THE STUDENT PUBLICATION OF THE COLLEGE OF DESIGN

volume 32

NEW FUTURISM

NC STATE UNIVERSITY | COLLEGE OF DESIGN

We stand on the last promontory of the centuries!...

WHY should we look back, when what we want is to

break down the mysterious doors of the impossible?

[TIME and SPACE DIED YESTERDAY.

We already live in the absolute,

because we have created eternal,

omnipresent SPEED. F.T. MARINETTI

The Student Publication
of the College of Design
volume 32

north carolina state university

marvin j. malecha, faia
dean of the college of design

published by the student publication

issn no. 0078-1444
lc 04417343

d. jason toth, editor

NEW FUTURISM

If you can go faster,
why do you need brakes?!

— INDUSTRIAL DESIGN STUDENT, COLLEGE OF DESIGN

This volume of the student publication combines two seductive endeavors: the pursuit of futurism and the articulation of a manifesto. One frames a way of seeing and the other expresses an intention to act. The topics explored within this volume include ways of thinking about design that cross-cultural values and timeless philosophical positions. It is desired by the editor of this volume that we be moved to act in ways that respond to new definitions and restructured societal priorities. It is the intention of the articles presented here to challenge accepted practices. The nature of inquiry presented in this monograph is as much about Da Vinci's "knowing how to see" as Scarpa's insistence that "truth is in the making."

The choice of futurism for this volume is fascinating because it is known as a movement founded on an intent to question fundamental assumptions of culture and the associated meaning of ritual reflected in written and visual languages. Through this frame of reference, it is possible to question not only the connection of design and designers to culture, but also to reflect on the disconnect evident among them. The exploration of the tenets and strategies of a manifesto holds the promise of what could evolve as an outcome of the exploration. A manifesto is as much about passion and optimism as it is about the substance of the material it portends to propagate. A manifesto is what is expected of a student publication. Such an expression is the essence of the power and influence of students on a school. Without passion among its students, a school (no matter how well provided for and endowed) is ordinary.

The articles selected by the editor range from a reprint of the Futurist Manifesto, to a 1984 science fiction short story, to new critical writing, thus making a connection among language across time. Viewed within the context of powerful technological developments, these reflections provide the stimuli for a rebirth of the spirits of futurism.

There is no more important exploration for students than the pursuit of the third realm of human knowledge—the design domain. As the students and faculty of the College of Design embrace this journey it will become apparent that this community is an important center of influence in the study and practice of the design disciplines. I welcome this endeavor and I anxiously anticipate the leadership that these students will provide for the design disciplines as they enter and pursue professional lives.

Along the journey, design thinking is our guide, and design making is our means for the exploration of ideas. This is the dance and the song of our lives.

Marvin J. Malecha, FAIA
Dean, North Carolina State University College of Design

In 1985, The Student Publication of the College of Design at NC State University, was printed for the last time, until a commemorative volume recounting 25 years of its existence was printed in 2003. In 2004, after twenty years of dormancy, a new volume was introduced to the community. Appropriately titled *Relevance*, this volume asked its readers to consider "Why?" "How?" "Where?" and "For Whom?" design remained as a vital, fluid, and active process. Considering the Publication had no voice for the last two decades of rapid technological advancement, raising these questions was timely and applicable. In an age of new information environments immersed in speed, connectivity, and the implosion of space and time, the publication must not only question the relevance of its existence, but question how its very existence is a response to how we experience and process. By what measure should we define the a 21st century academic publication, and how should the delivery of its message respond to how we experience this media-rich landscape?

Titled, *New Futurism*, the 32nd Volume of the Student Publication strives to reestablish the publication as a living and critical voice representing the current perspective of the faculty, alumni, and student body. Like the Italian Futurists, we begin the 21st century with a manifesto—a critical examination of how design responds to the speed and distribution of emerging technologies. We reject any notion to reexamine or reevaluate the benefits of computation and technology, and will use this forum as an outcry against any lamenting, Ludditic voices.

This volume serves to harness the power of the manifesto to build a publication that accurately reflects the universal dynamism of the 21st century. By recontextualizing the writings and visionary thought found in the Futurist manifestos, we intend to create a new, collective voice built around the collaborative efforts of those who embrace the discovery and application of new technologies.

Like Rip Van Winkle rising from his twenty-year nap, the newly revived publication navigates in a media saturated world, which is difficult to recognize. Surveying the landscape of print media reveals a massive shift in the presentation, immediacy, and delivery of information. Hybrid magazines and self-published publications present content to the reader in a hyper-media, information saturated environment of images, text, and video screens. Moving into the digital landscape, we see a similar trend in the exponential speed and immediacy to which information is distributed.

Through complex systems of semantic tagging, RSS feeds, webzines, blogs, social networks, video-streams, and wiki pages, the integration of information into any web environment has never been more accessible.

Our aim is to promote the synthesis of design and science, emotion and modern mechanics, and finally, humans and machines. We believe that the presentation in this volume will harness the energy and immediacy of this medium, and reflect the collaborative spirit of this university.

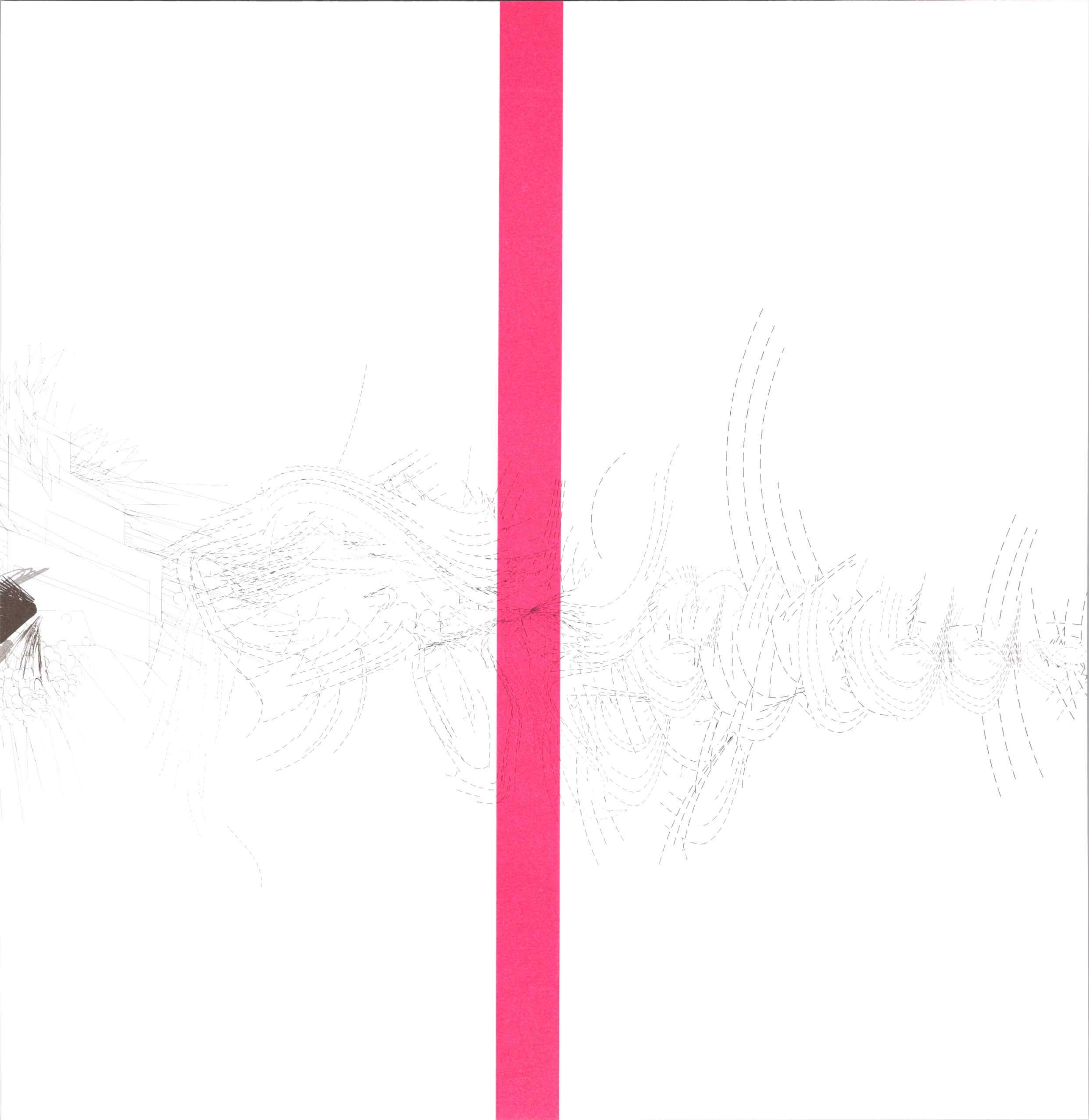
Thus, as seen in Ridley Scott's infamous 1984 Macintosh commercial, we sling our proverbial sledgehammer into the screen, boldly announcing the rebirth of a publication and the death of an era that had no voice.

D. Jason Toth
Editor

We affirm the world's magnificence
has been enriched by a NEW BEAUTY

For indeed…
all things move, all things run,
all things are RAPIDLY CHANGING.

This is the beauty of SPEED.



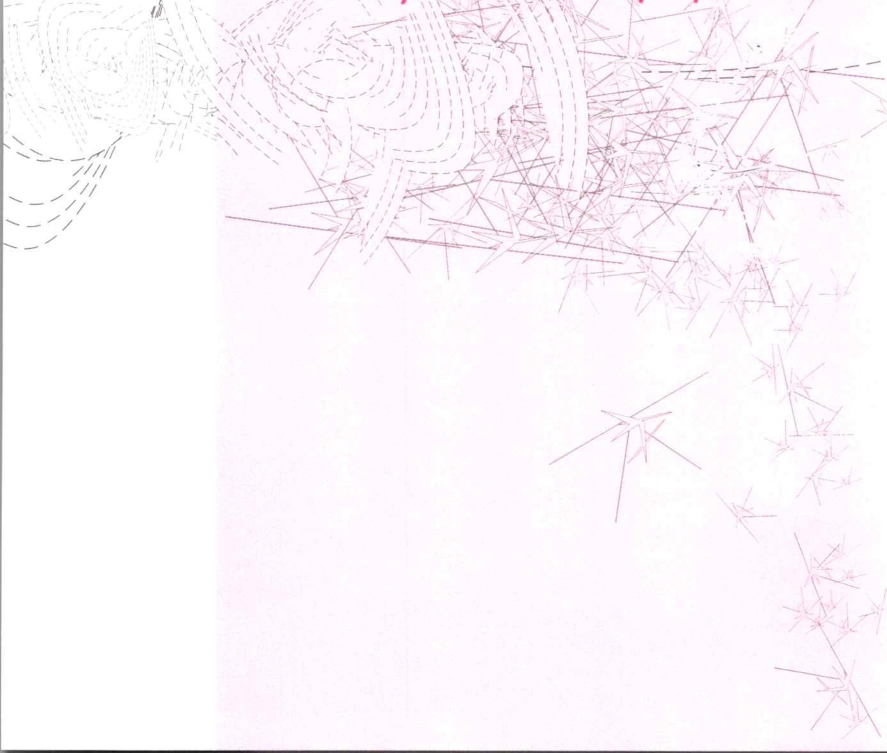
THE FOUNDING AND MANIFESTO OF FUTURISM

Fillipo Marinetti

TRANSLATION BY R.W. FLINT

PUBLISHED IN *Le Figaro*, PARIS, 20 FEBRUARY 1909

We had stayed up all night, my friends and I, under hanging mosque lamps with domes of filigreed brass, domes starred like our spirits, shining like them with the prisoned radiance of electric hearts. For hours we had trampled our atavistic ennui into rich oriental rugs, arguing up to the last confines of logic and blackening many reams of paper with our frenzied scribbling.



An immense pride was buoying us up, because we felt ourselves alone at that hour, alone, awake, and on our feet, like proud beacons or forward sentries against an army of hostile stars glaring down at us from their celestial encampments. Alone with stokers feeding the hellish fires of great ships, alone with the black spectres who grope in the red-hot bellies of locomotives launched on their crazy courses, alone with drunkards reeling like wounded birds along the city walls.

Suddenly we jumped, hearing the mighty noise of the huge double-decker trams that rumbled by outside, ablaze with colored lights, like villages on holiday suddenly struck and uprooted by the flooding Po and dragged over falls and through gorges to the sea.

Then the silence deepened. But, as we listened to the old canal muttering its feeble prayers and the creaking bones of sickly palaces above their damp green beards, under the windows we suddenly heard the famished roar of automobiles.

"Let's go!" I said. "Friends, away! Let's go! Mythology and the Mystic Ideal are defeated at last. We're about to see the centaur's birth and, soon after, the first flight of angels!... We must shake at the gates of life, test the bolts and hinges. Let's go! Look there, on the earth, the very first dawn! There's nothing to match the splendor of the sun's red sword, slashing for the first time through our millennial gloom!"

We went up to the three snorting beasts, to lay amorous hands on their torrid breasts. I stretched out on my car like a corpse on its bier, but revived at once under the steering wheel, a guillotine blade that threatened my stomach.

The raging broom of madness swept us out of ourselves and drove us through streets as rough and deep as the beds of torrents. Here and there, sick lamplight through window glass taught us to distrust the deceitful mathematics of our perishing eyes. I cried, "The scent, the scent alone is enough for our beasts."

And like young lions we ran after Death, its dark pelt blotched with pale crosses as it escaped down the vast violet living and throbbing sky.

But we had no ideal Mistress raising her divine form to the clouds, nor any cruel Queen to whom to offer our bodies, twisted like Byzantine rings! There was nothing to make us wish for death, unless the wish to be free at last from the weight of our courage!

And on we raced, hurling watchdogs against doorsteps, curling them under our burning tires like collars under a flatiron. Death, domesticated, met me at every turn, gracefully holding out a paw, or once in a while hunkering down, making velvety caressing eyes at me from every puddle.

"Let's break out of the horrible shell of wisdom and throw ourselves like pride-ripened fruit into the wide, contorted mouth of the wind! Let's give ourselves utterly to the Unknown, not in desperation but only to replenish the deep wells of the Absurd!"

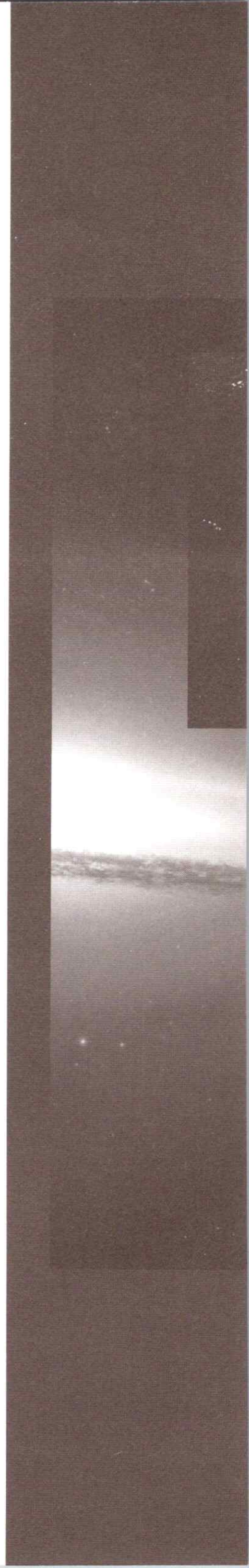
The words were scarcely out of my mouth when I spun my car around with the frenzy of a dog trying to bite its tail, and there, suddenly, were two cyclists coming towards me, shaking their fists, wobbling like two equally convincing but nevertheless contradictory arguments. Their stupid dilemma was blocking my way—Damn! Ouch!... I stopped short and to my disgust rolled over into a ditch with my wheels in the air...

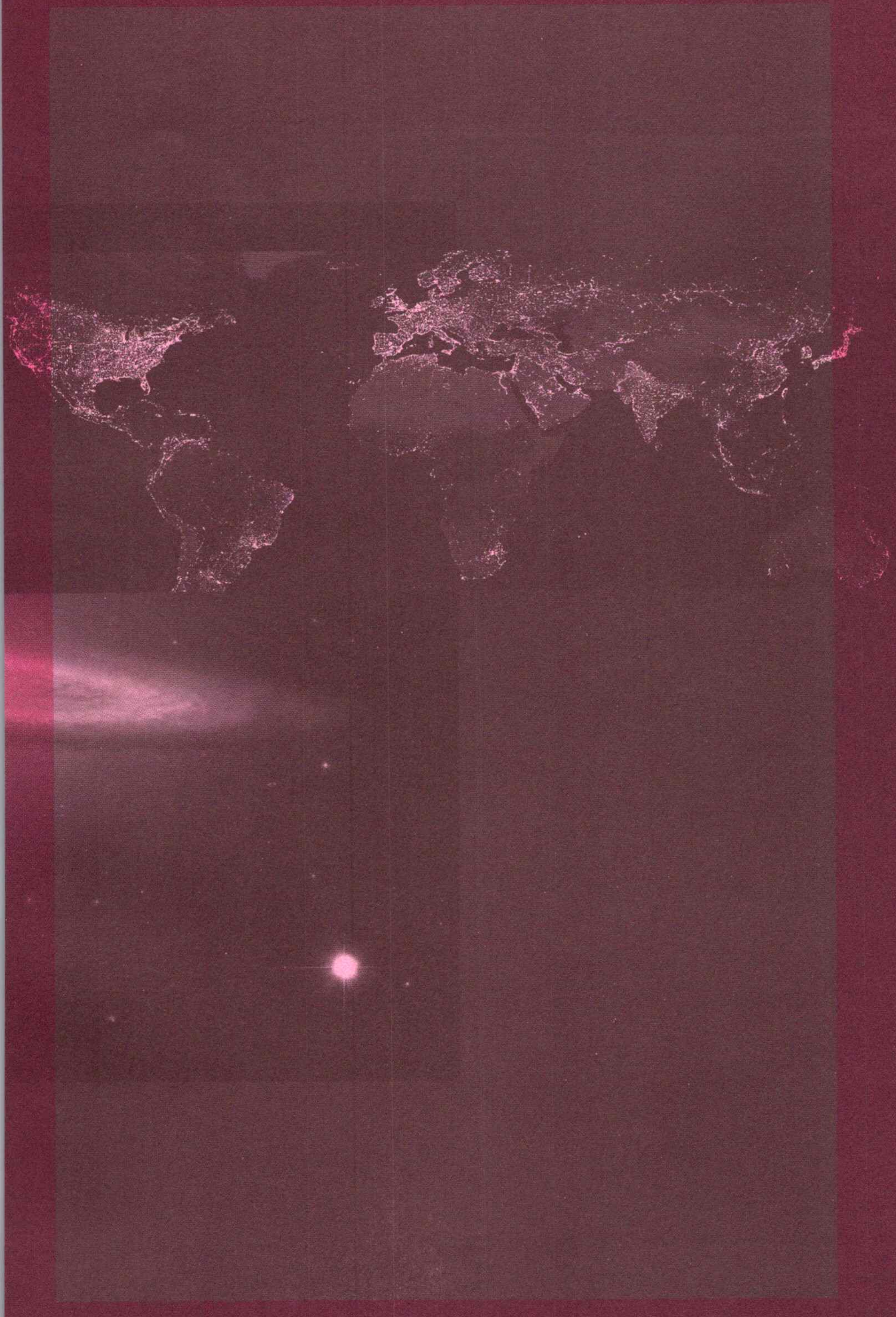
O maternal ditch, almost full of muddy water! Fair factory drain! I gulped down your nourishing sludge; and I remembered the blessed black beast of my Sudanese nurse... When I came up—torn, filthy, and stinking—from under the capsized car, I felt the white-hot iron of joy deliciously pass through my heart!

A crowd of fishermen with handlines and gouty naturalists were already swarming around the prodigy. With patient, loving care those people rigged a tall derrick and iron grapnels to fish out my car, like a big beached shark. Up it came from the ditch, slowly, leaving in the bottom, like scales, its heavy framework of good sense and its soft upholstery of comfort.

They thought it was dead, my beautiful shark, but a caress from me was enough to revive it; and there it was, alive again, running on its powerful fins!

AND SO, faces smeared with good factory muck—plastered with metallic waste, with senseless sweat, with celestial soot—we, bruised, our arms in slings, but UNAFRAID, DECLARED OUR HIGH INTENTIONS TO ALL THE LIVING OF THE EARTH...





Instantaneous Velocity, *Machines of Speed.* The velocity of an object is its speed in a particular direction. Drawn as a vector, it requires both speed and direction to define. Velocity is measured as a numerical value representing the physical quantity of an object's motion.

Martha Scotford

IRONICALLY, WE MUST DO WHAT THE FUTURISTS RAILED AGAINST: *looking at and admiring the past.*

BUT ONLY BRIEFLY IN ORDER TO DO BETTER WHAT THEY DID SUPPORT: *looking forward, celebrating what was newly possible, and creating new forms for new ideas from new materials and methods.*

Futurism was framed by the "The Founding and Manifesto of Futurism," published on 20 February 1909 on the front page of the Paris newspaper *Le Figaro*. It was written by an Italian, Filippo Marinetti, summarizing ideas of a small group of artists and writers. During the 'heroic' period of Futurism that lasted until 1920, over 50 manifestos were published on all art forms (LITERATURE, CINEMA, ARCHITECTURE, PAINTING, SCULPTURE, MUSIC, THEATER, DANCE, FASHION) as well as politics and entertainments. Marinetti would remain the primary promoter and propagandist, using the mass communication methods of newspapers, magazines, leaflets and flyers to reach thousands in the cultural capitals of Europe.

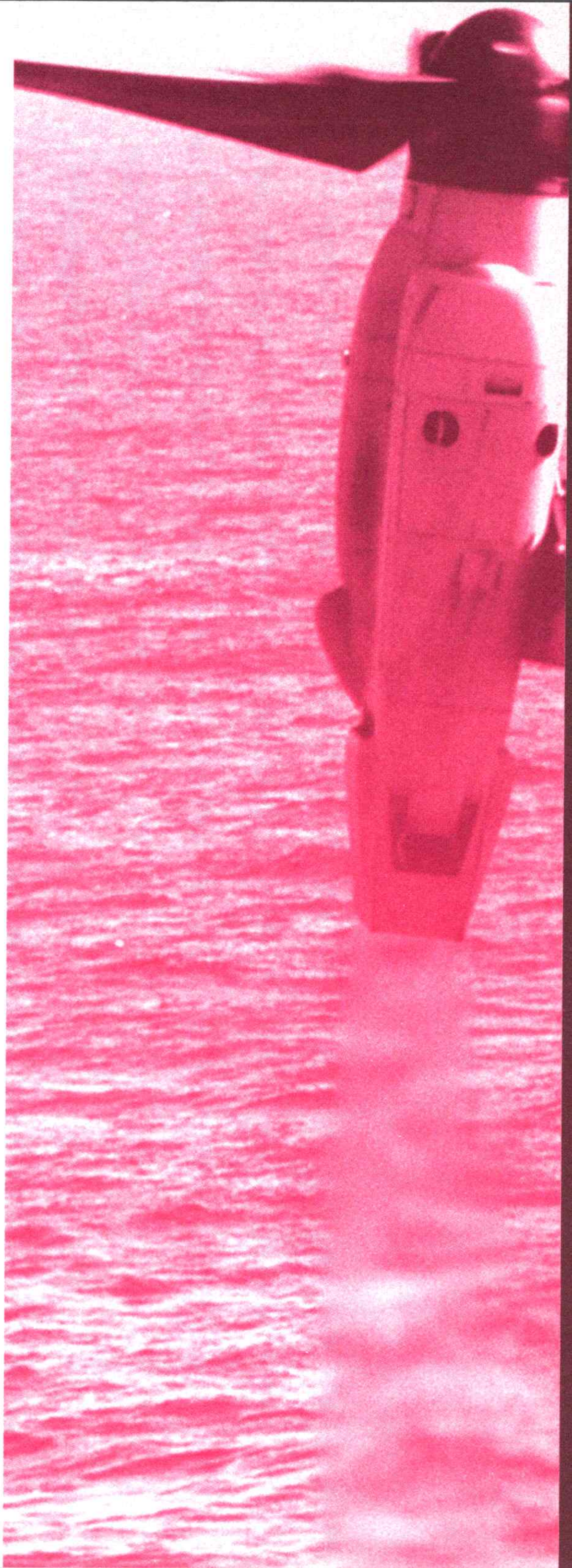
The activities and productions of the artists associated with Futurism can be divided into several periods. Before the 1909 manifesto, they were aware of the form and color experiments of the Post-Impressionists, the breakthrough of the Cubism, especially Picasso's *Demoiselles d'Avignon* (1906), the photographic studies by the American Eadweard Muybridge and the French Etienne-Jules Marey, the early cinema of Georges Melies and the Lumiere Brothers, and the Symbolist poets and artists like Mallarme and Munch.

