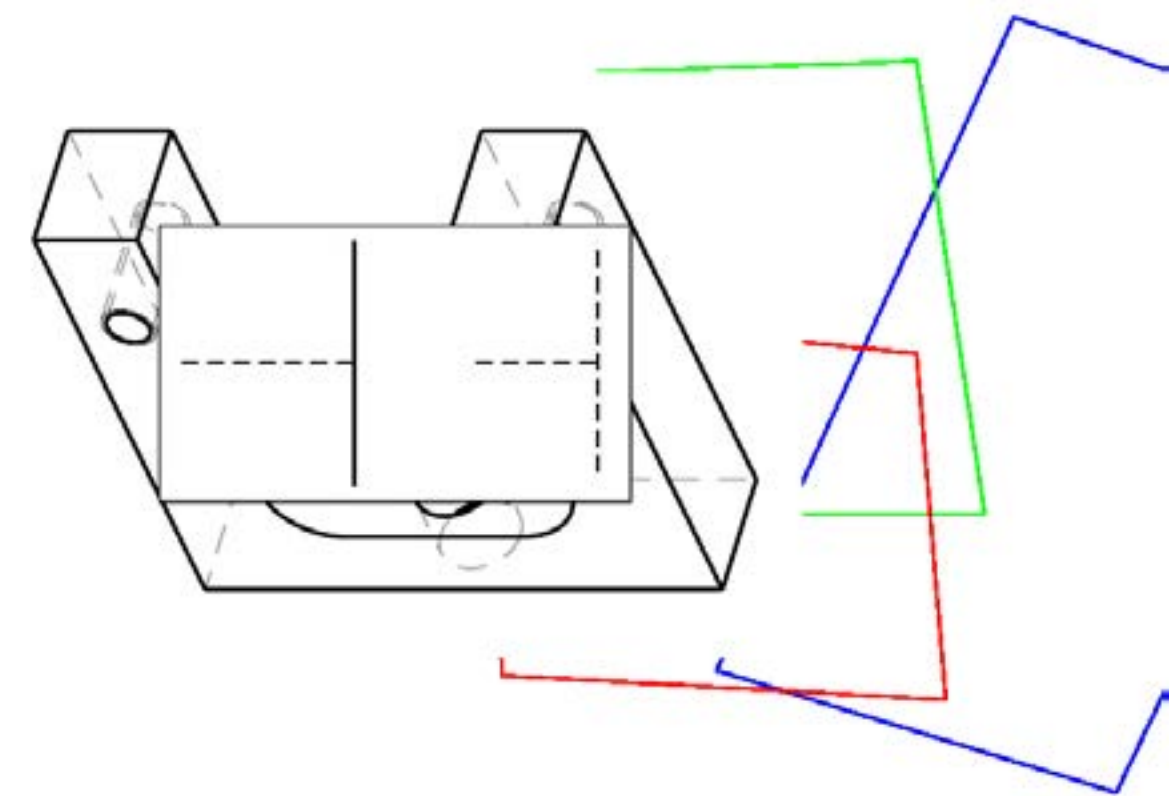# The Hidden Line Problem:

EXPERIMENTS IN SIMULATING THE HUMAN EXPERIENCE

BY DANIEL PILLIS

Dedicated to:

Chris Atkeson

James Duesing

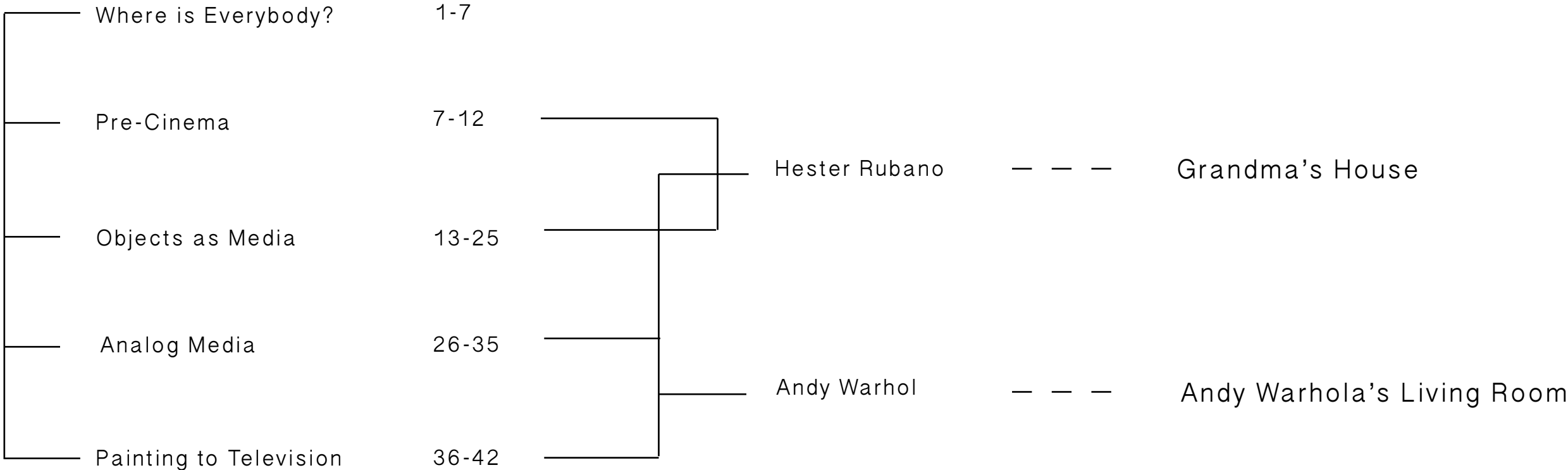Jessica Hodgins
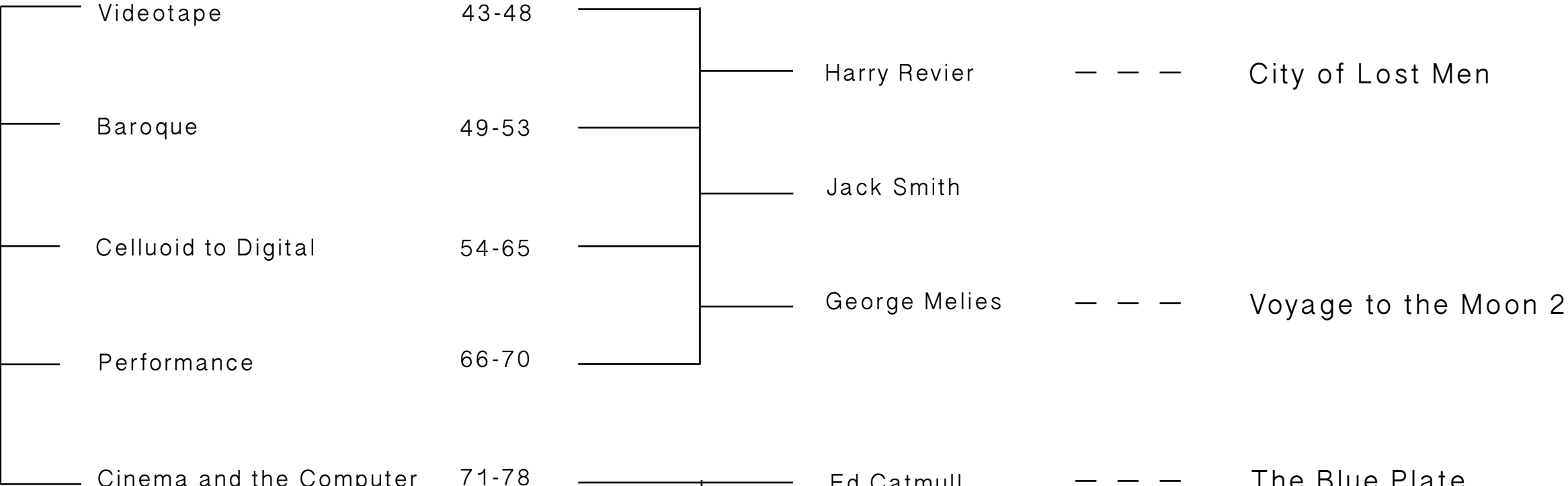
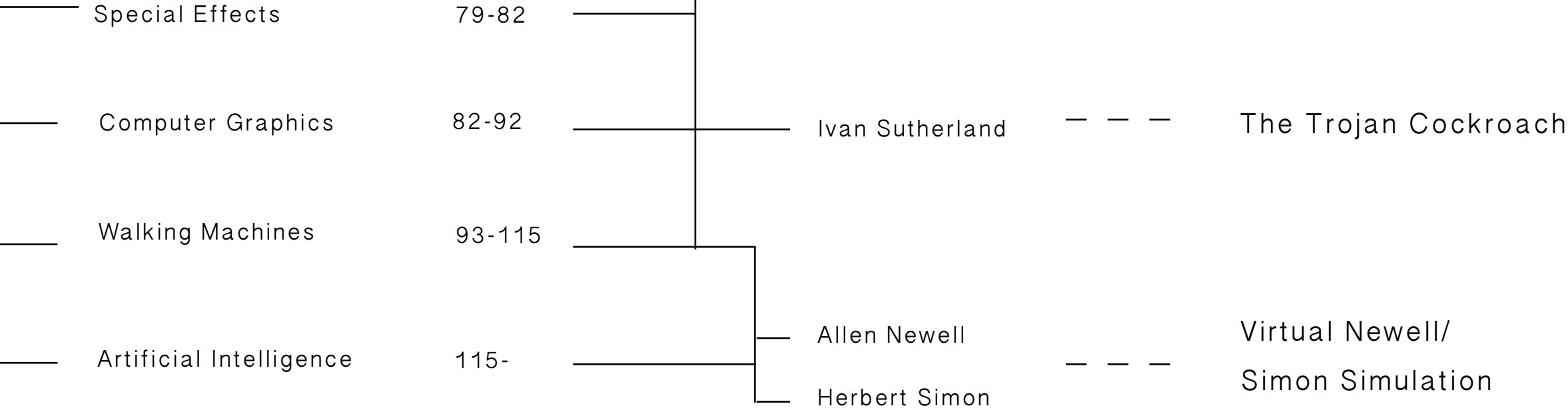Paolo Pedericini

Larry Shea

Ivan E. Sutherland

"In the vast syntax of the world, the different beings adjust themselves to one another, the plant communicates with the animal, the earth with the sea, man with everything around him. The relation of emulation enables things to imitate one another from one end of the universe to the other. By duplicating itself in a mirror the world abolishes the distance proper to it, in this way it overcomes the place allotted to each thing. But which of these images coursing through space are the original images? Which is the reality and which is the projection?"

-Michel Foucault

The Order of Things 18-19

"There is a fifth dimension beyond that which is known to man. It is a dimension as vast as space and as timeless as infinity. It is the middle ground between light and shadow, between science and superstition, and it lies between the pit of man's fears and the summit of his knowledge. This is the dimension of imagination. It is an area which we call the Twilight Zone."

-Rod Serling

The Twilight Zone
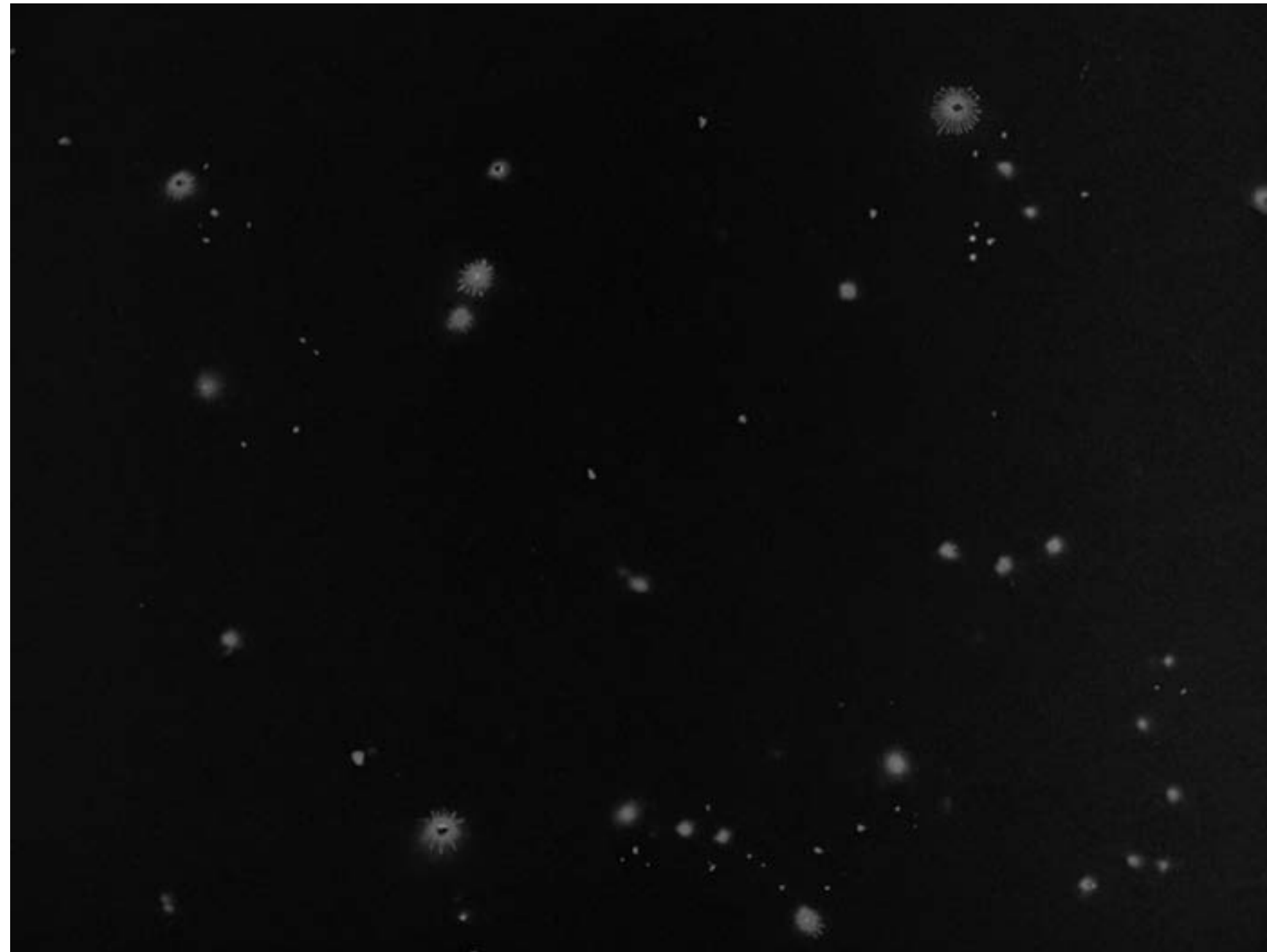
The Universe as seen in the opening titles of "The Twilight Zone" by Rod Serling

Opening scene of *Where is Everybody*

The only novel in a convenience store, The Last Man on Earth

The first episode of the first season of Rod Serling's *Twilight Zone* aired on October 2, 1959. Titled *Where is Everybody*, the episode tells the story of man named Mike Ferris, who awakens one day in an empty world, a town that at first seems occupied but is desolate, oddly empty of any human activity. The episode begins as a very typical, white American male emerges from a dusty street and enters a diner with loud jazz booming from a jukebox.

"The place is here.", Rod Serling announces, "The time is now. And the journey into the shadows that we are about to watch could be our journey." We are not given any information about the man other then a short monologue, "I'm not sure who I am" he says to no one, before questioning whether or not it's all just a dream.

"I must be a very imaginative guy. Nobody in the whole bloody world can have a dream as complete as mine" Ferris says to himself, as he wanders an empty pharmacy.

The technology of the imagination, in this case, the television, attests to his sentiment, as we, the viewer, have direct access to his dream. We follow him as he enters an aisle filled with racks of paperback books, finding one filled, top to bottom, with copies of a dimestore paperback "The Last Man on Earth". Is this a dream, where a novel will tell the story of the dream? He glances for a moment before continuing on.

A theatre projecting a film with which our character recognizes something about himself

A climactic scene in the empty movie theatre when Ferris breaks a mirror

Upon seeing a movie poster of *Battle Hymn* starring Rock Hudson, Ferris recognizes in the poster a military uniform, and suddenly, a moment of instant recognition occurs. He begins to proclaim, "The Air Force! I'm in the air force". He enters a darkened theatre, and for the second time, we witness his consumption of media as a replacement for human presence.

A film suddenly begins playing in the empty theatre. Ferris becomes desperate, thinking this must mean there is a projectionist. As a war film booms with jazz in the back of the cinema, we see the man obscured by the light of the projector, climatically crashing into a large mirror as the screen itself shatters on the television. He exits the theatre in a state of complete panic, running screaming into the street. We watch the man crumble to the ground, sulking.

Suddenly, we see a view from a different room. We see the image we had just seen of the man sobbing, but now it is on a flat screen monitor embedded in a wall. The camera cuts to show us a group of military officers, emotionless, watching the man scream through a small television screen.

Writing of *The Premature Old Age of Cinema*, Antonin Artaud meditates on the cinematic frame, the world that film creates and the excess, other world that it then cancels out, and in doing so, Artaud contemplates the potential of cinema to give form to "those darker, slow motion encounters with all that is concealed

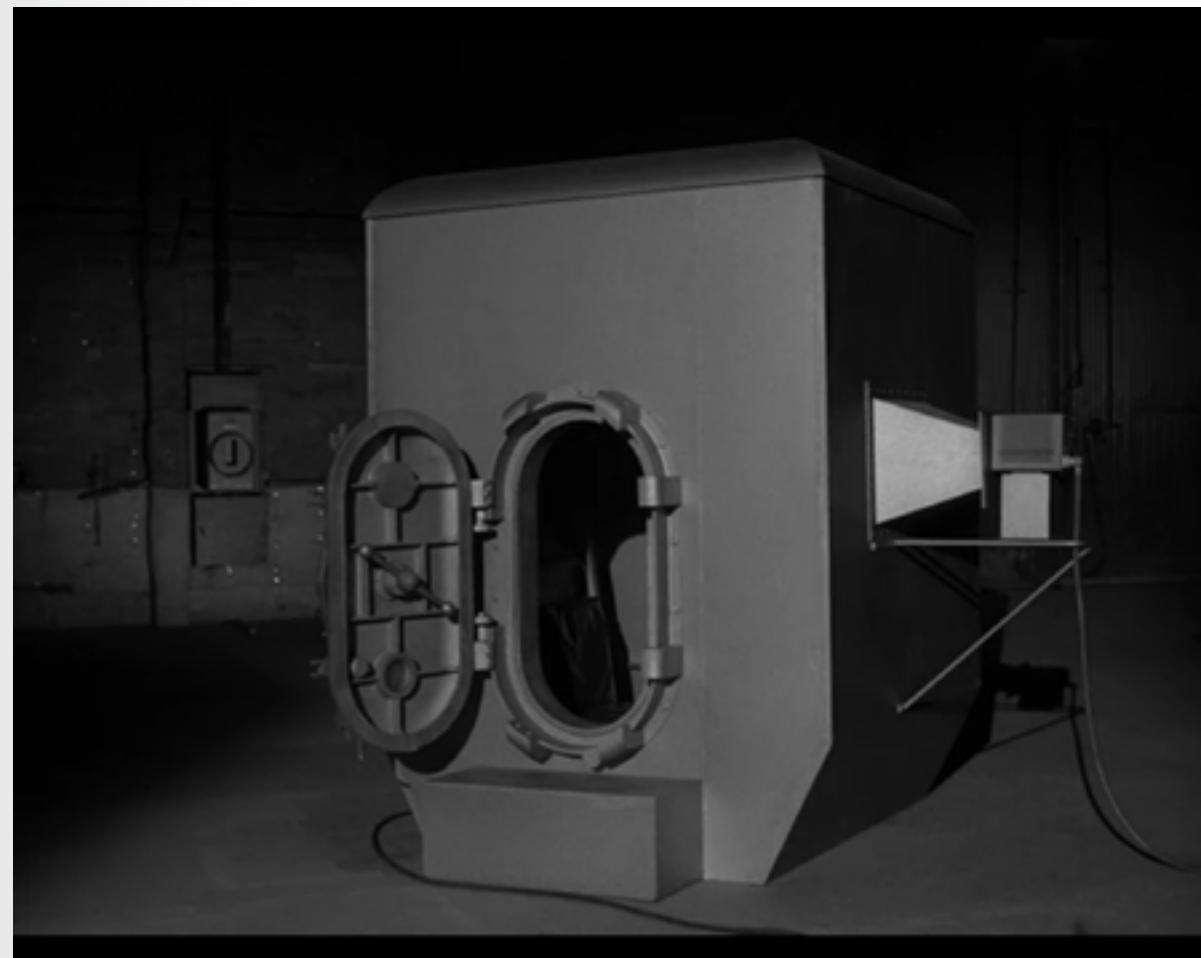The view from the monitor with which the Military views the subject in the simulator

between things, the images- crushed, trampled, slackened or dense- of all that swarms in the lower depths of the mind".[1] This episode alludes to Artaud's idea, as Serling uses film to explore a philosophical idea deeply rooted in the viewing experience itself.

As viewers, we discover we have been unwitting bystanders to a simulation of a trip to the moon. "The man was confined alone in a box for something in the neighborhood of 448 hours," we are told by one of the military officers, observing Ferris from afar   It is the future, inside this Twilight Zone from 1959 and "Mike Ferris" is indeed a a military officer undergoing a psychological test, to determine if his mind can survive the solitude and vast emptiness of space.

"If any one of you were confined in a box five feet square for two weeks I'd give you real good odds your imagination would run away with itself too," the general explains, as they continue to watch the man sob.

"We can pump oxygen in and waste material out. But there is one thing we can't simulate- that's a very basic need- mans hunger for companionship- the barrier of loneliness- that's one thing we haven't kicked yet."

---

1   Artaud, Antonin. The Theatre and Its Double, Trans. Mary Caroline Richards. New York: Grove Weidenfeld, 1958.

How do we experience media, this weird simulation of another place? "Media" is this empty town, a place familiar but false. When invested in the narrative of a film or media piece, how does the viewer survive? Who do we become when we forget ourselves? Mike Ferris, still alive, but only until the credits roll.

Serling has created a conflict which straddles the center of human existence- empathy for our own undefined interiority, a mirror to the black abyss.

The actor portraying the tormented character is not experiencing torment. What does an observation such as this signify when understood in terms of its relation to real experience, when real experience itself, the "real experience of torment" is, likewise, nothing more than an iterative instance of "torment" within a gradation of its historical realizations? The torment felt on the part of the viewer is a virtual torture, one shade of the real but still synthetic. Where does the first real experience happen, and what subsequent transformations does it endure through in order to complete itself as a fully realized mode of experience? The actor playing the man is me watching TV He does not have people, he has the stories about them instead. What function would stories have though, in a world without people? They would replace them, like the empty town full of books and movie theatres.

The simulator we discover our character has been immersed in, as the entire town was a simulation

The very nature of the future, our understanding of the past and our access to the present is now built on the network of associations people have developed through the history of various forms of media and their exposure to it. It is my understanding that all media functions as a surplus of consciousness, an auxiliary storage vehicle for all of human existence.

Media replaces the human, perfecting their physical embodiment and psychological experience in a fixed and looping virtual format. It is a pre-recorded formatted form of human existence that we become transfixed, even hypnotized by.

"Up there is an enemy known as isolation", the General says, as he points to the sky.

We are on the verge of a world fundamentally severed from the physical. The convergence of the physical world with its virtual and digital dimension occupies a subjective space which will occur in the organ of the eye, not the space that surrounds it. We will leave the world filled with trash. Our memory of the world will replace it.

"The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked."

-Ivan Sutherland

The Ultimate Display

PICTURES OF THE REAL

PRE-CINEMA

Magic Lantern Alphabet of Animals. London, Paris, New York: Raphael Tuck & Sons, not before 1886.

"Now we look into a mirror which only reveals its contents when lit from behind"

-Werner Nekes

LIGHT, IMAGE, MAGIC

Cinema, in its earliest form, was associated with magic and alchemy. The very notion that an image could move, exist as merely a configuration of light, or even moreso, depict the appearance of color, was for many centuries a truly new and unfathomable concept in human history.

Film theorist Matthew Solomon points out how "Magic and cinema were imbricate practices that renewed, incorporated and responded to each other historically"[2], The development of the Phantasagoria was a historical discipline rooted in the confluence of theatre, projection, and magic, as each media grew out of one another gradually. Further exploring this relationship, Doris Gassert writes of how "The early genre of the trick film had incessantly applied the techniques of stop trick, dissolve, superimposition, double exposure etc., that were conjured first and foremost by magicians and which soon established an intriguing repertoire of cinematic visual effects."[3]

2   Solomon, Matthew. "Up-to-Date Magic: Theatrical Conjuring and the Trick Film." Theatre Journal 58, no. 4 (2006): 595-615. doi:10.1353/tj.2007.0032. 596.
3   Gassert, Doris. ""You Met Me at a Very Strange Time in My Life." Fight Club and the Moving Image on the Verge of 'Going Digital'." Mashup Cultures, 2010, 49-64. doi:10.1007/978-3-7091-0096-7_4. 211.

CAMERA OBSCURA

The earliest known model for the modern cinema is arguably the camera obscura, considered the earliest conceptual form of photography and the primary technical system underlying analog projection. "Camera Obscura" is Latin for "darkened room", which became associated with the idea of a space void of its true contents and replaced with an apparition. Jonathan Crary writes that,

> "It has been known for at least two thousand years that when light passes through a small hole into a dark, enclosed interior, an inverted image will appear on the wall opposite the hole."[4]

This simple reduction of the world into its replica has indeed been a longstanding historical reality owing its foundations to the year 400 BC, when Mo-ti, the founder of Mohism, is credited with the initial conception of the technology underlying the pinhole camera.

The photographs to the left are dated from 1935 and show the use of the camera obscura in military aviation in the 1930's. The container was a metal capsule with a lens on the top. A soldier could draw images from the projected view, extending their perception. They were often used for training and bombing practice.

4   Crary, Jonathan. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century.* Cambridge, MA: MIT, 1990. 27.

In 350 BC Aristotle is credited as observing the phenomenon in his text *Problems* where he writes "sunlight traveling through small openings between the leaves of a tree, the holes of a sieve, the openings wickerwork, and even interlaced fingers will create circular patches of light on the ground".[5]

Ibn Al Haytham's 11th century camera obscura

Fredrich Kittler observes the development of this conceptual architecture, as he writes that "a passing comment by Aristotle led Arabic mathematicians like al-Kindi or Alhazen to construct the first workable models of a camera obscura, which were thus also the first models of linear perspective."[6] Kittler refers to the Arabian scholar Ibn Al Haytham', who has been documented in the 10th Century as a scientist investigating the directionality of light through this method, questioning

"How does light travel through transparent bodies? Light travels through transparent bodies in straight lines only.... But let us now mention something to prove this convincingly: the fact that light travels in straight lines is clearly observed in the lights which enter into dark rooms through holes.... [T]he entering light will be clearly observable in the dust which fills the air."[7]

This principle is later applied to the development of the pinhole camera.

5   Aristotle, and W. S. Hett. Aristotle: Problems. London: Heinemann, 1953. 253.

6   Hartmann, Frank. "Friedrich Kittler." Handbuch Medienpdagogik, 2008, 251-56. doi:10.1007/978-3-531-91158-8_34.

7   Sharifuddin, Teh, and Ajmal M. Razak. Al-Haytham: The Father of Physics (optic). Subang Jaya, Selangor: Higher Learning, 2004. 2.
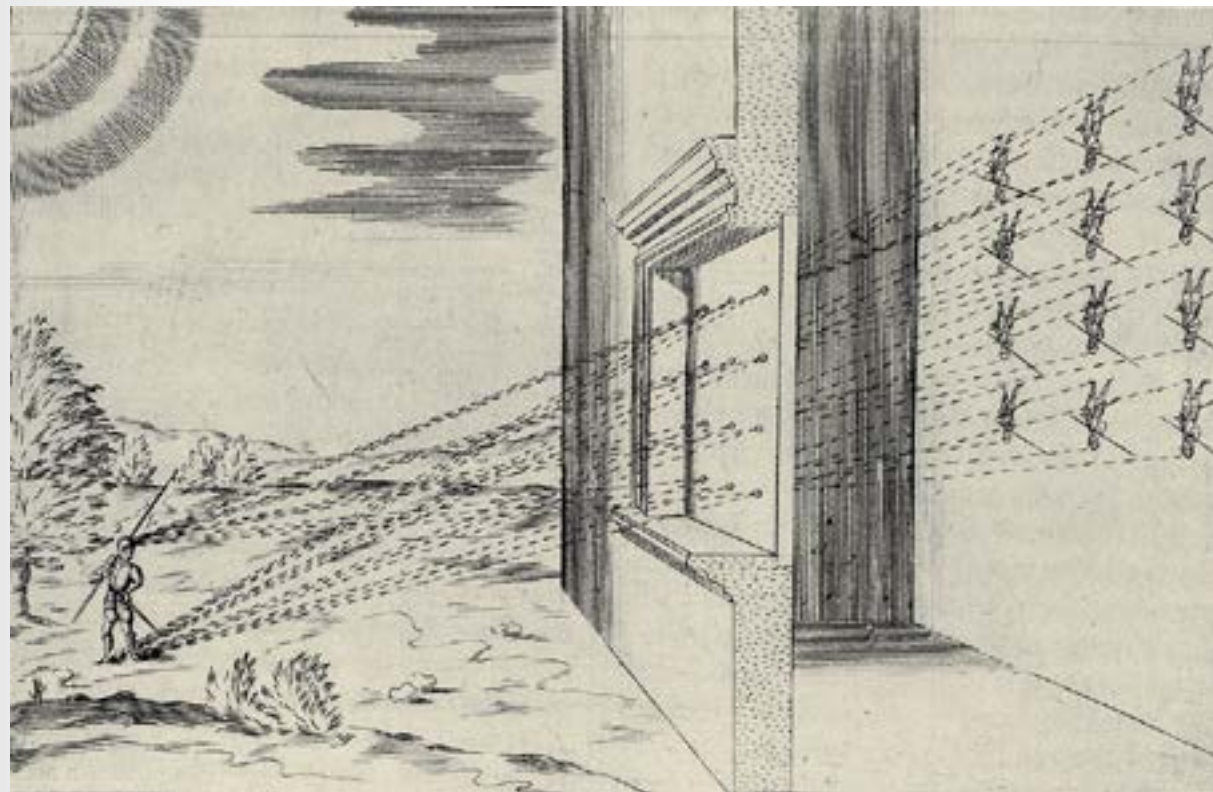
Mario Bettini, *Cimara Obscura en Apiaria universae philosophiae mathematicae*, Bologne, J. B. Ferronii, 1642, 38.

