible language for the Blind. One measure would eventually be what I could read using the SLO and my right eye with little or no usable vision.

My emerging visual language employed basic English three and four letter nouns, verbs and words indicating spatial relations (e.g., prepositions). Looking at pictorial image equivalencies for these words I created word-images - combinations of letters and graphically enhanced forms, signs and symbols. For example, the word sun becomes s o n and is hence easier to read because in this case the curvilinear shapes of the letters are separated. Additionally, the graphic enhances the meaning of the word. These reinforcement aids are desirable, especially when one must read up, down and around the lines of each letter that forms a word before grasping the meaning of the word, unlike the fully sighted person who scans the tops of letters and reads sentences in the same amount of time it may take a visually challenged person to look at a single word. Hence, as I have already suggested, no matter which seeing machine is used reading dense texts is an improbable task for the visually challenged.

My growing library of word-images (stored in Hypercard) is the basis for poems and poem animations that I am creating using the Mac. I find that poetry is a way to express oneself economically - using only a few words and images at a time to provide artworks that visually challenged individuals may take the effort to enjoy. To date, most of the work has not been done in color because the commercially available SLO is currently a high resolution monochromatic system. Qualities of motion explored with the poem animations are of increasing interest to me. At the moment, the cyberspace environment of the SLO is unforgivingly 2 dimensional. Through computer animation this space can perhaps be extended, although the SLO does not rely on stereoscopic vision. I am now animating fonts using a Silicon Graphics Imaging program and am studying color values in terms of spatial potential.<sup>7</sup> These experiments have yet to be tested in the Scanning Laser Ophthalmoscope environment.

Testing the library of word-images stored in Hypercard with the SLO required us to forge a Mac-SLO interface. Once the Mac/SLO link had been accomplished, attempting to communicate over the Internet seemed like a logical next step.

The Internet, established as a means of global communication, is primarily a visual tool. It is my fear that the Blind and visually challenged communities will not become Internet users unless visual as well as audio software is developed to accommodate their specific needs (including the establishment of graphically enhanced WWW sites catering to visually challenged users).

Testing the feasibility of the SLO-Internet connection involved a teleconference over the Internet between two locations at MIT. I was at CAVS. William Mitchell, Dean of the School of Architecture and Planning, Dr. Lloyd Aiello, Robert Webb and Vin Grabill were in the Dean's office several blocks away from CAVS. Using software that produces live video over the Internet the group in the Dean's office were able to observe my retina on their computer screen as I looked at examples of

my word-images and poem animations. The group then turned a live video camera on each other's faces and I was able to see each of them as they spoke. This was exciting for me since faces normally appear as unrecognizable blurs. The implication is that communication over great distance seems possible allowing Blind and visually challenged persons to read a poem or see a child's face, a micro-organism, a quasar or a star.

To date the SLO is an unwieldy, expensive, exotic machine that only works if you have some living retina. Hopefully one day there will be cheap, portable Scanning Laser Ophthalmoscopes and it will be feasible to bypass the retina by going directly to the heart of the visual cortex. So far, although I suffer from macular degeneration and proliferative retinopathy, two leading causes of blindness, I am a "tested" audience of one. Software and hardware must be coordinated and made flexible and pervasive enough to respond to many. The time is ripe. The Internet needs to attract visually challenged users now, at "the dawning of the age of global communication". Technology is now sophisticated enough to be able to include us all if our inclusion becomes a priority. Electronic palettes used interactively and creatively by the visually challenged can potentially produce new ideas and new forms of expression that in fact cannot be made by the fully sighted. By attacking the problem of how to include the visually challenged on the Internet, it is quite possible that some general communications problems will be resolved - such as how to make WWW sites graphically stronger and hence globally more accessible. It is my hope that Internet activists and sponsors will enable research institutes like MIT to make their laboratory technology available for exploration and play so that the visually challenged constituency can promote multi-sense communication.<sup>8</sup>

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#### Notes

<sup>1</sup> Elizabeth Goldring, in *Laser Treatment* (Boston, Blue Giant Press, 1983).

<sup>2</sup> Vin Grabill is associate Professor of Media at the University of Maryland, Baltimore County

<sup>3</sup> E. Goldring, Eye journal/video narration, "The Inner Eye: From the Inside Out", 1989

<sup>4</sup> "Eye/Sight", Lights/OROT, Yeshiva University Museum, 1989; Celebration of Light, Savonlinna, Finland, 1990; Options, Washington Project for the Arts, 1991, "Eye Room", Light, Space, Time, MIT Museum, 1994.

<sup>5</sup> in particular, Dr. Lloyd Aiello and Drs Jerry Cavallereno and Sven Bursell (Joslin clinic); Dr. George Timberlake (SERI)

<sup>6</sup> from "The Dark Paradoxical Gift", *New York Times Review of Books*, April 11, 1991

<sup>7</sup> The SGI work uses programs developed by the Visible Language Workshop, Media Lab, MIT and applied by YinYin Wong as part of her thesis project.

<sup>8</sup> Canon USA, along with Apple Computer and SONY have supported the SLO Internet and Visual Language for the Blind projects. MIT's Council for the Arts, CAVS, the Undergraduate Research Opportunities Program and School of Architecture and Planning have also contributed substantially to these explorations.