The manifesto defined the first authentic '*avant garde*,' a group with a shared ideology going beyond art into politics and daily life.

In this and subsequent writings they declare what they are for, what against, and how to change life. They were painters, sculptors, architects, poets, photographers, musicians, but most of them worked in several areas and dimensions.

From the beginning the Futurists were fascinated by the visual properties and creative possibilities of movement (ESPECIALLY SPEED), by light (ESPECIALLY ARTIFICIAL), by industrial forms (ESPECIALLY CARS, TRAINS AND AEROPLANES), and by the channels of mass communication.

Early paintings of dogs running (BALLA) become speeding cars and later studies of armored trains engaged in battle (SEVERINI). Studies of street lamps become paintings of night scenes (CARRA), landscapes in mist (RUSSOLO), exciting parties and dancers (SEVERINI). Printed materials are the stuff of paintings, words and symbolic sound represented as the new landscape (CARRA). In sculpture, much of the verbal aggression of the manifestos was realized in dynamic



and brutal forms that grab and thrust into the space they inhabit (BOCCIONI). In architecture, visionary drawings show a 'New City' with high-rise buildings including many levels for and modes of transportation (SANT'ELIA), as well as monumental plans for power plants, factories and apartment buildings (CHIATTONE).

Among the poets and other writers, the word pictures, usually collaged or melded into single experiences through typographic manipulation, were examples of concision, synthesis and simultaneity. In the 1913 manifesto "Destruction of Syntax," *in another example of their rejection of the classical past*, Marinetti declared that as current life was accelerated by science and modern conveniences, *Words in Freedom* would use "condensed metaphors."

In addition to words, onomatopoeia and **mathematical symbols** would provide the sounds and signs of modern living. The Futurists were the first to produce literature to be seen and heard from the page, especially the sounds of war (MARINETTI). Others created more playful compositions where letterforms created architectural spaces and became animated figures (CANGUILLO). The musicians would carry the use of sound away from harmony into 'noise' (RUSSOLO).

As the 19c invention of photography developed as an art form, it also became an instrument of scientific study of movement as well as a moving form itself. Both the science and the art of photography were taken up by the Futurists to create still and moving images of abstract and expressionist forms (BRAGAGLIA).

Their glorification of war in 1909 became a reality five years later. The Futurists were willingly drawn into the 'cleansing' First World War and its new use of tanks and planes. In the war they lost two principals: the architect Antonio Sant'Elia and the artist Umberto Boccioni. The movement's most pure and innovative work was done during the war years and much of it related to that subject. After 1920, the second period was less inventive, more politically engaged, and headed in the 1930s into a more decorative phase. Several began applying the forms to practical objects like furnishings, toys and fashion (BALLA AND DEPERO) and commercial promotions and advertising (DEPERO).

IN THE PRESENT, NECESSARILY SEPARATING OUT THE POLITICS AND IGNORING MANY OF THE SOCIAL VIEWS (MISOGYNISTIC), WE CAN APPRECIATE THE FUTURISTS FOR THEIR SERIOUS AND ALL-EMBRACING RETHINKING OF WHAT IT MEANS TO LIVE IN A WORLD OF SCIENCE AND INDUSTRY.

The futurists would inspire several other contemporaneous avant garde groups. *Dadaists* in the Netherlands and Germany picked up on their breaking of grammatical verbal syntax (as the *Cubists* had done with visual representational syntax) and the use of collage to create their own word pictures and visual poetry of sound, some of it with vastly different political meanings. During the years of the Revolution, *Russian Cubo-Futurists* combined the fragmented forms of multiple viewpoints and words in their paintings, and poets wrote using all available symbols. During the early Soviet period, *Constructivists* returned to geometry and abstract forms and symbols for a purity of vision as well as a search for a universal visual language.

The bombastic '*totality*' of the Futurists' often aggressive views, *combined with on and off associations with Fascism and Mussolini that continued through the 1930s*, tainted the movement and created a certain disdain and distance in the art historical world for several decades. It was not until a critical effort resulting in a huge encompassing 1986 exhibition in Venice was able to separate the artistic vision from the political and rehabilitate the Futurists for the future.

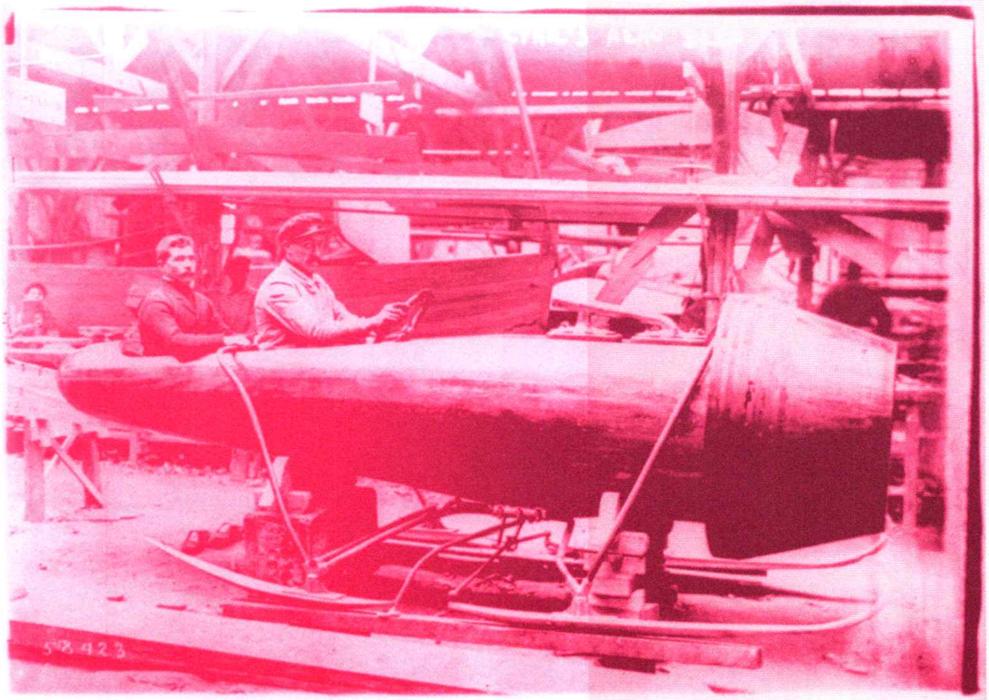
They were engaged with the primary issues and events of their time. They took on all of Western cultural tradition and said it no longer worked. Through the multiple manifestos they stated (not always clearly or concisely) what they believed, and then they made work that followed these principles.

THEY WERE ACTIVE IN ALL AREAS OF ART AND DESIGN; THEY TOOK SCIENTIFIC KNOWLEDGE AND INVENTION AND THE PRODUCTS OF MODERN, MECHANICAL TECHNOLOGY TO BE THEIR SUBJECTS AND THEIR METHODS.

They worked *across disciplines*, in *all available media*, in *all known dimensions*.

MARTHA SCOTFORD IS A PROFESSOR OF GRAPHIC DESIGN AND DIRECTOR OF INTERNATIONAL PROGRAMS AT NC STATE UNIVERSITY COLLEGE OF DESIGN. HER RESEARCH FOCUSES ON DESIGN HISTORY WITH AN EMPHASIS ON WOMEN IN DESIGN AND FEMINIST THEORY. HER WRITINGS HAVE APPEARED IN *THE AIGA JOURNAL OF GRAPHIC DESIGN*, *PRINT MAGAZINE*, *DESIGN ISSUES*, *VISIBLE LANGUAGE*, AND *EYE*. SHE IS THE AUTHOR OF *CIPE PINELES: A LIFE OF DESIGN*.

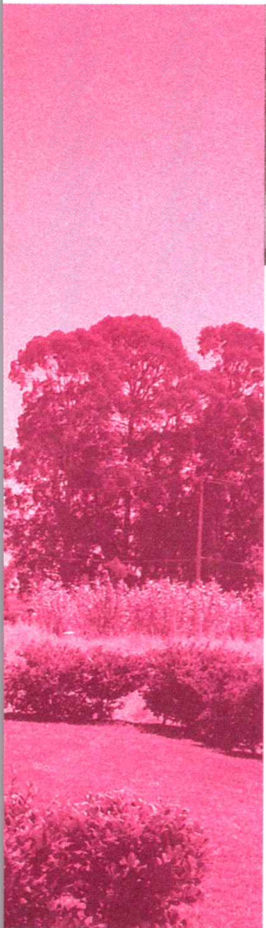
THIS ESSAY HAS BEEN INFORMED BY: THE COLLECTED RESEARCH FOUND IN "FUTURISMO & FUTURISMI," THE CATALOGUE FOR AN EXHIBITION ORGANIZED BY PONTUS HULTEN, PALAZZO GRASSI, VENICE, 1986, AND PUBLISHED BY BOMPIANI, MILANO; JOSHUA C. TAYLOR'S "FUTURISM," PUBLISHED BY THE MUSEUM OF MODERN ART, NY, 1961, AND DISTRIBUTED BY DOUBLEDAY & COMPANY, NY; "THE FUTURIST IMAGINATION," EDITED BY ANNE COFFIN HANSON, PUBLISHED BY YALE UNIVERSITY LIBRARY, NEW HAVEN, CT, 1983.



They were also seriously playful.

Plastic Dynamism, *Sustaining Plastic Landscapes.* Photosynthesis is the natural process by which one form of energy (sunlight) is converted into another (chemical). Nearly all living things depend on the energy produced from photosynthesis, making it vital to life on Earth.

THE AESTHETICS OF SUSTAINABILITY Lee-Anne Milburn



What, many ask, is sustainability? The traditional definition involves not paying for the present with the assets of the future (BRUNTLAND COMMISSION 1987). *But this definition leaves a great deal of room for debate.*

Often we present sustainability as occurring at the interaction of social, economic and environmental considerations (BARBIER 1987), but the structure and priorities of our society require that it more often be formed of layers of consideration, rather than interces. This layering, by definition, assigns priority to latter layers over earlier, losing the complexities of fine grained interactions and analysis as a result of a final simplified prioritization. Thus, discussions involving sustainability often begin with environmental considerations, but generally end with economics. Socio-cultural considerations can be lost somewhere in the transition.

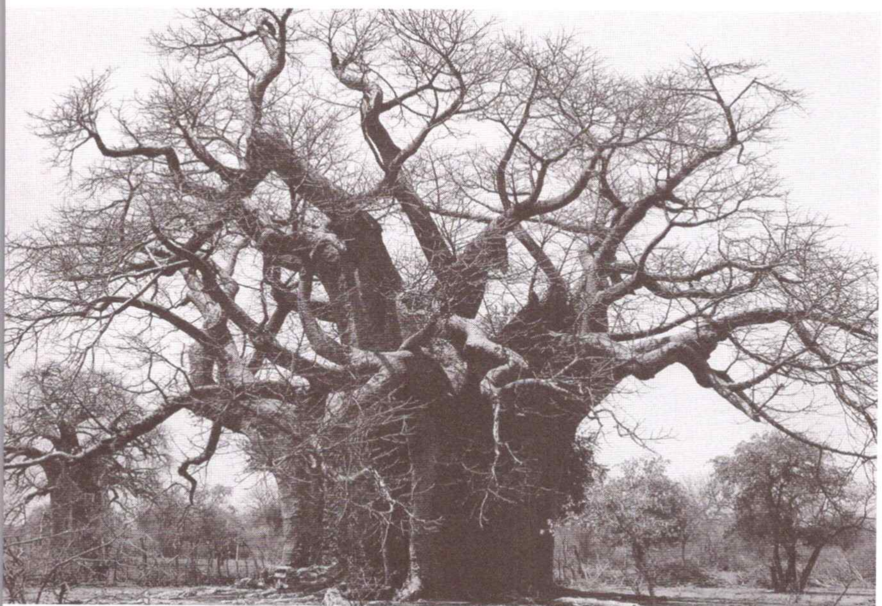
While discussions of sustainability and its principles occur at a theoretical level, decisions are implemented through pragmatic choices which reflect the complexity of our struggle with defining and applying sustainability. The status of design in landscape architecture (and possibly the other design disciplines) reflects this struggle. As a profession, we concurrently attempt to empower clients and the public and facilitate decision-making, while simultaneously recognizing that key environmentally sustainable approaches to design or maintenance appeal to few but the most sophisticated of audiences. This struggle is a microcosm of the problems inherent in the naive adoption of the rubric of sustainability, at either extreme. As a result, sustainability faces challenges from society's anthropocentric focus: a struggle to redirect priorities from the bottom of Maslow's (1943) hierarchy, to the top. It is certainly difficult to argue that we should put scarce resources into saving the red-cockaded woodpecker when people are homeless in Louisiana. In the case where environmental concerns attain sufficient currency to encourage the development of landscapes which meet the range of criteria generally considered sustainable, such as minimal use of resources for maintenance and providing habitat for a diversity of species, landscape aesthetics become critical to public acceptance.

HUMAN LANDSCAPES

Humans have evolved to prefer very specific types of landscapes. Open canopies with trees, prairie landscapes with distant enclosure, and wetlands reflect a preference for prospect and refuge, and water resources. Our preferences are based both on perceptions of safety and on a quest for evidence of care (NASSAUER 1995). The appearance of a landscape reflects cultural values—and maintenance is an expression of power and choice.

As such, sustainable landscapes require a relinquishing of control, and an acceptance of "messy" and "ugly" landscapes. *The general public continues to see these landscapes as primarily reflections of lack of care, poor character, and criminal activity. When asked to identify sustainable landscapes, most identify "natural areas"—areas with little understory and open canopies—and often planted as monocultures—areas with little value for plant or animal diversity.*

Western society's response to this conundrum has been to espouse the principles of sustainability, while continuing to maintain the vast majority of our urban open space to reflect those preferred landscapes. Most people who choose to live in golf course developments do so not because they play (and in fact many of them do not), but because they like the view. Proof of this exists in the form of many municipal parks which, for the majority of the year, sit empty, save for a few lone dog walkers. Ironically, the majority of people visit their local park



less than once per year. But threaten the existence of a park and a crisis of mammoth proportions results! The issue at hand is not a threat to a functional utilized resource, but rather a threat to the potential for use and the view. If in fact this is true, we are maintaining our public park landscapes at unsustainable levels to fulfill our desire to look at canopy trees with cleared understory, rather than use the resulting open space. We are thus mowing, spraying, trimming, and cleaning landscapes to provide a view for passing motorists.

In spite of this, Denis Cosgrove (1984) argues that our landscape fails to fulfill our needs. He claims that we live in a "landscape of alienation" where humans are outsiders, and our relationship to the landscape becomes that of owner and commodity.

If the landscape serves only our functional needs as he proposes, what then are our functional needs? It would seem that landscape, beyond being the space between, serves a primary function of aesthetics, rather than utility in our society today.

If this is true, and landscape has been relegated to the roles of framing, accentuating and punctuating (if that has indeed become landscape's function), is it any wonder that the mown lawn, Norwegian maple, and Chinese privet dominate the landscape?

Our attempts at sustainability may be failing simply because we are disengaged from the landscape to such an extent that has become a purely aesthetic artifact of evolved preference. Our attempts to "balance human and environmental needs" may be failing because, for most people, their human needs of the environment have become dominated by the aesthetic. After all, food comes from the grocery store, water from the tap, and clean air is legislated. How as designers can we create landscapes which fulfill both the human preference for maintained landscapes and the environment's need for "messy" ones?

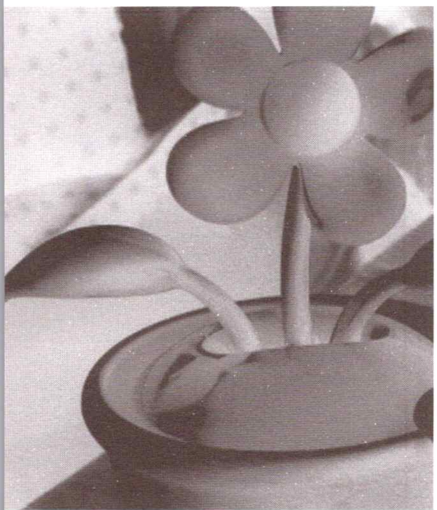
Education may be one answer, but preferences are deeply embedded, and reinforced by both biology and culture. Perhaps we need to look at alternative ways to address aesthetic preferences.

PLASTIC LANDSCAPES

Designers such as Ken Smith (KEN SMITH LANDSCAPE ARCHITECTURE) and Martha Schwartz (MARTHA SCHWARTZ, INC.) design landscapes with plastic plants—landscapes designed to be viewed but not physically experienced. The objection to these designs largely seems based, not on concern over lack of utility, but on aesthetics. If these landscapes were designed to more effectively mimic natural qualities (change, color, movement), would they serve our aesthetic preferences? Certainly, they address conservation goals—minimal water, nutrients, soil and energy goes into their maintenance. Plastic plants are being used to improve food and habitat availability to boost numbers of larval and juvenile fish.

If our criteria for landscape sustainability is pragmatically predicated on balancing public support and environmental benefit, ironically, plastic landscapes could fulfill sustainability criteria more effectively than our urban parks. What does this tell us about how we design and maintain our urban open space? What in turn does it tell us about our society?

If we are to find solutions to sustainability challenges within natural systems, somehow, as designers, we need to find ways to make the invisible visible, and illustrate process to those who are blinded by product. Unquestionably, there are many paths to take and a range of tools to adopt. Perhaps plastic plants are the answer—no irrigation, fertilizer, or fossil fuel consumption for maintenance, no potential to contaminate crops or change natural systems. They can certainly address the visual need for green, but, if sustainability is rooted in personal connection to our environment, it demands a "psychic" connection to nature, which is unlikely to occur in spaces without the smells, changes, and life resulting from natural plant life. Looking out the window is not enough to make it happen—*somehow we must get people to move out from behind their walls and interact.*



DR. LEE-ANNE MILBURN SERVES AS AN ASSISTANT PROFESSOR OF LANDSCAPE ARCHITECTURE AT NC STATE UNIVERSITY. HER CURRENT RESEARCH EXAMINES THE RELATIONSHIP BETWEEN RESEARCH AND PROFESSIONAL PRACTICE. IN 2004, SHE WON *THE NATIONAL AWARD FOR RESEARCH IN LANDSCAPE ARCHITECTURE* IN CANADA AND WAS NOMINATED FOR AN AWARD OF EXCELLENCE FOR HER PROFESSIONAL WORK. SHE IS A REGISTERED LANDSCAPE ARCHITECT.


NANOTECH

SO: When did you first become aware of the term "SINGULARITY"? Did you use that term in your first book, *The Age of Intelligent Machines*?

RK: No. I first became familiar with it probably around the late 1990s. In my latest book, *The Singularity is Near*, I have really focused on the point in time where these technologies become quite explosive and profoundly transformative.

In my earlier book, *The Age of Intelligent Machines*, I touched on that, and wrote about computers achieving human levels of intelligence and what that would mean. My main focus in this new book is on the merger of biological humanity with the technology that we are creating. Once nonbiological intelligence gets a foothold in our bodies and brains, which we have arguable already done in some people, but will do significantly in the 2020s, it will grow exponentially. We have about 1026 calculations per second (cps) (at most 1029) in biological humanity, and that figure won't change much in the next fifty years.

Our brains use a form of electro-chemical signaling that travels a few hundred feet per second, which is a million times slower than electronics. The inter-neuronal connections in our brains compute at about 200 calculations per second, which is also about a million times slower than electronics. We communicate our knowledge and skills using language, which is similarly a million times slower than computers can transmit information.

So biological intelligence, while it could be better educated and better organized, is not going to significantly change. Nonbiological intelligence, however, is multiplying by over 1,000 per decade in less than a decade. So once we can achieve the software of intelligence, which we will achieve through reverse-engineering the human brain, non-biological intelligence will soar past biological intelligence. But this isn't an alien invasion, it is something that will literally be deeply integrated in our bodies and brains. By the 2040s, the nonbiological intelligence that we create that year will be a billion times more powerful than the 1026 CPS that all biological humanity represents.

The word singularity is a metaphor, and the metaphor that we are using isn't really infinity, because these exponentials are finite. The real meaning of "singularity" is similar to the concept of the "event horizon" in physics. A black hole as physicists envision it has an event horizon around it, and you can't easily see past it. Similarly, it is difficult to see beyond this technological event horizon, because it is so profoundly transformative.

SO: Many semiconductor analysts are predicting that the field of robotics will become the next major growth industry. When do you predict that the ROBOTICS INDUSTRY will become a major, thriving industry?

RK: In the GNR revolutions I write about, 'R' nominally stands for robotics, but the real reference is to strong AI. By strong AI, I mean artificial Intelligence at human levels, some of which will be manifested in robots, and some of which will be manifested in virtual bodies and virtual reality. We will go into virtual reality environments, and have nanobots in our brain that will shut down the signals coming from our nerves and sense organs, and replace them with the signals that we would be receiving if we were in the virtual environment. We can be actors in this virtual environment, and have a virtual body. But this virtual body doesn't need to be the same as our real body.

We will encounter other people in similar situations in this VR. There will also be forms of

AI which perform specific tasks, like narrow AI programs do today in our economic infrastructure. Our economic infrastructure would collapse if all these current narrow AI programs stopped functioning, but this wasn't true 25 years ago. So these task specific AI programs will become very intelligent in the coming decades.

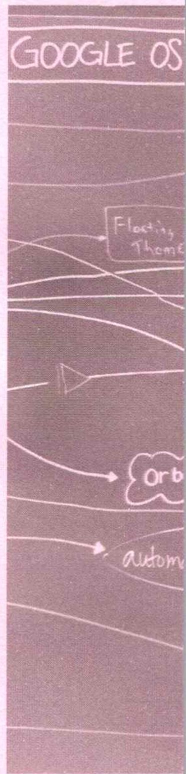
So strong AI won't just be robots; that is only one manifestation. The R revolution really is the strong AI revolution. Billions of dollars of financial transactions are done every day, in the form of intelligent algorithms, automatic detection of credit card fraud, and so forth. Every time you send an email or make a telephone call, intelligent algorithms route the information. Algorithms automatically diagnose electrocardiograms and blood cell images, fly airplanes, guide "smart" weapons, and so forth. I give dozens of examples in the book. These applications will become increasingly intelligent in the decades ahead. Machines are already performing tasks that previously could only be done by humans, and the tasks that this covers will increase in the coming years.

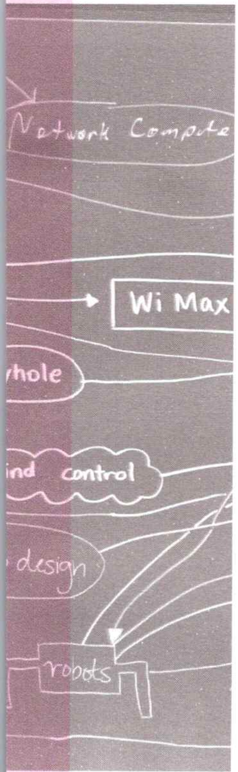
In order to achieve strong AI, we need to understand how the human brain works, and there are two fundamental requirements. One is the hardware requirement, which you mentioned. It is relatively uncontroversial today that we will achieve computer hardware equivalent to the human brain's computing capacity—just look at the semiconductor industry's own roadmap. This is a roadmap into which the semiconductor industry has put enormous effort. By 2020, a single chip will provide 1016 instructions per second, sufficient to emulate a single human brain.

We will go to the third dimension, effectively superseding the limits of Moore's law, which deals only in 2-D integrated circuits. These ideas were controversial notions when my last book (*The Age of Spiritual Machines*) was published in 1999, but is relatively uncontroversial today.