CAMERA AS MODEL FOR THE EYE

The findings of these experiments in the technology of the camera obscura also set the groundwork for a psychology of sense and perception. Crary writes that "During the seventeenth and eighteenth centuries the camera obscura was without question the most widely used model for explaining human vision, and for representing the relation of a perceiver and the position of a knowing subject to an external world."[8] As an external model of the eye, the camera obscura is the origin of experiments in virtual reality. Indeed, it in a way suggests by its very function that to some degree our world is virtual.

Goethe breaks down the phenomenon of the camera obscura and highlights this revelatory moment when he writes,

"Let a room be made as dark as possible; let there be a circular opening in the window shutter about three inches in diameter, which may be closed or not at pleasure. The sun being suffered to shine through this on a white surface, let the spectator from some little distance fix his eyes on this bright circle thus admitted."[9]

This early technology fundamentally shifted the way we experience the world. Suddenly, the eye was an apparatus, capable of being fooled by a blurry image into thinking the

8   Crary, Jonathan. Techniques of the Observer: On Vision and Modernity in the Nineteenth Century. Cambridge, MA: MIT, 1990. 37
9   Goethe, Johann Wolfgang Von. Theory of Colours. Cambridge, MA: M.I.T. Press, 1970. 48

The basement of my Grandmother's House Installation, all of my grandmother's lamps.

world continued onto a wall. This extension of ourselves is in a way inseparable, a dynamic that continues to this day. Crary comments on this overlap, writing "Perhaps the most important obstacle to an understanding of the camera obscura, or of any optical apparatus, is the idea that optical device and observer are two distinct entities, that the identity of observer exists independently from the optical device that is a physical piece of technical equipment."[10]

Kittler writes of how "The camera obscura was one of the first technologies for receiving images, and the lantern magica was one of the first technologies for sending images".[11] The relationship between seeing a world repeated in the present, the effect of the camera obscura is a phenomenon defined by its self enclosed circuit, as the thing being seen offers itself up as a variation of the present being inhabited. This is a weird moment in virtuality, as the first projection was actually a live feed! Only later in the form of a magic lantern did the idea begin to move.

10   Crary, Jonathan. Techniques of the Observer: On Vision and Modernity in the Nineteenth Century. Cambridge, MA: MIT, 1990. 36.
11   Kittler, Friedrich. Optical Media. John Wiley & Sons, 2009. 24

GRANDMA'S HOUSE

Centerpiece of Grandmother's house dining room, a curated photo album of her photos as if I lived her life

From September 2013 to September 2014, I lived and functioned inside an installation composed of the objects, ephemera, and furniture which had previously comprised the home of my grandmother.

In this instance, "Time" as a construct was defined by my Grandmother's house- it was always both a past, a present, and a stoppage in the temporal flow. A principal component of this installation was the usage and reflection of media in establishing and recreating a past experience.

Photographs for me always have this weird effect of making the very recent past immediately distant- as they are this sort of permanently separate dimension, always other than the actual moment that they document.

The same can be said for objects. They sit around, gradually changing but not of their own accord, and we live with them and yet are always lonely.

Any image, film or object contains the entirety of its worldview inside itself. The image contains its view, a film contains its characters- their ambitions, life and expectations-ending at the credits (in most cases). The discrete nature of aesthetic objects reveals to us both their origin and their place

Dining Room of Grandma's house

in time, as they reveal to us a way of being in the world, albeit one fixed to the moment of their making. In this way, the object is the story of the object, as objects and media speak to their own meaning through a confluence of technological attributes specific to each era in world history. In this way, objects, films and artworks are discrete units of time (and as such, life), mapped in themselves and containing a perfectly concealed array of data. The content enmeshed in media is both the remainder of the real and it's sole referent, as media both fills and drains the world, referring to it and reconstructing it simultaneously.

The next four pages are excerpts from an interview published in PARIS/
LA, published March 2015

Please tell me a bit about yourself? Are you an artist?

I like being asked if I'm an artist, but I have to say, the question always
frightens me. I haven't been asked that question in a while, since I guess I'm
in a context where its taken for granted. Posting on Craigslist opens one up to
a level of anonymity that, especially with a project like this, allows for a variety
of interpretations.

I spent the bulk of my time as a kid making art in the basement of my
grandparents house, so that makes the space very sacred to me and a place
of inspiration. I spent summers there making small naked paper drawings
of Dagwood and Blondie, which I would later burn in the furnace, sneaking
up the staircase and slyly slipping them in the fire. Very little had changed
aesthetically about the place since my mother had grown up there, and my
fondness for the 1960's Americana aesthetic has been formative in my identity,
both as a gay man and as an American. The novelty of the era speaks to
something about the failed American dream that I find enchanting; the rigid
structure of each family members gender, the simplicity of their careers and
toys, cowboys, dolls, bars and quaint kitchens, all emblems of something that I
see my installation as memorializing in a kind of memento mori.

When did you start this project?

I arrived in Pittsburgh at 4am or so at the tail end of August 2013, and my
future roommate, whom I hadn't met yet, left a key for me under the mat.

Prior to moving to Pittsburgh, I had been living in New York. There, I met
Thomas Lanigan-Schmidt, a humble magpie of sorts, a genius artist who
opened up his world to me and became my mentor. In the 1960's he hosted
a number of performances in the Lower East Side, where he would fill his
tenement with intricate, colorful tin foil sculptures and invite art world types
over, giving them tours in drag as Ethel Dull, a riff on the Warhol collector. So
upon meeting him, I started hanging out in his tenement in Hell's Kitchen, which
is a mind blowing, time traveling, gorgeous cozy enclave shoved in the center

One of the last photographs my grandmother has taken, of me standing in front of a U Haul filled with her belongings the day before I moved to Pittsburgh

of the city hovering above Times Square. He has the ashes of performance artist Jack Smith, an old friend of his, on a cupboard in his kitchen. The floor is covered with tiles from all different decades stapled together, and the walls are emblazoned with tin foil gilded sections and gorgeously colored murals. The real magic of Thomas's craft lies in creating delicately composed chalices, rats, and various objects of religious sacraments entirely out of saran wrap, candy wrappers and tin foil, as they then glisten like the real golden or silver incarnations, but are found to be light, "disposable" and made of everyday material.

I moved out of New York in the summer of 2013 and back to my family's in New Jersey. My grandmother, Hester Rubano, had to move out of her house and into a room at my mothers. She had started developing signs of dementia and could no longer live alone, and while not being a hoarder, had kept a miraculous archive of my family's life in the original house, a modest, small ranch that my grandfather and her had developed over the last 50 years.

I couldn't bare to part with her belongings and neither could she, so I spent days there sorting through her things with her, packaging everything up with the utmost care. This means countless calendars, holiday cards, shoes, lamps; a laundry list of odd ornaments and knick knacks, all of which were both personal and impersonal to me, but impossible for me to throw away in her presence.

So, all of this is happening as I'm back home temporarily before moving to Pittsburgh, where I had planned to share a house with another artist as both of us were beginning an MFA at Carnegie Mellon. We had rented out an entire house, and since he said he didn't have any furniture, I figured I would bring everything from my grandma's house with me when I moved, both to live with and to use as materials for artwork.

So, I arrived in Pittsburgh around 4am with a U-haul, quietly unlocking the door so as to not disturb my new roommate who was sleeping upstairs, and made a bed out of several afghans from my grandmothers.

The next day, my roommate called me and said he was breaking the lease and moving out- he thought I was a hoarder or a crazy person or something. He didn't understand that I considered my grandparents belongings as art materials and intended to organize them in my studio. So, I took over the lease, was lucky to get a small grant from the School of Art at CMU, and that's when I started the project. It was all sort of a disaster.

How long did it take you to complete?

I like thinking of the initial phase like playing a videotape and then watching it be rewound, where your memory of the forward, linear order hovers over its inversion, so you still make sense of things but everything is faster and backwards. I watched everything that had taken 60+ years to put in place and accumulate suddenly vanish into boxes in under two months, leaving me with the contents of my family's history in a state of fragmented disarray.

The process has since been both fast and slow, as within one month I fully restored the empty house into a working simulation, and in the 6 or so months since have gradually developed it, tweaking and refining it bit by bit.

How did you go about replicating the rooms? Did you replicate things from memory? photographs?

My grandmothers house does not exist- it was a very painful and laborious process to fully empty it, as it was the type of place pieced together through many years of hard labor, showing how people really make their lives piecemeal, bit by bit putting together a family and a history.

All of the rooms in the current iteration function as both replicas and variations- the original contents dictate the nature of each space but it is basically a mashup. So, in my childhood room, there was a ceramic yellow elephant bank, which is still filled with the coins I once inserted into it, so that's a constant throughout time, a weird interstice. In that room, the videos I play on the TV are both the old VHS tapes I have recorded of the Disney Channel circa 1986, as well as home movies which depict the space itself.

One side of the recreation of my childhood bedroom

So, in many ways the media also marks the space with a sort of temporal index, projecting into a ghost of its referent.

The most interesting element of the project for me has been mining over the countless photographs, 8mm films and documents that my grandparents accumulated, each of them representing a shadow of the original space and all the activities that had occurred there. The whole experience to me is like living though a novel, the narrative of my grandparents life scattered through all the media, letters, cards, objects, films and photos.

In replicating the rooms, I used the materials that were most associated with the original space, allowing the new architecture to dictate compromises I'd have to make in reconciling differences from my memory to the present reality. So it all functions as an approximation, the living room, for example, has a ceiling draped with afghans which replicates the feeling of warmth present in the original room, but clearly diverges from the original- the idea being that one cannot fully replicate something gone, but that the signifiers one associates with authentic experiences can be used as metaphors to distort and play with time.

Why did you embark on this project?

I embarked on this project more or less by necessity, as I did not want my grandmother to watch her life be thrown away, and once my roommate moved out, I had the opportunity to explore the house as a canvas since it was completely empty. It is very important to me as an artist to explore the nature of life as a creative medium, so I've been using my own life as a material. In a way I feel like I am living my life in reverse chronological order, living in a time before I was born.

One of my biggest problems as a person is the excruciating difference between a photo and lived experience, or between watching a movie and interacting with people, all those weird issues you run up against when you realize that something infinitely odd occurs to the real once its documented. So this is like living in a photograph, a still life, for me it is about slowing down time and trying to evade reality. I am fully conscious that I am hiding in the past and I'm okay with that, I think time does disappear when you don't have clocks, and that objects and spaces are psychological frameworks that both encase, inform, and disrupt temporal flow.


From Dining room, my grandmother's handwriting on a former peanut container

Recreation of my grandmother's bedroom

What is it like living in a recreation of (I'm assuming) the past?

It is both comforting and horrifying, as the weirdest part is not living with my own belongings, and feeling compelled to maintain the rigid arrangement of objects without much alteration. I stopped watching Netflix, stopped listening to music, and have more or less been consumed by the materials and activities my grandmother standardly performed. She lived alone for about 10 years and took photographs of her flowers, fixed lamps, or cleaned, so I've been continuing those activities. One of the primary outlets I have into real life is skyping with Thomas Lanigan-Schmidt, who himself lives in a time cache in Times Square. He's often quoted as talking about how, when he was young and starting as an artist, he used to fantasize about how the knick knacks he was making would end up one day in a house he would live in with his boyfriend, who at the time was an unrequited love. I like thinking about being able to live that life with him through a slippage in time of sorts.

When I wake up in the morning, I always feel like I'm in a strange place, particularly when I am in my grandmothers room. The perspective of waking there always throws me off, I feel like I am somewhere I am not supposed to be. When I sleep in my childhood room sometimes I can't calm down and it makes me very agitated. I think of all the nights growing up when I couldn't fall asleep there and how my grandma put a chair next to the bed in case I fell off. On the wall is a bulletin board that I used to scrape the cork off of, staying up all night peeling away the surface, all freaked out and young. Sometimes when I eat I think of how all the utensils were used for all the of the food my family ever ate, so intimately connected to these tools is my family's entire existence in a weird way.

I don't have cable but my grandmother had countless videotapes of live TV, so on any given day I'm watching 9/11 happen again, or soap operas from the 1990's. It's really quite revelatory to analyze the weird choices she made for programs to record, especially since having the old TV guides with the recorded selections circled, makes the whole experience stilted and makes my life sort of pause. Also, my grandmother saved newspapers from the birthdays of me and my brother for years in a wooden crate, so years of old newspapers lay around the house acting another index of time.

23
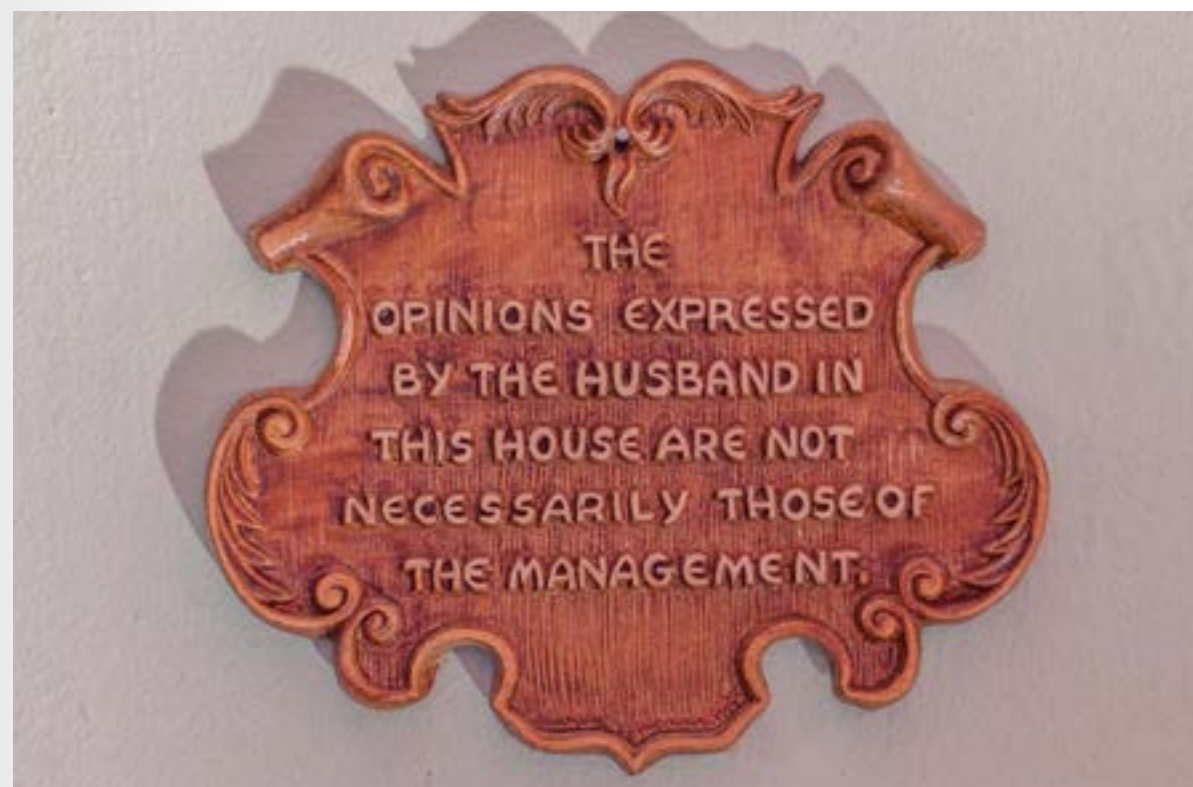
As much as it is a past, it is also a present, as my approach also entailed a degree of curatorial engagement, a sort of "queering" of their belongings. As such, a photo album, splayed apart and transformed into a lamp in the dining room, displays all the sailors and men my grandmother met while she was working as a Rosie the Riveter during World War II. In this way, an erotics of alternate ontologies emerged, as I gaze at men who could have- but were not my ancestry, the weird random slot machine of becoming a particular person, something that always fascinates me.

I don't think I would experience any of these things the same way if I was in the original space, since moving it and reconstructing it caused me to have a weird and disjointed relationship to its contents.

What are the reactions of those you invite over?

There's something weird I've noticed, which is how certain people "enter" the house and others "come in". I can tell when someone has "entered" which shows in their expression and posture, the sense that they become enveloped by the space and that its effect is actually working on them. Others "come in" which means that they stay in their own head, and they keep a distance, acting like a tourist.

I've hosted afternoon tea parties and a variety of formatted tours, some of which have been experiments in the psychological embodiment of gender or age. I've become myself as a child and, with a group of students, tapped into a dormant childlike perspective, using the space as a catalyst for performative discourse. A professor became the "baby sitter", all sorts of weird stuff like that. Once I embodied my grandmother, attempting to speak her life, which was really quite horrifying. One of the other graduate students here, Carl Bajandas, brought Peter Schjeldahl from the New Yorker over one morning, and I dressed as my grandfather to give him a tour, we eerily resembled one another. He seemed very delighted and engaged.

THE OPINIONS EXPRESSED BY THE HUSBAND IN THIS HOUSE ARE NOT NECESSARILY THOSE OF THE MANAGEMENT.

An optical illusion in the installation, from one angle a
princess, from the other an old maid

**Does your grandmother know about the project? If so, what does she think?
Has she visited? Would you want her to see it?**

My grandmother knows about the project but doesn't, insomuch as she
has been diagnosed with Alzheimer's and doesn't necessarily grasp "art"
regardless, but she was very happy I willfully inherited everything she owns! I
think about the project sometimes as me experiencing a form of Alzheimer's
with her belongings, since I can't make sense of them and have lost the
structure of many of their narratives. She's in an assisted living type of
situation now and doesn't think about her house anymore. In a way the house
could be seen as a physical manifestation of dementia. One of the images in
the house is of an optical illusion, an image of a woman who becomes a young
girl or an old lady depending on how you look at her. The house is like that,
and every day I feel different about it.

ANALOG MEDIA

The Camera Obscura was able to project space, but not movement.

The oldest form of artistic play using light to create movement is the shadowplay. Figures which are cut out of paper are used as manipulatable puppets. Silhouettes, in either black or white, are cut out and enlarged when projected as shadows. The silhouette is controlled by various rods and switches, to move and projected an animated shadow on a screen. Shadow puppets were best when mechanized, having multiple iterations of an action that would then be flipped in place or on top of the last, so that these images in succession would suggest a more animated movement. The puppet would have a base which acted as a folding hinge, allowing for a successive series of images to appear, morphing or altering the initial shadow without displacing it.

Shadow theaters operated according to a number of different principals depending on their design. These are the first true moments of the development of the illusion of movement. This is significant because the concept of the shadow is the most readily available physical correlate for anything that is a double of the original- in particular, the same technology informs both media and shadows- light.

Illustration of a camera obscura from page 807 of Ars Magna, Lucis et Umbrae "The Great Art of Light and Shadow", Rome 1646.

Illustration of a camera obscura from page 807 of Ars Magna, Lucis et Umbrae "The Great Art of Light and Shadow", Rome 1646 from the Rare Book Collection.
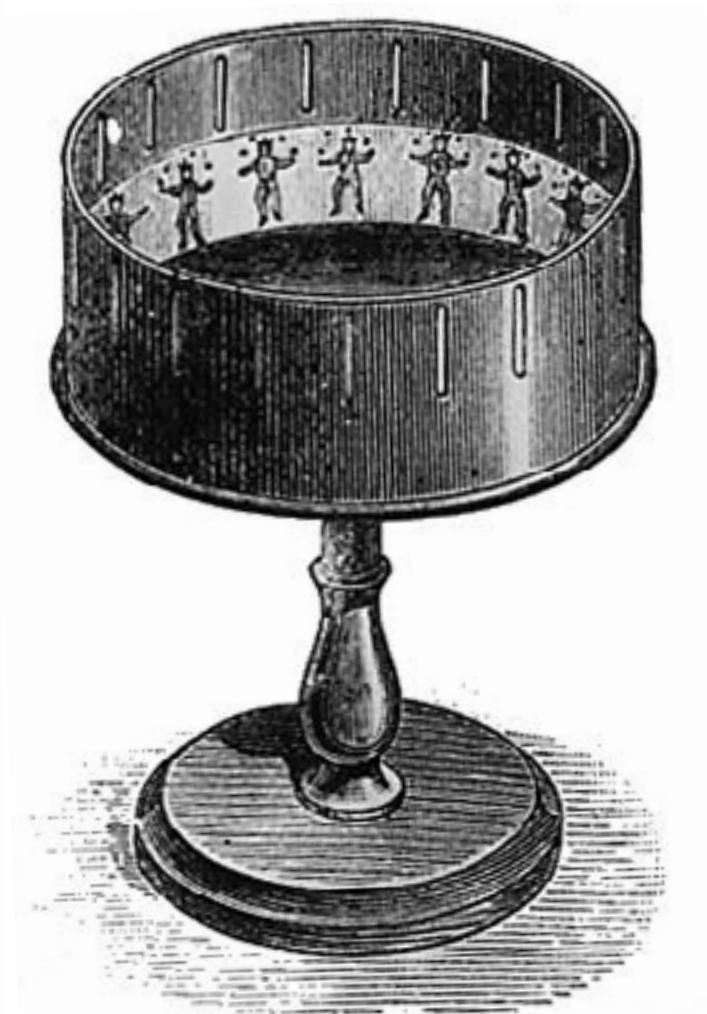
An engineer in the 15th century, Giovanni De Fontana, is cited as the first to describe and document the magic lantern in 1420, as he "used his engineering skills to mimic the magicians' tours de force - as when, for example, he showed that by attaching articulated skeletons to a massive clockwork device, one could literally make the dead walk - exactly what necromancers claimed to do with their spells."[12]

A great deal of these early "slideshows" depended on the control of the image, as a successive series of different images were arranged in a linear fashion, often along a single landscape. Ironically, one of the first and widely cited implementations of the moving image owes its origin to a magic lantern combined with a mechanical clock, the transmission of which depicted the projection of time through space on the wall of its owner, conceptually speaking, the logic of cinema thus designed.

The earliest known mention of this apparatus appears in engravings depicted in *Schubler's Architecture* published in 1724, and is described in an issue of *Scientific American* published January 5th, 1895, as "a luminous dial that projects the hour directly upon the floor with a considerable enlargement that is effected by the dial itself, which is composed of a lens."[13]

12   Grafton, Anthony. "Magic And Technology In Early Modern Europe." Seine Ursprnge Und Seine Geschichte in Verschiedenen Kulturen Der Magus: 1-26. doi:10.1515/9783050078915-001.
13

By the late 16th century optical lenses were invented to allow the camera obsucra to be refined. This principally altered the nature of painting and allowed for a more rigorous and thus mathematically accurate representation of the world.

THE SEVENTEENTH CENTURY

Experiments in animating pictures have their origins in the seventeenth century. Artists created picture animations which were the result of pulling paper controls that created the perception of autonomous movement, as an image would contort with a hidden mechanism. Also in the 17th century, the peepshow and the magic lantern become popular among traveling salesman, and exhibit displays become designed to handle the interruption of natural light. Creating a physical and portable means of projecting images was a crucial point of departure towards the eventual development of the television and the cinema.

1727 marks the discovery of silver nitrate used for photographic emulsion. The photograph image had yet to function.

The zoetrope is a drumlike apparatus that, when spinning at a constant momentum, produces the illusion of a moving image due to the convergence of multiple images in one rapid sequence. It was designed with a series of mirrors at its center placed in relationship to one another at precise angles.

Early sketch of a Zoetrope

In the 1700's the notion of the *perforated print* became commonplace, as an image broken down into dots would allow for light to create the structure of the image when backlit. Images painted on the rear of the surface would contain perforated outlines which structured the image's lighting. Light would illuminate both the image as well as the apertures through each hole, giving structure to an image or omitting it into a sort of constellation.

Around 1700, Martin Engelbrecht created a *Theatre of Perspective*- Various distances between cut out shapes are arranged in space in a box. Segments of images overlap to create the illusion of a real space, but they are simply two dimensional cut outs arranged with depth. Perspective operated as a result of each image plane and the spacing of each section.

An early example of a perforated print

Martin Engelbrecht's Theatre of Perspective

ANALOG MEDIA 2

View through the lens of my grandfather's original 16MM film projector

Martin Heidegger writes of how "The Idea "house" displays what anything is that is fashioned as a house. Particular, real, and possible houses, in contrast, are changing and transitory derivatives of the Idea and thus belong to what does not endure".[14]

By distilling from the space certain essential traits, equipment, things and sensations, the transitory loss of a space "that does not endure" became reformulated through materials, space, and light.

In the house I lived in, a re- interpretation of the original space, the aura of my grandparent's existence still remained, attached to the objects, textures and debris despite being transferred from one location to another.

Past time in the original house, existing as record on film, video, and sound, allowed the space to recover the essence of lived experience, as the sounds and imagery were formed by the relations between objects, carpets, and the relation between the living participants and the environment.

It is due to this crucial difference between the technology of reality and reality itself that the act of watching home movies isn't the same as being "home."

14   Harman, Graham. Heidegger Explained: From Phenomenon to Thing. Chicago: Open Court, 2007. 124.

Audio cassettes of myself as a child learning how to speak by listening to myself talking

Verena Andermatt Conley, writing in "Rethinking Technologies" wrote of how

"Without simply ignoring or simplifying technologies, we now need to emphasize the necessity of thinking the subject not only in its relation with other subjects, but also in, and with the astonishing complexities of, the world. Yet, paradoxically, at the confines of the universe, contrary to any overriding belief in "man" or "woman", machines show humans that our universe is opaque, or "haunted"."[15]

MEDIA

Four primary media formats and machines bracketed the objects and environment: the photograph, 8mm film, VHS cassettes of both home movies and recorded television, as well as analog audio, in the form of recorded conversations on cassette tapes and vinyl albums.

These odd, unaesthetic objects were designed for their function as storage devices for moments in real, unrehearsed temporal flow; movement and experience captured, compressed, and re-dispersed as a unique form of cultural data, the personal media repository that comprises an archive of the family.

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15   Conley, Verena Andermatt. Rethinking Technologies. Minneapolis: University of Minnesota Press, 1993. 24.

The static rendering of voice, motion or a living person's expression into the finite, compressed and artificial form of a tape cassette, celluloid reel, or photograph connotes a type of temporal caesura, the end of something embedded in the media. All film, tape and negative matter are thus the presence of absence, a weird and unruly different dimension where biological expression remains immanent in a flattened, lifeless representation.

In his preface to "Gramophone, Film, Typewriter", Frederick Kittler writes that "What remains of people is what media can store and communicate".[16] "Personhood" is thus compressed and nested inside the objects and storage vessels which comprise a genealogical system of media as memory, the easily neutralized personal ephemera inherited and discarded from our ancestors. Kittler also comments on how "Media always already provide the appearances of specters. For, according to Lacan, "in the real even the word corpse is already a euphemism".[17]

Kittler applies Lacan's methodology for distinguishing "between the real, the imaginary, and the symbolic as a theory of differentiation" to media, writing that "The symbolic includes the signs of language in their materiality and technicity; that is, they form, as letters and ciphers, a finite set which does not address the philosophical dream of an infinity of meaning. What counts are only differences (or in terms of the typewriter) the spaces between the elements of a system. For that reason the world of the symbolic, in Lacan, is already called "the world of the machine".[18]

Family photographs layered on panes of glass in front of mirrors

16, 17, 16   Kittler, Friedrich A., Geoffrey Winthrop-Young, and Michael Wutz. Gramophone, Film, Typewriter. Stanford, CA: Stanford University Press, 1999. 24, 32, 76.

As it is with the concept of corpse, the technology of a false environment replicates a past and brings with it the specters of its original motion, rendered still and static in the storage devices which contain them, merely citational as opposed to active and dynamic embodiments. The media is life, but the deadest form.

The house was a reference, full of referent points in multiple forms of media documents, each citing their origin in pictures spread throughout of the original space,

Kittler goes on to suggest that "The realm of the dead has the same dimensions as the storage and emission capacities for its culture. Media... are always already flight apparatuses into the other world".[19]

These technologies have crept into our daily lives and oddly refrain from startling us, as the conventions surrounding the recorded formatting of reality render it as a common and everyday occurrence, depleted of its former magic. The only thing lacking of course, was the physical existence of my grandmother. Despite these objects exhausting her aura, they always pointed outside of themselves to the idea, not the human.