The more controversial issue is whether we will have the software, because it is not sufficient to simply have powerful computers, we need to actually understand how human intelligence works. That doesn't necessarily mean copying every single pattern of every dendrite and ion channel. It really means understanding the basic principles of how the human brain performs certain tasks, such as remembering, reasoning, recognizing patterns and so on. That is a grand project, which I refer to as reverse-engineering the human brain, which is far further along than many people realize. We see exponential growth in every aspect of it. For instance, the spatial resolution of brain scanning is doubling every year in 3-D volume. For the first time we can actually see individual interneuronal connections in living brains, and see them signaling in real time. This capability was not feasible a few years ago. The amount of data that we are obtaining on the brain is doubling every year, and we are showing that we can turn this data into working models, and in the book I highlight a couple of dozen simulations of different regions of the brain. For example, there is now a simulation of the cerebellum, which is an important region of the brain devoted to skill formation. This region comprises over half of the neurons of the brain.

I make the case that we will have the principles of operation understood well within twenty years. At the end of the 2020s, we will have both the hardware and software to create human levels of intelligence. This includes emotional intelligence, which is really the cutting edge of intelligence, in a machine. Given that machines are already superior to humans in certain aspects, the human-intelligent computer combination will be quite formidable, and





this combination will continue to grow exponentially. Nonbiological intelligence will be able to examine its own source code and improve it in an iterative design cycle. We are doing something like that now with biotechnology, by reading our genes. So in the GNR revolutions I write about, R really stands for intelligence, which is the most powerful force in the universe. It is therefore the most influential of the revolutions.

SO: nanotechnology plays a key role in your forecasts. What advice would you give to someone wanting to invest today in nanotechnology corporations?

RK: Nanotechnology developments are currently in their formative stages. There are early applications of nanotechnology, but these do not represent the full vision of nanotechnology, the vision that Eric Drexler articulated in 1986. No one was willing to supervise this radical and interdisciplinary thesis except for my mentor Marvin Minsky. We have shown the feasibility of manipulating matter at the molecular level, which is what biology does. One of the ways to create nanotechnology is to start with biological mechanisms and modify them to extend the biological paradigm—to go beyond proteins. That vision of molecular nanotechnology assembly—of using massively parallel, fully programmable processes to grow objects with remarkable properties—is about twenty years away. There will be a smooth progression, and early adaptor applications, many of which I discuss in the book.

There are early applications in terms of nanoparticles. These nanoparticles have unique features due to nanosize components, but this is a slightly different concept. We are using the special properties of nanoscale objects, but we are not actually building objects molecule by molecule. So the real revolutionary aspect of nanotechnology is a couple of decades away, and it is too early to say which companies will be the leaders of that. Intel sees that the future of electronics is nanotechnology, and by some definitions today's electronics are already nanotechnology. Undoubtedly, there will be small corporations that will dominate. When search engines were formative, it would have been difficult to foresee that two Stanford undergrads would dominate that field. Nanotechnology is already a multi-billion dollar industry which will continue growing as we get closer to molecular manufacturing. When we actually have molecular manufacturing, it will be transforming—we will be able to inexpensively manufacture almost anything we need from feedstock materials and these information processes.

SO: You have emphasized the superior mechanical and electronic property of carbon nanotubes. When do you anticipate nanotubes being embedded in materials? When will we see the first computers with nanotube components?

RK: There is actually a nanotube-based memory that may hit the market next year. This is a dense, two-dimensional device that has attractive properties. But three-dimensional devices are still about one and a half decades away. There are alternatives to nanotubes, such as DNA itself. DNA has potential uses outside of biology, because of its affinity for linking to itself. DNA could also be used structurally. But the full potential of three-dimensional structures based on either carbon nanotubes or DNA, is a circa 2020 technology.

SO: You write in *The Singularity is Near* of feeling somewhat alone in your beliefs. How has the mainstream scientific community responded to your PROGNOSTICATIONS?

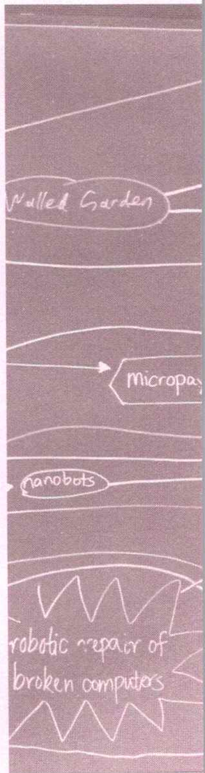
RK: Actually quite well. The book has been very well received; it has gotten very positive reviews in mainstream publications such as *The New York Times* and *The Wall Street Journal*. It has done very well, it has been #1 on the science list at Amazon, and ended up the fourth best selling science book of 2005 despite coming out at the end of the year. *The New York Times* cited it as the 13th most blogged about book of 2005. In terms of group intellectual debate, I believe that it has gotten a lot of respect, and has been well received. There are individuals who don't read the arguments and just read the conclusions. For some of these individuals, the conclusions are so distant from the conventional wisdom on these topics that they reject it out of hand. But for those who carefully read the arguments, the response is generally positive. This is not to say that everyone agrees with everything, but it has gotten a lot of serious response and respect. I do believe that these ideas are getting more widely distributed and accepted, I am obviously not the only person articulating these concepts. Nevertheless, the common wisdom is quite strong—even among friends and associates, the common wisdom regarding life cycle and the concept that life won't be much different in the future than it is today—still permeates people's thinking. Thoughts and statements regarding life's brevity and senescence are still quite influential. The deathist meme (*that death gives meaning to life*) is alive and well.

The biggest issue, which I put out in the beginning of Singularity, is linear vs. exponential thinking. It is remarkable how thoughtful people, including leading scientists, think linearly. This is just wrong, and I make this case, showing dozens of examples. But even though someone may be an expert regarding one aspect of technology or science, doesn't mean that they have studied technology forecasting. Relatively few futurists/prognosticators really have well-grounded methodologies. The common wisdom is to think linearly, to assume that the current pace of change will continue indefinitely. But this attitude is gradually changing, as more and more people understand the exponential perspective and how explosive an exponential can be. That is the true nature of these technology trends.

SO: What about OTHER technologies and INDUSTRIES such as the textile, aerospace, or automotive industries? Are all technology fields experiencing exponential growth?

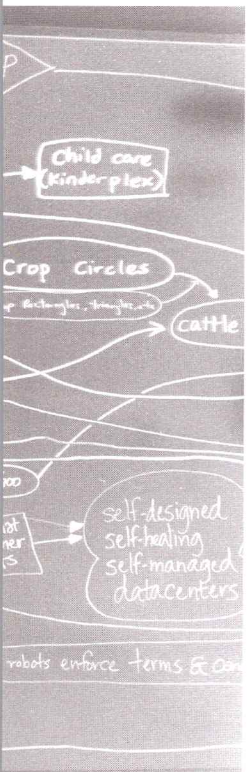
RK: The key issue is that information technology and information processes progress at an exponential pace. Biological evolution itself was an information process—the backbone is the genetic code, which is a digital code. I show in my book how that has accelerated very smoothly, in terms of the growth of complexity. The same thing is true of technological evolution, when it has to do with information. If we can measure the information content, which we can readily do with things like computation and communication, then we can discern that it progresses in this exponential fashion and subject to the law of accelerating returns.

The information technology needs to get to a point where it is capable of transforming an industry, and biology is a good example. Biology was not an information technology until recently—it was basically hit or miss. Drug development was called drug discovery, which meant that we didn't know why



a drug worked and we had no theory of its operation. These drugs and tools were relatively crude and had many negative side effects. 99.9% of the drugs on the market were designed in this haphazard pre-information era fashion.

The new paradigm in biology is to understand these processes as information processes, and to develop the tools to reprogram these processes and actually change our genes. We still have these genetic programs that are obsolete. The fat insulin receptor gene tells the body to hold on to every calorie, since it is programmed to anticipate that the next hunting season may be a failure. That was a good program 10,000 years ago, but is not a good program today. We have shown in experimental studies with mice that we can change those programs. There are many genes that we would like to turn off, and there is also new genetic information that we would like to insert. New gene therapy techniques are now beginning to work. We can turn enzymes on and off, which are the workhorses of biology, and there are many examples of that. Most current drug development is through this rational drug design. So biology is becoming an information technology, and we can see the clear exponential growth. The amount of genetic data we sequence is doubling every year, the speed with which we can sequence DNA is doubling every year, and the cost has come down by half every year. It took 15 years to sequence the HIV virus, but we sequenced the SARS virus in 31 days. AIDs drugs cost $30,000 per patient per year fifteen years ago, but didn't work very well. Now they're down to $100 per patient per year in poor countries and work much better.



Fields such as energy are still not information technologies, but that is going to change as well. For instance, in Singularity I describe how we could meet 100% of our energy needs through renewable energy with nanoengineered solar panels and fuel cells within twenty years, by capturing only 3% of 1% of the sunlight that hits the Earth. That will happen within twenty years, and it will be related to information technology, since it will be able to meet our energy needs in a highly distributed, renewable, clean fashion with nanoengineered devices. We will ultimately transform transportation in a similar way, with nanoengineered devices that can provide personal flying vehicles at very low cost. The transportation and energy industries are currently pre-information fields. Ultimately, however, information technologies will comprise almost everything of value, because we will be able to build anything at extremely low cost using nanoengineered materials and processes. We will have new methods of doing things like flying and creating energy.

SO: Most predictions of future technological developments have been inaccurate. What techniques do you use to improve the accuracy of your prognostications?

RK: I have a team of people that gathers data on many different industries and phenomena, and we build mathematical models. More and more areas of science and technology are now measurable in information terms. I use a data-driven approach, and I endeavor to build theoretical models of why these technologies progress. I have this theory of the law of accelerating returns, which is a theory of evolution. I then try to build mathematical models of how that applies to different phenomena and industries. Most futurists don't use this type of methodology, and some just make guesses. Many futurists are simply unaware of these trends—they make linear models. It is often said that we overestimate what can be done in the short term, because developing technologies turns out to be more difficult than we expect, but dramatically underestimate what can be achieved in the long term, because people think linearly.

SO: The Government has traditionally played a pivotal role in developing new technologies. Is the U.S. Government doing enough to support the nascent nanotechnology or the AI INDUSTRIES? Do these industries require Government support at this point?

RK: These industries will both be propelled forward by the enormous economic incentive. Nanotechnology will be able to create almost any physical product we need at very low cost. These devices will be quite powerful because they will have electronics and communications embedded throughout the device. So there is tremendous economic incentive to develop nanotechnology, and the same is true of artificial intelligence. Basic research has an important role to play—the Internet, for instance, came out of the Arpanet. The new world wide mesh concept—of having every device not simply connected to the net but actually become a node on the net, sending and receiving both its own and other people's messages—this arose out of a department of defense concept. It is now being adopted by civilian, commercial corporations. DARPA is actually playing a forward-looking role in such technologies as speech recognition and other AI fields.

In terms of national competitiveness, the key issue is that we are not graduating enough scientists and engineers. The figures regarding numbers of individuals receiving advanced technical degrees are dramatically growing in China, Japan, Korea, and India. These figures actually resemble exponential curves. China in particular is greatly outpacing the U.S., producing scientists and engineers, both at the undergraduate and doctoral level, in every scientific field. Although this is a real concern, there is now one integrated world economy, so we shouldn't see this problem as simply the U.S. vs. China. I am glad to see China and India economically engaged, and this isn't a zero-sum game—Chinese engineers are creating value. But to the extent that we care about issues such as national competitiveness, this is a concern. In the end, however, this is about what fields teenagers choose to enter.

The U.S. does lead in the application of these technologies. I speak at many conferences each year, including music conferences, graphic arts conferences, library conferences, and so on. Yet, every conference I attend reads like a computer conference, because they are so heavily engaged in computer technology. The level of computer technology used in any of a great diversity of fields is quite impressive.

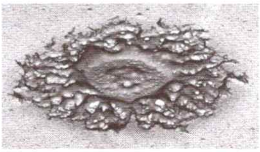
SO: How do you envision THE WORLD IN 2015? What economic and technological predictions would you make for that year?

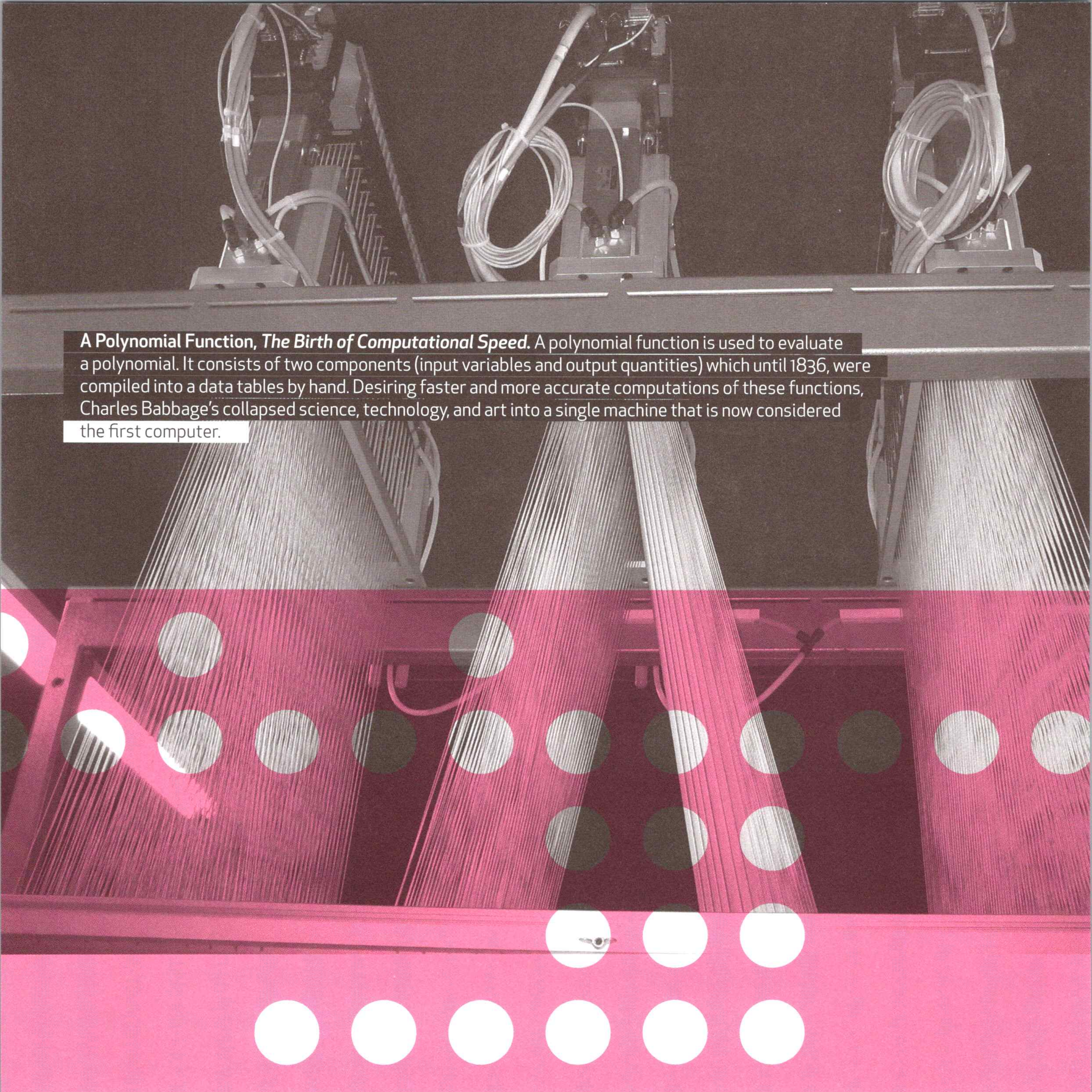
RK: By 2015, computers will be largely invisible, and will be very small. We will be dealing with a mesh of computing and communications that will be embedded in the environment and in our clothing. People in 2005 face a dilemma because, on the one hand, they want large, high-resolution displays. They can obtain these displays by buying expensive 72" flat-panel plasma monitors. But they also want portable devices, which have limited display capabilities. By 2015, we will have images input directly onto our retinas. This allows for a very high-resolution display that encompasses the entire visual field of view yet is physically tiny. These devices exist in 2005, and are used in high-performance applications, such as putting a soldier or a surgeon into a virtual reality environment. So in 2015, if we want a large, high-resolution computer image, it will just appear virtually in the air. We will have augmented reality, including pop-up displays explaining what is happening in the real world. We will be able to go into full-immersion, visual auditory virtual reality environments.

We will have useable language technologies. These are beginning to emerge, and by 2015 they will be quite effective. In this visual field of view, we will have virtual personalities with which you can interact. Computers will have virtual assistants with sufficient command of speech recognition that you can discuss subjects with them. Search engines won't wait to be asked—they will track your conversation and attempt to anticipate your needs and help you with routine transactions. These virtual assistants won't be at the human level, that won't happen until we have strong AI. But they will be useful, and many transactions will be mediated by these assistants. Computing will be very powerful, and it will be a mesh of computing. Individuals who need the power of a million computers for 25 milliseconds will be able to obtain that as needed.

By 2015, we will have real traction with nano-technology. I believe that we will be well on the way to overcoming major diseases, such as cancer, heart disease, and diabetes through the biotechnology revolution that we talked about. We will also make progress in learning how to stop and even reverse the ageing process.

SANDER OLSON IS AN INTERNET JOURNALIST WHO SPECIALIZES IN COVERING STORIES SURROUNDING THE HISTORY OF TECHNOLOGY, THE SEMICONDUCTOR INDUSTRY, AND NANOTECHNOLOGY. HE CREATED THE WEBSITE, NANOMAGAZINE.COM, AND HAS WRITTEN SEVERAL ARTICLES REGARDING NANOTECHNOLOGY RESEARCH.





A Polynomial Function, *The Birth of Computational Speed.* A polynomial function is used to evaluate a polynomial. It consists of two components (input variables and output quantities) which until 1836, were compiled into a data tables by hand. Desiring faster and more accurate computations of these functions, Charles Babbage's collapsed science, technology, and art into a single machine that is now considered the first computer.

Vita Plume

IMAGINE TEXTILE LOOMS AT THE CUTTING EDGE OF INFORMATION TECHNOLOGY! *These words might elicit a smile…a little irony to start the day.*

In North Carolina today we see two different worlds of textiles, looms and weaving. One is a world of the individual artist/ hand weaver or fiber artist; the second, an immense industry and major employer, now losing jobs, closing mills and moving its manual labor out of North Carolina.

From the very first back-strap, tapestry or basic manual looms, weaving has always required immense amounts of time and manual labor. The work of spinning and sizing thread, preparing the warp, warping the loom as well as the actual labor of weaving have taken untold hours. Therefore any development in textile technology that has increased the speed of production has had the potential to greatly increase the quantity of woven cloth and hence, the profitability. These ongoing efforts to improve and increase output while decreasing labor time and cost have resulted in improvements that have often been secretively (I.E. SILK PRODUCTION) guarded.

However, this information has moved around the globe, from location to location as textile industry centers have moved to new locations based on proximity to raw materials and the availability of cheap labor.

It has been the demand to produce huge quantities of cloth that has made it imperative to do so as cheaply and efficiently as possible. The development of the Jacquard loom was one huge step in this long, historic process. The Jacquard was developed to enable the production of complex brocade patterns, which up until that time, required the use of a draw loom. The draw loom required two operators. The draw boy raised and lowered a series of cords that controlled complex patterning possibilities while the weaver controlled the base structural threads and actually wove the cloth. Two efficient controllers or weavers could weave two rows or picks per minute.

In 1804, Joseph Marie Jacquard invented the Jacquard loom. The innovation introduced an automated punch card system to select the warp thread sequence that produced complex patterns. The development of the Jacquard loom allowed one skilled weaver to weave an average of forty-eight picks per minute. This was a prodigious increase in speed and production. We can appreciate the impact of the speed increase when we consider that today, "a supersonic jet aircraft flies up to about twenty-four times the average speed of a motor car." (ESSINGER, 38)

"What is true of great inventors is especially true of Joseph-Marie Jacquard. The modest, industrious Frenchman never guessed that the automatic punched-card loom he had devised to weave mesmerizingly complex and stunningly beautiful patterns would one day evolve into a tool whose breadth of possible applications was close to unlimited. Jacquard had invented a method to automate a complex process. But controlling the warp threads that enabled works of art to be woven into silk fabric barely begins to tap the potential of punched-card technology." (ESSINGER, 151)

What is equally interesting is the relationship of the punch cards used to automate the weaving process and the development of information processing and current computer technologies.

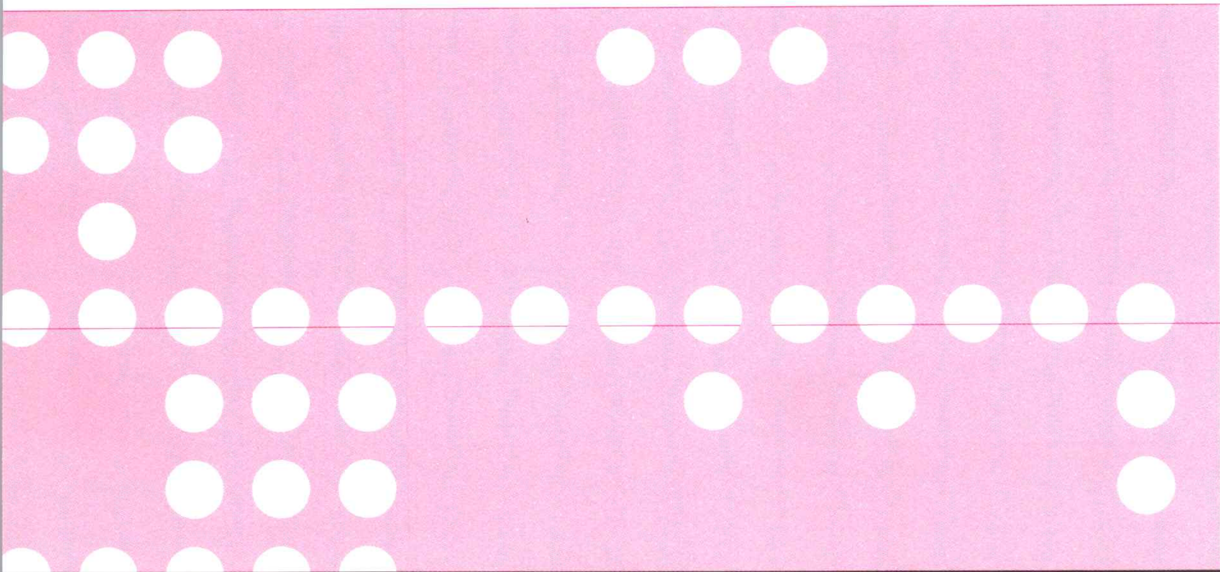
"The idea of having the presence or absence of a hole stand for a numerical quantity or a specific item of information would be absolutely fundamental to information processing in the years ahead.... The punched card became the first-ever system for processing information using a standardized data input device." (ESSINGER, 164)

In England during the 1800s, "computers" were human clerks whose job it was to undertake arithmetic calculations to compile astronomical and mathematical tables. (ESSINGER, 66) At the time these computers, being only human, were prone to errors and the tables they developed needed to be edited and corrected, also by hand, requiring hours of tedious work. Charles Babbage, an English mathematician, had been engaged to do exactly this editing and while doing so determined there must be an easier way! He proceeded to design the Difference Engine and then the Analytical Engine in an effort to do just that. The Analytical Engine (which was never built) was based on the use of a punch card system similar to that used in Jacquard weaving.