An early 8MM film of my mother as a child playing with dolls

19   Kittler, Friedrich A., Geoffrey Winthrop-Young, and Michael Wutz. Gramophone, Film, Typewriter. Stanford, CA: Stanford University Press, 1999. 22.
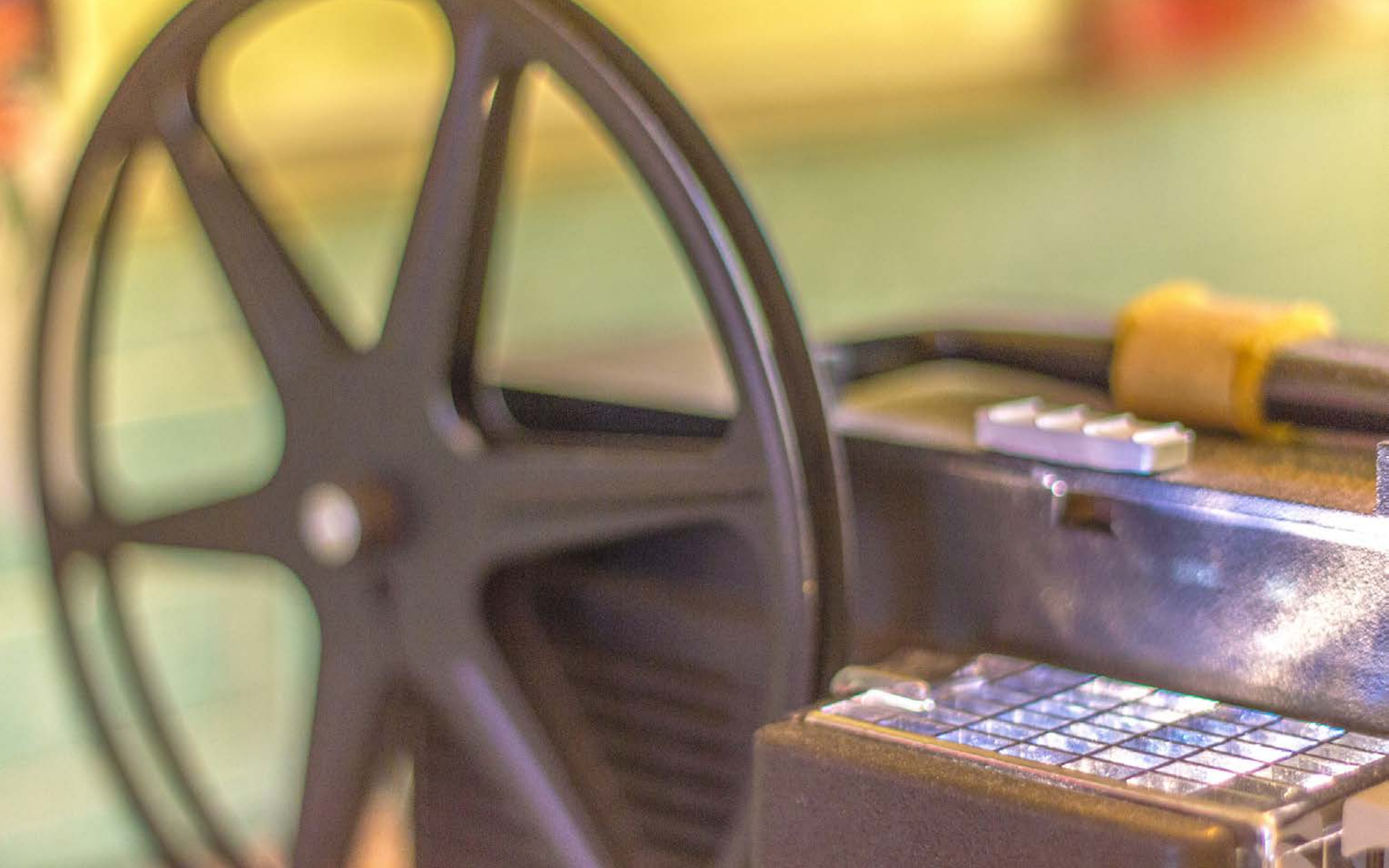
FROM PAINTING TO TV TO 3D

Photograph photographed for me by Donald Warhola of a family heirloom, Jesus, present in the orginal Andy Warhol Living Room

Initially, I wanted a photograph. I was asked by the Warhol's director, Eric Shiner, to be the first artist to create a window installation for the front of the Warhol Museum, working in the tradition of Warhol's early job experience at Hornes Department Store here in Pittsburgh. It was a unique context, to be working in the facade of the museum in the windows of the Gift Shop, a space marked by both the commercial values of Warhol's aesthetic as well as the private, transitional nexus between the interior of the museum and the public.

My search began in an attempt to find as many photos of Warhol's original Dawson Street home as I could. Surprisingly, very few photos are extant from Warhol's childhood, I learned this while speaking with Donald Warhola, who met with me to discuss his personal history as Warhol's nephew. Little did I know that Christmas at the Warhola's was a very sacred and spare affair, with Warhol often being gifted only a single piece of fruit.

Warhola pointed me in the direction of the image *Living Room* on the museum's seventh floor, as an alternative to a photograph. He later supplied me with several photos he took of photos he had of objects that were in the original Warhol home, seen to the left.

Andy Warhola's Living Room developed as an inquiry into the relations between Pittsburgh and Warhol, as I wanted to create a work that spoke to the role of the museum as Andy's new home here in Pittsburgh, a place where people have a chance to enter a very private, idiosyncratic space dedicated to an artist whose

Andy Warhol, Living Room, 1948, ©The Andy Warhol Foundation for the Visual Arts, Inc., courtesy of The Andy Warhol Museum, Pittsburgh

My living room installation in *Grandmothers House*

home here had been quite different when he was a young boy growing up on Dawson St.

This was one of the main reasons I responded to Andy Warhols *Living Room*, as it provided a point of entry into a temporal parallel with Warhol, as my first project as a student at Carnegie Mellon was eerily similar to a work he aesthetically executed while training as a student at Carnegie Tech.

I did not want my hand in the work, and in a somewhat ironic gesture, wanted to emphasize Warhol's. His *Living Room* painting as well as much of his other early, pre-New York work, is very unique in his oeuvre in that it features the fragile yet assured development of his aesthetic, albeit prior to the removal of his kinesthetic gestures in his trademark "Pop" commercial style. Taking a distinctly Warholian approach, I wanted to be a machine. By extracting the individual objects from a high resolution image, I was able to isolate elements of the composition and process them through a three dimensional rendering program to create shapes based on the light and dark values of the watercolor.

These 3D models were then used as templates, fed through a CNC router which cut the extruded shapes out of foam. The extruded shapes are, in every sense of the word, exact mechanical derivatives of the original image, and though they may be unrecognizable as representations of the original objects, it was important to me to let the data determine the shape of the sculptures, they are physical embodiments of light.

Facsimile of Warhola family photograph of Andy, center, in front of the original Dawson St. home

Once formed, these soft, light meshes were hardened with gallons of white latex paint, sanded and finally painted metallic silver to empathize the historical dynamic between Warhol's origin and his future as a superstar. I feel like the sculptures appear to be made from either steel or aluminum foil, an ambiguity I like, since there's something beautiful and not entirely arbitrary about the "Silver Factory" when you consider the artists roots in a industrial mining town like Pittsburgh. To point to the real, family photo facsimiles from Warhol's childhood adorn the shelves around the sculptures, each in a picture frame that once held my families photos.

These sculptures were part object, part image, part 3D model, as their form is a byproduct of all of these technologies. Conceptually, they are In line with Lanier's thoughts on digital objects, whereby "The definition of a digital object is based on assumptions of what aspects of it will turn out to be important. It will be a flat, mute nothing, if you ask something of it that exceeds those expectations. If you didn't specify the weight of a digital painting in the original definition, it isn't just weightless, it is less than weightless. A physical object, on the other hand, will be fully rich and real whatever you do to it. It will respond to any experiment a scientist can conceive. What makes something fully real is that it is impossible to represent it to completion."[20]

20, 21 Lanier, Jaron. *You Are Not a Gadget: A Manifesto.* New York: Alfred A. Knopf, 2010.

These sculptures are brushstrokes displaced into a digital object, rendered as a form- both their original and yet only a shadow of the object they refer to in reality.

In addition to the sculptures, viewers could peruse an assortment of ephemera that I brought from my personal collection of esoteric objects. I was particularly struck by a newspaper featured in a photograph of Warhol's time capsules from the day John F. Kennedy died, since I happened to have the exact same newspaper as well as an assortment of others, discovered in the trunk of a crashed car at my family's junkyard. These punctuate each window, speckled with objects from the store that speak to the time period of the late 40's and 50's.

Additionally, an animation featured on the three televisions displays a virtual tour through the extruded three dimensional sculpture made from the original image, allowing viewers to see the inside of the watercolor when viewed through its digital distillation. "[Digital cinema] is no longer an indexical media technology, but, rather, a sub genre of painting. No longer strictly locked in the photographic, cinema opens itself toward the painterly. Cinema becomes a particular branch of painting - painting in time"[21], a concept explored in the extruded model of a painting which becomes a temporal landscape.

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21   Lanier, Jaron. *You Are Not a Gadget: A Manifesto*. New York: Alfred A. Knopf, 2010. 27.

Illustration of a camera obscura from page 807 of Ars Magna, Lucis et Umbrae "The Great Art of Light and Shadow", Rome 1646 from the Rare Book Collection (r17 QC17.K6C46).

VIDEOTAPE

The advent of consumer grade equipment for the recording, distribution, playing and re-playing of commercial media brought with it a drastic shift in the everyday individuals relation to commercial media. With home movies, the family can finally become its own form of media, as the past time of watching television is now redundant, not only can one watch sitcoms about family, films about family, but a family can now watch itself.

This self-referential actualization is discussed in Johanna Burton's essay on contemporary sculpture, "Not a Single Point of View" , where she acknowledges how in the video art of the 1980s, "the internalized image of self began to be more overtly "projected" through the screen of culture"[22] and as such, art, "rather than mirroring purely interior psychic anxiety, reflected back the self's participation in, complicity with, and resistance to culture at large."[23]

This new set of media technologies that allow for a non-linear interface also profoundly alters our relation to home video. The experience of the self in time becomes mapped out with

22, 22 Brind, Susan, Ray McKenzie, and Damian Sutton. The State of the Real: Aesthetics in the Digital Age. I. B. Tauris & Company, Limited, 2007. 32, 34.

Childhood bedroom at Grandma's house with motion tracking targets

Displaced motion from handheld camera in 3D photo space of the re-installation

temporal controls. Being able to play, pause or fast forward the past in real time allows us to manipulate memory as a seemingly tangible medium, a pictorial arrangement of objects, textures, lighting and activity. Memory, in a sense, is disembodied and rendered as a variable, flexible, temporal hallucination.

In the act of home video recording, the presence of the camera standardly displaces a family members face, replacing their gaze with the extension of the recording eye, a gesture that implicitly frames the behavior existing around it.. In discussing the systematic gestures present in the act of photography, Francois Lauruelle writes that "The photographer does not throw himself into the World, he replaces himself firstly in his body as in a stance, and renounces all corporeal or psychic intentionality."[24]

One of the most striking repetitions is the reoccurring documentation of a somewhat staged action: family members instructed to walk towards the cameras, sometimes waving or smiling in acknowledgment. This motion is indicative of an understanding on the subjects part that the camcorder is capturing their gait, their smile, the at times all encompassing and odd knowledge of embodiment that a camera's gaze instills in the subject it is fixed upon.

24   Laruelle, Franois, and Tony Brachet. Dictionary of Non-philosophy. Minneapolis, MN: Univocal, 2013.
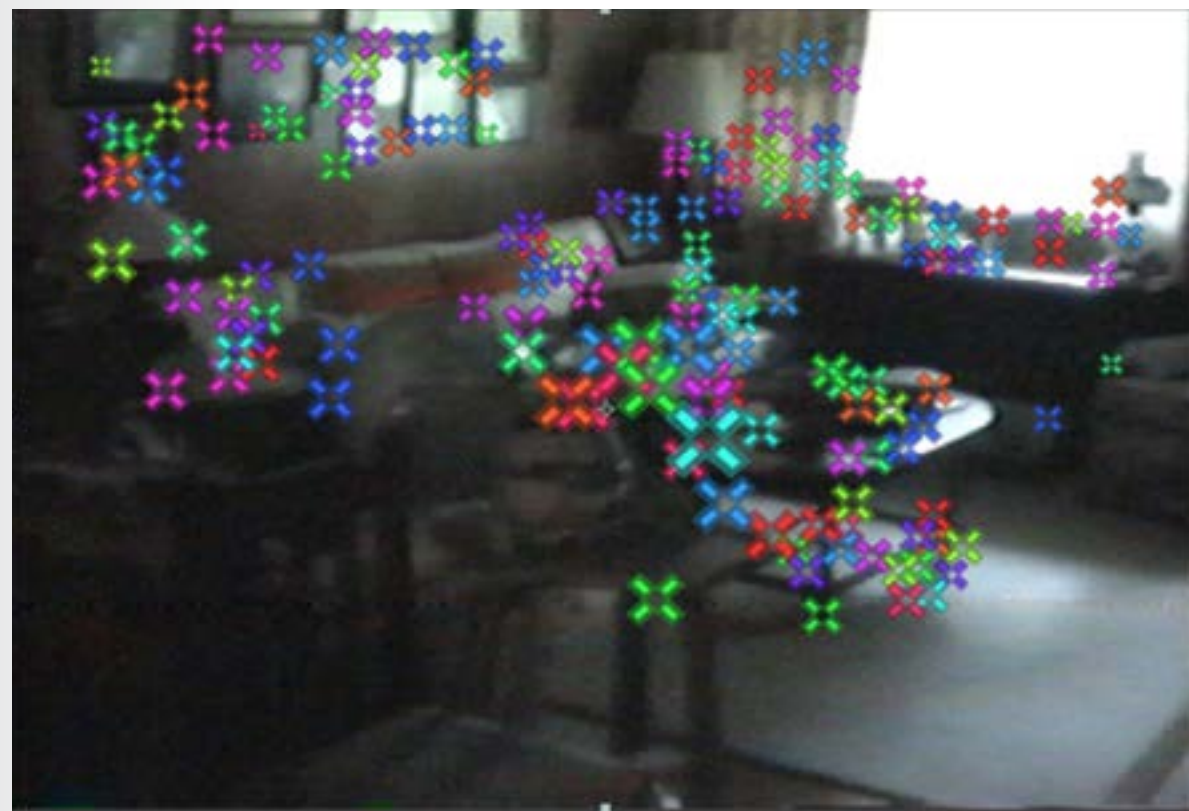
Original VHS home video from my greandmothers house circa 1992, the living room filled with motion tracking dots

The simultaneous interweaving of the past with the present allowed by the presence of watching dated home videos that one was present in brings with it the haunting absence of the original experience. As Alexander Galloway points out in "The Interface Effect", in cinema, "the self becomes a viewing self, and the world becomes a world viewed."[25] Burton discusses the notion of the "imaginary body", a space where the lived reality of the corporeality becomes fully interior, a point of view where "We watch ourselves seeing — newly and acutely aware of our predispositions and projections toward the images and objects of art — even while knowing that such an act is, by definition, fleeting, delusory, phantasmic".

The experience of "watching ourselves seeing" touches on the self consciousness imposed by the experience of personal media technology. In the same way that vision occludes the vehicle of it's operation, in real time, I cannot see myself as being, I see my body, looking down through my eyes, fragmented, broken and doubled in the presence of an equally cropped cinematic representation. I become present with myself in an intimate yet temporally disparate fashion.

My brother and grandmother, the filmographers of many of our home videos, became imprinted in the footage they recorded, as their point of view becomes transcribed by the tape: "On the one hand the observer is disjunct from the pure operation of the

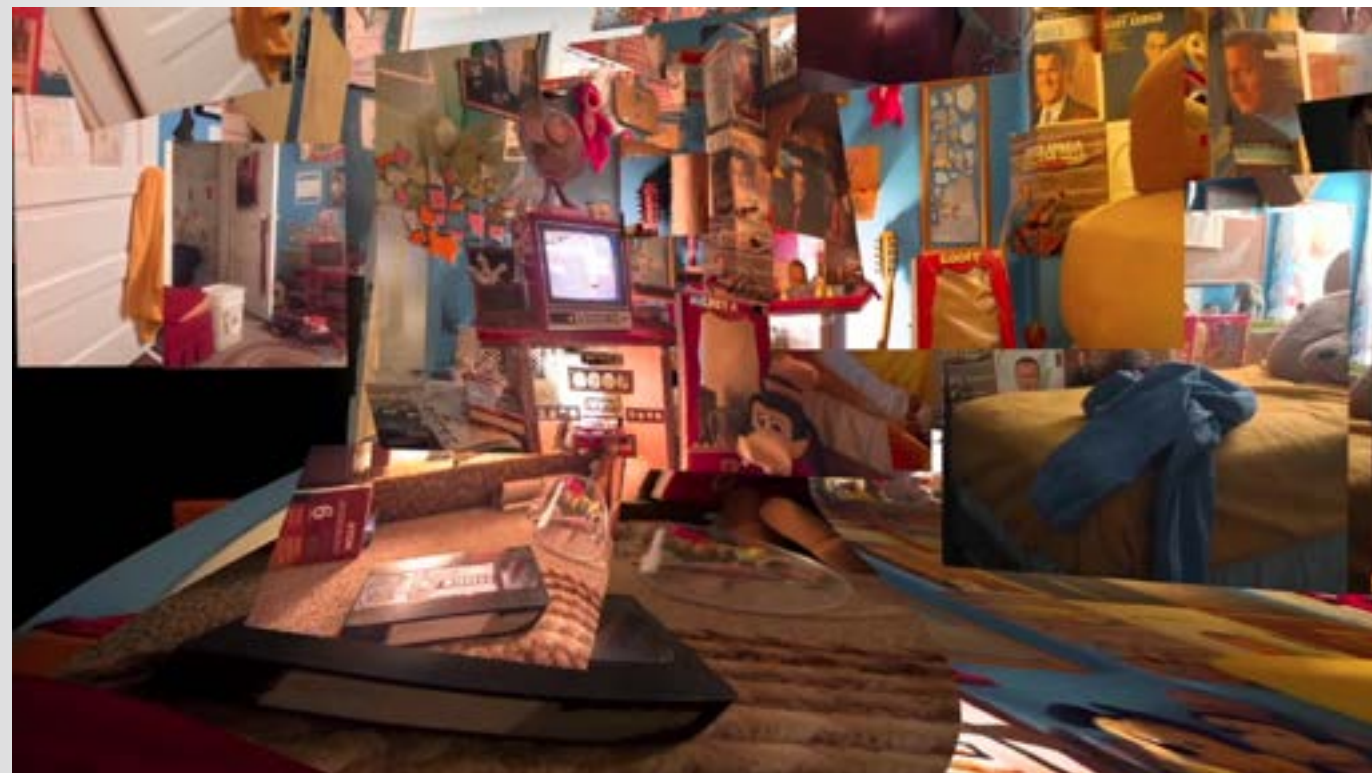25   Galloway, Alexander R. The Interface Effect. Cambridge, UK: Polity, 2012. 86.

Handheld camera footage with motion tracking points attached to features, my brother looking into the mirror with the camcorder, my grandmother to the left

device and is there as a disembodied witness to a mechanical and transcendental re-presentation of the world. On the other hand, however, his or her presence in the camera implies a spatial and temporal simultaneity of human subjectivity and objective apparatus. Thus the spectator is a more free floating inhabitant of the darkness, a marginal supplementary presence independent of the machinery of representation."[26]

I used motion tracking software to detect consistent objects within certain edits of the film, and used these motion targets to create motion paths of the cameras movements. I then attached the motion to a virtual camera. I placed the camera simulation with the motion tracked path embedded inside of it into the virtual environment, composed of thousands of digital photos of the re-installation of my grandparents home. This combination of analog handheld motion and a digital space resulted in a mixture of the two spaces, the two times, and the two medias (photography and video) which recalled the original home video, albeit digitally reconstructed.

Lanier comments on the degraded nature of the digitial image and its loss when he writes, "A digital image, or any other kind of digital fragment, is a useful compromise. It captures a certain limited measurement of reality within a standardized system that removes any of the original sources unique

26   Crary, Jonathan. Techniques of the Observer: On Vision and Modernity in the Nineteenth Century. Cambridge, MA: MIT Press, 1990. 42.

46

qualities."[27] The tapes themselves are also layers of other moving images recorded over themselves, much like the act of living in a simulated environment that is suspended over the real.

In her essay "Video: The Aesthetics of Narcissism", Rosalind Krauss describes the effect of video art as "enacting a sense of "a collapsed present, that is, a present time which is completely severed from a sense of its own past."[28] This "collapsed present" occurred in my installation during the odd and uncanny experience of projecting family footage of myself as a child in my dining room, as the activity of being in a room with "myself"- albeit some 20 years later, exposed the oddity of recording as a familial pastime.

Re-installation of my childhood bedroom viewed through the displaced camera angles of my grandmother's home movies

27   Lanier, Jaron. *You Are Not a Gadget: A Manifesto*. New York: Alfred A. Knopf, 2010. 22.

28   Krauss, Rosalind. "Video: The Aesthetics of Narcissism." October 1 (1976): 50. doi:10.2307/778507.

BAROQUE ILLUSIONISM

Illustration of a camera obscura from page 807 of Ars Magna, Lucis et Umbrae "The Great Art of Light and Shadow", Rome 1646 from the Rare Book Collection (r17 QC17.K6C46).

In the 16th Century, a frequent cause for debate and discussion amongst Baroque artists and their critics was the various merits of painting and sculpture, with the term "paragone" coming to signify the long standing tension between these dimensionally different mediums. As a means of reconciling the limitations of painting, advanced forms of illusionism were often used by Baroque painters who sought to traverse the boundaries of the two dimensional picture plane, expanding into and out of the surface of the painting by using techniques such as quadratura and tromp l'oeil.

 Tromp l'oeil, also used in Phantasmagorias and in a way, the very nature of the image making process, is a standard painting technique that was used to varying effect by Baroque painters in particular. Although each technique shares the effect of deceiving the viewer into believing that a flat surface has the properties of three dimensions, the context and effect of each varies in conjunction with the artists intentions, as each device interacts with the space the painting inhabits as well as the range of motion of the viewer in different manners.

 In "Annibale Carracci: A Study in the Reform of Italian Painting around 1590" Donald Posner writes of how "Illusionist architectural painting (quadratura), aimed at extending real architecture into an imaginary space, had existed ever since Peruzzi had 'opened up' the Sala delle Colonne in the Villa Farnese about 1516, but it was not until the second half of the sixteenth century that quadratura on ceilings really came into its own".[29]

Donald Posner, Annibale Carracci: A Study in the reform of Italian Painting Around 1590 (New York: Phaidon Publishers, 1971), 36.

Pozzi

Drawing inspiration from Michelangelo's Sistine ceiling, Annibale's use of quadro riportato is inextricably connected to the content he wished to portray, as Posner writes that Annibale was "convinced that the mythological representation, as belonging to the highest class of painting, should be rendered objectively and in isolating frames".[30]

Unlike the pre-cinema experiements discussed earlier, these experiements both suggest movement and addtionally fully replace the world instead of "occuring" in it, as their relation to architecture intervenes with ones sense of space. The resulting effect of Annibale's use of quadro riportato inverts the customary structure of a ceiling fresco, as it ceases to be the limit of the room or an atmospheric allusion to the heavens, but instead "the ceiling could be seen, imaginatively, as a setting erected to contain and display individual pictures".[31] These false frames also suggest narrative throught their grid like structure and the implied continuity. Furthermore, in order to encompass the curved nature of the vaulted ceiling, Carracci took inspiration from Pellegrino Tibaldi's work in the Palzazzo Poggi, as he "combined pictures painted like easel-paintings with figures in the corners of the ceiling perceptively foreshortened for the view from below"[32] .

Quadro Riportato does not make use of illusionistic foreshortening, but with the addition of seemingly three

32 Donald Posner, Annibale Carracci: A Study in the reform of Italian Painting Around 1590 (New York: Phaidon Publishers, 1971), 36

50

dimensional sculptures that conjoin each frame, an advanced form of illusion is achieved. By uniting the otherwise separate framed images with the illusion of large marble sculptures in a mixed decoration of technique, Annibale's use of quadratura deepens the space of the ceiling, producing the effect of overlapping surfaces and depth, while still containing the room within itself. The sculptures protrude into the real space, thus making the false space deceive our sense of depth perception.

The Italian painter Andrea Pozzo drew from his experience as a stage designer and architect in order to achieve breathtaking frescos, unifying his understanding of perspective theory with his skills in painting and sculpture and thus mastering architectural illusionism. Affiliated with the Jesuit Church, his art took on an evangelical and political approach, as his images were meant to convince his audience of the supremacy of the Jesuit Order. In 1693 Pozzo published an influential text on architecture and illusionism entitled *Perspectiva pictorum et architectorum*, a work which disseminated and spread his theory of perspective.

At the height of his career between 1685 and 1694, Pozzo was commissioned to paint frescoes on the ceiling of the nave of the Jesuit church of Sant' Ignazio in Rome, in which he displayed his virtuoso by rendering the allegorical image Apotheosis of St. Ignatius, a celebration of the missionary to whom the church was decorated. This sprawling, architechturally complex vortex of luminous imagery "approaches infinity by subordinating its hosts

Carracci

of figures to the most systematic and elaborate quadratura ever devised".[33] Geometrically precise columns ascend upwards into the heavens as quadrants of embanked figures float and rest on various ledges, illusionistically expanding and ultimately evaporating the existence of the ceiling to show the sky and heavens above.   Seemingly "real" figures are seen clinging to seemingly "real" sculptures, the effects of Pozzo's mastery of quadratura resulting in a seamless blurring of painting and feigned sculptural architecture.

Pozzo's innovative understanding of trompe l'oeil enabled him to artificially construct an illusory dome in Sant Ignazio, a flat canvas which seems to recede into the ceiling despite its two dimensional foundations. This illuminated illusion is constrained however, by its relation to the viewers position, since "unlike the quadraturists from Bologna, who worked with multiple vanishing points, Pozzo constructed his painted architecture to be seen from a single ideal vantage point".

Due to this, the deceptive impact of the fictive dome is easily distorted when viewed from other angles, resulting in "disinganno", the dissolution of the illusion that results from leaving the ideal viewing point. Anamorphosis, the distortion of an image when viewed from an incorrect angle, would thus result, effectively causing the ceiling to collapse in the viewers perception.

Pozzo

33 Steffi Roettgen, Italian Fresco- The Baroque Era 1600-1800 New York: Abbeville Press Publishers, 2007. pg. 263

CELLULOID TO DIGITAL

The history of cinema in its present incarnation is bound up in the developments of numerous significant technologies, including, but not limited to: the technology of theatre, the photograph, celluloid film and its development, sound recording, home theatre technology, VHS, the history of special effects stretching back to magic, and the computer, to say the least.

Perhaps most importantly, the history of cinema is also bound up with the logic and possibilities of a particular place and time: Sunset Boulevard, California, the early days of Hollywood.

4500 Sunset Boulevard, the first film lot in Hollywood

"In 1913, A couple named Thoren leased a portion of their fig orchard at 4500 Sunset Boulevard (where Sunset meets Hollywood Boulevard) to a movie company headed by L.L. Bums and Harry Revier. The company used the peninsula of land where the boulevards meet as their backlot. When that company folded. Burns ran a film laboratory in a shed among the fig trees. When he sold that business to Kinonacolor. one of the earliest attempts at color movies. Burns and Revier looked for a new production site.[34]

34

55

The building on the left is the old Lasky Barn, once situated in a lemon and orange grove on Vine Street and Selma Avenue. [1]

"They leased land from Jacob Stern at Selma Avenue and Vine Street. The partners built an open stage and a laboratory shed among the lemon trees. They used Stern's horse barn for an office. Stern's only stipulation was that his horse and carriage remain in the building." [35]

Harry Revier, a fledgling B Movie Director known as "three finger Harry" because he had three missing fingers on his right hand, is considered "one of the first producer-directors working in California (possibly first)." His studio produced some of the first films in the area that later became Hollywood. Very little about his early life is known, and he is largely overlooked.

One of Revier's most significant works, *City of Lost Men*, completed in 1940, is the end result of a twelve part serial series. The series ran under the title "The Lost City", a fantasy adventure chronicle that depicts the trials and tribulations of scientist Bruce Gordon and Zolok, the last of the Lemurians.

As a serial film, segments were released as stand alone films, structured through numerous matinee screenings and a thirsty audience of young kids astounded by cinema. As such, twelve different films were made in the Lost City series, each one with a distinct title:

35,36 Williams, Greg. The Story of Hollywood: An Illustrated History. Place of Publication Not Identified: BL Press, 2005. 67.

A collection of six posters from the original serial issue of each chapter of "The Lost City"

The plot is a winding garbled mess of incoherent racist tropes- summarily, the world is having erratic electrical storms, so brash Bruce Gordon, an electrical engineer, invents a metal detector that traces the storms to an unexplored region of Africa, where he discovers a "Magnetic Mountain" with a hidden Lost City, run by Zolok, a demented technical wizard a la "The Tempest"- Zolok, being the cause of the disasters, commands an army of lobotomized African American Giants, created in a lab where we witness their heads and bodies strangely mutating.

An accidental metaphor for colonialism featuring giant, barbaric slave mutants, it is an inherently xenophobic and racist

film that masquerades as a charming novelty. After a series of misadventures including a wild cast of slave traders, spider men, jungle queens and zombies, finally, we see Zolok mistakenly blow up his own Lost City and Bruce Gordon sweeps the damsel in distress off her feet, returning home, bride in hand, to America, somehow surviving the mystical and dangerous world of "Central Africa", happy and at peace.

Considered to be "The first lull-blown science fiction serial, released in January 1935, The Lost City looks like a 1930s science fiction pulp magazine cover come to life."[36] The resulting mainstreamed version, "City of Lost Men" released in the 1980's on videocassette as a condensed version of the serial, was a chopped up and sewed together mixture of 12 1 hour long parts. The end result is a nearly incoherent, pre-post modern post modern pastiche of bad taste and worse special effects.

I began to make a process for breaking down the film and trying to understand the fundamental elements of its creation. Technically, the film had a significant impact on the burgeoning development of special effects, as numerous influential technicians developed techniques on the film. Kenneth Strickfaden created electrical machinery and props for both *City* and Universal's *Frankenstein*, (1931), as well as Flash Gordon and many other sci-fi moves from the 30's and 40's. The art

Scene from "The Lost City" when scene detector is analyzing features to detect scene cuts

36

director also went on to work on the popular Bela Lugosi thriller *White Zombie* and other Flash Gordon serials as well.

"The nihilist says to the british constructivist, "Your idea of transparency allows us to escape from that, allows us to see through the disguise of reality, the theater of media events, the fiction of history that blocks our vision. Perhaps the surface of the world system is in fact a window onto the emptiness that lies behind it, an emptiness that can only acquire real meaning in the context of the unending, blind conspiracy that ceaselessly attempts to block it out behind the walls of a hall of mirrors."[37]

CITY OF LOST MEN PROJECTION MAPPING

"City of Lost Men" was an experiment in immersive media, an exploration of different forms of virtual reality, but based on the materials of a celluloid serial film.

The film became rendered as a real time environment in its entirety, allowing the viewer to enter a space where the cinematic became immediate, divorced from the dichotomy of spectator/spectacle. The intention was to break the film apart in a theatre until it once more spoke to the level of life present in real performance, digitally manifested.

Film Director Harry Revier

37   Haq, Nav, and Tirdad Zolghadr. *Lapdogs of the Bourgeoisie: Class Hegemony in Contemporary Art.* Berlin: Sternberg Press, 2009. 32.
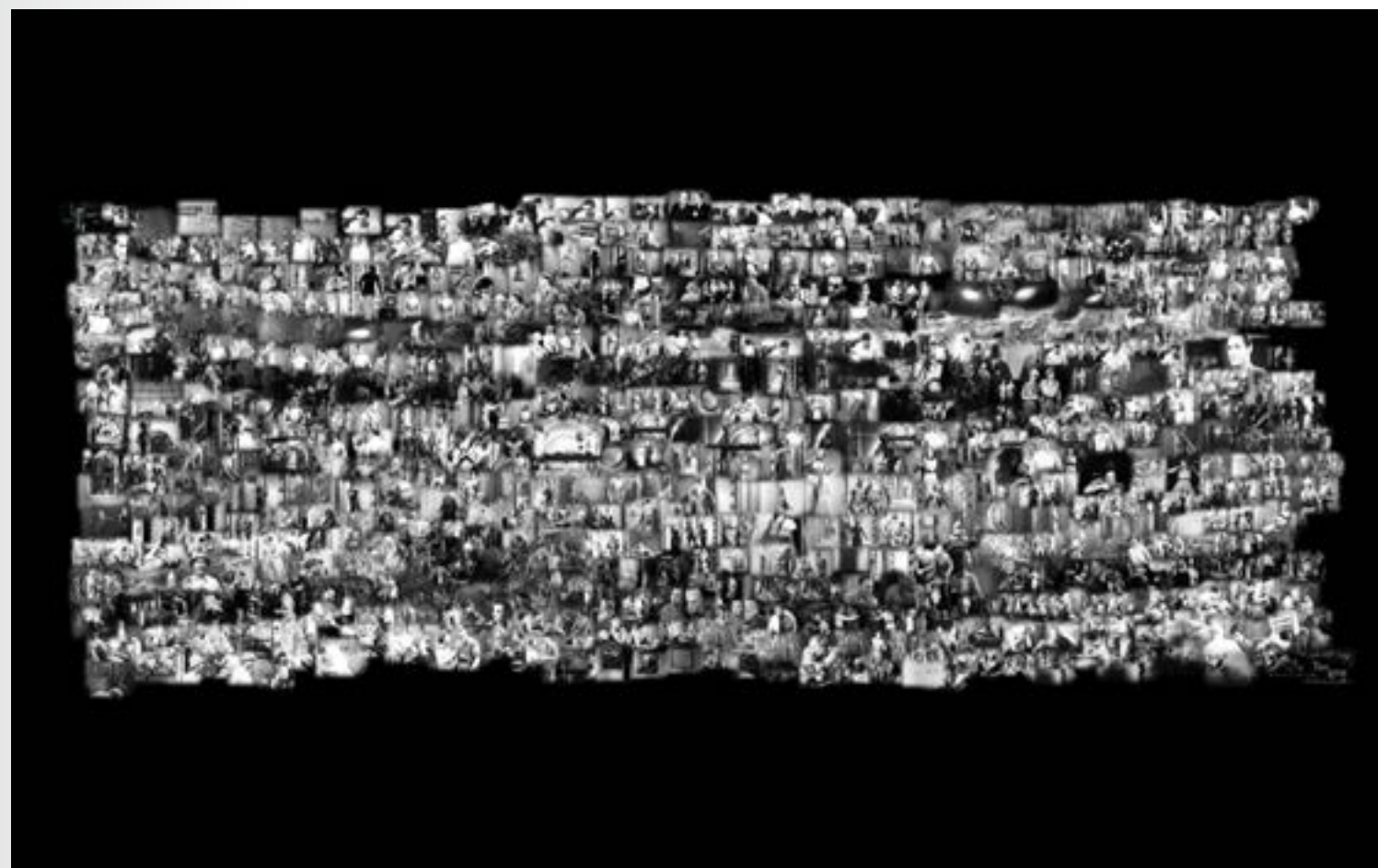
Every edit from the City of Lost Men Serial in chronlogical
order, still from projection mapping source

DOWNLOADING MOVIES

"When you come upon a video clip or picture or stretch of
writing that has been made available in the web 2.0 manner, you
almost never have access to the history or the locality in which
it was perceived to have meaning by the anonymous person
who left it there. A song might have been temder, or brave or
redemptive in context, but those qualities will usually be lost."[38]

I unedited the film, segment by segment, in order to better
understand the machinations of cinema and attempt to decode
the nature of subtlety conveyed controversial content.

The ability to crop, capture, control zoom loop and alter
any form of media in real time is a weird and rare interaction,
allowing for the media to become a material, detached from
its primacy as cultural data. Ownership over this, though latent
in the original copyright holder seems easily transferred when
occurring in the private space of ones personal computer.

By downloading *City of Lost Men* I assumed the role of
editor, director, and producer, un-editing the film and removing
all the breaks in motion, isolating each cut and looping them.

38   Lanier, Jaron. *You Are Not a Gadget: A Manifesto.* New York: Alfred A. Knopf, 2010. 139.

Three projectors in the audience supplied the projection feeds
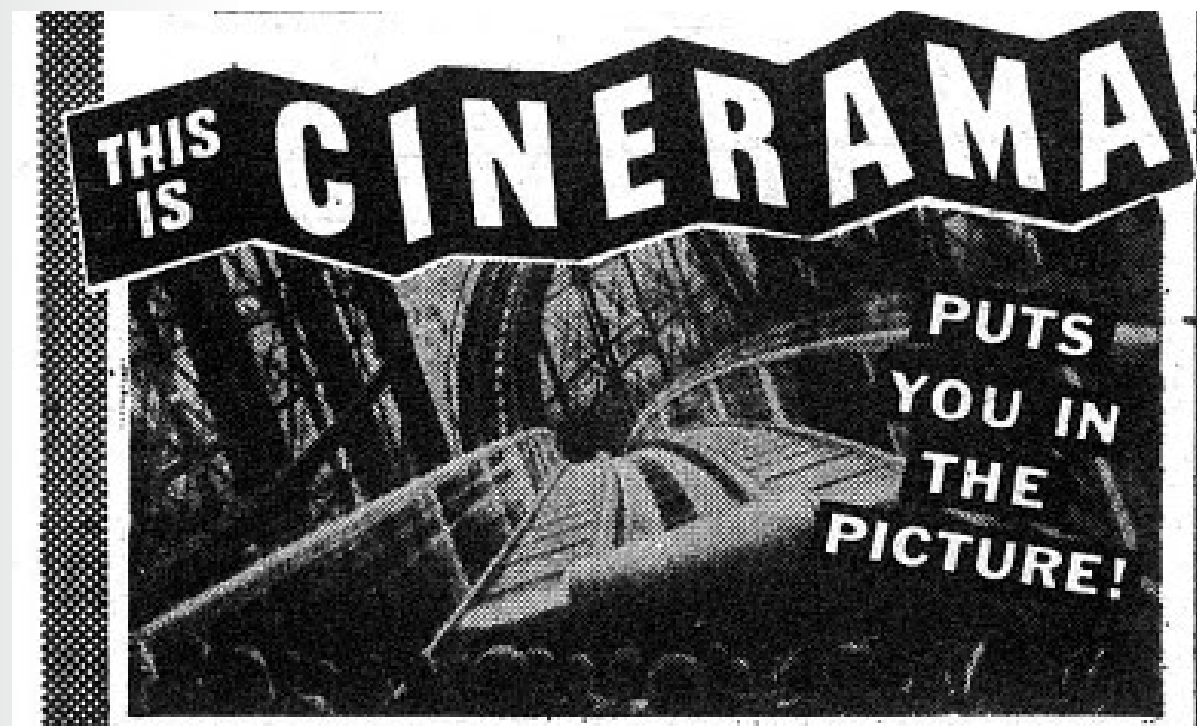
An early ad for Cinerama, which also made use of the three projector system

Each scene in the film, contained in its camera cut, was broken out of the edit and looped into its own segment. These segments were then stitched together into a panoramic field, which cinematically re-structured the narrative apparatus into a chronological, scene by scene looping environment.

Approximately 820 individual video clips were the set of edits extracted from the original. Each one was arranged in a grid. The chronological grid was then projected inside a curved theatre.

CINERAMA

Cinema imposes a grid onto time. Both as a function of its durational nature, as well as it's indexical formatting, cinema is dictated by its intervals, which, when cumulative, condense and detail time as a fluid, immersive experience for the audience. Each interval is an edit.

The flattening of space caused by the development of the moving image also set into motion a variety of experiments towards expanding the image into multiple dimensions.

Cinerama, a projection and cinematic technique developed by Fred Waller in the 1950's, introduced audiences to an experience that verged on full immersion, a panorama that broke the cinematic image into thirds, each of which occupied an angle

of space in the projection environment. This effect created an ocular immersion in the cinematic spectacle: the rims of your eyes fully filled with the projected image. The films were projected on a curved screen from, standardly, three projectors were used, which met and merged with their adjacent projections.

"The projector literally disappears at the moment the digital interface becomes standard. No longer do we see the physical object of the image which, in sequence, constitutes the mirage of the moving image."[39] (Kelty and Landecker)

I presented the work in the context of the Kresge Theatre, a historic theatre on Carnegie Mellon Campus known for its history of stage productions in the 1920s and 30s, the time of Revier's productions. Multiple perspectives were taken in the content and its context, in creating a spatial rendition of a chronological un-edited film in a room that existed through the development of theatre into film, and film into digital.

Interior view of stage and theatre with animated panoramic projection

39   "A Theory of Animation: Cells, L-systems, and Film." Academia.edu. Accessed May 04, 2016. http://www.academia.edu/12468963/A_Theory_of_Animation_Cells_L-systems_and_Film.
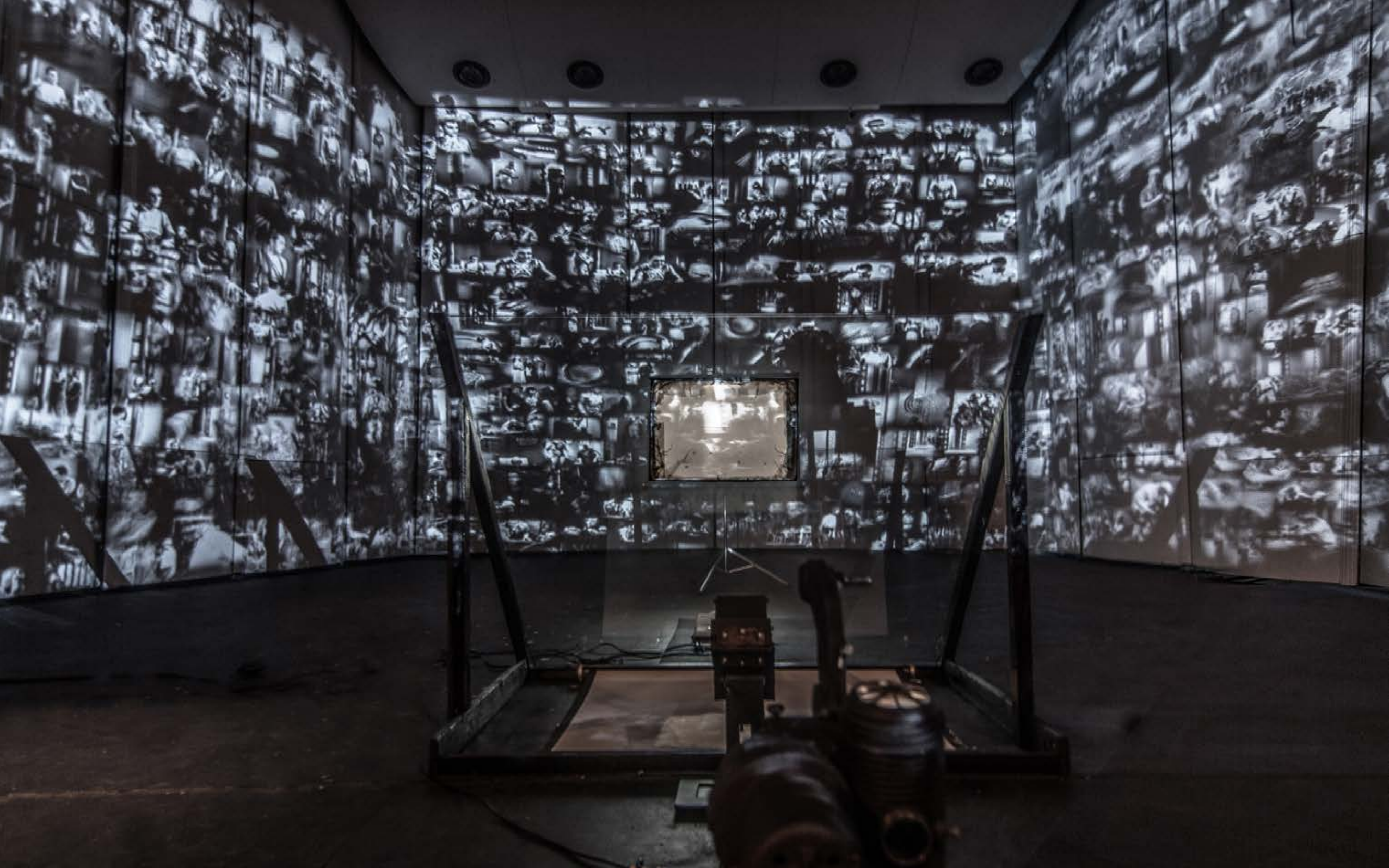
High resolution scan of the cover of Michael Pepper's "The True Story of Pepper's Ghost" published in 1890, full PDF on archive.org

Through this project I argued for a critical reading of the film *City of Lost Men*. Similar intentions underlaid the work of Micheal Pepper, as it is reported that "Both accounts by Michael Pepper and Dickens indicate their desire to confront audiences with an illusion that required active deciphering."[40]. Present in the theatre was a large pane of glass set into a rigid wooden frame at a 45 degree angle, a Pepper's Ghost an illusionistic device dating to the nineteenth century.

An invention by Michael Pepper, a Pepper's Ghost is a device which creates the illusionistic presence of a ghostly volumetric hologram. As evidenced in the quote above, a Pepper's Ghost was used in Fantasmagoria lectures, a circuit of surreal apparition based carnival sideshows which featured the projection of a person through a pane of glass, effectively creating a living volumetric hologram. As described below, the introduction of the illusionistic technique was at the crux of a crucial intersection between the arts and sciences-

Michelle Pierson writes of how, "Many of the key architectural features and instruments used in Pepper's and Morton's lectures- a darkened theatre, a mirror, a spirit lamp with a salted wick, a magic lantern- were used in the practice

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40   Groth, Helen. "Reading Victorian Illusions: Dickens's Haunted Man and Dr. Pepper's "Ghost"." Victorian Studies 50, no. 1 (2007): 43-65. doi:10.2979/vic.2007.50.1.43. 57.
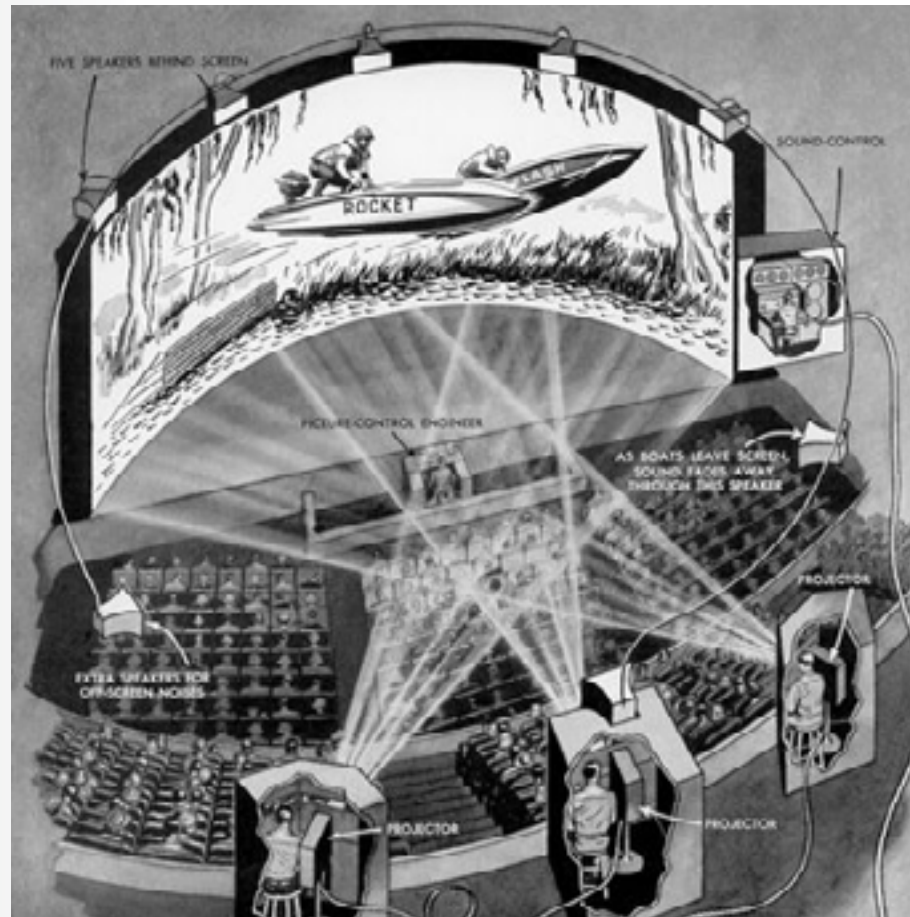
Drawing of Cinerama Concept
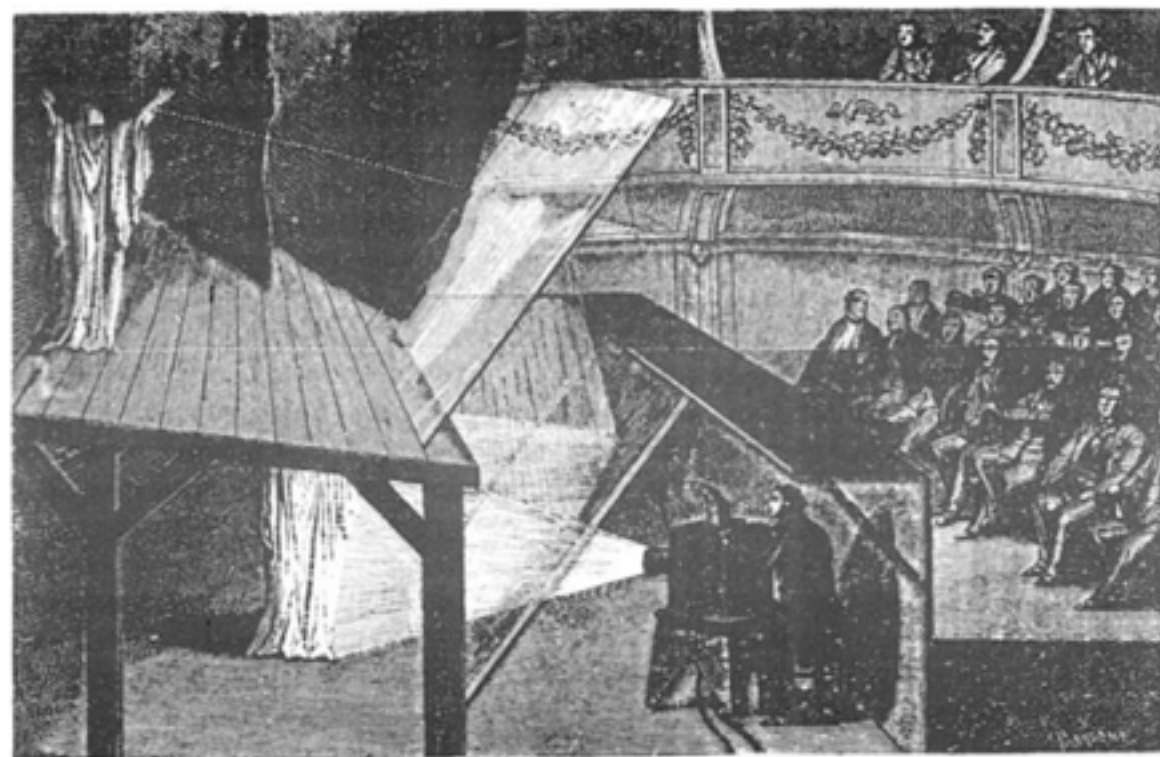
"Arrangement with a glass sheet and mirror," in Adolphe Ganot, Natural History for General Readers. Ed. and trans. E. Atkinson. London: Longmans, 1872. in John Henry Pepper, The True History of Pepper's Ghost. 1890. Facsimile ed. London: Projection Box, 1996.

of natural magic. Nineteenth-century popular science not only inherited its instruments from natural magic but also a tradition of public performance that subordinated the visual articulation of instruction and amusement to the intensification of aesthetic effect. Therein lay the secret to turning science into entertainment."[41]

The Peppers Ghost incorporated in the cinerama version of City of Lost Men was part of a system that allowed the viewer to re-edit the film. A theatre light canister on the side of the stage contained a camera, which fed a live feed of any particular scene a viewer was interacting with onto the Peppers Ghost, which was then projected over by the empty reel of a 35mm Film Projector.

This system let the viewer recompose the film in real time through a volumetric projection which was then diluted into the empty frame of a celluloid projectors light. This system was meant to both act as a form of cinematic exegesis and as a commentary on the digitization and computerized form of film present in cinema, a distinctly virtual form. In particular, this was meant to allow for the racial content to be reconstructed in the narrative, as multiple readings and reworking allow for a re-interpretation of the material through a different lens. Of the film, Roy Kinnard, "When a New York TV station broadcast The Lost City in the 1950s, the serial was considered so offensive and protests against it were so vocal that it was pulled in mid-run. Lost is historically important as one of the earliest sound science fiction movies, and as one of the first science fiction serials."[42]

41   Pierson, Michele. "Special Effects: Still in Search of Wonder," Columbia, May 2002. 14.
42   Science Fiction Serials: A Critical Filmography of the 31

PERFORMANCE

A still from Jack Smith's *Normal Love*, 1963

Regis Debray, in the essay "The Three Ages of Looking", outlined a broad framework for distinguishing between different approaches to seeing throughout history, as the result of the impact of different forms of knowledge dissemination: Logosphere, Graphosphere, Videosphere, each corresponding to a different "regime" represented as "after writing," "after printing," and "after the audiovisual." And while there are problems in such sweeping historical characterizations, Debray identifies significant cultural issues concerning the "investment" in images.

"The three "regimes" of presence", "representation," and "simulation" could roughly correspond to technologies of projections (before cinema), recording, rendering. Each of these stages created apparatuses for the creation of illusions or experieces that evoke "realities" that one could describe as fugitive, situated and situational."[43]

Though innumerable technologies form the genealogy of modern representational systems, the work of Jack Smith is particularly pertinent in suggesting continuity between historical and contemporary formations of immersion.

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A photograph of Jack Smith by Uzi Parnes

Jack Smith was born on November 14, 1932 in Colombus, Ohio, growing up fatherless in trailer parks in Texas and Wisconsin . Upon settling in New York in early 50's, he began experimenting with photography as a means of constructing elaborate scenarios, lush and erotic environments, which, when later projected as slides, would serve as experiments in the structure of theatre.

In the late 60's Smith began creating experimental theatre experiences in his loft-turned-theatre, *The Plaster Foundation*, where small gatherings would witness "performances that were variations on themes of personal relationships, perceived wrongs, and riffs on movie and radio drama of the 1950s, often featuring slide projection."[44] These performances were rooted in Antonin Artaud's theory that "the spectator is in the middle and the spectacle surrounds him"[45] (AA 258), and in this way, Smith empathized the lived experience of the audience inside the performance, as the difference between an actor and a non-actor was constantly in play.

Stefan Brecht writes of Smith's method, writing that "He was figuring out how to do it while doing it."[46] This experimental approach has its foundation in the Dada, Surrealist, and Futurist experiments in theatre from the early 20th century, merging them with the influence of mid-twentieth century pop culture and

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45
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Left, Maria Montez, original actress.   RIght, Jack Smith and Mario Montez filming

activating their dialogue with a distinctly queer and forthright assessment of humanity.

Jack Smith's role in the development of experimental theatre can be seen as a result of the shifting media landscape in which he lay heir to, as the emergence of a Hollywood star system, a transition from live theatre to recorded image, is a period in media history marked by a radical repositioning of the individual in relation to its image, both culturally and socially. Smith, born in "Golden Age" saw the rise of the "B-movie" star, a category resulting from a new mode of production, a cinema designed to make low-budget, accessible and yet melodramatic, distant worlds available to a wide public.

Influenced and obsessed with B-Movie star Maria Montez, it is said that "Smith saw her as the maker of all art and, in a process of projection, revisited her in the series of women and men he was to love and all the beauty he intended to create in his life. Thus at times, metaphorically, every pertinent phenomenon was screened through her"[47]

This influence extended into his art in a profound and formative manner, as a friend and performer, Rene Rivera, became cast as a character called "Mario Montez", deigned by Smith as her likeness embodied in male form. Mario Montez, dressed in drag, would perform in much of Smith's early film

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work, including the controversial and influential "Flaming Creatures", a short, scandalous underground film which incited riots and court hearings due to its provocative display of human genetalia and counterculture lifestyles.

Writing of Smith's theatre, film historian Edward Leffingwell remarks that "As art events and actions of the early 1960's embraced the worlds of dance, cinema, photography, music, and new technology in the gestation of what would be the multidisciplinary vogue known as expanded cinema, Smith combined film and slide projection with performance to produce one of the lively hybrid forms of the genre. And along the way, he collapsed the distinction between the development of an event and its performance."[48] In this light, Smith's engages in a type of theatre that parallels Antonin Artaud's Theatre of Cruelty, even incorporating taped radio speechs by Artaud during slide show projections of Normal Love in the early 1960's. (FC 162).

Both the Theatre of Smith and Artaud's Theatre of Cruelty share a theory of acting rooted in "a metaphysics of speech, gesture, and expression, in order to rescue (theatre) from its psychological and human stagnation" (AA 243) in which Smith contributes an expanded theatres which "put onstage particular energies that matched no existing mental forms already existing as habit within our consciousness" 9 a metaphysical form embodied in Smith's interplay of slide projection, performance, environment and film.

Illustration of a camera obscura from page 807 of Ars Magna, Lucis et Umbrae "The Great Art of Light and Shadow", Rome 1646 from the Rare Book Collection (r17 QC17.K6C46).

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Image Below: Me in Jack Smith mode during a Jack Smith cult film festival I held at Grandmother's house, turning the house into a work inspired by Smith.