"The day when Babbage decided to make use of Jacquard cards in his design for his Analytical Engine is one of the most momentous in our story. It is, literally, the day when the bridge between the weaving industry and the embryonic information technology industry was created. Babbage's decision was the most explicit confirmation, by the man who is today regarded as the father of the computer... that in essence a computer is merely a special kind of Jacquard loom." (ESSINGER, 66)

"We may say most aptly that the Analytical Engine weaves algebraic patterns just as the Jacquard loom weaves flower and leaves." (Ada Lovelace's notes to describe how the Analytical Engine works). (ESSINGER, 140)

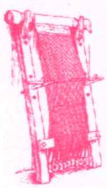
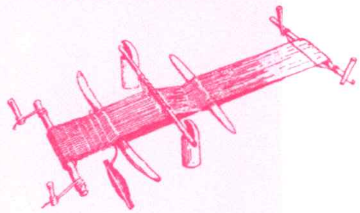
In 1880 Herman Hollerith, a young mechanical engineer, was invited to assist in the collection and analysis of statistical data from the first U.S. census. This information was collected, collated and cross-referenced from thousands of pieces of paper



onto master graphic tables. In 1880, analyzing a population of 50 million took a total of 1495 clerks, (employed to run a manual system known as the "tally") seven years to collate. By 1900 the population had grown to 76 million and the collation of data would not be completed before the next census would need to take place. (ESSINGER, 157)

Hollerith's brother-in-law was in the silk weaving business, hence Hollerith was well acquainted with the operation of the Jacquard loom. He first experimented with rolls of punched paper, but soon adapted the notion of using punched cards to record single, separate, units of information such as census material for processing and monitoring. Hollerith's vision however was broader and he developed an entire family of machines to be used in unison. These included the production of the card itself, a card punch to punch the cards, as well as a machine to facilitate the sorting and counting of the results—a counter. (ESSINGER 164–166). By 1900 he had created a system of automated machines he called 'tabulators.' This process was basically analogous to the operation of the Jacquard loom; the difference was that…the cards themselves were sorted into different categories rather than that certain warp threads were raised to form a line of weaving. (ESSINGER, 171)

At this time two other important new 'business machines' had been developed: the typewriter and the cash register. In 1911 Hollerith sold his company to Charles Ranlegh Flint who merged it with Computing Scale Company of Dayton, Ohio, and the International Time recording Company of Endicott, New York. Hollerith stayed on the board and worked with Thomas Watson to develop a model corporation with organized research and sales departments. In 1924 in recognition of the important role that tabulating machines were playing in the business profitability, C-T-R changed its name to International Business Machines (IBM). By 1928 it was the fourth largest office machine supplier in the world.

TIMELINE OF LOOMING TECHNOLOGIES	NEOLITHIC AGE	5000 BC	3000 BC
	EARLIEST WARP-WEIGHTED LOOMS	EARLIEST REPRESENTATION OF A LOOM	EGYPTIAN LINEN PRODUCED ON HORIZONTAL GROUND LOOMS
			
PRODUCTION SPEED			1 INCH OF MATERIAL/DAY

IBM on the face of it may seem a long way from that of Joseph-Marie Jacquard. But in fact the two worlds are connected by the clearest strand of logic. Any successful invention gives rise to improved versions of itself that will in due course foster the creation of an industry… inventions tend to be created by lone geniuses but are typically developed and furthered by practical-minded, even ruthless, realists…. (ESSINGER 193)

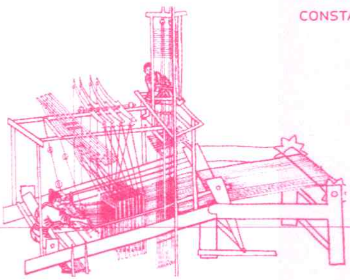
In 1939 Howard Aiken worked with IBM to build the first "Automatic Computing Plant" which cost more than $100,000 ($1.5 million today) and was 51 feet long, 8 feet high, 2 feet wide, weighed 5 tons and could store 72 numbers in its memory. It was developed with the assistance of the U.S. Army, as a top-secret project, and ran its first test in 1943. This first automatic digital calculating devise is considered to be the world's first computer. Named the Harvard Mark I, it was programmed by a series of instructions coded on punched paper tape. (ESSINGER, 227)

2000 – 1000 BC

FIRST REPRESENTATION OF CHINESE SILK WEAVING, WHICH WAS ALREADY DEVELOPED BY THIS TIME.

400 BC, CHINA
520 AD, SYRIA

EARLY SAMPLES OF DRAWLOOM FABRICS DATED TO THIS TIME



END OF 10TH CENTURY

SILK WEAVING HAD REACHED A PEAK IN WORKMANSHIP, BEAUTY, AND DESIGN FROM CONSTANTINOPLE TO CHINA

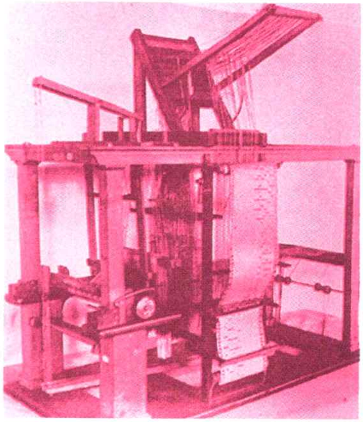
13TH – 15TH CENTURY

ITALY HAD MAINTAINED A MONOPOLY ON SILK WEAVING IN EUROPE

15TH CENTURY

ITALIAN WEAVERS MOVE TO FRANCE AND BEGIN FRENCH SILK INDUSTRY IN LYONS

In the 1930s and 40s the refinement of the vacuum tube made it possible to use rapid switching devices on the Electronic Numerical Integrator and Calculator (ENIAC) developed by J. Presper Eckert and John W. Mauchly at the University of Pennsylvania. Punched cards were still used but this was the first all-electronic digital computer using vacuum tubes, operating at the speed of light. 1940–1970 saw huge developments in the computing industry. It is important to note that during this period a computer still had to read and sort a new pile of punched cards (containing the raw data) every time it was used.



It was only in the mid 1970s that a dramatic change evolved whereby punched card technology was replaced by magnetic tape or floppy disks.

The impact of punched card technology on our world has been immense. This development has also been a story of individual geniuses trying to solve very real problems in the worlds they inhabited in an effort to relieve the drudgery of manual labor. Speeding up production processes as well as ensuring accuracy were the main drivers of these developments. These innovations were further explored and utilized by designers and engineers, working in teams to innovate, perfect and investigate possible further applications. Essinger likens this process of invention and development to a river with the idea starting as the source and gradually widening and developing tributaries until it flows into a larger body of knowledge and application.

1567

THE DRAW LOOM, LONG USED IN ASIA, WAS INTRODUCED TO BRITAIN BY FLEMISH WEAVERS

1725

BASILE BOUCHON INVENTED A PUNCHED PAPER ROLL SELECTION DEVICE THAT TOOK THE PLACE OF THE DRAW BOY

1728

M. FAUCON (FALCON) BUILT THE FIRST PROTOTYPE LOOM THAT UTILIZED A CHAIN OF PUNCH CARDS. IT WAS HOPELESSLY SLOW AND INEFFECTIVE. (ESSINGER, 36)

1804

1ST JACQUARD LOOM PATENTED BY JACQUES-MARIE JACQUARD IN LYONS, FRANCE

24 INCHES OF MATERIAL/DAY

1836

CHARLES BABBAGE DECIDES TO USE JACQUARD STYLE PUNCH CARDS IN THE DEVELOPMENT OF HIS ANALYTICAL ENGINE

Introduction of idea that computers are human clerks who whose job is to undertake arithmetic calculations to compile astronomical and mathematical tables.

1 CALCULATION/SECOND

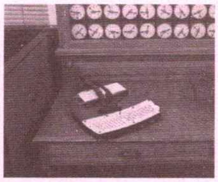
It is interesting to note that, while the textile industry and society itself have been changed significantly by the development of both the punched card and the Jacquard loom, this technology has remained in the realm of industry. Studio weavers and textile artists have, until very recently, had almost no access. Industrial looms are large, expensive and require special laboratories and technicians to operate them. Huge production runs are required to make them cost efficient and the expense of stopping production to allow access to artists has been deemed to be impractical or more likely not profitable.

There have been some projects, where artists have been invited into mills such as Mueller Zell in Germany in 1991. In the 80s and 90s two universities, The Rhode Island School of Design and the Philadelphia College of Textiles and Science (now Philadelphia University) experimented with visiting artist Jacquard projects. In these situations faculty, technicians or graduate students provided technical support to assist and weave the concept the 'artists' had developed. These projects were instrumental in helping break barriers and gave textile artists and weavers a view into another way of thinking about and producing cloth. However, access was limited to a few invited participants. In the past fifteen years, Jacquard handlooms have been developed and hand weavers have begun to access these through academic institutions.

It has taken more than 200 years for this technology to wind its way through this complex development to be accessible to the hand weaver!

1837

INVENTION OF THE TELEGRAPH USING PUNCHED PAPER TAPE TO RELAY INFORMATION AT A DISTANCE USING ELECTRIC CURRENT.



1881

WILLIAM J. HAMMER WORKING FOR THOMAS EDISON DISCOVERS THE EDISON EFFECT IN A VACUUM TUBE

1884

HERMAN HOLLERITH PATENTS HIS FIRST CENSUS TABULATIONS MACHINE TO ASSIST WITH COLLECTING AND HANDLING LARGE AMOUNTS OF INFORMATION TO US IN 1890 U.S. CENSUS

1896

HOLLERITH STARTS THE TABULATING MACHINE COMPANY 'TABULATOR'– "FIRST SUCCESSFULLY COMPLETED LOOM TO WEAVE INFORMATION RATHER THAN FABRIC" (ESSINGER, 150)

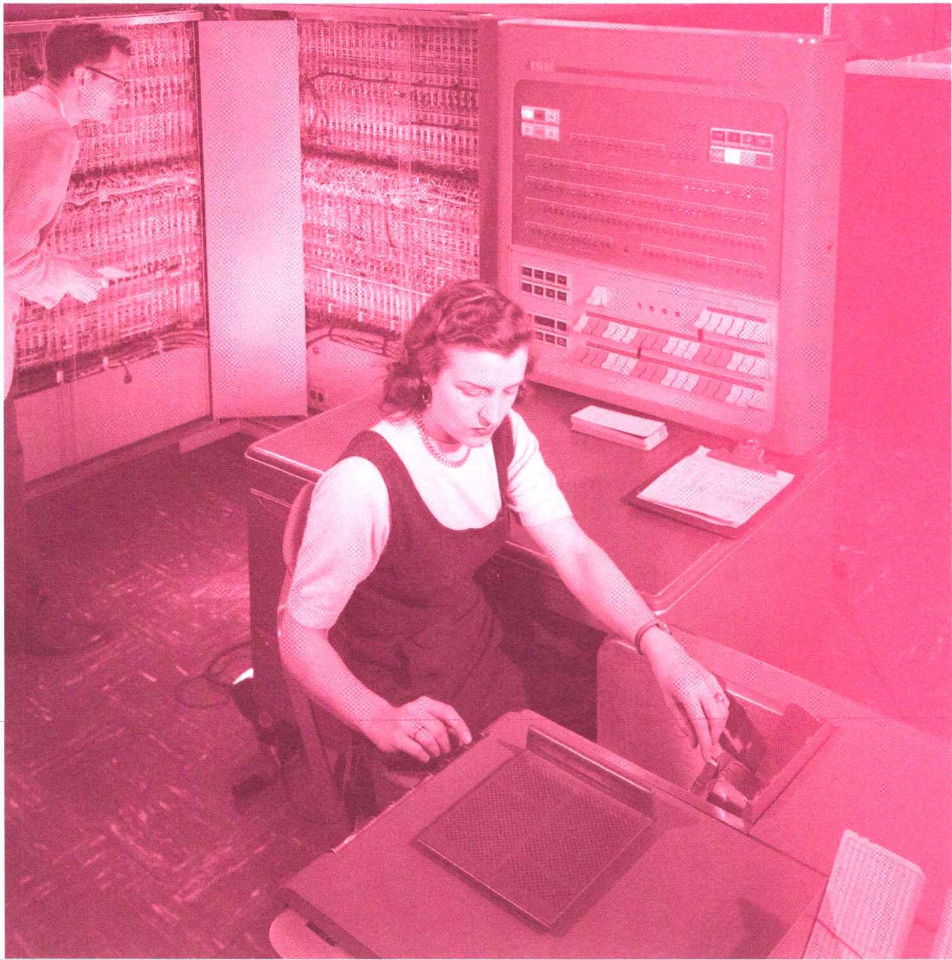
1911

CHARLES RANLEGH FLINT PURCHASES HOLLERITH'S TABULATING MACHINE COMPANY AND MERGES IT WITH THREE OTHERS TO FORM THE COMPUTING–TABULATING–RECORDING COMPANY OR C-T-R

48 CALCULATIONS/SECOND

North Carolina is anxiously watching as the labor intensive work of the manufacture of textiles moves offshore to countries where labor can be bought more cheaply. One way to stem this flow is to move away from the present labor intensive model to one emphasizing innovative research and excellence in design; the exploration of new materials combined with innovative construction methods results in a new range of products.

Areas of exploration already include medical textiles (artificial veins, arteries and cartilage), sound insulation, membranes for architectural applications, as well as exploring the structure of the material interlacement of woven communication webs.



1924

THE COMPUTING-TABULATING-RECORDING COMPANY CHANGES ITS NAME TO INTERNATIONAL BUSINESS MACHINES (IBM)

640 CALULATIONS/SECOND

Paul Greenhalgh, president of the Nova Scotia College of Art and Design asserts:

"The next phase of modernity will be characterized by four things: INTERDISCIPLINARITY, GLOBALITY, PAN-TECHNICALITY and ECLECTICISM. Those institutions and individuals in all fields of human endeavour who understand this best will be the ones who produce the most significant works in the coming decades."

He goes on to describe this phase as one of interdisciplinary, premised on relational rather than reductivist vision. "Interdisciplinarity does not imply a lessening of the specialized intense knowledges, but rather the recognition that their interaction, and additionally the development of new approaches is premised on interaction…" (GRENNHALGH)

He contends that we will begin to see the end of the separate solitudes of the arts and sciences that has undermined industrial culture for over a century. Artists and scientists have seen each other at opposite ends of the research spectrum and it is the development, interest and use of new technologies that Greenhalgh believes will allow the discovery of common threads in art and science to meet in the labs and studios of the world. He coins the term 'pan-technicality' to imply that craft and art studios will be the location for the merge of traditional tools with concepts and high technology. While he locates this space in artists studios it is my hope that this could be a true collaboration and also occur in the realms of industry, commerce and communication.

1936

THE WORD COMPUTER STILL REFERS TO A HUMAN CLERK

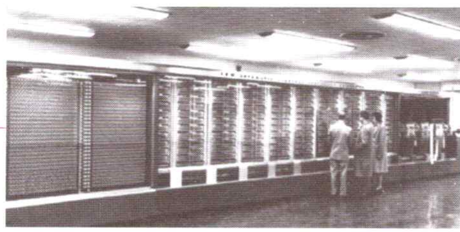
BY THE 1930'S TABULATORS COULD COUNT AND SORT 30,000 PUNCHED CARDS PER HOUR, OR ABOUT 8 PER SECOND

1937

ALAN TURING PUBLISHES 'ON COMPUTABLE NUMBERS, WITH AN APPLICATION TO THE ENTSCHEID-UNGSPROBLEM [DECISION PROB-LEM]' AND PROVIDES INSPIRATION FOR DIGITAL COMPUTER

1939

IBM, WORKING WITH HOWARD AIKEN, BEGINS TO BUILD THE FIRST "AUTOMATIC COMPUTING PLANT", THE HARVARD MARK I AT A COST OF OVER $100,000 ($1.5 MILLION TODAY)



1943 – 50

DEVELOPMENT OF 1ST GENERATION COMPUTERS UTILIZING VACUUM TUBES AND PUNCH CARDS

1959

INTRODUCTION OF THE TRANSISTOR ENABLED THE COMPUTER TO PROCESS 100,000 INSTRUCTIONS PER SECOND

100,000/SECOND

TIMELINE OF INSTRUCTIONS PER SECOND SINCE 1974

PROCESSOR	KIPS*	YEAR
INTEL 8080	640 KIPS AT 2 MHZ	1974
MOTOROLA 68000	1 MIPS AT 8 MHZ	1979
INTEL 386DX	8.5 MIPS AT 25 MHZ	1988
INTEL 486DX	54 MIPS AT 66 MHZ	1992
POWERPC 600S (G2)	35 MIPS AT 33 MHZ	1994
INTEL PENTIUM PRO	541 MIPS AT 200 MHZ	1996
ARM 7500FE	35.9 MIPS AT 40 MHZ	1996
POWERPC G3	525 MIPS AT 233 MHZ	1997
ZILOG EZ80	80 MIPS AT 50 MHZ	1999
INTEL PENTIUM III	1354 MIPS AT 500 MHZ	1999
AMD ATHLON	3561 MIPS AT 1.2 GHZ	2000
AMD XP 2400+	5935 MIPS AT 2.0 GHZ	2002
PENTIUM 4 EXTREME EDITION	9726 MIPS AT 3.2 GHZ	2003
ARM CORTEX A8	2000 MIPS AT 1.0 GHZ	2005
XBOX360 IBM "XENON" SINGLE CORE	6400 MIPS AT 3.2 GHZ	2005
AMD ATHLON FX-57	12000 MIPS AT 2.8 GHZ	2005
AMD ATHLON 64 3800+ X2 (DUAL CORE)	14564 MIPS AT 2.2 GHZ	2005
CELL BE'S POWER PROCESSOR ELEMENT	6400 MIPS AT 3.2 GHZ	2006
AMD ATHLON FX-60 (DUAL CORE)	18938 MIPS AT 2.6 GHZ	2006
INTEL CORE 2 X6800	27079 MIPS AT 2.93 GHZ	2006

* KIPS = 1,000 OF INSTRUCTIONS/SEC.
MIPS = 1,000,000 OF INSTRUCTIONS/SEC.

MY LOVE OF PRECISION AND ESSENTIAL BREVITY HAS NATURALLY GIVEN ME A TASTE FOR NUMBERS, WHICH LIVE AND BREATHE ON THE PAPER LIKE LIVING BEINGS IN OUR NEW NUMERICAL SENSIBILITY.

— F.T. MARINETTI

1960

NEW GENERATION OF PUNCHED CARDS—PERFORATIONS READ BY IMPULSES OF LIGHT

1983 – 1987

BONAS AND STAUBLI LAUNCH FIRST ELECTRONICALLY CONTROLLED JACQUARD WEAVING MACHINES

To conclude this essay I quote the words of Sadie Plant (1979) from her book *Zeros and Ones*.

"The yarn is neither metaphorical or literal, but quite simply material, a gathering of threads which twist and turn through the history of computing, technology, the sciences and arts. In and out of the punched holes of automated looms, up and down through the ages of spinning and weaving, back and forth through the fabrication of fabrics, shuttles and looms, cotton and silk, canvas and paper, brushes and pens, typewriter carriages, telephone wires, synthetic fibers, electrical filaments, silicon strands, fiber-optic cables, pixilated screens, telecom lines, the World Wide Web, the Net, and matrices to come." (PLANT, 12)

VITA PLUME IS A TEACHER AND FINE ARTIST WHO SERVES AS AN ASSOCIATE PROFESSOR IN ART + DESIGN AT NC STATE UNIVERSITY. HER WORK INVESTIGATES THE RELATIONSHIP BETWEEN TRADITIONAL LATVIAN HAND WEAVING TECHNIQUES AND THE LATEST RESEARCH IN COMPUTERIZED DESIGN SYSTEMS SUCH AS THE DOBBY AND JACQUARD LOOMS. HER WORK HAS BEEN EXHIBITED THROUGHOUT CANADA, FINLAND, LATVIA, POLAND, AND THE UNITED STATES.

THIS PAPER IS INDEBTED TO THE RESEARCH AND CLARITY OF JAMES ESSINGER'S BOOK, *JACQUARD'S WEB*. WHILE THIS ESSAY USES MANY QUOTATIONS FROM HIS TEXT, MUCH OF THE SENSE OF THIS OVERVIEW IS HUGELY INDEBTED TO HIS IDEAS.

1984

IBM MANUFACTURES LAST COMPUTER PUNCH CARD

INTRODUCTION OF THE FIRST, COMMERCIALLY SUCCESSFUL PERSONAL COMPUTER BY MACINTOSH

2000

U.S. PRESIDENTIAL ELECTION GAINS NOTORIETY DUE TO PROBLEMS ARISING FROM IMPERFECTLY AND MISPUNCHED CARDS

2003

NC STATE UNIVERSITY COLLEGE OF DESIGN PURCHASES A DIGITAL HAND JACQUARD LOOM

Coefficient of Friction, *The Force of Opposing Bodies.* Friction is a force generated from the exchange of atomic energy between two surfaces moving in opposite directions. It is a force that can either halt or propel the motion of these two objects based on the interaction between their surfaces.

WHY DON'T THE REST OF US LIKE THE BUILDINGS ARCHITECTS LIKE?

Robert Campbell

Memory and Invention—the rhyming "e" is the memory that lurks within invention. All art and all periods must work within this spectrum. There is always memory. There is always invention. The question is the relationship between the two. The tension between them is where the energy comes from. There is no energy in architecture if it is only a memory of the past.

There is no energy if it is only invention. And I find as a critic of architecture writing for the Globe, for a general newspaper, that the connection between memory and invention has been severed in our culture. The readers who send me email fall into one of two groups. Either they hate modernism and love everything old—and that's by far the majority—or they think it's boring to imitate the past, and they want everything to be new and daring and experimental. I call them the "rads" and the "trads"—the radicals and the traditionalists, the "pastists" and the "futurists." They need each other. they are equal and opposite. They live in each other's eyes. If one were to disappear, the other would have to disappear too. They need each other just as the U.S. and the U.S.S.R. needed each other to define who they were during the Cold War.

The trads want everything to look *beau-ti-ful*. That is to say, they want it to look like the buildings of the past they have learned and been conditioned to love. Picasso pointed out, as others have, that anything new is ugly. Our perception of what is beautiful is a learned response. Someone has noted that there is no record of anyone having said that the Alps were beautiful until the eighteenth century. Until then, the Alps were dangerous and frightening. But a taste for the sublime came in and made them beautiful. A new response was formulated and learned.

The rads among my readers take the opposite view. They can't believe that citizens of Boston are building imitations of nineteenth-century architecture, wrapped in thick blankets of redbrick and topped with hats of phony mansard roofs, all in an attempt to "fit into" a historic neighborhood. Why can't we live in our own time, they say. Or better yet, why can't we live in the future? Why can't we use computers to make groovy new shapes—there must be some more contemporary new term than groovy: awesome new shapes—that will broadcast our daring, our boldness, our march into the future. We've seen examples of that in recent months in the many idiotic proposals by famous architects for the World Trade Center site.

Here's my main point. The rads and the trads are the same. They're much more like each other than they are different. That's because they both seek to substitute a utopia of another time for the time we actually live in. The trads find utopia in the past; the rads find it in the future.

The utopia of the trads is a world of beaten copper and weathered wood and small paned windows and genteel manners. It is a world that, of course, never quite existed. It is a false utopia, a fiction about the past created by the present. The utopia of the rads, by contrast, is a fiction about the future. This is avant-gardism, the curse of the twentieth century in my opinion. Going back to Hegel and Marx, this view judges the value of anything by its novelty, by whether it's helping to bring into existence a future that is struggling to be born.

This kind of futurism expresses itself in the work of my architecture students as a love affair with the unpredictable shapes and collisions they can generate on their computers. You see buildings now that look like an abandoned game of Pick-up-Sticks. The architect of some of those has just won the Pritzker Prize, the highest international award in architecture. Or they may look like inflated muffins that didn't rise quite properly in the oven. That's called "blob architecture"—biomorphic shapes. Or they may look like frozen explosions.

Avant-gardism usually rides on some new wrinkle of technology, whether it's the speeding cars of the Italian futurists in the early twentieth century, or the public health and hygiene movement that underlay so much of early modernism. Now it's computers.

What both the rads and the trads ignore, in their love of utopias of the past and the future, is the present. They both try to elbow aside the real world we live in and substitute a world of another era. It's a lot easier to design a utopia than to deal with the complex reality of a present time and place.

You don't have to deal with the tension between memory and invention. You just take one or the other. If you do that, you inevitably create architecture that is thin, bloodless, weak, and boring. An example of bad trad is the Darden Graduate School of Business Administration at the University of Virginia by Robert Stern—a kind of cardboard model of Thomas Jefferson blown up like an inflated Michelin Man. All memory and no invention. An example of bad rad would be Frank Gehry's Experience Music Project in Seattle, which is little more than a meaningless free-form sculpture that jumped off a computer screen. Its shapes appear arbitrary and thus lack meaning and significance: it's all invention and no memory.