CINEMA AND THE COMPUTER

Central to these conversations is the nature of information transmission, as media's relation to its audience has been historically staggered according to developments which change this relationship.
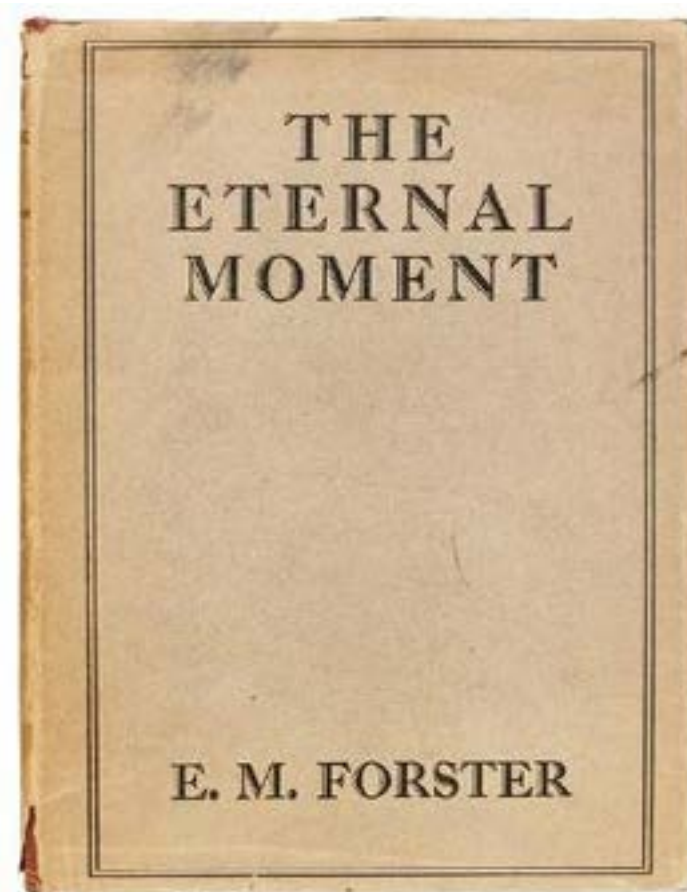
In a compilation of essays titled "Future Cinemas", Timothy Druckrey writes:

"Our theaters of the artificial have generated phantasmic experiences whose effects strain to induce sensations of affinity with incredulous "realities". So deeply has the relationship to "photographic resolution" [a kind of epistemological plateau] engrained itself in the imaginary that even the "virtual" worlds of computer graphics substitute themselves - if fleetingly - for existing worlds untethered from history, unfettered by the forces of physics, and liberated from any banal correspondence to actuality. The "cinema of attractions," and the "epic cinema" no longer capture or envelop the imagination. Now our "realities" are conjured and, often cold calculated (in both senses of the term.)"[49]

In the 1950's at the Institute for Advanced Study in Princeton, NJ, the birth of modern computing was developing under the watchful eye of John von Neumann and the Los
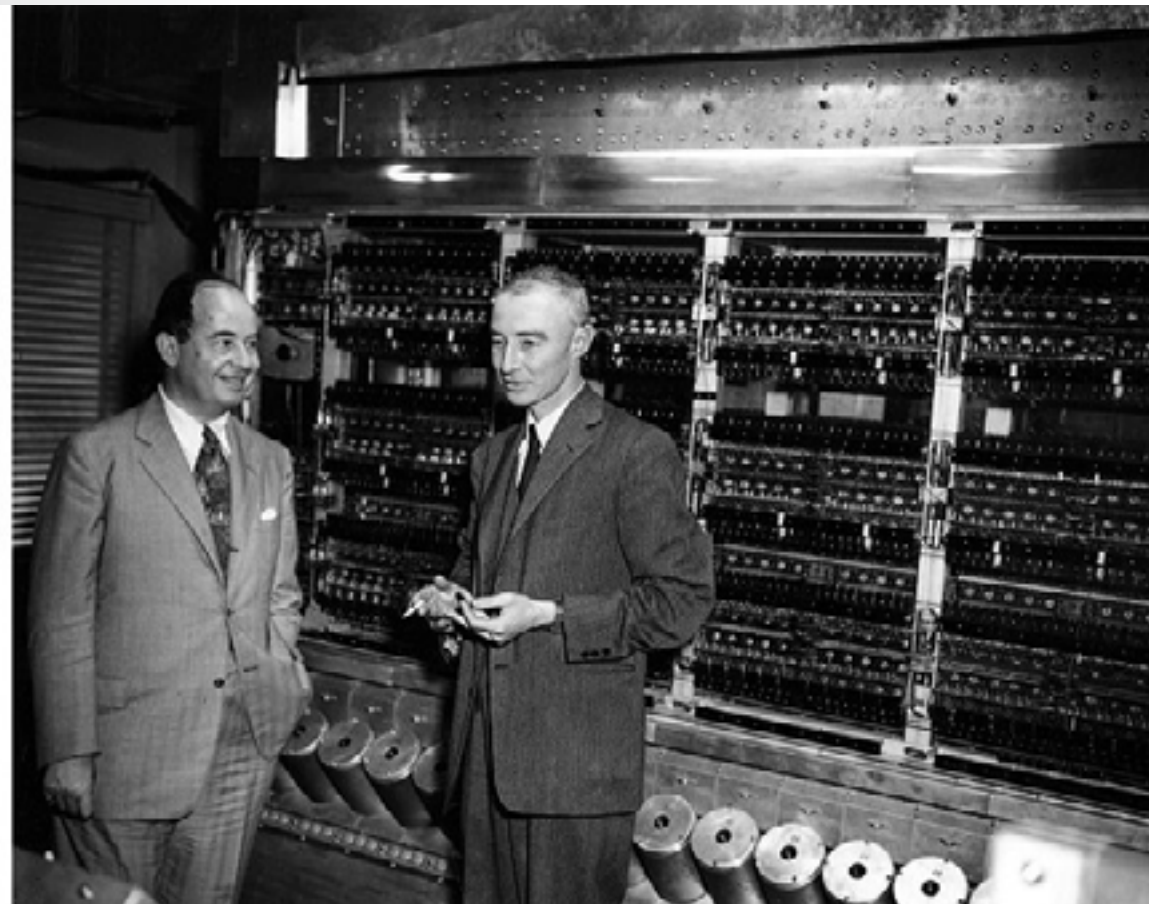
John von Neumann (left) and Institute for Advanced Study (IAS) Director J. Robert Oppenheimer in front of the IAS Computer in Princeton, New Jersey.

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Alamos group. A latecomer to the project, Nils Barricelli, started performing late computational processes on the machine, nicknamed MANIAC (Mathematical Analyzer, Numerical Integrator, and Computer). These experiments were later discovered to be early models of synthetic life, the birth of artificial intelligence, Baricelli's universe on punch cards.

In 1972, the worlds first fully computer animated motion graphic was rendered by Ed Catmull while in residence at the University of Utah, "A Computer Animated Hand". In addition to the hand, this sequence featured a 3d model of an artificial heart valve as well as two figures, who appear to interact with one another. This is the first documented example of a virtual person.

In 1909, E.M. Forester published a short story entitled "The Machine Stops". An allegory for the future, taking place somewhere in the 2000's, the story details the relationship between a mother and son, who like all humans, live underground and only communicate via "blue plates" reflective blue panes of glass where their images appear.

These three narratives punctuate the story of the modern computer as well as the nature of our relationship to the machine.

Cover of first printing of E.M. Forster's short story collection The Eternal Moment, featuring the first printing of The Machine Stops

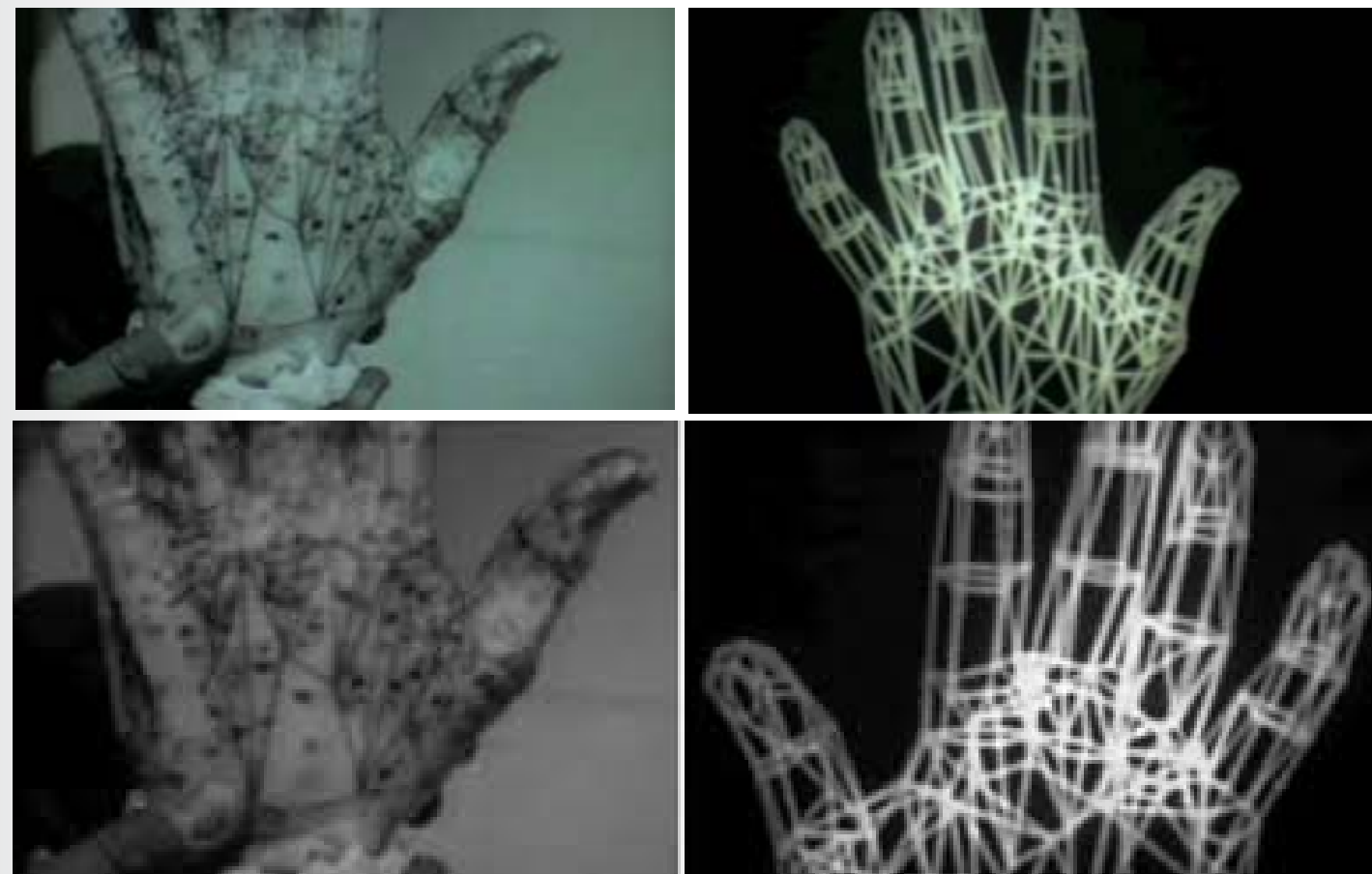Stills from *A Computer Generated Hand,* by Ed Catmull

John von Neumann and his group of scientists and mathematicians were living inside MANIAC while they were developing its hardware, the computers mainframe literally taking up the entirety of the office where it was born.

The primary function of this research was developing nuclear power, the bomb, in order to enable America to have the firepower necessary to defeat Russia. A covert operation occurring in this office was run by the Italian Norwegian Mathematician Nil's Barricelli, as he had begin to program sequences into MANIAC which were experiments in constructing infinitely random, self autonomous strands of information which mimic the DNA structure of molecules in machine language, a program that would give birth to the notion that there is life inside the machines that surround us.

A COMPUTER ANIMATED HAND

The film opens with the swirling movements of a crudely rendered three dimensional hand, appearing to greet the viewer, before showing off its range of motion, clenching, curling, and variously pointing as it flexes it's fingers.

This disembodied hand was the result of an arduous analog to digital process whereby Catmull's real physical hand was remodeled as a sculpture, with geometry mapped over its planes. These planes were then mathematically mapped into three

dimensional space where the coordinates could then be fed into a computer.

The result is an eerie, strikingly familiar object, a disembodied hand nonetheless appearing to move as if kinetically connected to a wrist, the body to which it is attached nonexistent, yet its motion very much the same that we are accustomed to in the biological human. In addition to the hand, two figures were created, each from a model of Edwin Catmull's wife, demonstrated in the short film interacting with one another through basic facial expressions. These two faces are likewise the first appearance of a fully digital human, a non-exaggerated variation of the human form reconstructed as digital data.

This hand and these figures signal the birth of the modern era of computer graphics. For the first time, one could see something in a world that composed of a completely different form of matter, code, which stood for and enacted something biologically extant in our physical world. The very essence of virtuality was born thus, in the moment of de-familiarized recognition where the world of the computer was able to hold internally a simulation of our collective human body.

Writing about the history of computer imaging at the very start of the 1990's, Andy Darley pointed out that "it is possible to discern developments whereby realistic imaging techniques developed in one domain, cross over and are applied in the

Stills from *A Computer Generated Hand,* by Ed Catmull

I re-created the hand according to the precise geometry of the original and remodeled it, allowing me to use it as the main character. This hand was then injected with motion data captured using a leap motion controller, which allowed me to extract real data from my hand gestures and place it inside the digital hand. This process allowed me to interact with the digital environment I created in the real space, and transfer the dynamics of my motion into the three dimensionally generated space.

"Many of the computer animation techniques that came out of MIT, Bell Laboratories, and the University of Utah during the 1970s- didn't just facilitate the development of military, medical, and industrial applications for computer graphics technologies (I.e., flight simulation, scientific and medical visualization, and computer aided design), they also facilitated the development of the computer graphics tools used to produce special effects for Hollywood films in the 1970s and 1980s. "

From then on, as the requisite software and computing power evolved allowing for continued experimentation in the realm of computer graphics, subsequent works featured complex shading, coloring, depth of field and a variety of rigging techniques allowing for experiments in motion. A large wealth

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A young Ed Catmull

of this work was done to foster scientific visualization and as such much of the images are of solar systems, organ research, experiments in three dimensional modeling of physics and other groundbreaking work in visualizing real, extant objects from a virtual and as such infinitely manipulatable perspective.

Jonathan Crary comments on the development of three dimensional graphics rendering, and he points to the particularly of this medias "severed relation" to the real-

"Computer aided design, synthetic holography, flight simulators, computer animation, robotic image recognition, ray tracing, texture mapping, motion control, virtual environment helmets, magnetic resonance imaging, and multispectral sensors are only a few of the techniques that are relocating vision to a place severed from a human observer"[51] (Crary)

The wealth of early computer generated animation available online serves to create an archive of a particular cultural vernacular present during the late 1970's and 1980's, a world of lush colored curves, noodle-y spirals jumping around on checkerboards, weird proto human machine hybrids and neon laced loops of future highways.

The aesthetic of much of this early work lucidly emphasizes

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the materials by which it is made, being very much "within" the data void of the computer, as these graphic objects often hover without a context, or, are likewise made of materials that approximate the real but serve to offer an ideal, uniform and unadulterated textured version of their original referent. By extracting and pulling from these animations looped segments which then become isolated animations, I am able to catalog and archive the movements and dynamics crucial to these early experiments and re-collect them into a uniform world where they can cohabitate with one another.

This world became a modern 3-dimensional space that catalogs the animations according to their inter- relationships, creating compositions that attempt to articulate a time line of computer graphics, starting from the television as a vehicle for visualization and ending with the computer as the modern incarnation of the media center.

Crazy points to the type of conceptual space I tried to develop, in tandem with earlier incarnations of similar ideas with different media, when he writes: The formulation and diffusion of computer generated imagery heralds the ubiquitous implantation of fabricated visual "spaces" radically different from the mimetic capacities of film, photography, and television. These latter three, at least until the mid-1970s, were generally forms of analog media that still corresponded to the optical wavelengths
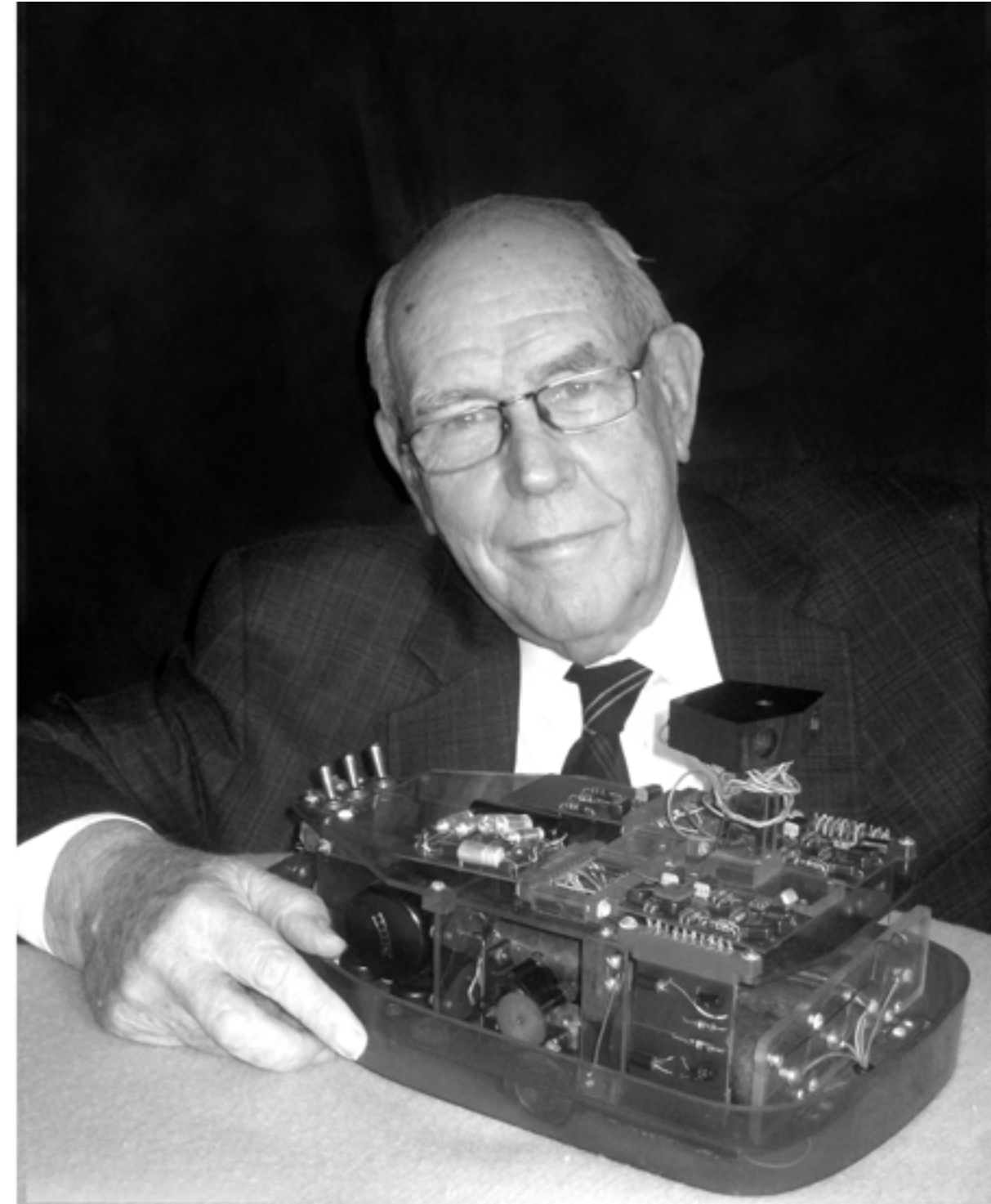
Stills from *A Computer Generated Hand,* by Ed Catmull
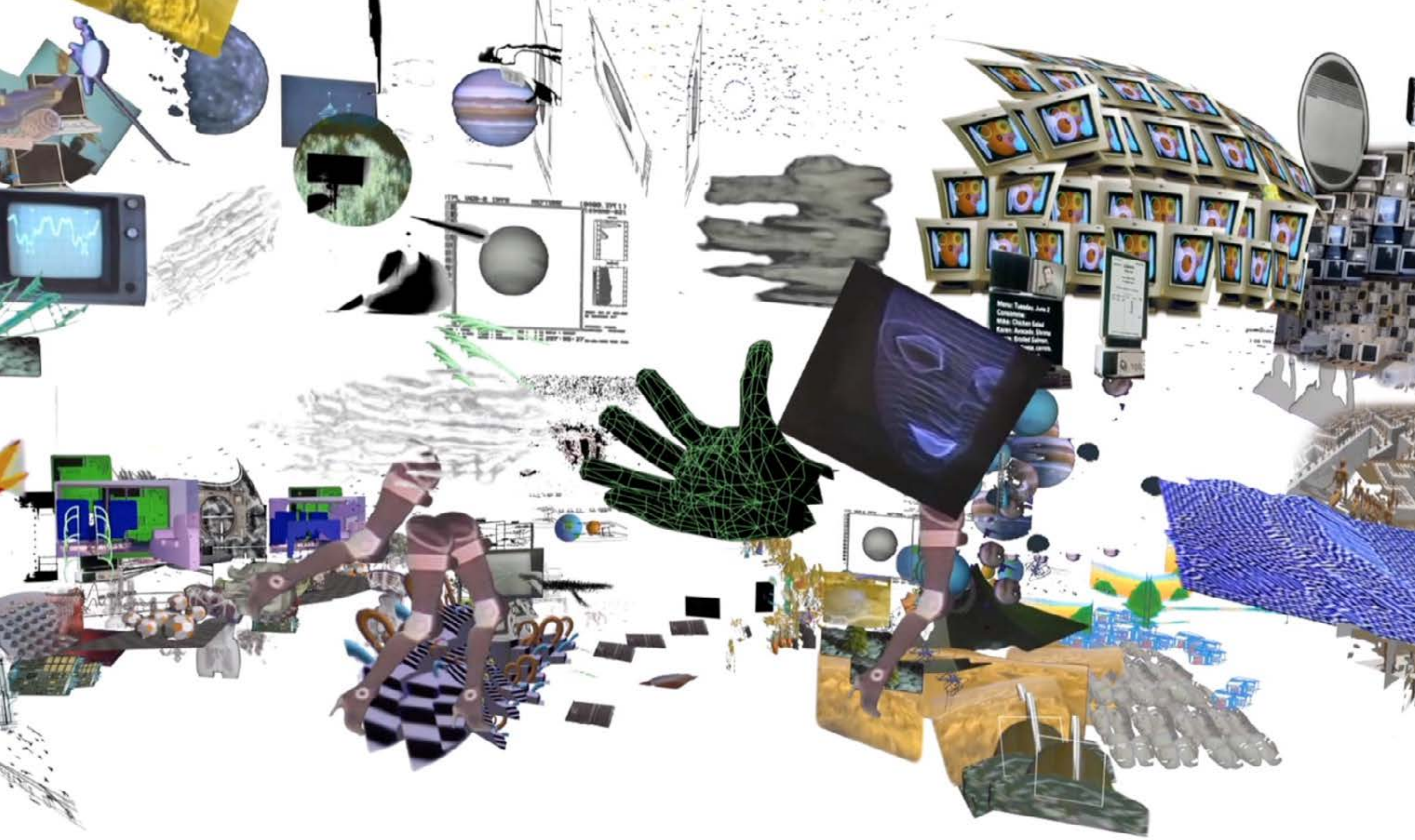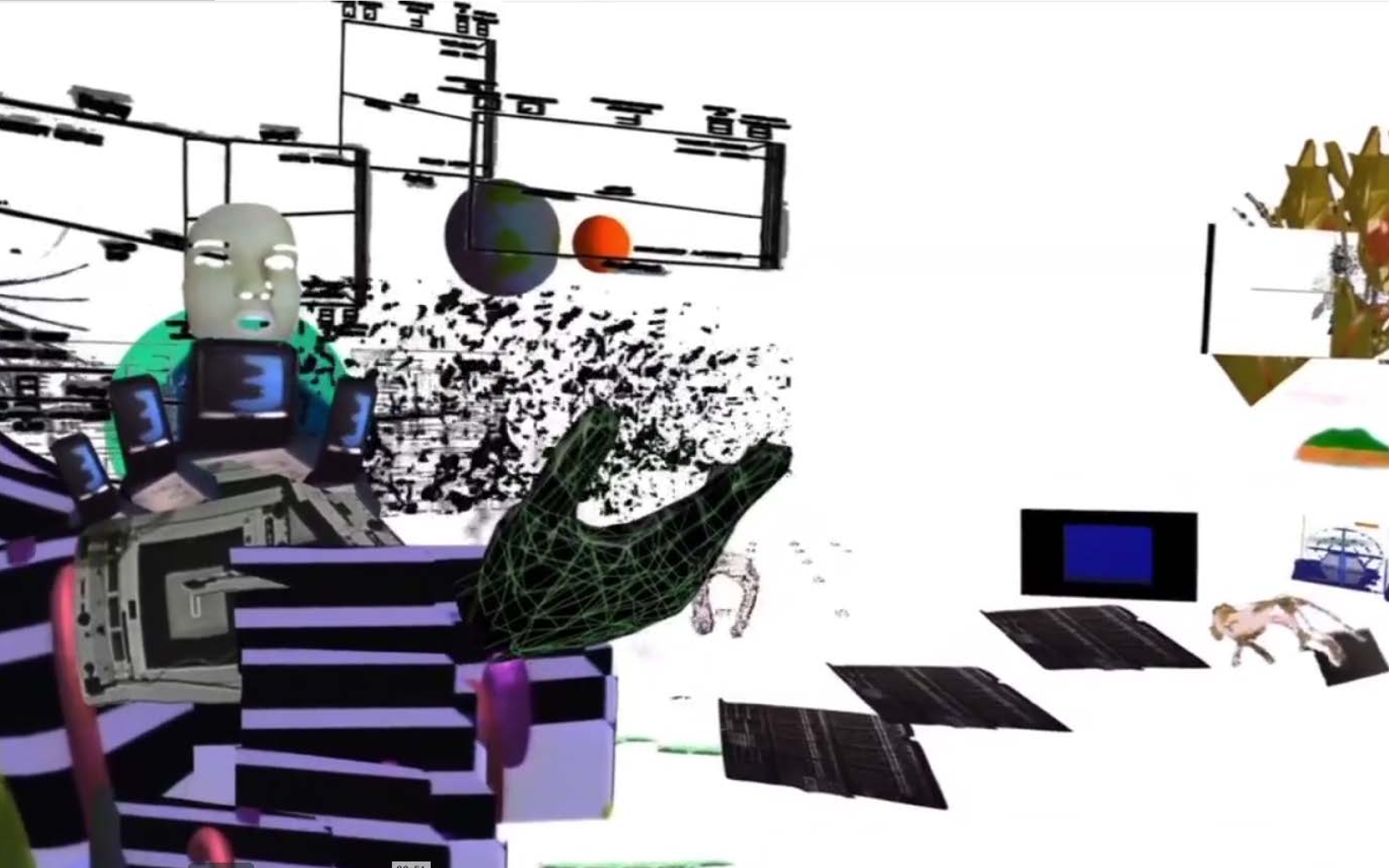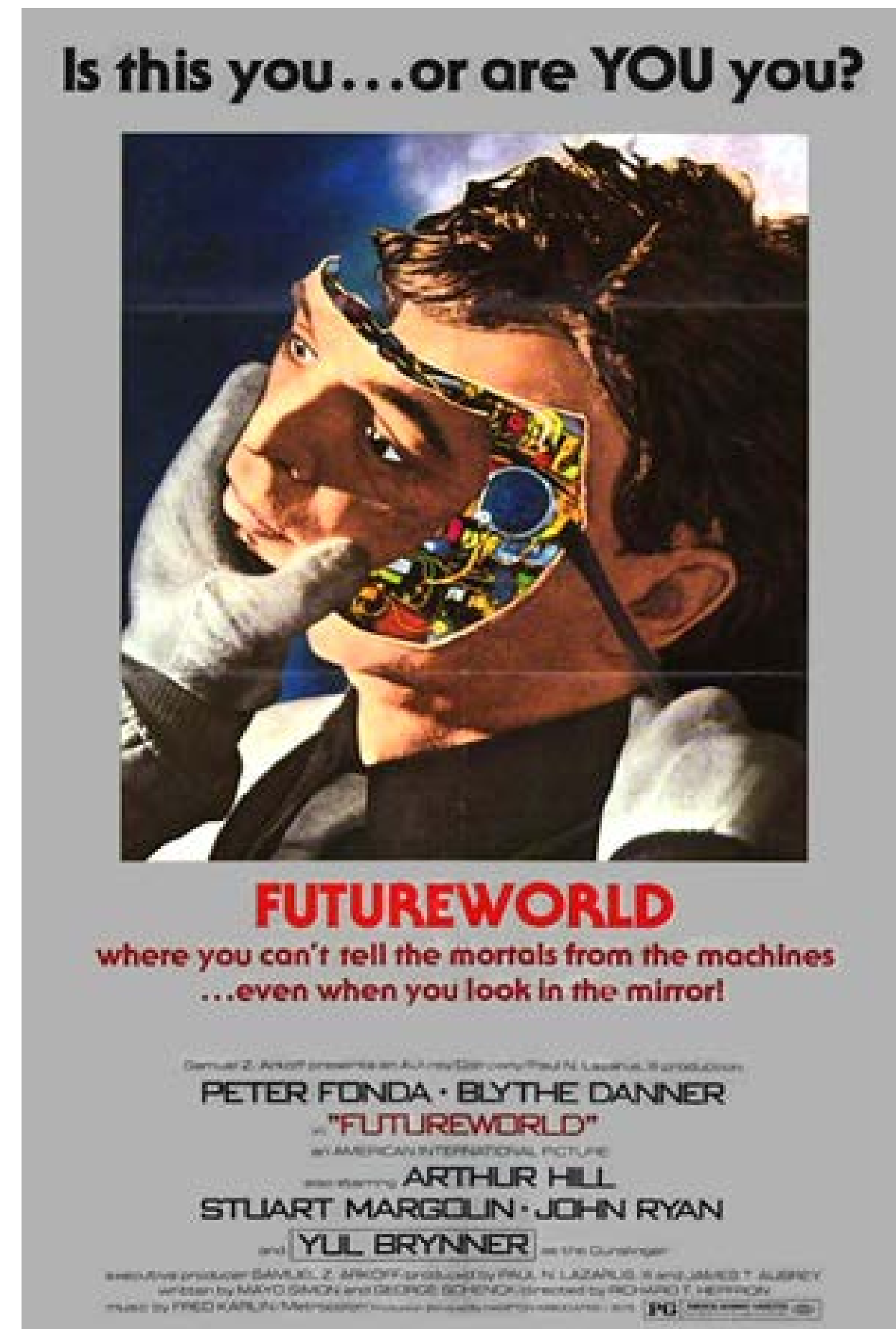
Ed Catmull's Computer Generated Hand was fetured in a background shot in this film, the first appearance of 3D motion graphics in a feature film

FUTUREWORLD

COMPUTER GRAPHICS

Ivan E. Sutherland, as an undergraduate at Carnegie Tech in the 1940's, and in the present day, posing with his Machina Versatilis

Ivan E. Sutherland

Ivan Edward Sutherland was born in 1938 in Hastings, Nebraska. He was born there because he wanted to be with his mother. What follows is a story of Ivan's life, told to me directly from his mouth, and sometimes mine.

He is oftentimes considered to be the father of computer graphics.

RICHTER BLOCKS

Richter blocks played a significant role in how Ivan learned to think. He did not read until the third grade, but developed a highly sensitive visual language as a result of playing with these blocks. Each block part fits into certain architectural configurations with other parts; their relations, though variable, have constraints.

BLUEPRINTS

When Ivan was in grade school, each pupil had to cover their school-owned textbooks. Ivan's mother was thrifty, so Ivan's textbooks were covered with blueprints his father had discarded instead of store-bought covers.

During class, if his mind wandered, he would stare at his blueprints on the book covers and try to figure out what the diagrams meant. Ivan did not like to draw on paper because the eraser left ugly marks. He would have much preferred an interface that did not become messy so easily.

Ivan Sutherland as an undergraduate at
Carnegie Tech, courtesy University Archives
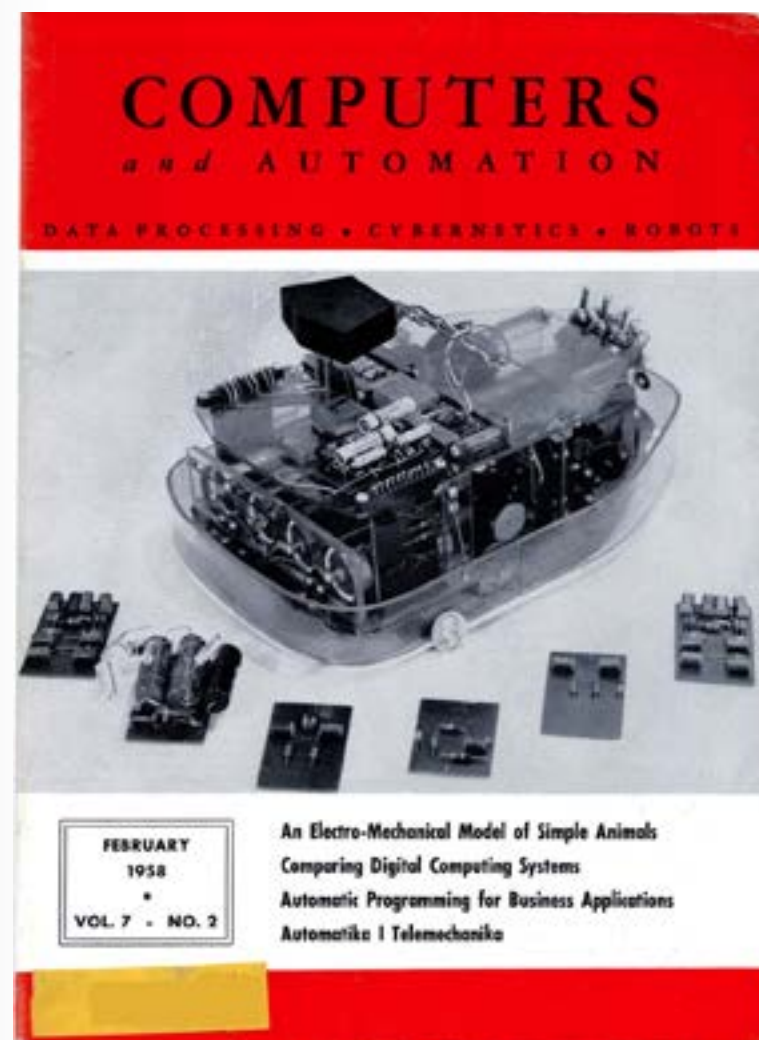
FRANKEN, THE MECHANICAL MOUSE

Anne Sutherland, their mother, took young Ivan and Bert to a Math Teacher's conference. There, the brothers met Edmund C. Berkeley, one of the founders of the Association for Computing Machinery. Bert and Ivan worked for Berkeley during high school.

Berkeley supported them in building a maze similar to the work of Claude Shannon, then a scientist at Bell Labs. Shannon had built a mechanical mouse that would fidget its way through a maze until it reached its goal. It would remember the path it had chosen in future trials. Ivan and Bert created a mouse they called "Franken", named after Frankenstein.

BELL LABS

Early on, Ivan had an opportunity to visit Bell Laboratories with Bert. A young Ivan accompanied Bert and Claude Shannon on a tour of the lab.

Shannon initially considered Bert to be the subject of the visit, but towards the end, young Ivan worked up the courage to ask Shannon questions about his method and work. Shannon later remarked, that at that point he came to the realization that "there were two of them"...

In 1958, when Ivan was a senior at Carnegie Tech, he co-published an article with his brother, Bert, and Malcolm G. Mugglin in Computers and Automation. Titled "An Electro-Mechanical Model of Simple Animals", the article begins:

"OUR SUBJECT lies in a novel and relatively unexplored field: to make a machine that mimics some of the characteristics of living things."[1]

The subject of the article was "Machina versatilis", a robot Ivan and his brother had been designing since high school, one of the first cybernetic animals to utilize transistors.

Machina versatilis was able to "chase lights, squeal appealingly when it bumped something, and attempt to avoid obstacles".

MIT

Ivan graduated from Carnegie Tech with a Bachelor's degree in 1959.

The same year, Ivan married Marcia, his first wife, who had grown up in Pittsburgh. Ivan chose to attend Caltech for graduate school, in order to take his bride as far away from his new mother-in-law as possible. Ivan and Marcia moved to California, where they lived a block away from the route of the Rose Parade.

Computers and Automation featuring An Electro-Mechanical Model of Simple Animals

1

Ivan at the TX-2

In January, during Ivan's first year at Caltech, Marvin Minsky and Oliver Selfridge from MIT came for a visit. During a large luncheon at the Atheneum, they told Ivan about the developing field of "computing" at MIT. Ivan held a National Science Foundation Fellowship that could be applied anywhere, so he transferred to MIT the following fall.

Claude Shannon, Marvin Minsky, and Steven Coons were on his Thesis Committee at MIT. Shannon remembered the much younger Ivan who had visited him, 10 years earlier.

The TX-2 Computer was developed at MIT Lincoln labs in 1958. It had a 7" CRT display with a resolution of 1024x1024 pixels. Designed by Wesley A. Clark, at the time it was the most powerful computer in the world.

There was no such thing as a mouse, so the TX-2 used a light pen to interact with the screen.

At the end of the summer of 1960, Ivan approached Wesley Clark at the Lincoln Laboratory. Ivan wanted to see if he could use the TX-2 for experiments with drawing. Clark said yes.

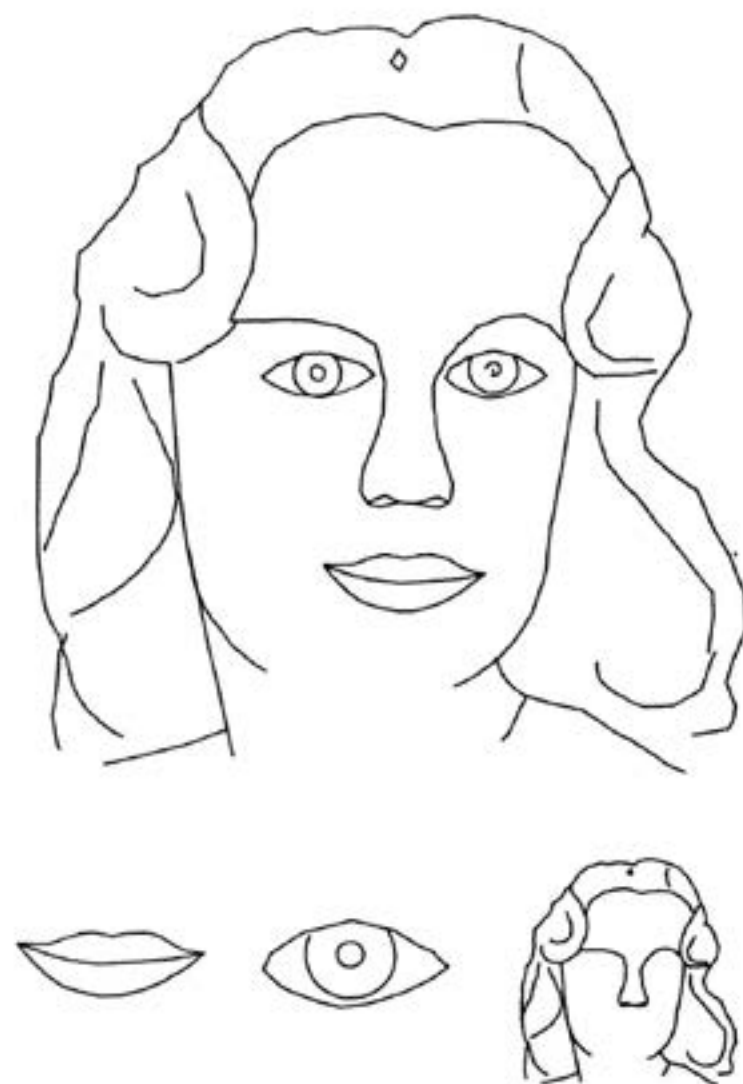Wesley Clark later said of this encounter that he "had built the machine for Ivan, but didn't know it at the time"...
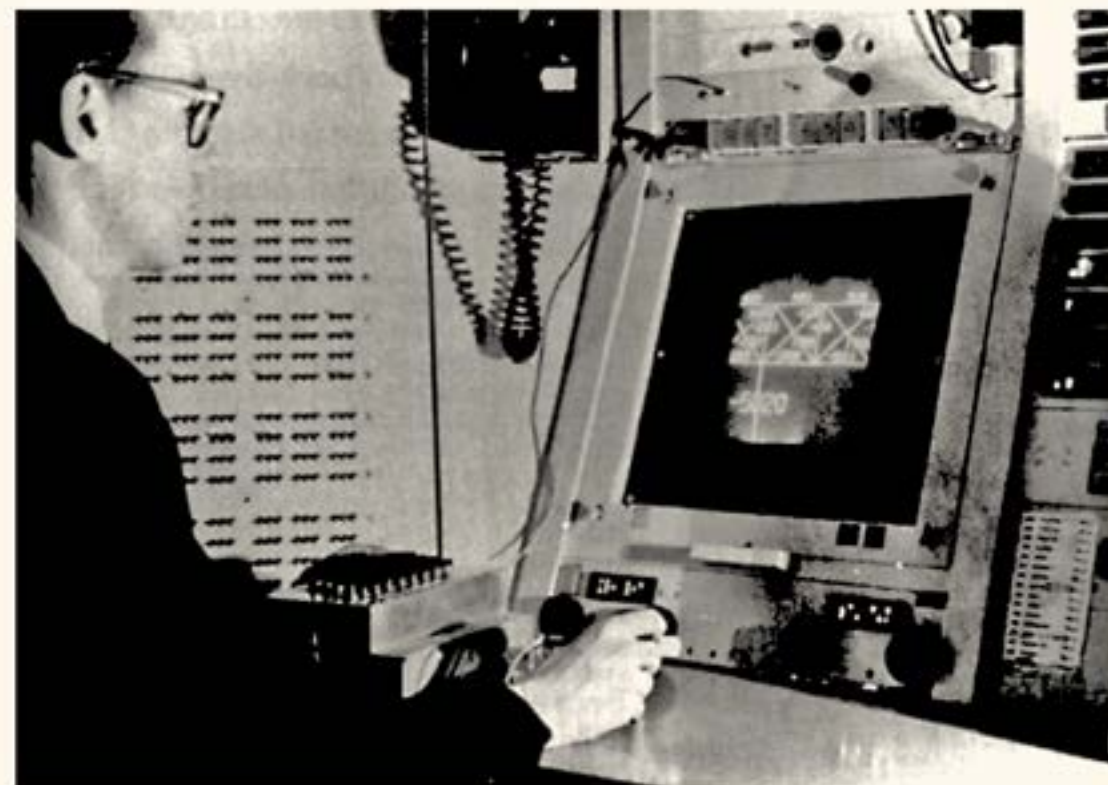
FIGURE 9.9.
GIRL TRACED FROM PHOTOGRAPH

Figure 9.9: (Originally on page 134.)

"Girl traced from photograph", Ivan Sutherland, 1963

On the TX-2, Ivan created the first real-time graphics display system in the universe, Sketchpad.

The display of "INK" on the screen provided a way for the light pen to start tracking. When the light pen touched "INK", the computer would begin tracking the pen position and "INK" would vanish. You could then begin to draw straight lines onto the screen from the light pen. Upon seeing the straight lines, Ivan's advisor, Claude Shannon, said "I think you should do circles."

In creating circles and lines, he ran into a problem. The computer has to figure out what is not on the screen and eliminate it, while still retaining its relations on the screen. He named this process clipping. When using Sketchpad, a user could set up constraints and relationships between segments and arcs, or combine horizontal and vertical lines into various shapes. You could bring in a copy of another picture as an "instance". You could reduce, magnify, rotate and place shapes.

Sketchpad simultaneously introduced the concept of a "window", the concept of "clipping", the ability to zoom, rotate, and duplicate polygonal shapes, the concept of drag and drop, the concept of copying and pasting, constraint specification, and "rubber banding"

It was magic.

Ivan finished with a Ph.D from MIT in 1963.

The first head mounted display

After military service, Ivan arrived as an associate professor at Harvard University in 1965.

Ivan had previously visited Bell Helicopter in Fort Worth, TX, where a "head mounted display" was in use to help aid a helicopter pilot land at night. A camera was mounted on the roof of the laboratory, where two people were playing catch. An observer in the lab could see this from a live feed, because the camera on the roof turned when the observer turned his head.

At one point, a player threw the ball at the camera. The observer ducked. The observer clearly thought he was where the camera was. Ivan thought, instead of a camera, why don't we use a computer?

He worked with a small group, including graduate student and future long term collaborator, Bob Sproull, on a head-mounted display they named "The Sword of Damocles". This refers to the Greek myth of Damocles, whose momentary good fortune was beset by a large sword, suspended over his head by a horse hair — the impending doom present in all abundance.

The display, whose position was measured by a mechanical connection from the ceiling, could rotate with the viewer. Half-silvered mirrors in the display imposed both the images generated by the computer and objects in the room into one view.
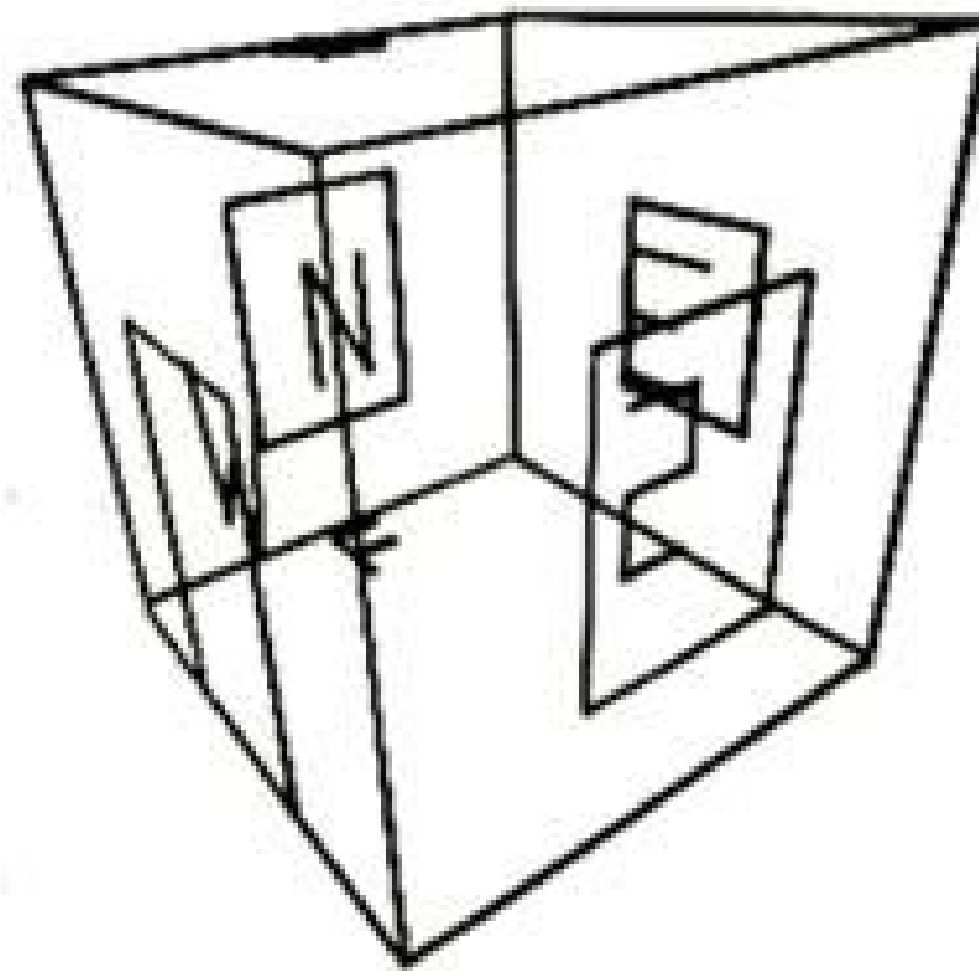
The first simulation was a geometric cube floating in the room with the viewer. Each wall of the cube was labeled with its orientation, N/S/E/W. The floor and ceiling were labeled respectively.

EVANS & SUTHERLAND

In 1968, while still at Harvard, Ivan cofounded a computer graphics company with David C. Evans, Evans & Sutherland. The idea came up while out at a restaurant in Phoenix, Arizona. Ivan moved out to Utah to be near David.

UNIVERSITY OF UTAH

Ivan also started teaching at the University of Utah in 1968, where he taught until 1974. The department at Utah was too small to cover a comprehensive computer science program, so they focused on the burgeoning field of Computer Graphics. This was a wise choice, as it resulted in the first class of students who developed and championed the discipline. Students at the time included:

David C. Evans

CLASS
Bui Tuong Phong
developer of the Phong shading method
Henri Gouraud
developer of Gouraud smooth shading
Frank Crow
developer of antialiasing algorithms
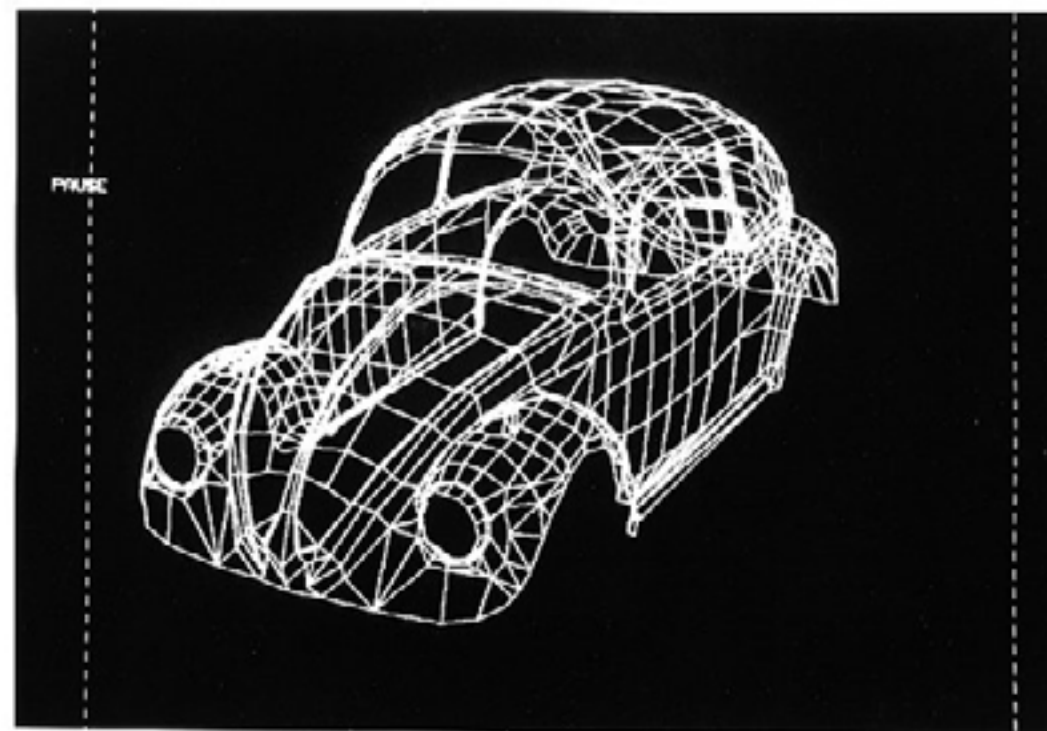Edwin Catmull
co-founder of Pixar, President of Disney
John Warnock co-founder of Adobe
Jim Clark,
founder of Silicon Graphics, Inc.

Image from the University of Utah, taping Ivan's Volkswagon Beetle
to make a 3D model

The 3D model produced from Ivan's Volkswagon Beetle

Ivan had the idea that they could measure objects in order to make computer models of them. Ivan brought a whole bunch of yardsticks, tape measures, yellow watercolor paints, strings, carpentering levels and squares to class one day.

This picture shows several students measuring the polygonal faces of Ivan's Volkswagen Beetle, mapping out the planes to find the coordinates. The class also experimented with photogrammetry, taking numerous photographs from multiple angles of an object as references for 3D models.

Evans and Sutherland received a contract to make graphics "of naval interest." Ivan asked his student, Danny Cohen, to add an airplane to a rendering they made of an Aircraft Carrier. Danny added Snoopy on his Sopwith Camel, doing a barrel roll over the model of a nuclear carrier.

Ivan thought this picture much funnier than the Admirals who later saw it.

Raj Reddy in an Oculus Rift

In the early 1980's, Raj Reddy, the founding director of the Robotics Institute at CMU, called up Ivan while he was at Caltech and said "Why don't you come back to Carnegie Mellon and run the Robotics Institute?".

Ivan thought about it, but decided not to. He knew he wouldn't be any good at something he didn't think was fun. He was able to arrange an ideal situation instead, as a self appointed "Visiting Scientist". So, the Institute provided him with a garage on campus, and he began to build a machine.

LEGGED LOCOMOTION

While at Caltech, Ivan met a young man named Marc Raibert. They met in Pasadena, California, while Marc was working at the Jet Propulsion Laboratory there. According to Ivan, Marc was persistent in having an opportunity to meet with Ivan, and his persistence paid off, as they soon became good friends and colleagues.

Ivan and Marc mutually encouraged one another in their research. Raibert told Ivan about his vision for "dynamic legged locomotion" and Ivan got excited . More than 40 years after his Machina versatilis, he returned to Carnegie Mellon to continue his investigation of "electric animals". Ivan decided to build a hexapod, inspired by insect locomotion. If you ask Ivan why he decided to do this, he will tell you, "because it was fun."
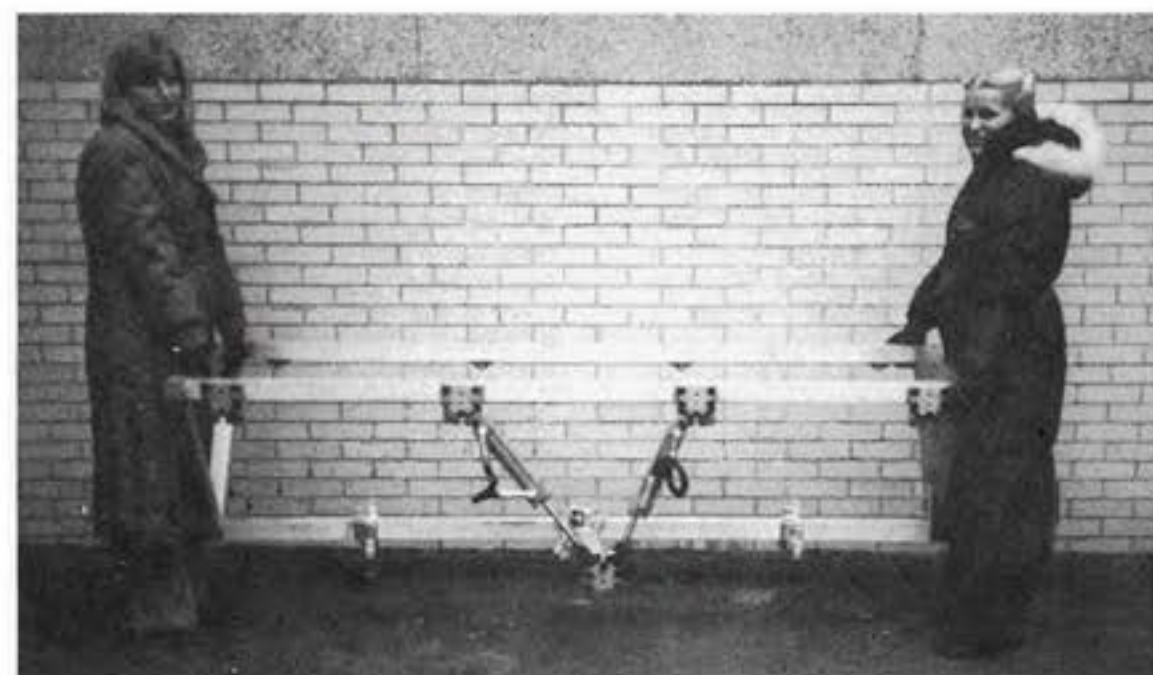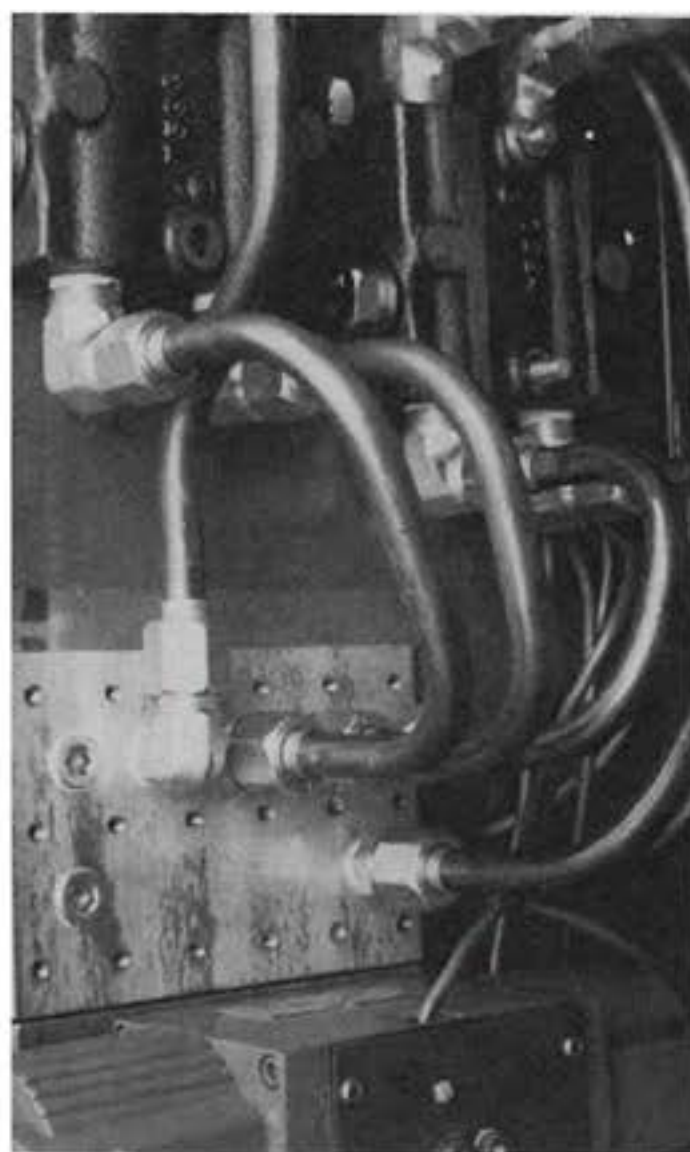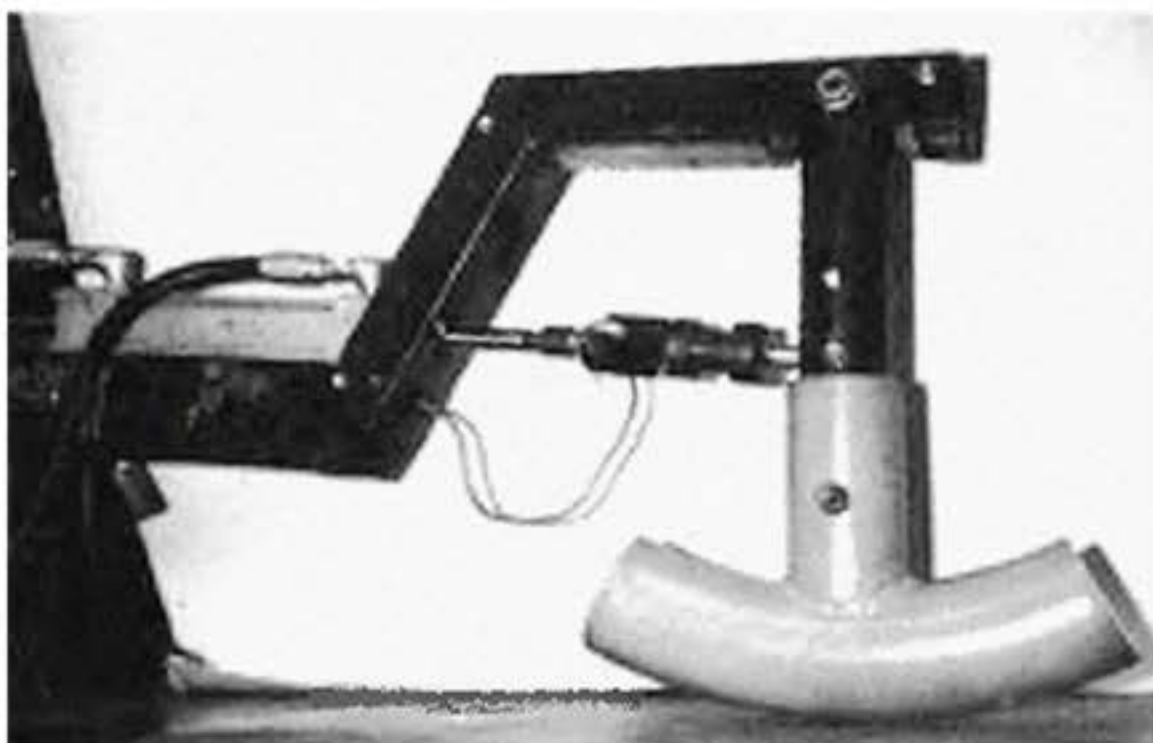
Ivan had first thought it would be small, but he thought it would be more fun if a human could ride it. Having a human rider set the scale, Ivan says. Finished in 1983, Ivan's machine is significant in being "the first man-carrying computer-controlled walking machine". At eight feet long, with six hydraulically actuated legs, an 18 horsepower gasoline engine, three degrees of freedom for each leg, and a Motorola 68000 microcomputer on board, the hexapod was a sight to behold. And it worked.