The dirty secret of avant-garde architecture is that it's easy to invent new shapes. Children do it all the time. So do cartoonists. What's hard is to give those shapes and forms any meaning. You can't do that without referring them to some kind of tradition. You can say, I'm within the tradition and I'm innovating within it. You can say, I'm breaking out of the tradition. But if there isn't a tradition, your forms lack an essential frame of reference.

I've spent my life as a critic trying to bridge the rad-trad gap. I've failed so far and I think it's getting worse. So my influence has probably been negative.

I want to give you a couple of quotes—I love to quote people more eloquent than myself. This is from J.M. Richards, a great British architectural scholar and critic:

> Architecture cannot progress by the fits and starts that a succession of revolutionary ideas involves. Nor, if it exists perpetually in a state of revolution, will it achieve any kind of public following, since public interest thrives on a capacity to admire what is already familiar and a need to label and classify.

I think he got that exactly right. If you think of a teenager learning for the first time about baseball or rock music, that's how you move into any new subject, by admiring what's familiar and by labeling and classifying.

Lewis Mumford said that what he valued in architecture is what he valued in life itself: "Balance, variety, and an insurgent spontaneity." But you can't have insurgent spontaneity unless there is some stable frame against which to be insurgent.

Here is a contrasting quote from another architectural theorist, Charles Jencks:

> The architect proceeds as the avant-garde does in any battle, as a provocateur. He saps the edges of taste, undermines the conventional boundaries, assaults the thresholds of respectability, and shocks the psychic stability of the past by introducing the new, the strange, the exotic, and the erotic.

I'm so tired of that kind of language. Every time I pick up an art magazine I read that the latest artist is "challenging my preconceptions." What the artists and the editors don't realize is that my only remaining preconception about art is that my preconceptions will be challenged. Where do you go from there?

My own definition of architecture is simpler: architecture is the art of making places. Places can be corridors or rooms. They can be streets and squares. They can be gardens and campuses. These are all places for human habitation. Architecture is not primarily an art of self-expression, nor is it primarily an intellectual activity. Buildings are not dramatic sculptures or amazing site installations. They exist to create places. And you appreciate a work of architecture in only one way, by inhabiting it. It is an art, but it is not an art of painting or sculpture. You can't appreciate it like a painting, by looking at it. You can't appreciate it like a sculpture, by walking around it. You must inhabit it. You don't have to do that physically with your body; you can do it with your imagination. You can look at a building and see a window and imagine yourself inside looking out and imaginatively inhabit that building. That is how you experience architecture.

It's interesting that people have no problems with the contemporary or avant-garde designs of their cars or their sound systems. Those things come and go in our lives. Of architecture we ask, I think, that it provide us with reassurance of stability, that it not change too quickly.

Kenneth Frampton, another great architectural historian at Columbia, once compared the Italian futurists and their love of fast automobiles with architecture in our own time:

> Now once again [as at the time of the futurists] we live in an age in which speed and cybernetic disposability are advanced as the order of the day. But it must be seriously questioned whether speed and ephemerality ever had anything to do with architecture. And further, whether architecture is not, to the contrary, an essentially anachronistic form of art whose fundamental task is to stand against the fungibility of things and the mortality of the species.

I think we have to accept the fact that architecture, like any other language, like the English language, is a language of conventions. We don't write poetry in Esperanto because nobody would understand it. If we invent a new architectural language—and it was the architect Charles Moore who said that "modernist architects designed in Esperanto"—we are separating ourselves from the larger culture. Conventions are arbitrary. A blue rug could perfectly well be a red rug in some other language. The language, the terms, are entirely arbitrary.

Creativity in the absence of convention is a meaningless concept. When Robert Frost said, "For me, writing free verse would be like playing tennis without a net," he was saying, "Without a net and a court and a book of rules, how would I know whether I had made a good shot?"—without iambic pentameter, without some tradition, without some framing. Another favorite quote is from Erik Erikson: "Play needs firm limits, then free movement within those limits." You need both those things. Or as Van Quine, a professor of philosophy at Harvard, once said: "We cannot halt the change of language, but we can drag our feet."

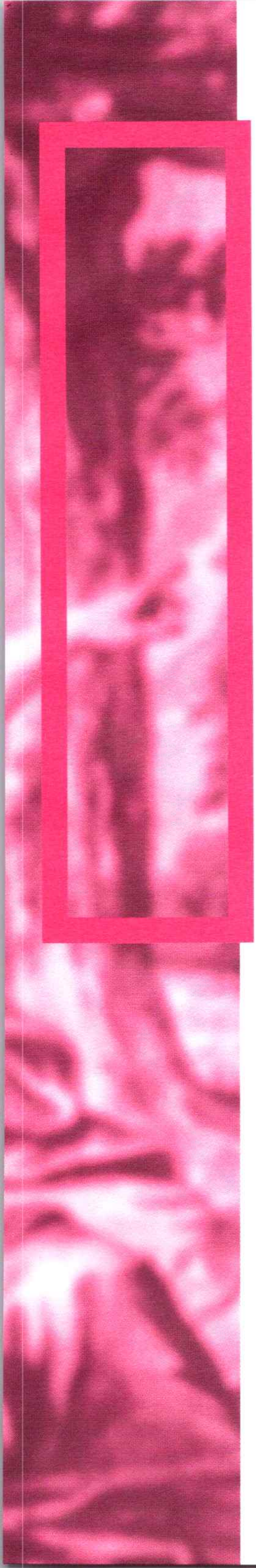
Going back to the tension between memory and invention. I lived in Lowell House at Harvard for three years, and I've never been able to persuade myself that it would have been better if Walter Gropius had come to Harvard ten years earlier than he did and insisted that all the houses be modern. The conventional language did reinforce a sense of place and of time at Harvard, just as does the conventional language of all those little red Veritas emblems. Harvard is a stage set, just as is any city. Now it is so into its brand image—red brick, Georgian, all that kind of iconic imagery—that every time Harvard renovates the Faculty Club, it looks older.

At Princeton, the board of trustees and its planners have divided the campus into four quadrants. The old part of the campus is brand-image Princeton, where they're building a Gothic Revival dorm. Princeton existed for 150 years before it ever did any Gothic Revival; that didn't come along until about 1900. Gothic Revival was seen as the Anglophile tradition that America should be following, instead of all those other foreign things. That's brand-image Princeton. Then they're doing another quadrant that opens to the future with buildings by Frank Gehry and other current stars. So at Princeton, the rad-trad conflict is now immortalized by stylistic zoning. It's a new invention.

I'd like to add another point about architecture and the university. Very often, architects build for their peer group, and the hell with the rest of the world. I think that some of my fellow architecture critics—for example Herb Muschamp at *The New Times* who is brilliant in many ways—believe that architecture is something that is practiced by fifty people around the world for an audience of maybe three thousand. I don't see how you can make that case about architecture when we all have to live in it and experience it; it's got to be part of our lives. This kind of error happens, I believe, partly because architecture schools, which are a new invention—the first one was at MIT in the 1880s—are in universities. University professors of architecture tend to believe, falsely, that architecture is primarily an intellectual activity, just like, say, philosophy. They dream up totally unreadable theories. I don't know what the poor kids do when they come to school to study architecture and run into some kind of buzz-saw verbiage like this:

> A coherent and differentiated special paradigm overlays both the natural and historical determination of places and the homogeneous construction of modern space. Such changes in the nature of contemporary space give rise to the replacement of a long lasting epistemology of conservative systems by nonisolated complex models that approach reality as an unstable set of vaguely delimited locations crossed by flows of energy and matter.

That's a quote from the prospectus of a prominent school of architecture. If you read it over ten times, you can sort of figure out what the author is trying to say, but he has no idea how to say it. Why would someone write this way? I think you all know as well as I do: to send smoke signals to your peers in other places. These bizarre words are tokens that tell everybody that you're in the same in-group that they're in, a kind of international cult of appreciators.



I want to say a bit about architecture critics. You may ask yourself, why are there architecture critics? Other critics are consumer guides, telling you whether to buy a ticket. Nobody buys a ticket to see a new building, unless it's a very heavily hyped art museum. Architecture critics merely try to stimulate a conversation about how we should build our world.

I think architecture critics go wrong when they behave like other critics. The experience of works of art other than architecture is normally a framed experience. When you look at a painting, you see it in a frame. It is framed off in space. When you go to a movie, it begins and ends. It is framed off in time.

Buildings, however, are framed neither in time nor in space. They exist in a relatively stable relation to their spatial context, especially the context of other buildings. And they exist indefinitely in time.

What makes this easier to understand is that this used to be true of painting too. Before the Renaissance, a painting always existed in some permanent relationship to time and space. It was an altarpiece, or it was a mural, or it was something that was locked into a particular place and had the purpose not of being an artwork to be appreciated, but that of explaining the meaning of Christianity or whatever else. Then it dawned on someone in the Renaissance that you could take the painting off the wall, frame it, sign it, and send it out into the marketplace where it could be sold. Painting changed forever. Now you could talk about an Ucello or a Kandinsky as a commodity, as a brand-name product.

What I'm arguing is that the same thing has happened to architecture. It has become frameable and signable. We've found a way to rip the building out of its context in time and space. And that, of course, is the result of the arrival of photography and other visual media. Photography is the removal of context. You can't define it any better than that. A photograph of a work of architecture frames it off from the world and freezes it at a single moment in time; it frames it in both time and in space.

We now live in a media culture so pervasive that we barely notice it. It is a world of framed visual images in our magazines, on our screens, and increasingly in our imaginations. We have come, therefore, to think of buildings as we think of paintings, not as existing in a specific time and place but in the worldwide stream of images.

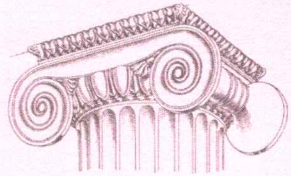
A building that always reminds me of the change brought about by photography is a house that I've never seen (and nobody I know has ever seen it) by Richard Meier, called the Smith House in Darien, Connecticut. Every architect of my generation knows the Smith House because of the famous color photographs by the great photographer Ezra Stoller.

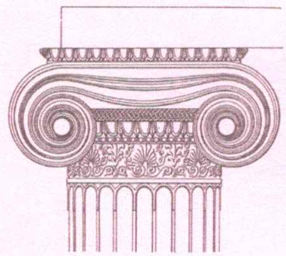
Here is the question: Is it the image or the house that is the end product of the design process?

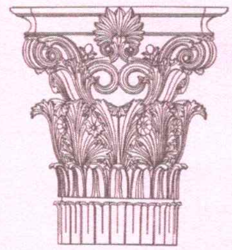
I believe you have to say it's the image. The house becomes merely a means to the image. The image is a far more potent and influential presence in world culture. Once that's realized, architects begin to design with an eye to the eventual photograph, an eye to the media world, not the physical world.

But I'm wandering off my topic…

ROBERT CAMPBELL IS AN AWARD-WINNING ARCHITECTURE CRITIC OF *THE BOSTON GLOBE*. HIS WRITINGS ON EVERY ASPECT OF THE BUILT ENVIRONMENT HAVE BEEN A STAPLE IN THE ARCHITECTURAL COMMUNITY SINCE THE EARLY 1970S. IN 1996 HE WAS AWARDED THE PULITZER PRIZE FOR CRITICISM.







THIS POST-SCRIPT TO ROBERT CAMPBELL'S VIEW OF THE RADS AND TRADS, WAS WRITTEN BY Wendy Redfield IN RESPONSE TO A REQUEST TO CONSIDER THE ESSAY IN RELATION TO DESIGN EDUCATION.

Robert Campbell's essay is so pithy and cogent that an introduction isn't necessary. Rather, think of this as a post-script responding to some of Campbell's main points in light of our primary business in the college: the education of designers—and in this particular case—of architects.

The dirty secret of avant-garde architecture is that it's easy to invent new shapes...What's hard is to give those shapes and forms any meaning... Creativity in the absence of convention is a meaningless concept.

Probably the most unsettling tension most architects experience upon leaving school is that between what their education has taught them is most important, and what is desired by their newly encountered clients. There exists a tremendous gap these days between what we teach in school and hold as professionals to be worthwhile, and the aesthetic frame of reference of most Americans. As Campbell would have it, the fault is mainly on our side, because we have as a discipline removed ourselves from general culture, retreating to an elitist enclave. **BOTH CAMPBELL'S** *'rads'* **AND** *'trads'* **EMBRACE ELITIST POSITIONS**. While the *'trads'* claim a certain relevance to the general population by virtue of allegiance to architectural tradition, we must wonder which general population is familiar with the proportions and constructional derivation of, say, the Classical Orders. Would this be the general population typically drawn to homes characterized by a butchered patchwork of pseudo-styles referred to sneeringly by architects as McMansions? *Surely not.*

Meanwhile the *'rads'* simply adopt the posture that what the general public may want or like is itself irrelevant—that it is simply too ignorant and too uncultured to judge what is good and what is bad. The layperson's desire for good architecture must therefore simply be ignored in favor of pleasing and amusing one's colleagues and the tiny handful of clients who actually 'get it'.

And as for those architects dealing with the vast majority of the client pool not conforming to the preferred taste structure? Well it is these architects' lot to trick and cajole their clients—'sneaking in' as many covert moments of 'good design' as possible without attracting too much attention. Have we really fallen this far? What values are we conveying to our students that creates such an odd combination of arrogance and low ambition in the professionals they become?

THIS SUPPOSED CHOICE BETWEEN ONE ELITIST TRADITION OR ANOTHER IS CLEARLY NO CHOICE AT ALL—particularly if in combining both we still only reach a tiny fragment of those whose culture we presumably represent. If we as architects want to not only survive as a discipline, but contribute to our society, we cannot isolate ourselves from what matters to most people. We have to care about what everyone else cares about. Is this really so hard to do? Are architects not people too?

This said, we must not be too hasty to throw out our disciplinary territory either, for populism is not the answer. No matter how hard Venturi and others since him have tried, we will never find true beauty in the products of a consumer-driven culture alone; the *Las Vegas Strip* will never be the *Champs Elysee*. Simply '*giving the people what they want*' in our society is sadly a very impoverished prospect. We must face the fact squarely that the average American's familiarity with the great architectural legacy of Western civilization (LET ALONE TRADITIONS FROM OTHER CULTURES) is virtually non-existent. As architects turn over design decisions and direction to non-professional community groups, the contribution that architecture can truly make in people's lives is extinguished for good.

The backlash against elitist tendencies in architecture has been severe, resulting in a form of community design which reduces the architect's role to little more than that of a waitress taking orders in a diner. We must powerfully reaffirm that architecture has a knowledge base, and that those trained in architecture possess knowledge that people who have simply enjoyed living in buildings all their lives do not. Not only have we alienated much of the general population, but come to mistrust our own ability to exercise a leadership role in shaping and constructing the world.

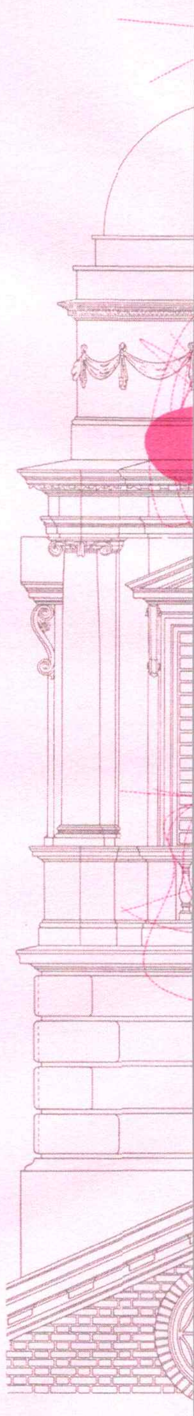
BUT TO LEAD, AS THE SAYING GOES, WE MUST LEARN FIRST TO FOLLOW. We must find a way to bridge the gap that currently exists between the values embraced in schools of architecture, the profession, and the common level of understanding of the American population—not by lowering our standards, or '*dumbing-down*' our work, but by addressing our common ground. When it comes to our clients, we must learn to '*speak their language*' for they will never, no matter how long we wait, come to speak ours. And I am not talking about mere salesmanship, where we attempt to '*talk our clients into*' what they don't really want or understand. I'M TALKING ABOUT REALLY EXAMINING HOW ARCHITECTURE CAN SERVE TO FRAME AND ARTICULATE SHARED HUMAN EXPERIENCE.
For if we want people to understand and love our buildings, we have to care about, understand, and work within existing structures of meaning and habit that are larger than architecture—*structures that are common to all*. We have to stop referring to our clients as '*users*', and rather as our fellow human beings.

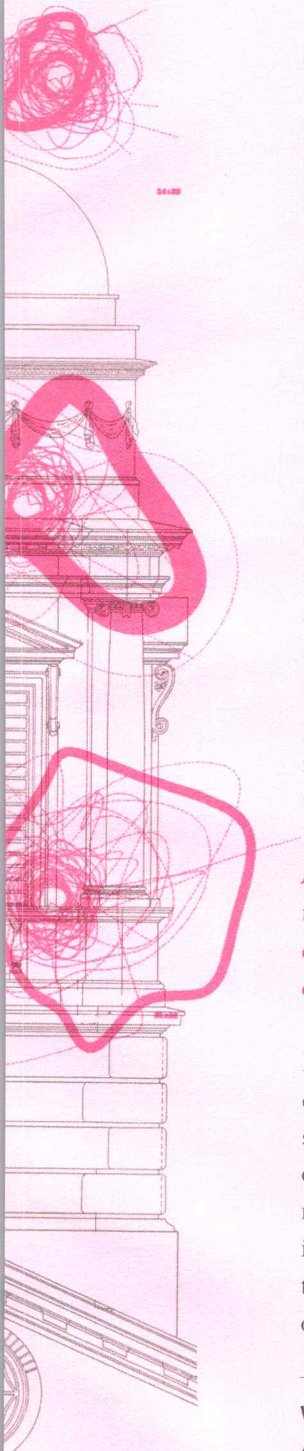
It must be seriously questioned whether speed and ephemerality ever had anything to do with architecture. And further, whether architecture is not, to the contrary, an essentially anachronistic form of art whose fundamental task is to stand against the fungibility of things and the mortality of the species.

WHICH BRINGS ME TO TIMELESSNESS. Whatever happened to timelessness in architecture? Whatever happened to one of architecture's perennial and most inspiring claims: permanence? The obsession with '*the new*' in our culture and in our schools is not only disturbing, but confusing too. Don't we understand that what is 'new' today is 'old' tomorrow? Are we really interested in investing our hard work into designs that will by nature become obsolete almost by the time they could be built? How 'cool' is a groovy shape that (REGARDLESS OF HOW GROOVY IT IS) will appear dated, irrelevant, and, *well*, silly in ten years or less? Is this really what we aspire to in our work?

Surely, a more alluring proposition is to create an architecture that can speak not only to our own moment, or even our own generation, but rather to many generations across time—an architecture that will never go out of date because it makes a fundamental connection to being human.

And does this mean we must give up timeliness? Modernity? Well…*of course not*. There was nothing historicist about the *Pyramids of Gizeh*, or the *Pantheon*, or the *Barcelona Pavilion*, or *Exeter Library* when they were built. They were each significant, original, technologically progressive, and even 'futurist' conceptions in their time. But they still speak to us today, and I dare say they always will. So how is timelessness to be achieved in architecture and encouraged in our studios in school? How do we





propose to make buildings relevant to people's lives? How do we create buildings and places that will be cared-for, maintained, and cherished not only by the people we design them for, but by the people we will never know who will live long after we are gone?

Perhaps I am mistaken, but I don't believe we will find the answer in technology, no matter how useful its tools may be and become. Rather, **I BELIEVE WHAT IS CALLED FOR IS A QUITE LOW-TECH SOLUTION: ONE OF THE REACTIVATION OF THE COMPASSIONATE, INQUISITIVE, IMAGINATIVE MIND.**

Architects and students of architecture must not focus on imagery and composition to the exclusion of all else, no matter how intrinsic these aspects of architecture may be. We need to focus on architecture's capacity to set a worthy stage for life through orchestrating ritual: by raising simple acts that we all know, value, and understand to a level of poetry; by creating the potential for rich experiences, rather than one big groovy shape. Architecture has this power—it always has and still does!

Architecture is not primarily an art of self-expression, nor is it primarily an intellectual activity. Buildings exist to create places. And you appreciate a work of architecture in only one way, by inhabiting it.

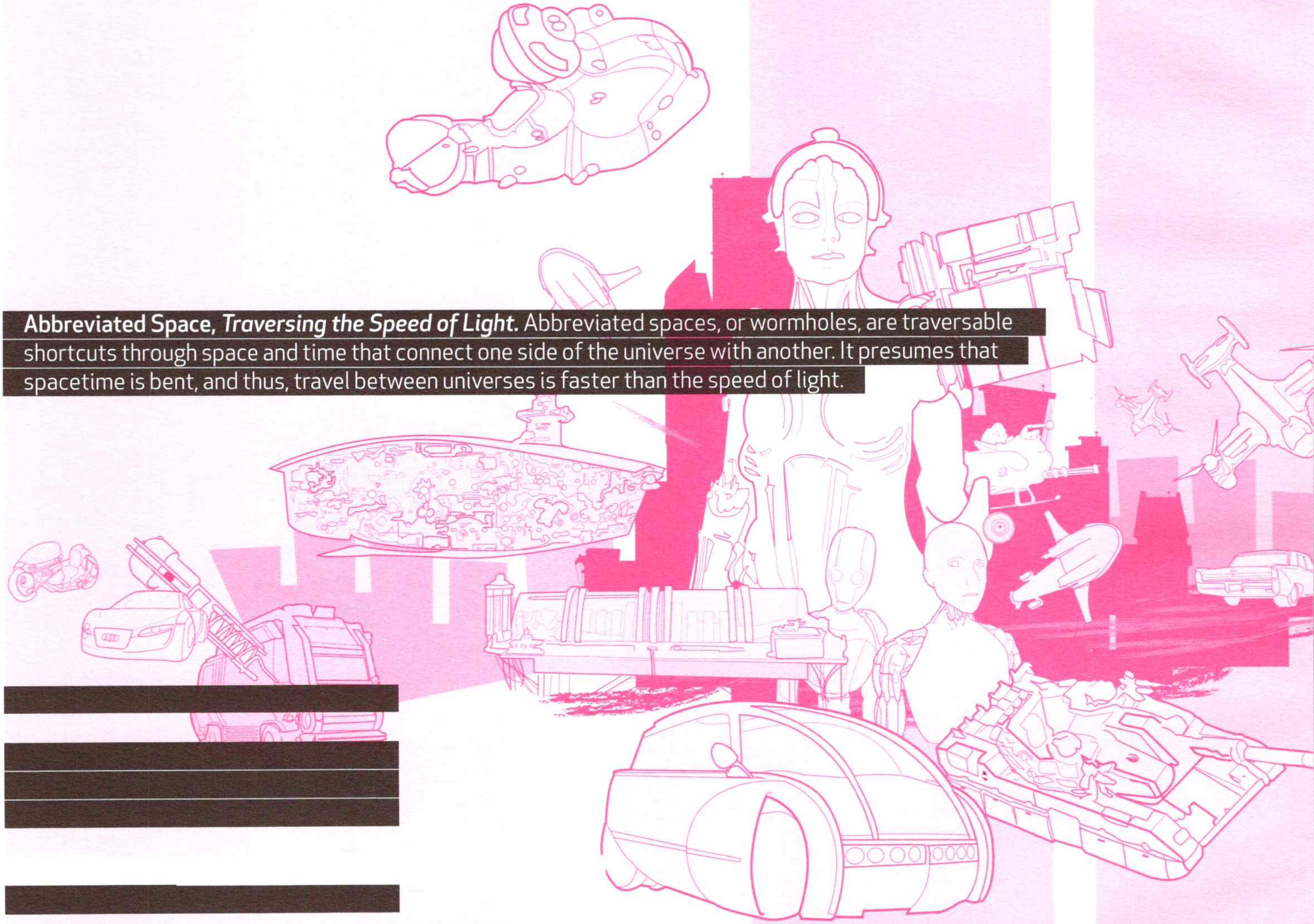
Let us take as one example the potent architectural concept of '*threshold*.' Architecture can make the simple act of entering one's front door mean all sorts of wonderful things to people. It has signified the moment of removal from the profane world and entry into the safe harbor that is home; it has articulated this most basic distinction between inside and outside as alternately monumental, humble, definite, ambiguous, straightforward, and serpentine. Rather than worrying about what will 'look cool' in a drawing or model, the student designing a threshold should ponder: what process of transformation must a person psychologically and spiritually go through in order to properly return home? And how can architecture support and ennoble such a transformation?