Students nicknamed it "The Trojan Cockroach".

COLLABORATION

A young man named Michael Ullner was a graduate student at CalTech, and he came with Ivan to CMU to do a post doc Ivan's long term collaborator, Bob Sproull, was a professor at CMU. They had first met when Ivan taught at Harvard and Bob was an undergraduate years earlier.

Ivan's brother, Bert, was in charge of the cockpit. He was able to finagle a Navy F-4 jet control stick from an old flying buddy in San Diego. Marc Donner, a PhD student at CMU, asked to be involved, and Ivan suggested he work out a system for programming gaits.

Marc Donner wrote a custom language to program the Hexapod, named OWL. It treated each leg independently and coordinated a gait cycle between each leg. Donner's PhD thesis, titled "Real-Time Control of Walking", is considered by some to be the first "official" PhD in Robotics granted by CMU.
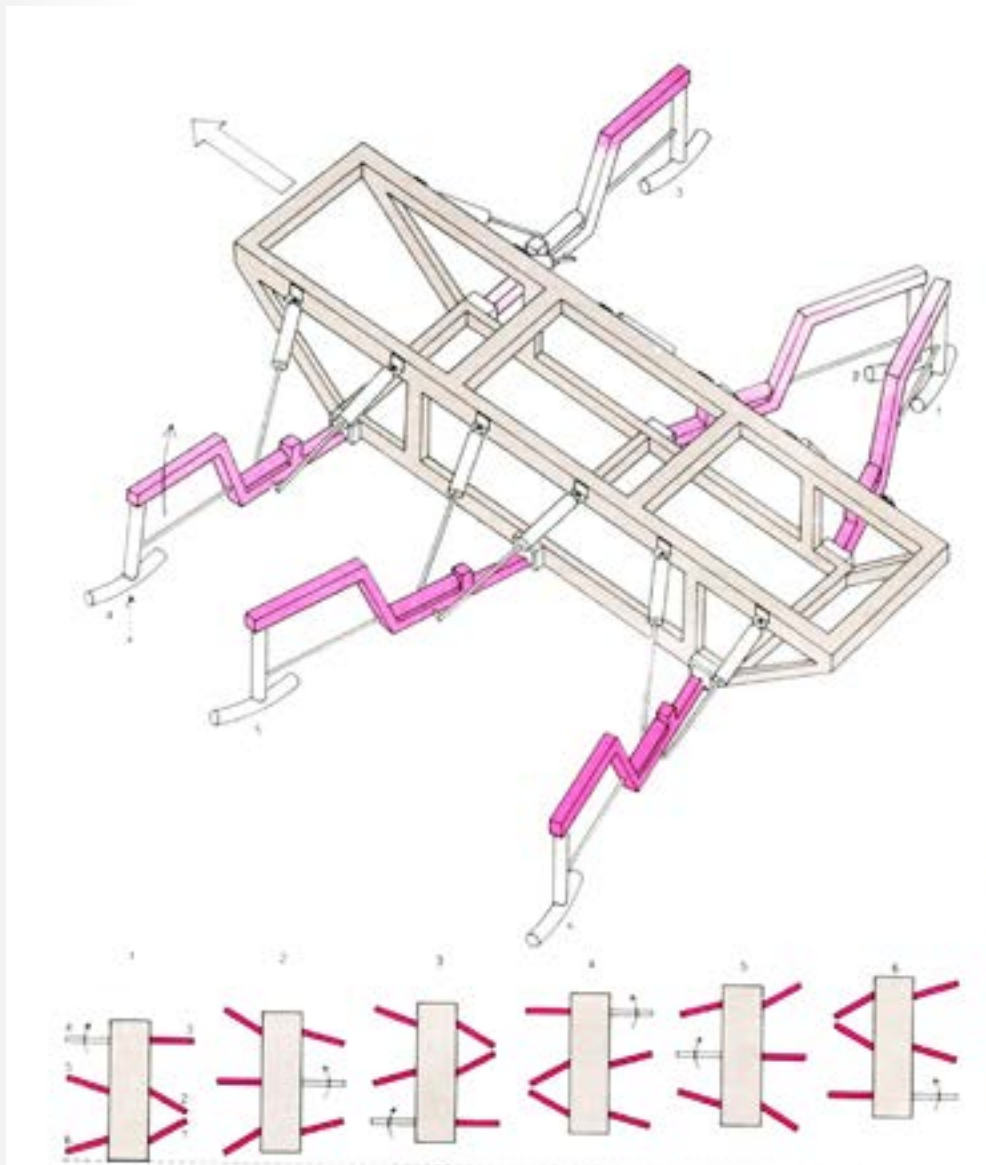
Diagram and gait studies for the Trojan Cockroach

Donner provided compelling insight into the nature of the insect nervous system and its parallels in robotic control systems. A major question in converting animal or insect locomotion to robotic movement is to discover the logic of the control system. A ganglion, a cluster of neurons, is associated with each leg in insects like ants and cockroaches. There is, however, a limited amount of connection between each leg to a common center. Instead, research suggests that control is distributed. Physiologists have shown that brainless and headless insects can still walk.

An observation from Ivan led to the concept of the "virtual leg".

CONTROL, CONTROL, YOU MUST LEARN CONTROL

A built in microprocessor controlled the movement of the legs by switching valves on and off to regulate the flow of oil to the hydraulic actuators.

The sensors in each leg sent information to the computer to report their position in space. The Trojan Cockroach crawled at about two miles per hour.

Each variable displacement pump was attached to three cylinders. Each leg was actuated by two cylinders.

When the two cylinders moved in opposite directions, the leg would move in a horizontal plane.

When the two cylinders moved in the same direction, the leg would move in a vertical plane.
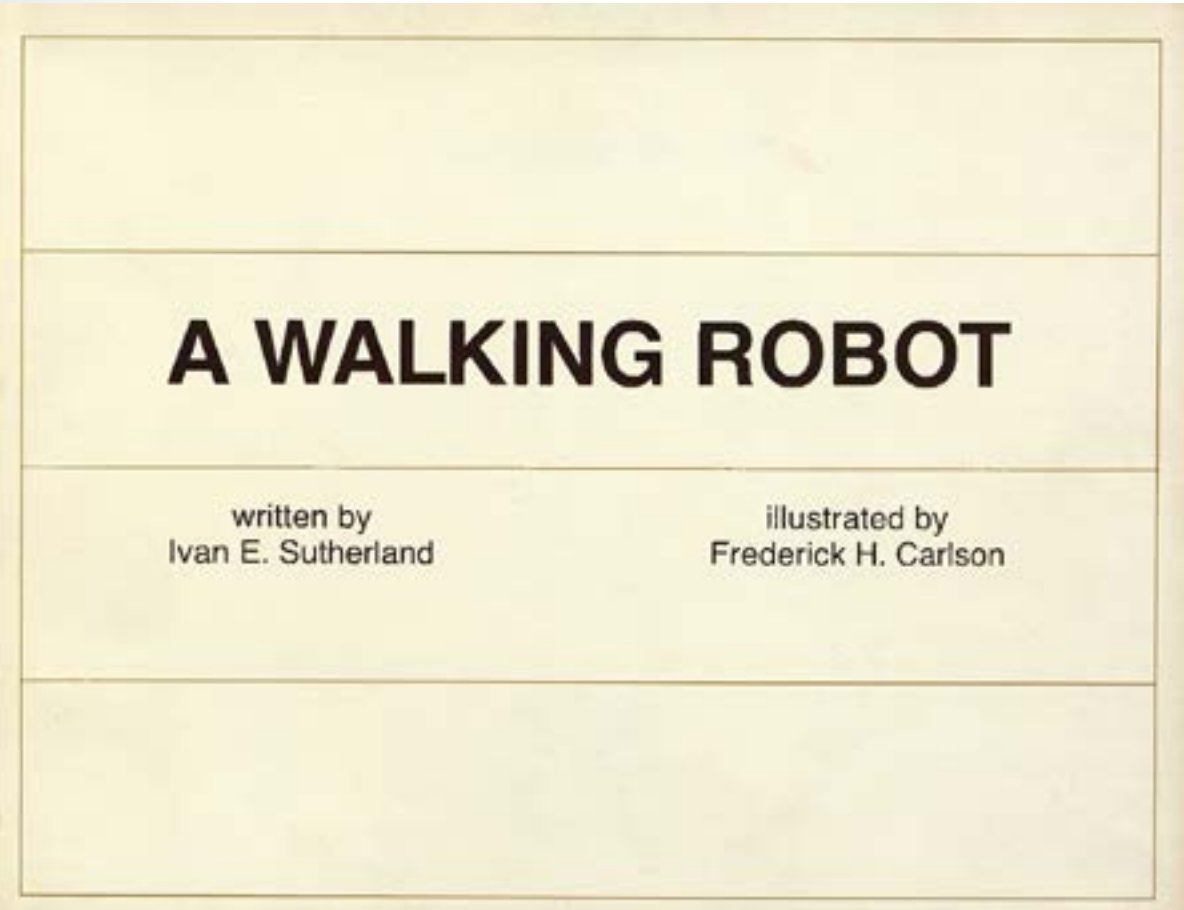
Cover of *A Walking Robot*

Claude Shannon came to visit and stayed with Ivan. He came by the garage to watch the hexapod.

Afterwards, during dinner at the Sutherland's, Shannon remarked "I saw Ivan's walking machine do a pirouette".

Ivan found the description funny because of the machine's immense size, but it did move very elegantly.

Shannon wrote what Ivan calls "a bit of doggerel - a "Higgledy Piggledy":

A Higgledy Piggledy

by Claude Shannon

"Ivan E. Sutherland built a huge cockroach, 12 horsepower clout,
but the roach,
waxing vengeful for previous roach genocide,
hexapodantally stamped Ivan out"

A passive dynamic walker, Edward Muybridge photosequence

In 1981, Ivan published "A Six-Legged Walking Machine", a detailed analysis of the hexapod. The version you see on display is the second printing, published in 1983, titled "A Walking Robot". Frederick H. Carlson drew the illustrations and Eddie Frank typeset the pages.

In retrospect, Ivan looks back and takes account of some of the mistakes in the Trojan Cockroach's design. Mistakes lead to discovery though, and many things were learned in the process. The scale of the machine did not fit the six legged design, as nature is prone to making hexapods with different proportions in mind. Balance would prove to be key in developing walking machines. Ivan and Marc co-published an article seen here in "Scientific American" which sketches out their different approaches to machines that walk. This was only the beginning.

PASSIVE DYNAMIC WALKING

In the late 1980's, Tad McGreer at Cornell perfected "passive dynamic walking". Tad, inspired by gliders, was interested in finding ways for robots to move without motors, sensors, or brains.

McGreer created a simple planar mechanism with two legs that could walk down a slight slope without any other energy source or control. The swing leg is a pendulum, and the stance leg is an inverted pendulum. The pendulums are tied together at the hip.

There is something altogether unsettling about watching this mechanism walk. Life for a moment becomes movement, as the movement of the legs is blinding to the eye, the precision seemingly human, automatic and natural.

EDWARD MUYBRIDGE

In 1860, Edward Muybridge left San Francisco on a trip to England to purchase antiquarian books. He mistakenly missed his boat, and was forced to travel by stagecoach across the country, intending to board a ship to England from New York.

En route through Texas, Muybridge's stagecoach lost control, crashing violently and injured everyone on board. Muybridge was violently thrown from the vehicle, suffering severe head injuries. He never fully recovered.

Psychologists have since speculated that Muybridge sustained substantial injuries to the orbitofrontal cortex, a part of the brain directly above the eyes. During his time recovering from this accident, Muybridge became interested in the burgeoning field of photography. He began taking photos.

Display case from Posner Center Exhibition
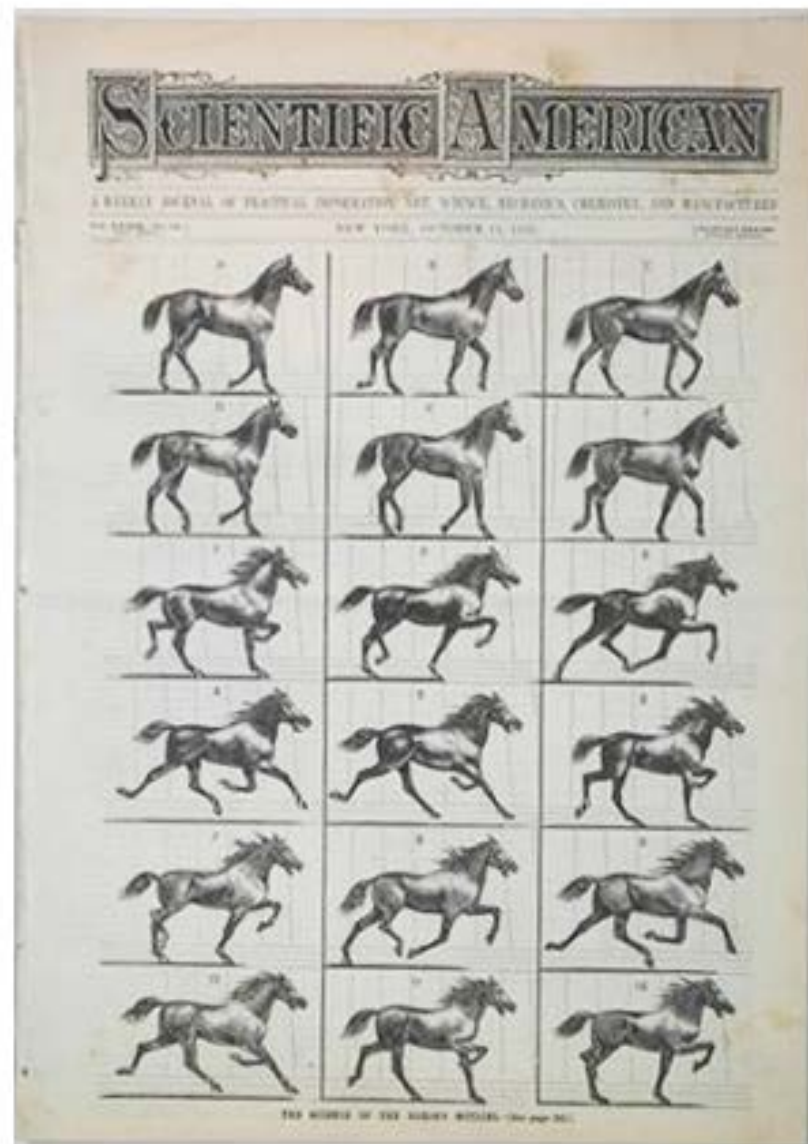
Scientific American - New York, October 19, 1878

HORSES

In 1872, nearly a decade later, Leland Stanford was racing horses. Stanford was considered by some to be a "robber baron". Stanford hired Muybridge to settle a debate- were all four feet of a horse off of the ground when they gallup?

It was traditionally thought that horses trot with one foot always against the ground, and that all feet are off the ground at a point mid-full gallop. Stanford believed in "unsupported transit", claiming that in both trot and gallup, there was a moment when all feet were off the ground.

To test this claim, Muybridge arranged a number of large glass plate cameras in a line along the edge of a racetrack. He set them each to be triggered by a snapping thread as each horse passed.

This study, titled Sallie Gardner at a Gallop or The Horse in Motion shows images of a horse with all feet off the ground during a trot. The illustrators had gotten it wrong. Between 1883 and 1886, Muybridge took over 100,000 images. In 1887, his major collected work was published, comprising 20,000 of the photographs, a groundbreaking work titled Animal Locomotion: an Electro-Photographic Investigation of Connective Phases of Animal Movements.

The etymology of the word "Robot" is rooted both in the history of theater and class politics. In Czechian, a "robotnik" was a peasant or a serf in the 19th century. The word "Robot" itself first appears in a theatrical play, entitled "R.U.R.", a science fiction play by Czech writer Karel Capek. R.U.R. is an acronym which stands for Rossum's Universal Robots.

It premiered on January 21, 1921, and introduced the word "Robot" to the world. R.U.R. takes place in a factory that makes artificial people out of synthetic organic matter. It details the uprising of a hostile robot revolution, ultimately resulting in the extinction of the human race.

ROSSUM'S ELECTRIC ANIMALS

The story starts with a scientist named Rossum, who, while researching marine biology, discovered a chemical that acted like a protoplasmic agent, similar to the living content of a human cell. Rossum began to try to make his own animals, initially failing to fully form a living copy of a dog and a man. His intention, beyond defying God, was to nullify God's existence all together. His nephew came to visit him, and seeing a different potential for the protoplasm, locked Rossum in his lab and hijacked his research.

The outcome of the younger Rossum's work results in a world filled with an inexpensive, popular and widespread "robotic" workforce. The play goes on to detail the outcomes of this new

First edition of R.U.R. Rossum's Universal Robots

work force - a decline in human births, a new, world-wide robot economy, and the gradual development of ever more advanced, fully formed versions of Rossum's Universal Robots.

ELECTRIC FROG LEGS

Luigi Galvani was born in 1737 in Bologna, Italy.

On January 26th, 1781, he discovered frog electricity.

Galvani was slowly skinning a frog on a table sometime in the middle of the 18th century. The table had been used for conducting experiments with static electricity. He was rubbing the skins of frogs.

His assistant, by accident, touched an exposed sciatic nerve of the frog with a metal scalpel that had been charged with static electricity. They looked down and saw sparks, and the dead frogs legs started kicking. Seeing this happen made Galvani investigate the relationship between electricity and animation. Galvani prepared an electrostatic generator with a connection to a copper wire, and attached this to a nerve above a frogs leg. The leg began to move.

This was the discovery of "animal electricity".
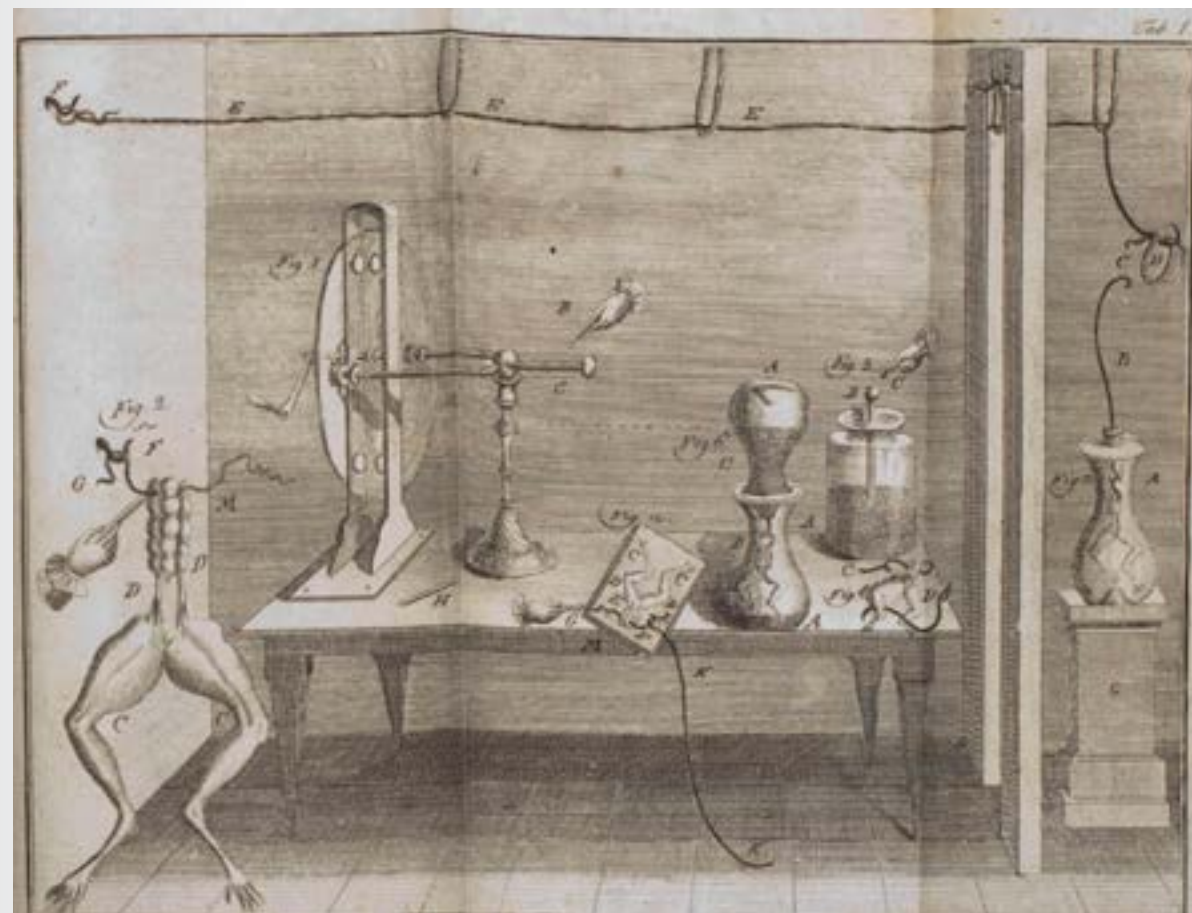
Prints from Galvani's treatise on the physio electrical effects of animal electricity

Luigi Galvani

Galvani's deduction was that there is a fluid that flows from the brain through the nerves into the muscles where it is turned into motion.

The phenomenon becomes known as "Galvanism". Today, the study of galvanism is called electrophysiology.

"Wherever frogs could be caught they were used to repeat the strange phenomenon. In the light of the struggle and revolt against established order which marked the period (a successful revolution by the colonial Americans against the British crown, and the beginnings of revolt against the King of France), it can be seen how eagerly laymen and scientists in great numbers hunted the hapless frog to see for themselves how by the use of a few pieces of metal, dismembered limbs were caused to revive. Here, indeed, was the promise of the release of a new vital force."[2]

_____

2
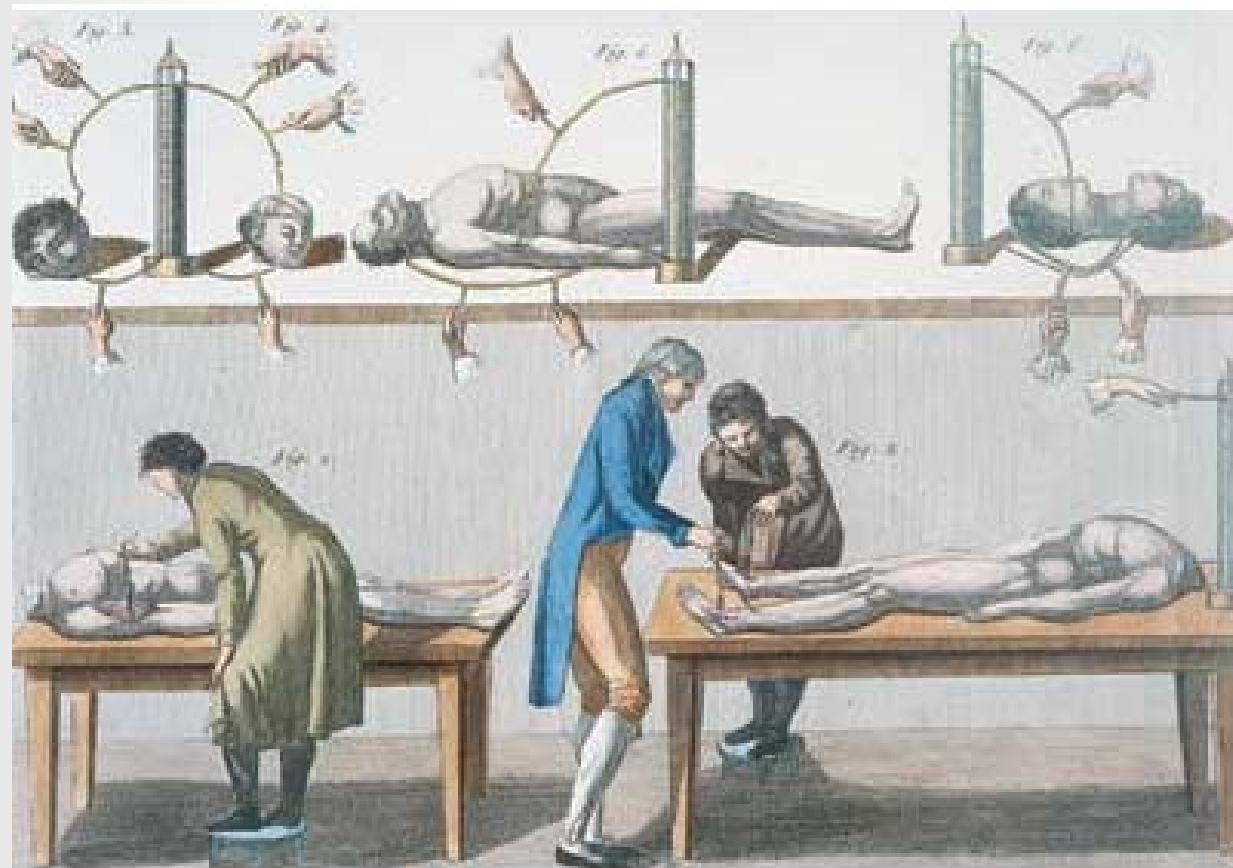
Stills from *A Computer Generated Hand,* by Ed Catmull

REANIMATION

On the 17th of January, 1803, a man named George Foster was hanged at the Newgate Prison for the murder of his wife and child, who he had drowned in the Paddington Canal. Immediately after being hanged, his body was brought to the home of Joannis Aldini. Aldini, who had worked with Galvani on the bio-electricity experiments, attached a voltaic pile of 120 copper and zinc discs to the beheaded corpse. When the rods touched Foster's mouth and ear, an alarming incident was recorded, as Aldini wrote that "the jaw began to quiver, the adjoining muscles were horribly contorted, and the left eye actually opened." When one rod touched the rectum, the whole body convulsed- Aldini writes that "so much increased as almost to give an appearance of reanimation".

Aldini's attempt at reanimation ultimately failed- though, if it hadn't, the accompanying court officials would have ensured his demise regardless. A news report at the time observed, "as the law says, the condemned shall hang until he is dead; consequently, if recovered, they are liable to be again hanged up until they are dead."[3]

15 years later, Mary Shelley published Frankenstein.

3

Quadroped Hopper, Marc Raibert

How do you put life in legs? Ivan's friend, Marc Raibert, decided to use springs.

"Mechanical machines have a mind of their own. If you look at a mechanism that has a spring in the leg and a mass in the body, such a spring and mass forms an oscillator. There is a sharing of responsibility for producing a motion between what the control system does and what the mechanical system does" -Marc Raibert

At around the same time that Ivan was working on his cockroach, Marc Raibert founded the Leg Laboratory. The Leg Lab's current website cites the founding moment of the research, reproduced below.

Ivan and Marc met with Dr. Craig I. Fields, the director of DARPA, and he purportedly "salivated at the mouth" when Raibert pulled a small hopping machine out of a box. Some of the reasons cited by Raibert to develop robotic legs were mobility, an understanding of human locomotion, and expanding the accessibility of the world. The Leg Laboratory was based at Carnegie Mellon University from 1980-1986. Marc went to MIT in 1987, and started another Leg Laboratory there. At the lab they developed dynamically stable running monopods, bipeds, quadrupeds, hoppers, and more. The springs used in the legs of

these machines allowed for a "passive rebound" during the stance phase, and they used hydraulic actuators for the thrusting motion and angle control. (Raibert 1986).

Ivan and Marc's dream began to grow. An ad was put in the paper "looking for someone to work in a robotics lab". Ben Brown responded, and met with Ivan and Marc for an interview. Mike Chepponis was hired, and Jessica Hodgins joined in 1983. Jeff Koechling, Karl Murphy, Eugene Hastings, and others also worked in the lab.

The team at the leg lab discovered that control could be done with a few simple algorithms, in part because the mechanical system itself was responsible for a share of the computing. They applied Ivan's idea of the "virtual leg". The control mechanism would coordinate groups of legs simultaneously that shared support, making them all act like a single leg.
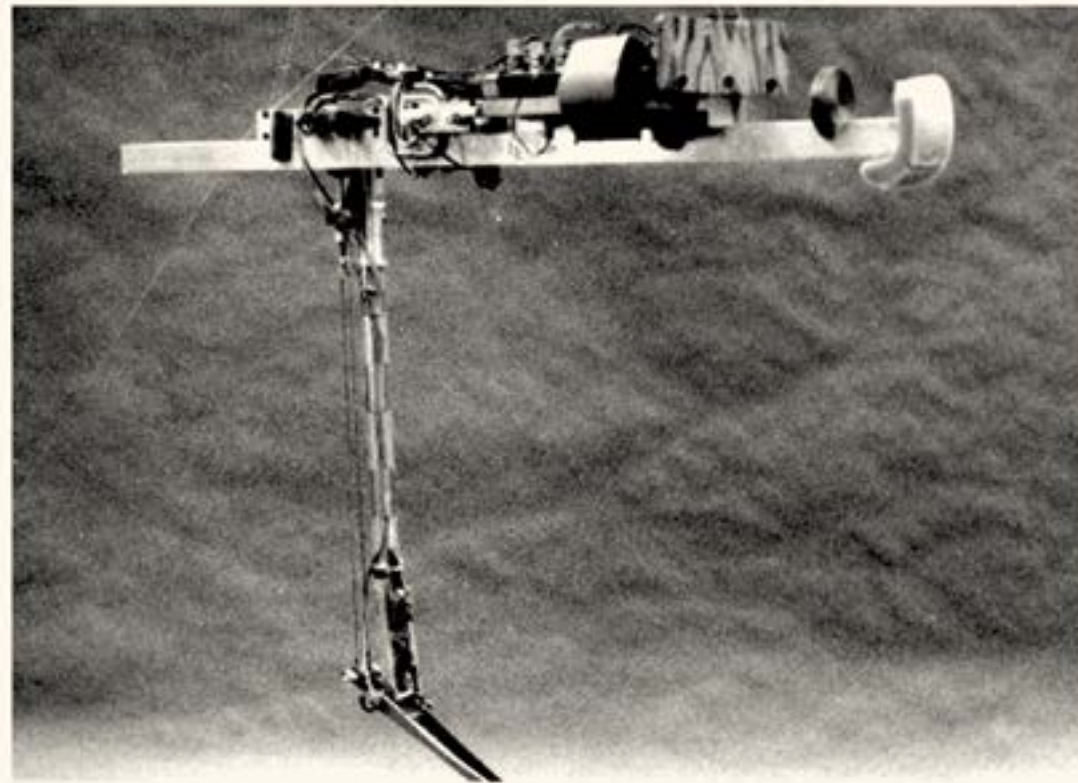
This is a foot from one of the Leg Laboratory's planar bipeds, featuring an internal binary foot switch used to detect ground contact. The switch was taken from dead HP calculators, and at one point, the lab ran out of calculators of the necessary model, causing panic. Also, next to the foot is one of Ben Brown's earliest bow legged hoppers. Garth Zeglin continued this research with Ben during his time at CMU.

Leg Laboratory Vitrine at Posner Center
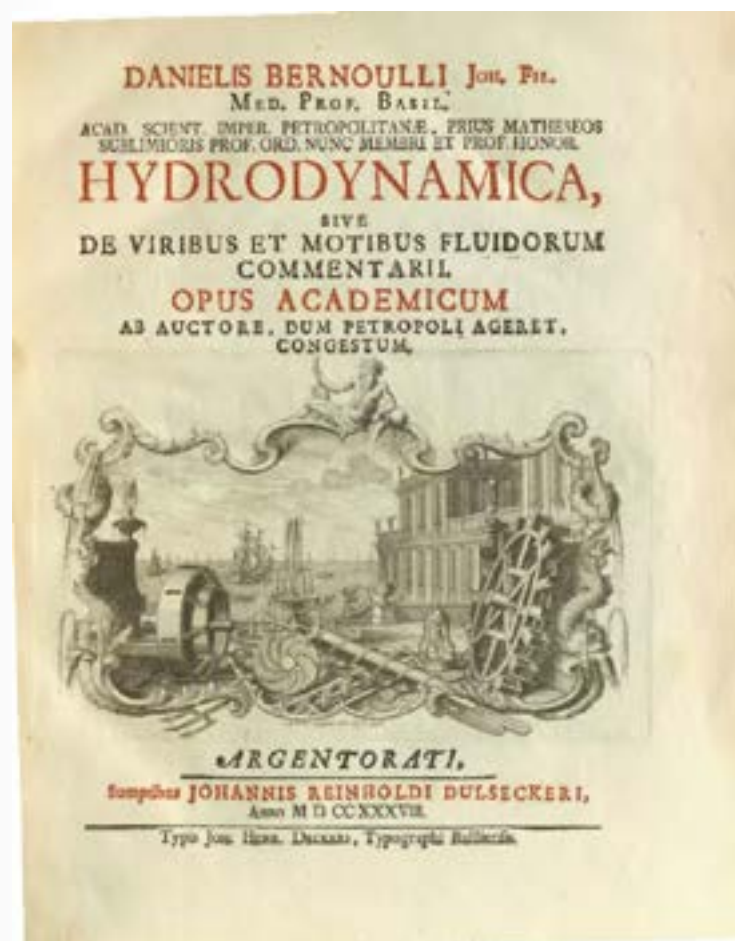
A One Legged Hopper from the Leg Laboratory

Studies at the Leg Lab emphasized the kinetic energy of the mass of walking machines. Raibert's lab developed actively balanced systems, which were unique in their ability to tip and maintain balance. Their designs allow for a sufficient base of support to be maintained in motion. The "polygon of support" is more free, and so these machines have increased mobility, as they can move all their legs to new footholds at a time. This takes into account the energy stored in each spring and the center of mass to deal with the potential speed and movement of the machine. The idea of active balance was central to figuring out a means of replicating animal locomotion.

RESEARCH ON ACTIVE BALANCE

Active balance as a concept has an interesting history, which goes back to the work of Claude Shannon, Ivan's advisor at MIT and the father of information theory. In 1951, Shannon used parts from an erector set to build a machine that balanced an inverted pendulum atop a small powered cart. The "Inverted Pendulum" idea used here proved crucial to understanding balance in legged systems. It is also crucial for launching rockets such as the Saturn V that went to the moon. Rockets are balanced on their thrusters in the same way an inverted pendulum is balanced on a cart.

Front page from Daniel Bernouilli's Hyrdronamica

Daniel Bernoulli wrote his doctoral dissertation on breathing.

Born in 1700 to a family of mathematicians, Daniel's father, Johann Bernoulli, was one of the early developers of calculus.

Bernoulli's study of anatomy and medicine led him to be inspired by William Harvey's On the Movement of Heat and Blood in Animals, which stated that "The heart is like a pump which forces blood to flow like a fluid through the arteries".

This metaphor between the mechanical and the natural inspired much of Daniel's work in the rules of fluid movement. Daniel designed an hour glass that would work while at sea. The trickle of sand remained constant even when the ship was turbulent. He designed it while ill in Venice when he was 23.

Daniel punctured the wall of a horizontal pipe with an open ended straw. The height to which the fluid rose was noted as an outcome of the fluid's pressure in the pipe. Soon, doctors throughout Europe began sticking pointed glass tubes directly into patients veins to measure blood pressure. For 170 years, this was how blood pressure was measured. Daniel realized kinetic energy in a fluid is exchanged for pressure. This is now how we measure the speed of air as it passes a plane.

Daniel's most important work was written in St Petersburg,

Hydronamica. Hydronamica is the first correct analysis of water flowing from a hole in a container.

This was based on an application of the the Law of Conservation of Energy. In this work, Daniel developed the idea of potential energy. Bernoulli's equation is a foundational element of physics, fluid mechanics, and aeronautical science. Daniel developed theories that led to the development of watermills, windmills, water pumps and water propellers.
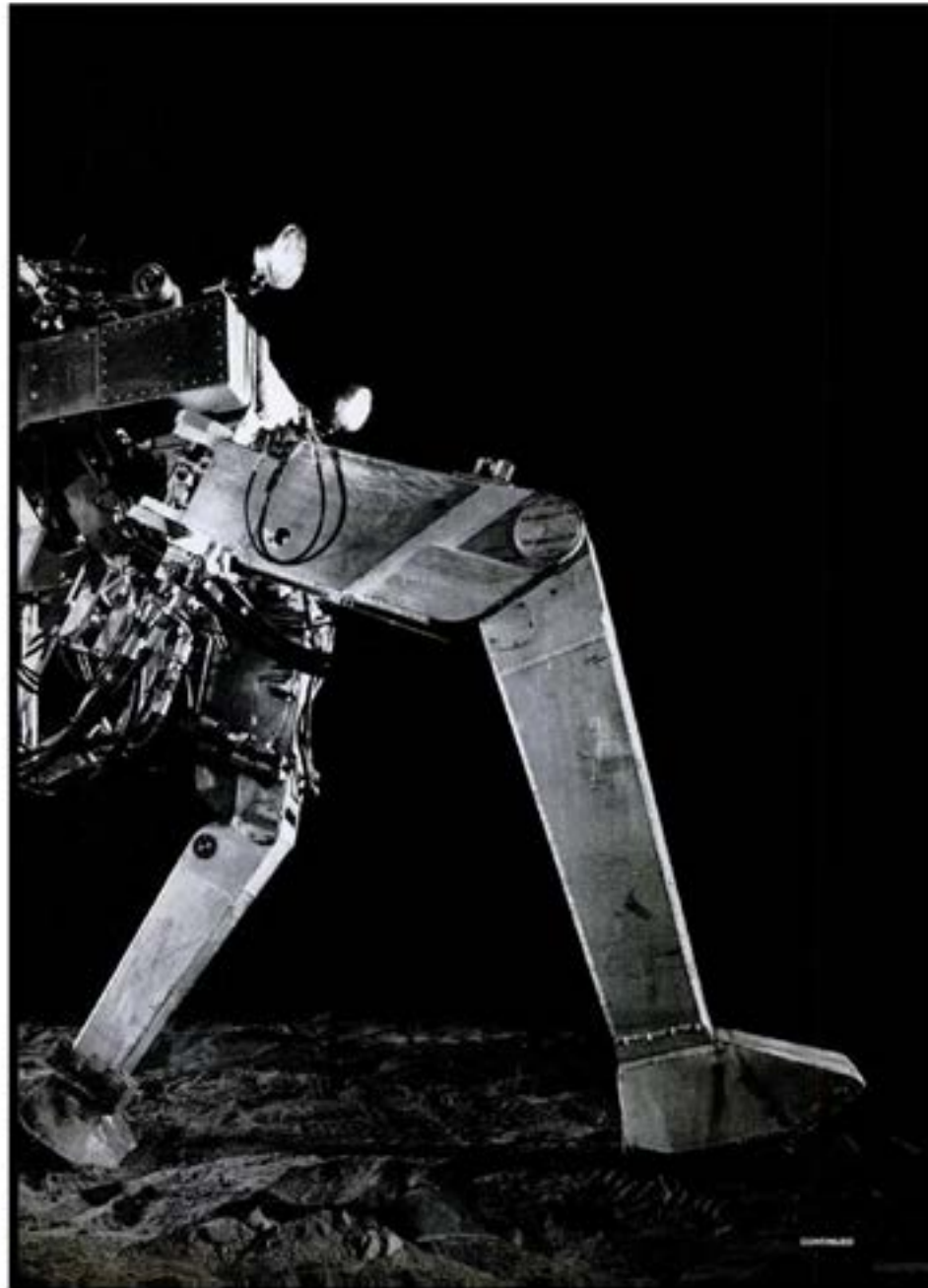
THE HYDRAULIC SYSTEM

The principles Daniel Bernoulli developed led to the innovations necessary for modern hydraulic equipment, a fundamental power source for many walking robots.

The hydraulic system of the Trojan Cockroach or any other walking machine can be thought of as a machines internal infrastructure, where the valves and hydraulics are the muscles, and the central hydraulic pump is the heart.

A metaphor to use for understanding hydraulics is to think of oil flow as current and pressure as voltage
.
PUMPS

The pumps used in the Trojan Cockroach's hydraulic systems are used for flow and not for pressure. As the shaft turns the

Hydronamica next to a hydraulic cylnder from the Trojan Cockroach

chamber containing oil, the oils flow is constrained, which squeezes oil out into an outlet pipe. This moderates the pressure by absorbing the flow.

WALKING MACHINES

The history of machines that walk is long and varied.

Cybernetic Zoo is an online resource that contains an exhaustive survey of historical ephemera related to robots that reference to biological designs. Many of the photos here are from this fantastic repository, and it is highly recommended as a virtual zoo.

Most of the robots built prior to the dynamic machines of Raibert were considered "static crawlers". The Trojan Cockroach as well as the machines see here are statically balance systems, which was the standard approach to legged locomotion for many years. This concept centers on the "polygon of support" provided by the feet, which allows the system to prevent tipping because the "polygon of support" is always underneath the center of mass.

Ralph Mosher's GE Quadroped

"Everything must have a beginning, to speak in Sanchean phrase; and that beginning must be linked to something that went before. The Hindoos give the world an elephant to support it, but they make the elephant stand upon a tortoise. Invention, it must be humbly admitted, does not consist in creating out of void, but out of chaos; the materials must, in the first place, be afforded: it can give form to dark, shapeless substances but cannot bring into being the substance itself".
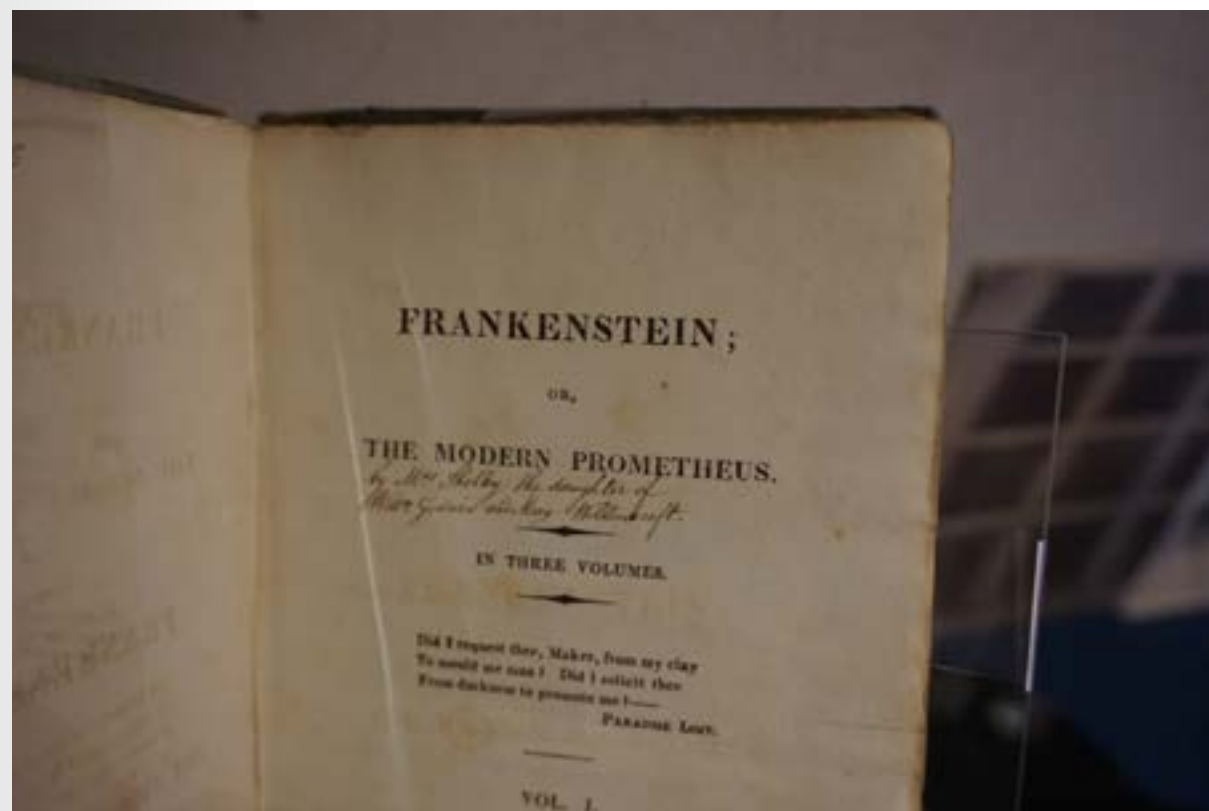
-Mary Shelley's Frankenstein; or, The Modern Prometheus, introduction, pg. IX

Shelley's meditation on the emergence of new phenomena touches on the very nature of invention and its potential, the materials and means needed to push the boundaries of knowledge.

Whether this is applied to the discoveries of fluid movements or to the gait cycles of a walking machine, the notion that the core of invention lies in something brute and at the base of being human holds true.

FRANKENSTEIN

In the preface to her novel, Frankenstein, Mary Shelley mentions the work of Luigi Galvani. She recounts chatting with Lord Byron and Percy Shelley late into the night while summering

Miniature of Mary Shelley by Reginald Easton, allegedly drawn from her death mask c. 1857

in a castle. They spoke of the philosophy of "Galvanism". One of the crucial paragraphs, reproduced below, illustrates the moment of recognition that life is a force, a creative force, though it is often outside of our control.

From Frankenstein, Chapter 5-

IT WAS on a dreary night of November that I beheld the accomplishment of my toils. With an anxiety that almost amounted to agony, collected the instruments of life around me, that I might infuse a spark of being into the lifeless thing that lay at my feet. It was already one in the morning; the rain pattered dismally against the panes, and my candle was nearly burnt out, when, by the glimmer of the half-extinguished light, I saw the dull yellow eye of the creature open; it breathed hard, and a convulsive motion agitated its limbs.

This passage from Frankenstein brings to bear the idea of life lost, but later restored. Life is in springs, in mechanical parts, in liquids, images, just about anything. It is an error to differentiate so quickly.

Where could ideas come from other than the world?

First printing of *Frankenstein* by Mary Shelley

FRANKENSTEIN

To know a truth- the biology is distinct from technology, that the world is purely physical, that machines are made of mechanical parts- is to know that we can question the status of these truths and endeavor to change them. The very nature of the idea of "life", "the living", "the real"- all are easily turned on their heads through the ages by the brilliance of certain individuals.

When you put your life into something, it might come to life.
THE CLOCK WAS INVENTED SO WE COULD ALL BE LATE

Ivan was in Australia lying on the beach and had the idea for the first in/first out register set in which the entire set of latches was fully symmetric from the front to back.

When Oracle bought Sun Microsystems, Ivan moved to Portland to found the "Asynchronous Research Center" with Marly Roncken. His primary focus is figuring out a way to help the industry escape from the "Tyranny of the clock". Ivan is spending his time rethinking time, the way it works, and how it structures our world.

He continues doing VLSI design and works with students at Portland State University.

Ivan said in a lecture once, "As the sands of time begin to run out, you mostly have memories. But young people are wonderful"

ACTA ERUDITORUM

Translated as "Reports/Acts of the scholars", this was the first scientific journal, published from 1682-1782. It was founded by Otto Mencke and Gottfried Leibniz. A monthly publication, it was a fulcrum point for advances in science and a place where ideas were shared among enthusiasts, laying the groundwork for our era's advances.

Below is the first published illustration of the "Step reckoner", a digital mechanical calculator invented by Leibniz. Completed in

Acta Eruditorum showing Gottfried Leibniz's Step reckoner

1694, it was the first calculator that could perform addition, subtraction, multiplication and division. Only two prototypes were ever built.

Somewhere in this design one could find the idea of the computer, the concept of which has taken several hundred years to ferment.

BIG DOGS

Raibert founded Boston Dynamics in 1992, after many years developing legs with colleagues in his labs at CMU and MIT. Boston Dynamics was purchased by Google in 2013.

Little Dog, seen here, is a smaller version one of Boston Dynamics most widely publicized accomplishments. A smaller version of their groundbreaking Big Dog, it is quadruped designed to further develop research on legged locomotion. Each leg has three electric motors, and it's torso houses an onboard computer for sensing, actuation, and control.

THE STORY

I found the parts of the Trojan Cockroach in the hallway of the basement of Wean here at CMU.

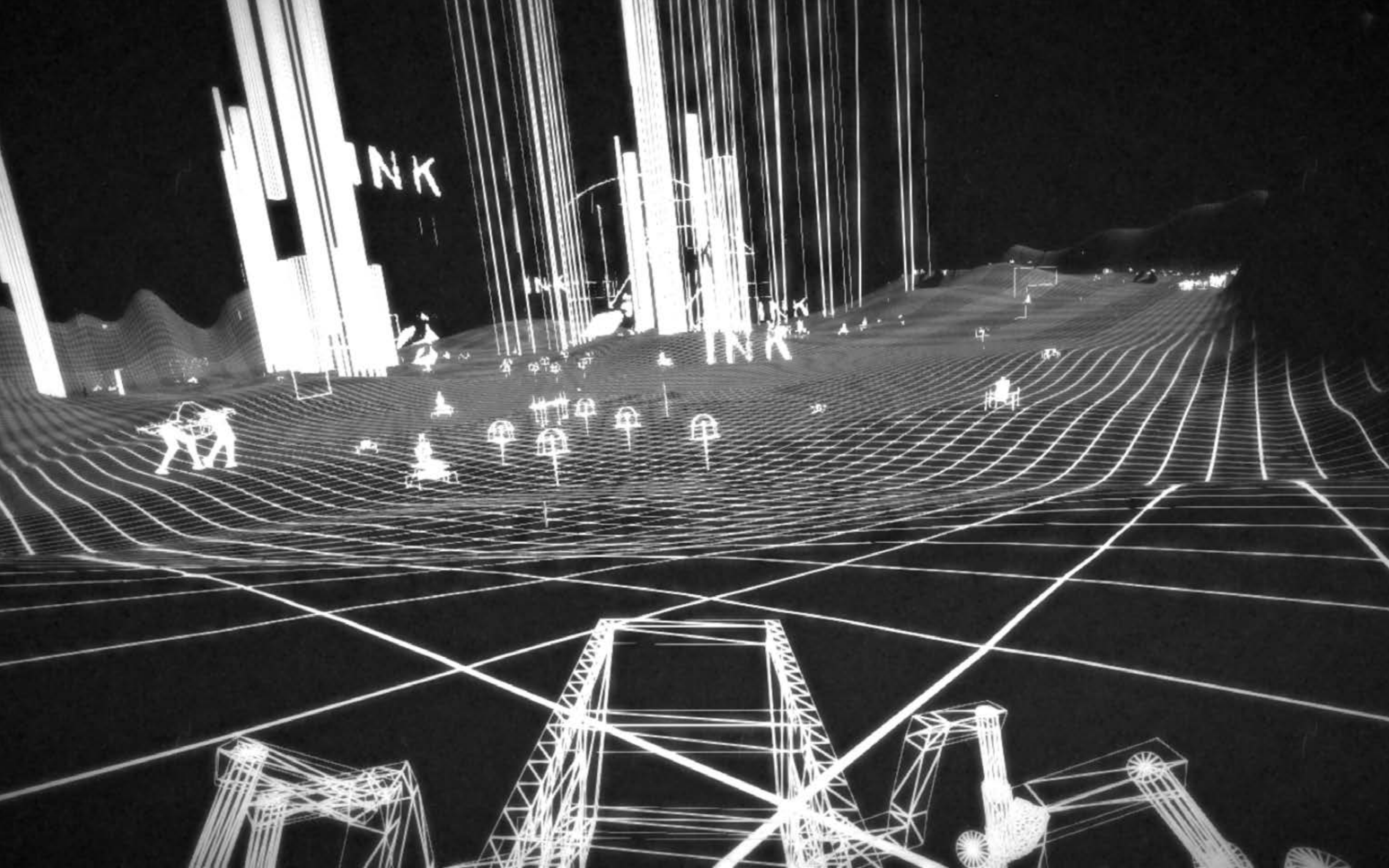Jessica Hodgins told me Chris Atkeson had picked them up

from the basement of a local family that had recently moved out of Pittsburgh. I had been eyeing them for several weeks as I thought it was an interesting pile of junk.

Finding out that this pile of junk was a huge hexapondantal walking robot invented by Ivan Sutherland was a very intense thing. It instilled in me a sense of reverence for the lost personality of this moving machine, as the person that made it was somehow, somewhere inside of it. It was, almost, a living thing.

Working on this project was a significant part of my life. I got to meet Raj Reddy, who walked me underneath Carnegie Mellon to find the "garage" where Ivan and crew once worked. Now it's a closet.

I was able to meet Ben Brown and Matt Mason, both of whom are still here working on hands and legs. A young roboticist working with Ben Brown inspired me with his amazing designs for walking robots, and it's a joy to look towards the future at where this science will go.

IVAN SUTHERLAND'S
TROJAN COCKROACH

ARTIFICIAL INTELLIGENCE

Gary Kasparov, famously lost to IBM's Deep Blue in 1997.

"Turing said that machines must be like humans; Andy Warhol added that everyone should be a machine."

Verena Andermatt Conley, writing in "Rethinking Technologies" wrote of how

"Without simply ignoring or simplifying technologies, we now need to emphasize the necessity of thinking the subject not only in its relation with other subjects, but also in, and with the astonishing complexities of, the world. Yet, paradoxically, at the confines of the universe, contrary to any overriding belief in "man" or "woman", machines show humans that our universe is opaque, or "haunted"."

Kittler writes of how "Media always already provide the appearances of specters. For, according to Lacan, "in the real even the word corpse is already a euphemism". Kittlers conceptualization of media formats is built on a differentiation between the gestural and the digital, distinguishing between the nature of literature in the face of technology and its original form, the written word with it's "surrogate sensuality".

What counts are only differences (or in terms of the typewriter) the spaces between the elements of a system. For that reason the world of the symbolic, in Lacan, is already called "the world of the machine".

Christopher Atkeson's office

MAN LANDS ON MOON

"A truly three-dimensional display is one in which the echoes appear as bright spots in an actual volume of light, at points representing the spatial positions of the corresponding objects." (Schroeter)

"This is the decisive point in volumetric displays. The image is not being created on a plane, nor on two, as in steroscopy, it is created in a volume. As a result the image is perceived as spatial. How can this be done?" (Schroeter)

"This means that similar to film, volumetric displays function on the bass of the series of physiological optics with the addition of the third dimension. Human perception visualizes a three-dimensional image produced onto the the rapidly moving planes. It can (in principle) be viewed from all sides without additional glasses. Contrasted to geometrical optics, this plane is being moved, therby becoming transplane. The image then appears in the volume, described by many authors as image-space or image-volume. Therefore in studies of volumetic displays the term pixedl (short for picture element) has been replace by voxel (short for volume element, see Blendell and Schwarz 2000, 31-3). Since the volumetric display in an ideal case is really three dimensional, it can instantly provided information on the spatial structure and the situatededness of objects. "   (Schroeter)

Parker and Wallis-

Suppose big stars and big budget virtual sets, and big production values in every way, were harnessed to create a simulated world that home participants could enter in large numbers. This would be something like a cross between Second Life and tele-immersion. (Lanier 108-109)

The use of redundancy, a description of things that replaces narrative and plot, predominate. Techniques of description, those techniques which train the eye on the existing world, become self-expression, themselves become the theme. Seen in this light, the means Boltanski employs are the logical stylistic means of the era- they are its content. (Boltanski 33)

PERQ