ARCHITECTURE IS ABOVE ALL INCLUSIVE AND SYNTHETIC; *it resists simple answers and reductive formulae*. The mytho-phenomenological approach I describe above of course must be balanced by rigorous composition, thoughtful site response, economic and constructional pragmatism, and application of *up-to-the-minute* technology wherever needed. The question is not what to consider and what not to consider in the rich palette that is architecture's realm, but rather what at this particular moment to stress—what most needs strengthening.

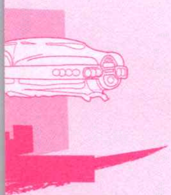
In my view, this is the meaningful connection between architectural form and human experience. Architecture has been in self-imposed exile on the pages of magazines read only by architects for too long. *It must return to the world and make the world better by doing so.*

WENDY REDFIELD SERVES AS ASSOCIATE DIRECTOR OF THE SCHOOL OF ARCHITECTURE AND ASSOCIATE PROFESSOR AT NC STATE UNIVERSITY COLLEGE OF DESIGN. SHE IS A PARTNER IN THE FIRM CLARK AND REDFIELD ARCHITECTS IN CHARLOTTESVILLE, VIRGINIA. REDFIELD HAS DELIVERED PAPERS AT CONFERENCES NATIONALLY AND INTERNATIONALLY, AND HAS MOUNTED EXHIBITS ON THE SUBJECT OF SITE REPRESENTATION AND ANALYSIS.

Abbreviated Space, ***Traversing the Speed of Light.*** Abbreviated spaces, or wormholes, are traversable shortcuts through space and time that connect one side of the universe with another. It presumes that spacetime is bent, and thus, travel between universes is faster than the speed of light.



Mercifully, the whole thing is starting to fade, to become an episode. When I do still catch the odd glimpse, it's peripheral; mere fragments of mad-doctor chrome, confining themselves to the corner of the eye. There was that flying-wing liner over San Francisco last week, but it was almost translucent.



And the shark-fin roadsters have gotten scarcer, and freeways discreetly avoid unfolding themselves into the gleaming eighty lane monsters I was forced to drive last month in my rented Toyota. And I know that none of it will follow me to New York; my vision is narrowing to a single wavelength of probability. I've worked hard for that. Television helped a lot.

I suppose it started in London, in that bogus Greek taverna in Battersea Park Road, with lunch on Cohen's corporate tab. Dead steam-table food and it took them thirty minutes to find an ice bucket for the retsina. Cohen works for Barris-Watford, who publish big, trendy "*trade*" paperbacks: illustrated histories of the neon sign, the pinball machine, the windup toys of Occupied Japan. I'd gone over to shoot a series of shoe ads; California girls with tanned legs and frisky day-glow jogging shoes had capered for me down the escalators of St. John's Wood and across the platforms of Tooting Bec. A lean and hungry young agency had decided that the mystery of London Transport would sell waffle-tread nylon runners. They decide; I shoot. And Cohen, whom I knew vaguely from the old days in New York, had invited me to lunch the day before I was due out of Heathrow. He brought along a very fashionably dressed young woman named Dialta Downes, who was virtually chinless and evidently a noted pop-art historian. In retrospect, I see her walking in beside Cohen under a floating neon sign that flashes THIS WAY LIES MADNESS in huge sans-serif capitals.

Cohen introduced us and explained that Dialta was the prime mover behind the latest Barris-Watford project, an illustrated history of what she called "*American Streamlined Moderne*." Cohen called it "*raygun Gothic*." Their working title was *The Airstream Futuropolis: The Tomorrow That Never Was*.

There's a British obsession with the more baroque elements of American pop culture, something like the weird cowboys-and-Indians fetish of the West Germans or the aberrant French hunger for old Jerry Lewis films. In Dialta Downes this manifested itself in a mania for a uniquely American form of architecture that most Americans are scarcely aware of. At first I wasn't sure what she was talking about, but gradually it began to dawn on me. I found myself remembering Sunday morning television in the Fifties.

Sometimes they'd run old eroded newsreels as filler on the local station. You'd sit there with a peanut butter sandwich and a glass of milk, and a static-ridden Hollywood baritone would tell you that there was *A Flying Car in Your Future*. And three Detroit engineers would putter around with this big old Nash with wings, and you'd see it rumbling furiously down some deserted Michigan runway. You never actually saw it take off, but it flew away to Dialta Downes's never-never land, true home of a generation of completely uninhibited technophiles. She was talking about those odds and ends of "*futuristic*" Thirties and Forties architecture you pass daily in American cities without noticing; the movie marquees ribbed to radiate some mysterious energy, the dime stores faced with fluted aluminum, the chrome-tube chairs gathering dust in the lobbies of transient hotels. She saw these things as segments of a dreamworld, abandoned in the uncaring present; she wanted me to photograph them for her.

THE THIRTIES HAD SEEN THE FIRST GENERATION OF AMERICAN INDUSTRIAL DESIGNERS; until the Thirties, all pencil sharpeners had looked like pencil sharpeners–your basic Victorian mechanism, perhaps with a curlicue of decorative trim. After the advent of the designers, some pencil sharpeners looked as though they'd been put together in wind tunnels. For the most part, the change was only skin deep; under the streamlined chrome shell, you'd find the same Victorian mechanism. Which made a certain kind of sense, because the most successful American designers had been recruited from the ranks of Broadway theater designers. It was all a stage set, a series of elaborate props for playing at living in the future.

Over coffee, Cohen produced a fat manila envelope full of glossies. I saw the winged statues that guard the Hoover Dam, forty-foot concrete hood ornaments leaning steadfastly into an imaginary hurricane. I saw a dozen shots of Frank Lloyd Wright's *Johnson's Wax Building*, juxtaposed with the covers of old *Amazing Stories* pulps, by an artist named Frank R. Paul; the employees of Johnson's Wax must have felt as though they were walking into one of Paul's spray-paint pulp utopias. Wright's building looked as though it had been designed for people who wore white togas and Lucite sandals. I hesitated over one sketch of a particularly grandiose prop-driven airliner, all wing, like a fat symmetrical boomerang with windows in unlikely places. Labeled arrows indicated the locations of the grand ballroom and two squash courts. It was dated 1936.

"This thing couldn't have flown…?" I looked at Dialta Downes.

> *"Oh, no, quite impossible, even with those twelve giant props; but they loved the look, don't you see? New York to London in less than two days, first-class dining rooms, private cabins, sun decks, dancing to jazz in the evening…The designers were populists, you see; they were trying to give the public what it wanted. What the public wanted was the future."*

I'd been in Burbank for three days, trying to suffuse a really dull-looking rocker with charisma, when I got the package from Cohen. It is possible to photograph what isn't there; it's damned hard to do, and consequently a very marketable talent. While I'm not bad at it, I'm not exactly the best, either, and this poor guy strained my Nikon's credibility. I got out, depressed because I do like to do a good job, but not totally depressed, because I did make sure I'd gotten the check for the job, and I decided to restore myself with the sublime artiness of the Barris-Watford assignment. Cohen had sent me some books on Thirties design, more photos of stream-lined buildings, and a list of Dialta Downes's fifty favorite examples of the style in California.

ARCHITECTURAL PHOTOGRAPHY CAN INVOLVE A LOT OF WAITING; the building becomes a kind of sundial, while you wait for a shadow to crawl away from a detail you want, or for the mass and balance of the structure to reveal itself in a certain way. While I was waiting, I thought myself in Dialta Downes's America. When I isolated a few of the factory buildings on the ground glass of the Hasselblad, they came across with a kind of sinister totalitarian dignity, like the stadiums Albert Speer built for Hitler. But the rest of it was relentlessly tacky: ephemeral stuff extruded by the collective American subconscious of the Thirties, tending mostly to survive along depressing strips lined with dusty motels, mattress wholesalers, and small used-car lots. I went for the gas stations in a big way.

During the high point of the *Downes Age*, they put MING THE MERCILESS in charge of designing California gas stations. Favoring the architecture of his native Mongo, he cruised up and down the coast erecting raygun emplacements in white stucco. Lots of them featured superfluous central towers ringed with those strange radiator flanges that were a signature motif of the style, and made them look as though they might generate potent bursts of raw technological enthusiasm, if you could only find the switch that turned them on. I shot one in San Jose an hour before the bulldozers arrived and drove right through the structural truth of plaster and lathing and cheap concrete.

> *"Think of it," Dialta Downes had said, "as a kind of alternate America: a 1980 that never happened. An architecture of broken dreams."*

And that was my frame of mind as I made the stations of her convoluted socioarchitectural cross in my red Toyota as I gradually tuned in to her image of a shadowy America-that-wasn't, of Coca-Cola plants like beached submarines, and fifth-run movie houses like the temples of some lost sect that had worshiped blue mirrors and geometry. And as I moved among these secret ruins, I found myself wondering what the inhabitants of that lost future would think of the world I lived in. The Thirties dreamed white marble and slip-stream chrome, immortal crystal and burnished bronze, but the rockets on the covers of the Gernsback pulps had fallen on London in the dead of night, screaming. After the war, everyone had a car—no wings for it—and the promised superhighway to drive it down, so that the sky itself darkened, and the fumes ate the marble and pitted the miracle crystal…

And one day, on the outskirts of Bolinas, when I was setting up to shoot a particularly lavish example of Ming's martial architecture, I penetrated a fine membrane, a membrane of probability…

EVER SO GENTLY, I WENT OVER THE *edge*—

And looked up to see a twelve-engined thing like a bloated boomerang, all wing, thrumming its way east with an elephantine grace, so low that I could count the rivets in its dull silver skin, and hear maybe the echo of jazz. I took it to Kihn.

Merv Kihn, free-lance journalist with an extensive line in Texas pterodactyls, redneck UFO contactees, bush-league Loch Ness monsters, and the Top Ten conspiracy theories in the loonier reaches of the American mass mind.

> *"It's good," said Kihn, polishing his yellow Polaroid shooting glasses on the hem of his Hawaiian shirt, "but it's not mental; lacks the true quill."*

"But I saw it, Mervyn." We were seated poolside in brilliant Arizona sunlight. He was in Tucson waiting for a group of retired Las Vegas civil servants whose leader received messages from THEM on her microwave oven. I'd driven all night and was feeling it.

> "OF COURSE YOU DID. OF COURSE YOU SAW IT. *You've read my stuff; haven't you grasped my blanket solution to the* UFO *problem?*

It's simple, plain and country simple: people"—he settled the glasses carefully on his longhawk nose and fixed me with his best basilisk glare—*"see…things. People see these things. Nothing's there, but people see them anyway. Because they need to, probably. You've read Jung, you should know the score…In your case, it's so obvious: You admit you were thinking about this crackpot architecture, having fantasies… Look, I'm sure you've taken your share of drugs, right? How many people survived the Sixties in California without having the odd hallucination? All those nights when you discovered that whole armies of Disney technicians had been employed to weave animated holograms of Egyptian hieroglyphs into the fabric of your jeans, say, or the times when—"*

"But it wasn't like that."

"Of course not. It wasn't like that at all; it was 'in a setting of clear reality,' right? Everything normal, and then there's the monster, the mandala, the neon cigar. In your case, a giant Tom Swift airplane. It happens all the time. You aren't even crazy. You know that, don't you?"

He fished a beer out of the battered foam cooler beside his deck chair.

"Last week I was in Virginia. Grayson County. Interviewed a sixteen-year-old girl who'd been assaulted by a bar hade."

"*A what?*"

"A bear head. The severed head of a bear. This bar hade, see, was floating around on its own little flying saucer, looked kind of like the hubcaps on cousin Wayne's vintage Caddy. Had red, glowing eyes like two cigar stubs and telescoping chrome antennas poking up behind its ears." He burped.

"It assaulted her? How?"

"You don't want to know; you're obviously impressionable. 'It was cold'"—he lapsed into his bad southern accent—*"'and metallic.' It made electronic noises. Now that is the real thing, the straight goods from the mass unconscious, friend; that little girl is a witch. There's just no place for her to function in this society. She'd have seen the devil, if she hadn't been brought up on 'The Bionic Man' and all those 'StarTrek' reruns. she is clued into the* MAIN VEIN. *And she knows that it happened to her. I got out ten minutes before the heavy UFO boys showed up with the polygraph."*

I must have looked pained, because he set his beer down carefully beside the cooler and sat up.

"If you want a classier explanation, I'd say you saw a SEMIOTIC GHOST. *All these contactee stories, for instance, are framed in a kind of sci-fi imagery that permeates our culture. I could buy aliens, but not aliens that look like Fifties' comic art. They're semiotic phantoms, bits of deep cultural imagery that have split off and taken on a life of their own, like the Jules Verne airships that those old Kansas farmers were always seeing. But you saw a different kind of ghost, that's all. That plane was part of the mass unconscious, once. You picked up on that, somehow. The important thing is not to worry about it."*

I DID WORRY ABOUT IT, THOUGH. Kihn combed his thinning blond hair and went off to hear what They had had to say over the radar range lately, and I drew the curtains in my room and lay down in air-conditioned darkness to worry about it. I was still worrying about it when I woke up. Kihn had left a note on my door; he was flying up north in a chartered plane to check out a cattle-mutilation rumor ("*muties*," HE CALLED THEM; ANOTHER OF HIS JOURNALISTIC SPECIALTIES).

I had a meal, showered, took a crumbling diet pill that had been kicking around in the bottom of my shaving kit for three years, and headed back to Los Angeles.

The speed limited my vision to the tunnel of the Toyota's headlights. The body could drive, I told myself, while the mind maintained. Maintained and stayed away from the weird peripheral window dressing of amphetamine and exhaustion, the spectral, luminous vegetation that grows out of the corners of the mind's eye along late night highways. But the mind had its own ideas, and Kihn's opinion of what I was already thinking of as my "*sighting*" rattled endlessly through my head in a tight, lopsided orbit. *Semiotic ghosts*. Fragments of the MASS DREAM, whirling past in the wind of my passage. Somehow this feedback-loop aggravated the diet pill, and the speed-vegetation along the road began to assume the colors of infrared satellite images, glowing shreds blown apart in the Toyota's slipstream.

I pulled over, then, and a half-dozen aluminum beer cans winked goodnight as I killed the headlights. I wondered what time it was in London, and tried to imagine Dialta Downes having breakfast in her Hampstead flat, surrounded by streamlined chrome figurines and books on American culture.

Desert nights in that country are enormous; the moon is closer. I watched the moon for a long time and decided that Kihn was right. The main thing was not to worry. All across the continent, daily, people who were more normal than I'd ever aspired to be saw giant birds, Bigfeet, flying oil refineries; they kept Kihn busy and solvent. Why should I be upset by a glimpse of the nineteen-thirties pop imagination loose over Bolinas? I decided to go to sleep, with nothing worse to worry about than rattlesnakes and cannibal hippies, safe amid the friendly roadside garbage of my own familiar continuum. In the morning I'd drive down to Nogales and photograph the old brothels, something I'd intended to do for years. The diet pill had given up.

THE LIGHT WOKE ME, AND THEN THE VOICES. The light came from somewhere behind me and threw shifting shadows inside the car. The voices were calm, indistinct, male and female, engaged in conversation.

My neck was stiff and my eyeballs felt gritty in their sockets. My leg had gone to sleep, pressed against the steering wheel. I fumbled for my glasses in the pocket of my work shirt and finally got them on. THEN I LOOKED BEHIND ME AND SAW *The city*.

The books on Thirties design were in the trunk; one of them contained sketches of an idealized city that drew on *Metropolis* and *Things to Come*, but squared everything, soaring up through an architect's perfect clouds to zeppelin docks and mad neon spires. That city was a scale model of the one that rose behind me. Spire stood on spire in gleaming ziggurat steps that climbed to a central golden temple tower ringed with the crazy radiator flanges of the Mongo gas stations. You could hide the Empire State Building in the smallest of those towers. Roads of crystal soared between the spires, crossed and recrossed by smooth silver shapes like beads of running mercury. The air was thick with ships: giant wing-liners, little darting silver things (sometimes one of the quicksilver shapes from the sky bridges rose gracefully into the air and flew up to join the dance), mile-long blimps, hovering dragonfly things that were gyrocopters…

I closed my eyes tight and swung around in the seat. When I opened them, I willed myself to see the mileage meter, the pale road dust on the black plastic dashboard, the overflowing ashtray.

"Amphetamine psychosis," I said. I opened my eyes. The dash was still there, the dust, the crushed filter tips. Very carefully, without moving my head, I turned the headlights on. AND SAW *them*.

They were blond. They were standing beside their car, an aluminum avocado with a central shark-fin rudder jutting up from its spine and smooth black tires like a child's toy. He had his arm around her waist and was gesturing toward the city. They were both in white: loose clothing, bare legs, spotless white sun shoes. Neither of them seemed aware of the beams of my headlights. He was saying something wise and strong, and she was nodding, and suddenly I was frightened, frightened in an entirely different way. Sanity had ceased to be an issue; I knew, somehow, that the city behind me was Tucson—a dream Tucson thrown up out of the collective yearning of an era. That it was real, entirely real. But the couple in front of me lived in it, and they frightened me.

They were the children of Dialta Downes's '80-that-wasn't; they were HEIRS TO THE DREAM. They were white, blond, and they probably had blue eyes. They were AMERICAN. Dialta had said that the Future had come to America first, but had finally passed it by. But not here, in the heart of the DREAM. Here, we'd gone on and on, in a dream logic that knew nothing of pollution, the finite bounds of fossil fuel, or foreign wars it was possible to lose. They were smug, happy, and utterly content with themselves and their world. And in the DREAM, it was their world.

BEHIND ME, THE ILLUMINATED CITY: Searchlights swept the sky for the sheer joy of it. I imagined them thronging the plazas of white marble, orderly and alert, their bright eyes shining with enthusiasm for their floodlit avenues and silver cars.

It had all the sinister fruitiness of Hitler Youth propaganda.

I put the car in gear and drove forward slowly, until the bumper was within three feet of them. They still hadn't seen me. I rolled the window down and listened to what the man was saying. His words were bright and hollow as the pitch in some Chamber of Commerce brochure, and I knew that he believed in them absolutely.

> "*John*," I heard the woman say, "*we've forgotten to take our food pills.*"

She clicked two bright wafers from a thing on her belt and passed one to him. I backed onto the highway and headed for Los Angeles, wincing and shaking my head.

I phoned Kihn from a gas station. A new one, in bad Spanish Modern. He was back from his expedition and didn't seem to mind the call.

> "*Yeah, that is a weird one. Did you try to get any pictures? Not that they ever come out, but it adds an interesting frisson to your story, not having the pictures turn out…*"

But what should I do?

> "*Watch lots of television, particularly game shows and soaps. Go to porn movies. Ever see Nazi Love Motel? They've got it on cable, here. Really awful. Just what you need.*"

What was he talking about?

> "*Quit yelling and listen to me. I'm letting you in on a trade secret: Really bad media can exorcise your semiotic ghosts. If it keeps the saucer people off my back, it can keep these Art Deco futuroids off yours. Try it. What have you got to lose?*"

Then he begged off, pleading an early-morning date with the ELECT.

"The who?"

"These oldsters from Vegas; the ones with the microwaves."

I considered putting a collect call through to London, getting Cohen at Barris-Watford and telling him his photographer was checked out for a protracted season in the TWILIGHT ZONE. In the end, I let a machine mix me a really impossible cup of black coffee and climbed back into the Toyota for the haul to Los Angeles.

Los Angeles was a bad idea, and I spent two weeks there. It was prime Downes country; too much of the DREAM there, and too many fragments of the DREAM waiting to snare me. I nearly wrecked the car on a stretch of overpass near Disneyland, when the road fanned out like an origami trick and left me swerving through a dozen minilanes of whizzing chrome teardrops with shark fins. Even worse, Hollywood was full of people who looked too much like the couple I'd seen in Arizona. I hired an Italian director who was making ends meet doing darkroom work and installing patio decks around swimming pools until his ship came in; he made prints of all the negatives I'd accumulated on the Downes job. I didn't want to look at the stuff myself. It didn't seem to bother Leonardo, though, and when he was finished I checked the prints, riffling through them like a deck of cards, sealed them up, and sent them air freight to London. Then I took a taxi to a theater that was showing *Nazi Love Motel*, and kept my eyes shut all the way.

Cohen's congratulatory wire was forwarded to me in San Francisco a week later. Dialta had loved the pictures. He admired the way I'd "*really gotten into it*," and looked forward to working with me again. That afternoon I spotted a flying wing over Castro Street, but there was something tenuous about it, as though it were only half there. I rushed into the nearest newsstand and gathered up as much as I could find on the petroleum crisis and the nuclear energy hazard. I'd just decided to buy a plane ticket for New York.

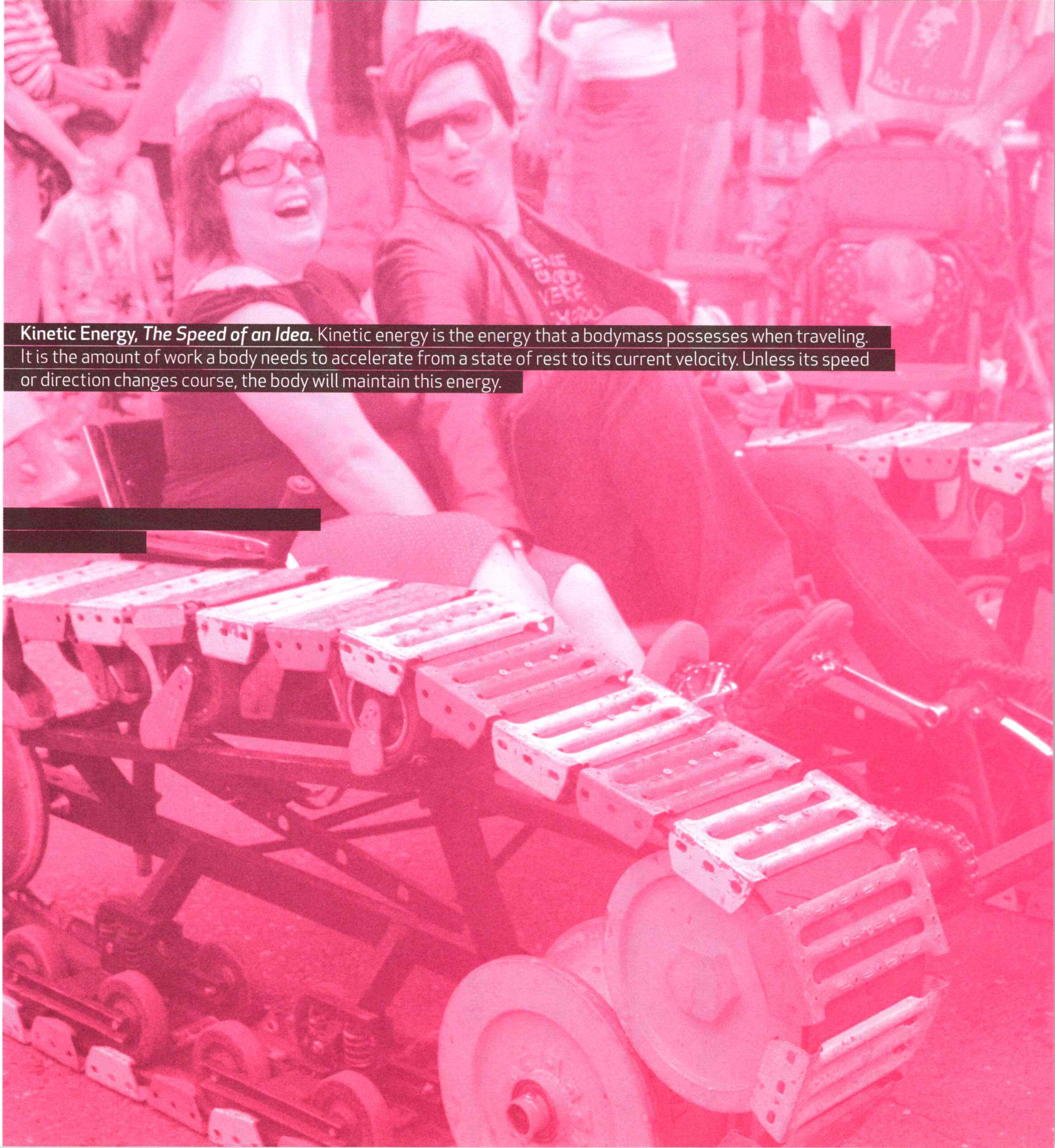
"*Hell of a world we live in, huh?*" The proprietor was a thin black man with bad teeth and an obvious wig. I nodded, fishing in my jeans for change, anxious to find a park bench where I could submerge myself in hard evidence of the human near-dystopia we live in. "*But it could be worse, huh?*"

"That's right," I said, "or even worse, it could be perfect."

He watched me as I headed down the street with my little bundle of *condensed catastrophe*.

WILLIAM GIBSON IS A WRITER AND A SIGNIFICANT PLAYER IN THE GENRE OF "CYBERPUNK" LITERATURE. HE GAINED CULT STATUS AFTER HIS FIRST NOVEL, *NEUROMANCER*, RECEIVED THREE MAJOR SCIENCE FICTION AWARDS, ESTABLISHING HIM AS A CRITICAL VOICE ON THE RELATIONSHIP BETWEEN TECHNOLOGY AND HUMANITY. HE IS GIVEN CREDIT FOR COINING THE PHRASE "CYBERSPACE" IN ADDITION TO ENVISIONING THE INTERNET AND VIRTUAL REALITY.

Kinetic Energy, *The Speed of an Idea.* Kinetic energy is the energy that a bodymass possesses when traveling. It is the amount of work a body needs to accelerate from a state of rest to its current velocity. Unless its speed or direction changes course, the body will maintain this energy.

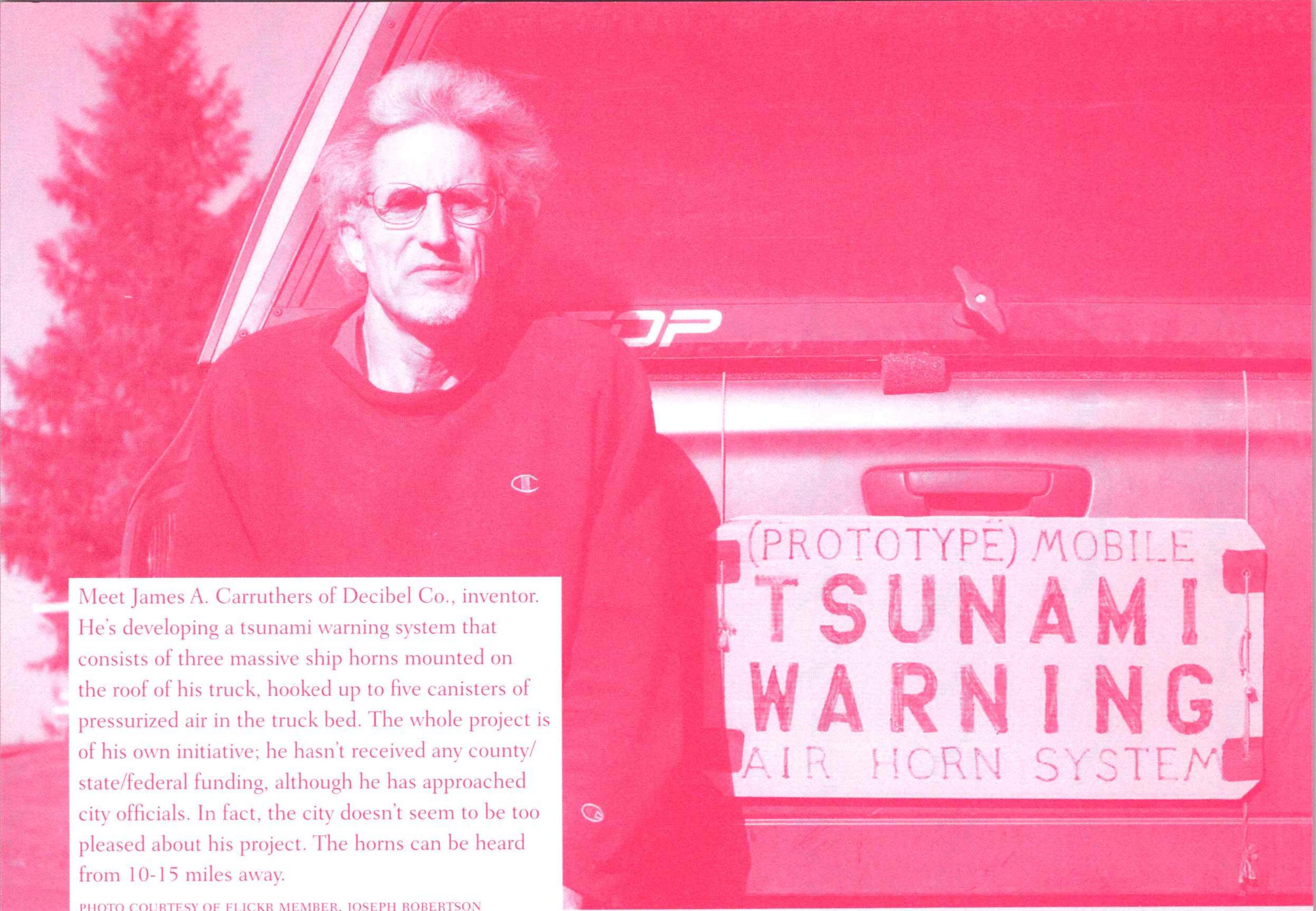


posted by DWIGHT + JESSICA 02.07.06 11:22 PM It's easy to design most anything today. Computers are very cheap (in comparison to past years), desktop printers are practically free, digital cameras are cheaper than ever. And possibly most important of all is the easier interface of design software and programs. A simple Google search could turn up answers to most any question. And with a 24-hour Kinko's around the corner, you can have a professional finished final product in a matter of minutes.

There is a recent debate relating to the Design It Yourself movement, started by author Ellen Lupton. Her latest book, in conjunction with her graduate students, is titled *DIY: Design It Yourself*. The book instructs the "average Joe" how to recognize good design, and do it themselves. A complimentary web site has templates and other goodies to download. There are lessons on how to design most everything, with the basic message being, "why buy when you can do it yourself?"

So far among the design community, some heated arguments have arisen. Many designers disagree with encouraging people to do their own design because they may send out the wrong message, or mess up their reputation...

What do you think about Lupton's way of educating non-designers? What do you think about people doing their own design work? What is your reaction to design done by non-designers? How do you think this book affects the field of design? Are Ellen Lupton (and her class) "traitors" to the design community? What is the role of a designer?



Meet James A. Carruthers of Decibel Co., inventor. He's developing a tsunami warning system that consists of three massive ship horns mounted on the roof of his truck, hooked up to five canisters of pressurized air in the truck bed. The whole project is of his own initiative; he hasn't received any county/state/federal funding, although he has approached city officials. In fact, the city doesn't seem to be too pleased about his project. The horns can be heard from 10-15 miles away.

PHOTO COURTESY OF FLICKR MEMBER, JOSEPH ROBERTSON

posted by TYLER 02.09.06 11:22 PM I think Lupton's way of educating non-designers is quite good, although we all know that one book does not a professional designer make. (by the way, the title *Design It Yourself* is a play on the long-standing ethic of 'Do It Yourself', which is nothing new really). My impression is that the book is about sharing the joy and power of design with a public that is increasingly interested in better designed things—they realize that good design improves quality of life; so, I think her interest in spreading the love of design is a very good one, and the book can serve to empower people to literally 'make their own choices', rather than being subjected to what professional designers or corporate America would have them buy.

Meet our "happy hipster DIY couple" showing off their recently completed homemade birdhouse inspired by the magazine, *Readymade*.

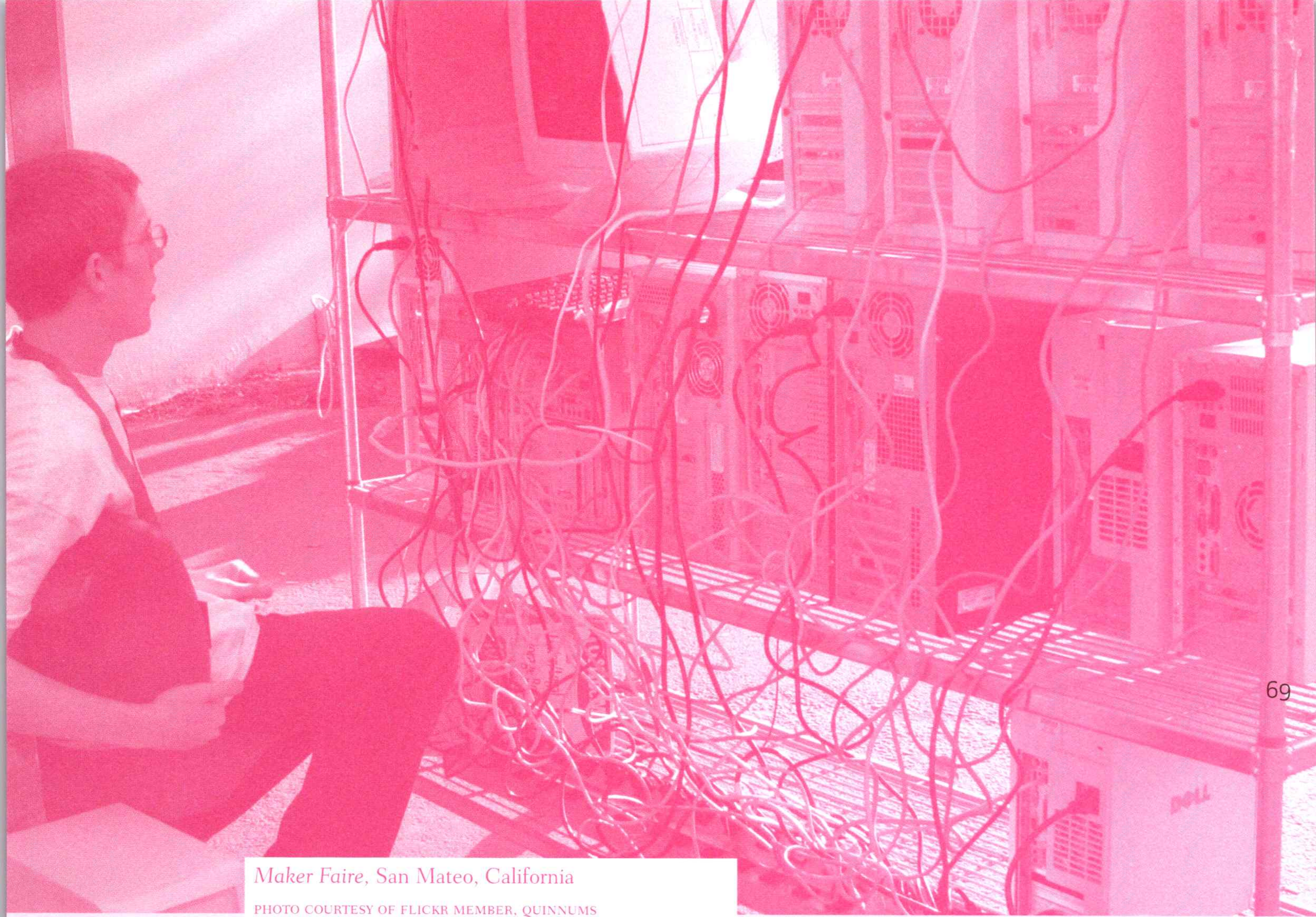
PHOTO COURTESY OF FLICKR MEMBER, MAHALIE

I am very much in favor of this sort of empowerment and view it as a part of democratic society—that people have a choice in how to organize and live their lives. I really enjoy seeing people do their own design work, precisely for the reasons mentioned above. They have exercised their creative powers, just like when you grow your own food, fix your own car, or own your own house. You are taking control over another aspect of your life and that is incredibly important; more people should try that because it feels great. Artists who are self-taught are called 'folk artists' and their work has a naive charm and quirky character. I think the same is true of designers, although, like folk artists, there are obvious exceptions who come to master their craft and make amazing things.

Meet inventors seen at the first *Maker Faire* held at the San Mateo, California fairgrounds on April 22-23, 2006. Sponsored by *Make* magazine, the event drew over 20,000 makers and crafters of all ages with the goal to "unite, inspire, and inform a growing community of resourceful people who undertake amazing projects in their backyards, basements, and garages." The event included a range of activities from expositions and competitions to workshops and demonstrations with a focus on the intersection of science and engineering through emerging technologies.

PHOTO COURTESY OF FLICKR MEMBER, PRAWNPIE

posted by ADRIENNE 02.15.06 3:36 PM Easy access/affordability of the [digital] camera did not erase the photographer's existence. People still go to a photographer for "professional" family photos, fashion shoots, or images for books/magazines etc. I don't think there's anything wrong with a designer teaching others about "design", since it is a way of thinking. If people become more aware then they will begin to understand what design actually is. I think its great when people make their own things; it provides a creative outlet or a way to express one's self. There's a feeling of self accomplishment in making something on your own. I think Ellen's idea of designing a way to educate people about how to design is great. In my eyes this is one step forward, not back. It doesn't mean they're going to take over our job or eliminate the designer forever; but, they might appreciate it more.



Maker Faire, San Mateo, California

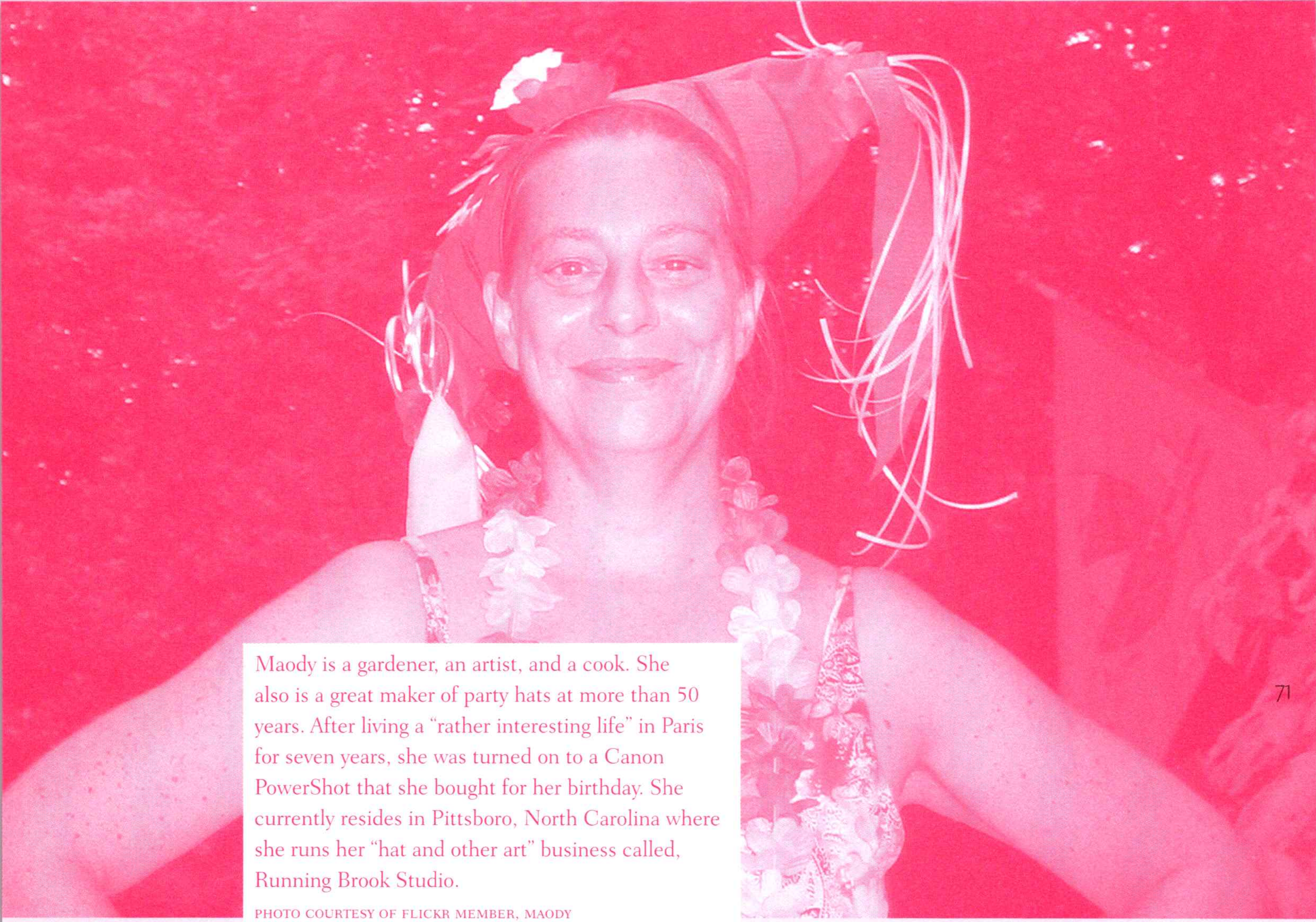
PHOTO COURTESY OF FLICKR MEMBER, QUINNUMS

posted by MEGAN 02.15.06 3:58 PM Okay—my thoughts are in support of Ellen and her students. Yes, at first, one might be taken back, but when you really start to think about it, their 'education' is a good one. It by no means makes people professional designers; however, it does make them more conscious and aware. Isn't that what we struggle with all of the time being a designer? So often you hear "oh they just don't understand..." Well this helps them to gain a greater understanding of design and its involvement in everyday life. More people will become more aware (better aware). I don't think this will make people 'think' they can do it and that design is easy—I think it helps them to understand design!

Rachel spent most of the day making her new toy which she named "Chubby Splash"—some scraps of material, leftover buttons and lots of hard work. :)

PHOTO COURTESY OF FLICKR MEMBER, BRENDA ANDERSON

posted by JESSICA 02.15.2006 4:00 PM Hmm. . .This is an interesting one. Overall, maybe non-designers "doing design" is a great thing. I think it could make for a new level of creativity (meaning creativity without any restraints that formally educated designers often work within). These non-designers would break "rules" of design without knowing it. Then, designers may ask ourselves why we have these restraints in the first place? How do I know what "good design" is? Most of it is from my own personal opinion, but it is also from



Maody is a gardener, an artist, and a cook. She also is a great maker of party hats at more than 50 years. After living a "rather interesting life" in Paris for seven years, she was turned on to a Canon PowerShot that she bought for her birthday. She currently resides in Pittsboro, North Carolina where she runs her "hat and other art" business called, Running Brook Studio.

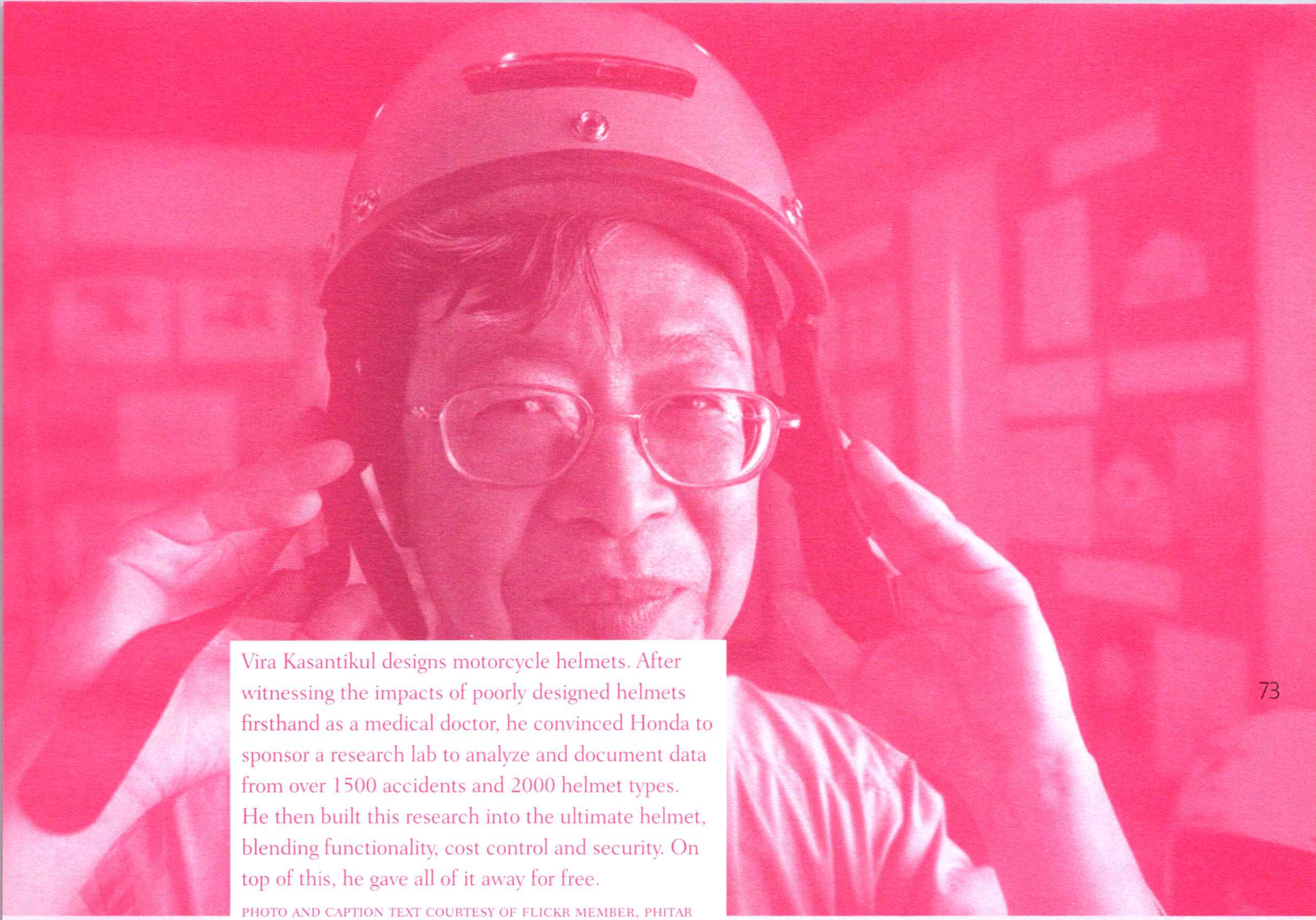
PHOTO COURTESY OF FLICKR MEMBER, MAODY

what I have been told during my design education. This "do-it-yourself design" could also be a good thing for designers in a way that designers don't want to admit. If we now have to compete with "do-it-yourself design" then shouldn't that push us further to perfect our craft as "professional designers"? It seems to me that the designers who are upset about this issue may also be the ones that are upset that an uneducated non-designer could produce something more successful than that of a professional designer...

Nheam Pholet runs a successful car cleaning company in Cambodia. He also designs and builds his own automobiles. He calls this one "the Angkor." It is equipped with massage seats, electric top, homemade wood veneer, video karaoke, and a gas door. "He could not find the types of cars he wanted, so he built his own…simple as that."

PHOTO AND CAPTION TEXT COURTESY OF FLICKR MEMBER, PHITAR

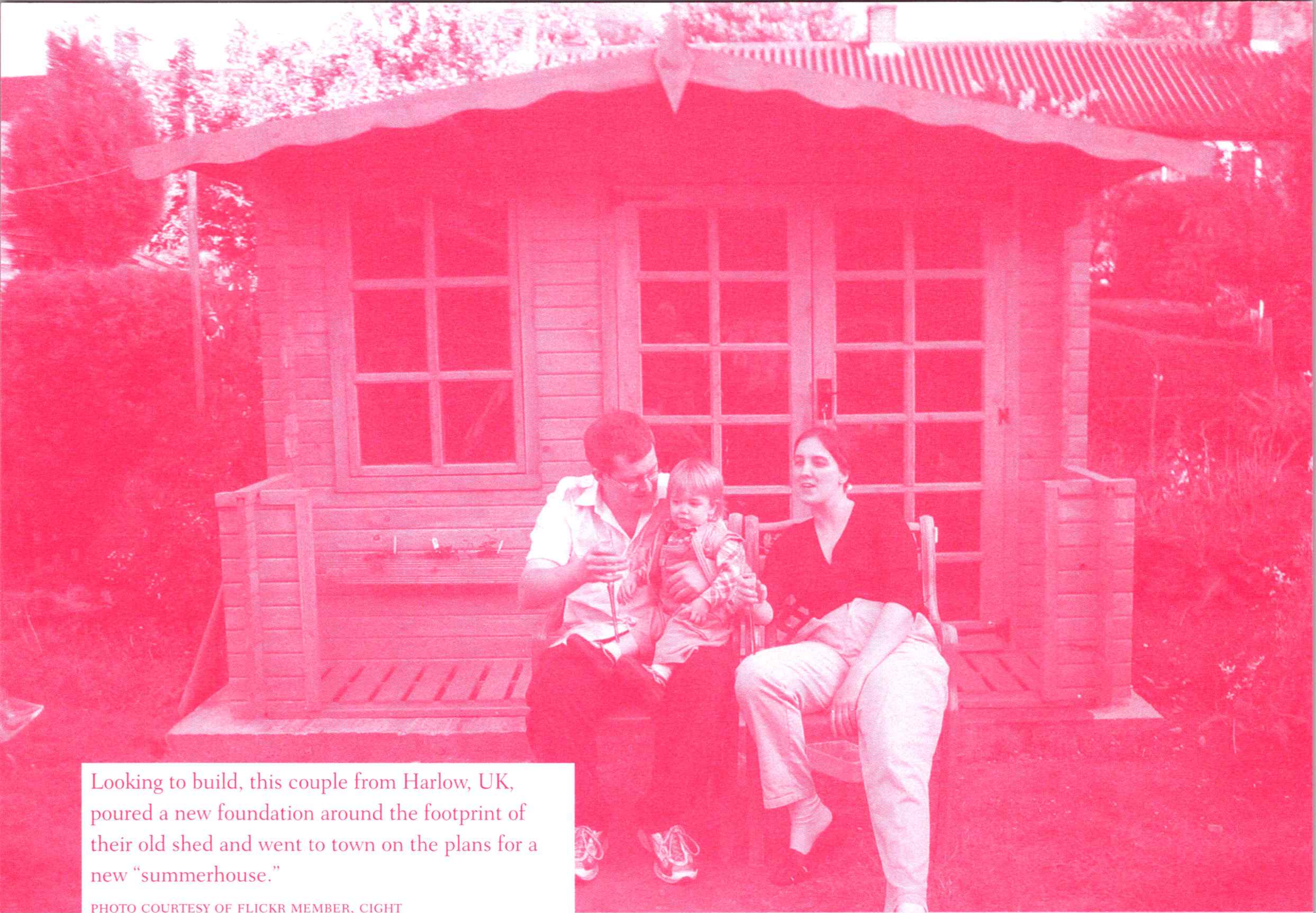
posted by MATTHEW 02.15.06 4:34 PM I'd say: Keep in mind that anybody who makes design is a designer. You may get a degree here, but this isn't a regulated field (like medicine). Your degree doesn't get you in the door of an exclusive club, it just helps you to develop the talents which in turn will help you excel in the future. And really, if "untrained" designers are taking jobs, I'll bet they're the jobs we don't want, or will be better off without. (you know, the awkward ones that never materialize because you discover the prospective client doesn't really want a designer, after all.) Oh, I said "we." They are we, too, is my whole point. And I think Tyler said (and I hadn't thought of this) that raising awareness of design can't hurt. It's a good thought. So I just take issue with the implicit notion of the "other," the us-vs-them. Designer equals one who designs. Training and study can equal good designer, but it must not be the only way… And I think all that we can say with certainty about the role of the designer is this: To design.



Vira Kasantikul designs motorcycle helmets. After witnessing the impacts of poorly designed helmets firsthand as a medical doctor, he convinced Honda to sponsor a research lab to analyze and document data from over 1500 accidents and 2000 helmet types. He then built this research into the ultimate helmet, blending functionality, cost control and security. On top of this, he gave all of it away for free.

PHOTO AND CAPTION TEXT COURTESY OF FLICKR MEMBER, PHITAR

posted by BERKOWHO? 02.15. 06 5:15 PM As designers (trained or untrained) our strength is not in knowing how to use technologies or media or different reproduction methods; it is in how we use them. This book shows you how to access those media, but it doesn't teach people what they really need to know to make those products successful: idea generation, concept development, choosing a visual language, understanding an audience, thinking critically, iterations, revisions, blah, blah blah… This stuff can't be taught with a book. We, as people who did their time in school, have that "stuff", and we're not giving it away by showing some examples of creative thinking in a book. The book shows you how to make your ideas real, but it doesn't show you where those clever ideas in the examples come from, and it's clear that they came from design students and not your average "schmo."



Looking to build, this couple from Harlow, UK, poured a new foundation around the footprint of their old shed and went to town on the plans for a new "summerhouse."

PHOTO COURTESY OF FLICKR MEMBER, CIGHT

posted by TRACY 02.15.06 5:41 PM All design disciplines are affected by DIY…I cook my own meals, without the benefit of a "trained expert" (chef); I do my own investing, banking & taxes (eek!) without the benefit of an Accountant, Broker or Financial Advisor; I occasionally "heal thyself" without running to an M.D.… I am, therefore, a member of the DIY community. For the types of investments that I make, I'm HARDLY making the financial experts quake about the future of their professions… but I try to make informed decisions, and

Helen Cooper is a PhD candidate in sign language recognition using computer vision at the University of Surrey. She took this photo of her father in her backyard, hand carving and assembling a new bed for her flat in Petersfield, UK.

PHOTO COURTESY OF FLICKR MEMBER, EGMEL

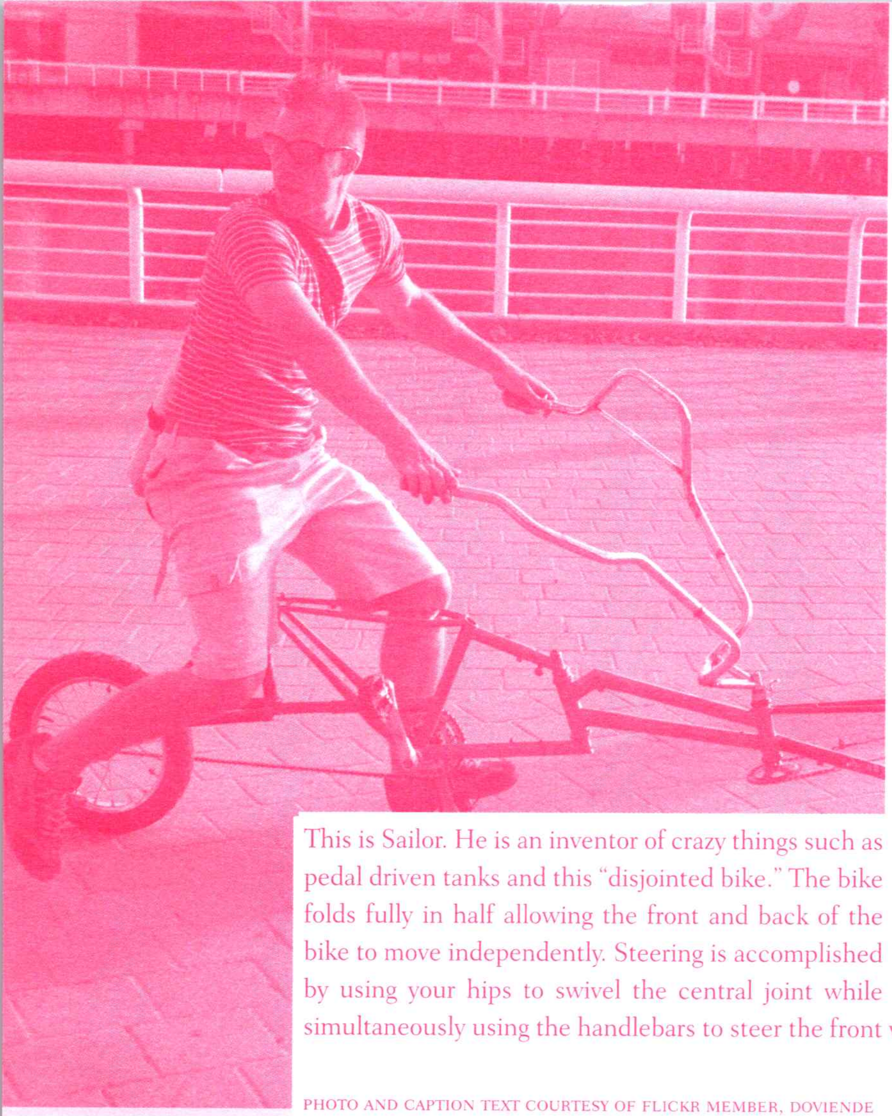
in the process I have a better appreciation for their skills. Sarcasm aside, this is a trend that can actually aid the design profession...our audiences and clients will be more educated about the design process and will hopefully develop an appreciation for the value of good, smart design. More effective collaborations can take place, and more sophisticated solutions can be arrived at...

Tall bikes are created by connecting two or more conventional bike frames or spare parts into one very tall, mutant bicycle. Bicycle "hacking" is a cheap and creative hobby and has become a popular form of recreational bike clubs and activist groups. Individuals often modify these bikes for festivals and tall bike jousting competitions.

PHOTO AND CAPTION TEXT COURTESY OF FLICKR MEMBER, DOVIENDE

posted by TONY 03.11.06 2:13 PM   DIY initiative/gumption/interest is one part of the equation. The rest is slowly showing up in the software you are using right now: networked visual and creative databases (including AI-like/smart templates) + tagged original content + results-oriented user interfaces + dynamic/motion-based push and pull screen dialog = **?** (the last two items could be redundant—that's being hopeful).

This is contingent on more effective and meaningful modes of communication shared between both people and machines. 'Do/Design It Yourself' is a necessary step in many ways. In the short run we need to move forward without bemoaning in an endless loop of how common, non-stylish folk just are not worthy of knowing the special skills—don't we want understanding of the *radically complex* via the *beautifully useful* for all?

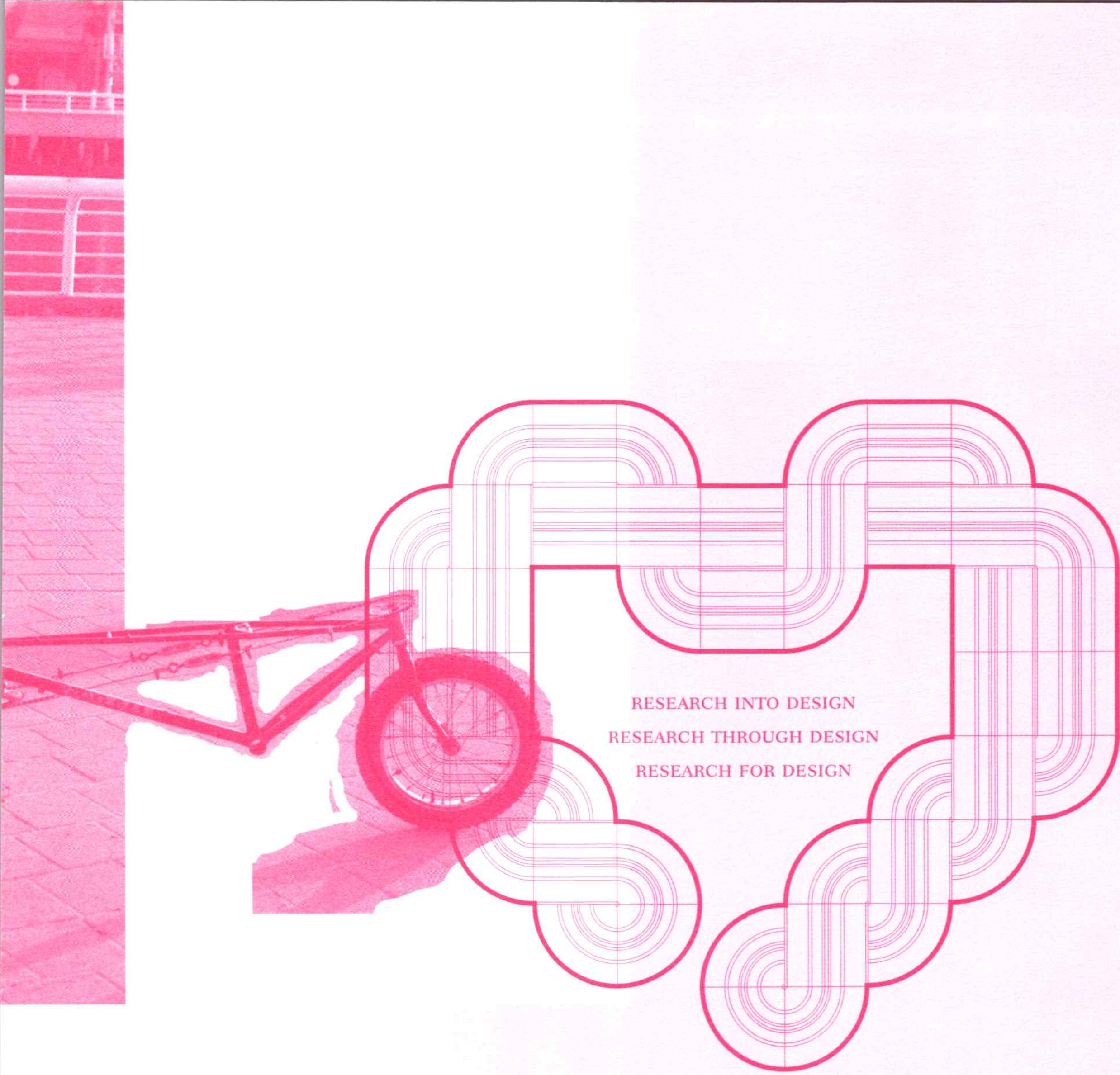


This is Sailor. He is an inventor of crazy things such as pedal driven tanks and this "disjointed bike." The bike folds fully in half allowing the front and back of the bike to move independently. Steering is accomplished by using your hips to swivel the central joint while simultaneously using the handlebars to steer the front wheel.

PHOTO AND CAPTION TEXT COURTESY OF FLICKR MEMBER, DOVIENDE

Wake up Design (CAP-D)! We have folks across this fine globe teaching Composition 101 (choose your language) with good old notions of text (book) literacy, but they now have students writing with sound, motion, and image too...

Time to drop the facade folks and get honest with a creative life where you are not the center but something far more useful.



(De)Acceleration, *Changes in Direction.* Acceleration measures the rate of change of an object's velocity over time. It can have both a positive and negative value, the latter signifying a decrease in velocity of an object … deacceleration also includes a change in direction.

INITIAL THOUGHTS ON RESEARCH METHODS

Teal Triggs

'The one question I always ask my students when they start a new project is *'if you were at a cocktail party and had to tell a non-designer party-goer what your research was about in two sentences, what would they be?'* The idea is that party conversation is normally formed around fleeting soundbites of information and the art of such a discourse is in the ability to quickly and effectively convey a point before moving on to the next guest. It is also about good old accessible communication.

I've heard of other lecturers using equivalent scenarios such as the 'elevator ride talk'. Here a student takes the elevator with the Head of Department and gets stuck for a set period of time. In those few uncomfortable moments the student is engaged into conversation as to what they are currently working on [THE READER SHOULD NOTE THAT THIS IS NOT A DISSIMILAR SITUATION FOR STAFF WHEN THEY ARE ASKED THIS QUESTION BY THE HEAD OF COLLEGE!]. The student only has a few moments to convey convincingly the main thrust of his of her work. Such an exercise is intended to encourage students to articulate their work so that it becomes a " *'practiced way of telling' about what they do, why and how."*

For those of us involved in visual communication, the articulation of ideas, whether our own or others, is what we are trained to do. And, for the most part, we do it very well. However, as Graphic Design matures as a profession and as an academic discipline, the articulation of the process by which we move from the idea to the solution needs to be brought to the fore, both in terms of design as an applied activity (DESIGN AS BEING A SERVICE) and as 'pure' design research (DESIGN AS ENQUIRY) (NELSON & STOLTERMAN 2000). Equally, consideration must be given to the intersection between client-led design and the more formalized research processes located within the academy (GROCOTT 2003).

WHAT IS RESEARCH?

'RESEARCH' is generally defined as a *'systematic enquiry'*, which employs a *'kit of parts'* or methods to collect, collate and analyze data (ALLISON 1988: 26; GRIX 2001: 29). These may utilise quantitative (E.G STATISTICAL INFERENCE, DISCOURSE ANALYSIS, ETC.) or qualitative (E.G. GROUNDED THEORIES, CASE STUDIES, ETHNOGRAPHIC STUDIES, ETC.) research techniques. Research by its very definition is a rigorous process and focused around the all-essential research question or hypothesis. Different forms of research involve different stages of development and it is important to consider *'fitness for purpose'* in terms of what the researcher sets out to achieve. For example, interview techniques, observational methods or surveys might be employed in gathering relevant data. Most research follows a generic structure consisting of the following: defining the research question or purpose statement, conducting a literature review, identifying the method(s) of enquiry and theoretical framework(s), enlisting data collection, analysis and evaluation, synthesis and writing up.

WHAT IS DESIGN RESEARCH?

Christopher Frayling's 1993 seminal essay 'Research in Art and Design', goes some way in identifying models of design research: RESEARCH INTO DESIGN, RESEARCH THROUGH DESIGN, and RESEARCH FOR DESIGN (FRAYLING, 1993). The research process must be understood THROUGH design practice as exemplified by an exploration into materials and technologies, as well as by research INTO design understood as the more conventional form of contextualized investigations including historical or sociological approaches. The final model—RESEARCH FOR DESIGN—proposes that the research process is a means to an end and whose primary aim is to lead to the artefact itself and not to the dissemination of understanding or knowledge. The artefact is '*central to the communication*' of the research process where research is embedded and not made explicit in the final outcome.

Darren Newbury, Research Co-ordinator for Visual Communication at the University of Central England, suggests that Frayling's research models reinforce '*the institutional divide between theory and practice in art and design*' (NEWBURY 1996: 215-219) whereas in actuality, the boundaries are less well defined between the 'practical' and academic. Newbury proposes that for art and design research herein lies an opportunity for innovation in moving between models and blurring the relationships to develop a new 'interactive' form of research activity. [1] Peter Lunenfeld, Professor in the Media Design Program at Art Center College of Design in Pasadena, takes these ideas one-step further calling for new categories of design research specifically in relationship to digital technologies. Here he introduces 'RESEARCH FOR DESIGN' a model which uses '*its own media to perform the investigations*'. He explains that 'DESIGN AS RESEARCH *is a rational practice, but it is one in which emotion is allowed its own power and intelligence*' (LUNENFELD 2003: 12).

The design research process has been described as belonging to an '*iterative*' process (GAMMAN AND PASCOE 2004) where a testing procedure is used and repeated at several points in order to enable effective results. Research in this case is completed 'in the process of execution'. It is a more 'interactive' practice defining the research process itself (NEWBURY 1996: 13). Lisa Grocott from the Melbourne company *Studio Anybody* and RMIT University, suggests however that in her experience the 'iterative' or discovery-led process '*sets up a stumbling re-entry into a commercial world*'. Client schedules tend to dictate budgets and therefore how long the project is ultimately allowed to take. Funded research in the academy has similar constraints, however, its main focus is to engage with a research process. Such variables create tensions between the way in which the academy and 'real world' research activity

[1] AT THE SAME TIME, IT IS WORTH NOTING THAT STUART EVANS AND IAN PADGETT WHO WERE INVOLVED IN ORGANIZING **THE MATRIX SERIES** OF RESEARCH CONFERENCES HELD AT CENTRAL ST. MARTINS BETWEEN 1988 - 1999, HAVE WARNED THAT WHILE A DISCIPLINE AND A PROFESSION MAY SHARE SIMILAR AREAS OF ACTIVITY, THEY WILL 'HAVE DIFFERING IMPERATIVES AT A TIME MAY BE IN CONFLICT' (EVANS AND PADGETT 1995: 115).

PHASE 1

THE PROCESS BEGAN ON THE COMPUTER TO CREATE A DIGITAL TYPEFACE DESIGN AND COLOR SEPARATIONS.

THE FOLLOWING TYPEFACE STUDY WAS CONDUCTED BY THREE GRADUATE, GRAPHIC DESIGN STUDENTS FOR A SYMPOSIUM TITLED, "GLOBAL/LOCAL." THEIR MAIN INTENTION WAS TO INVESTIGATE THE ANALOG PRODUCTION OF A DIGITALLY CREATED, MODULAR TYPEFACE USING THE SCHOOL'S TWO MAIN PRINTING TECHNOLOGIES. AFTER DESIGNING THE TYPESET ON THE COMPUTER, THEY CARVED THE COMPLEX, VECTOR PATTERNS USING A LASER CUTTER AND THEN PRINTED A SET OF POSTERS USING THE COLLEGE'S VANDERCOOK LETTERPRESS.

PHOTOS AND PROJECT COURTESY OF NC STATE STUDENTS: JON HARRIS, TYLER GALLOWAY, AND AMBER HOWARD

is undertaken. The challenge here is to negotiate the '*professional relationship between speculative research and commercial activity*' (GROCOTT 2003: 84).

In a seminar I gave at North Carolina State University (21 FEBRUARY 2005), MA Graphic Design students proposed the term 'GENERATIVE' rather than 'ITERATIVE' be used to describe the design research process. The Oxford Modern English Dictionary defines 'generative' as '*of, or concerning procreation; able to produce, productive*'. A 'generative view' is a social science research term and implies that there are causal links between things and ones that may be affected by both internal and external observable causes. 'Generative' describes the potential for moving forward and signifies a more positive and less mechanistic approach to the design process thereby allowing for flexibility and responsiveness in the use of developmental strategies (E.G. INTUITION, CREATIVITY AND EXPERIMENTATION). Embedded within the 'generative' is, for the design process, the crucial element of critical reflection.

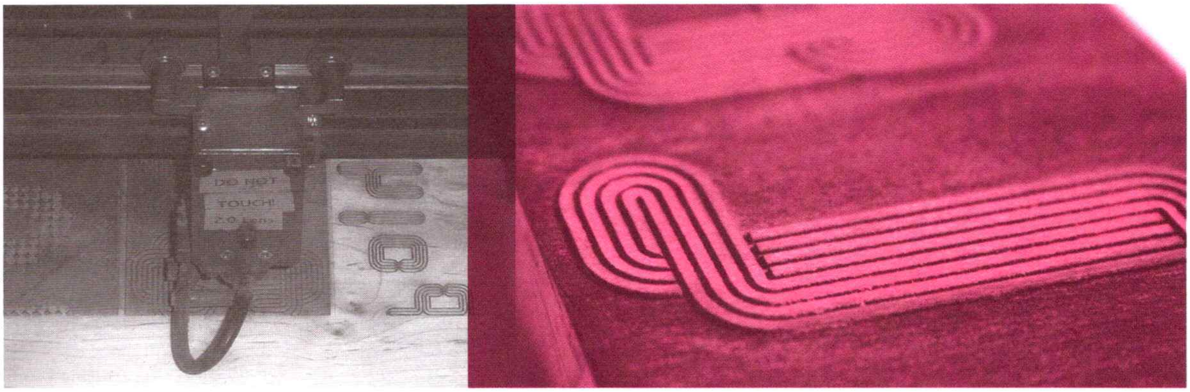
VISUAL RESEARCH FOR GRAPHIC DESIGN

Ultimately, any form of research must be directed by intended goals and outcomes. The careful crafting of the research question is key to ensuring a successful process. Yet, at the same time, there must be an explicit link between the question, the research method(s) (techniques or procedures) and methodology(s) (the plan of action) in order to obtain the desired outcome(s) (CROTTY 2004: 3). One way in which graphic design research has established these links is through the domain of visual enquiry (ROSE 2001; KRESS AND VAN LEEUWEN 1996) by utilizing methods ranging from '*photography to ethnography to semiotics to observation*' (EMMISON AND SMITH 2000). In particular, it is worth looking at what social semiotics might contribute to our understanding of visual meaning.

Theo van Leeuwen, Professor of Language and Communication at Cardiff University, has written that social semiotics may be applied to different modes of communication including language, gesture, images, music, and so forth. He proposes that each of these modes carry '*cultural value and significance*' and are understood by their position within a context. Social semiotics does not divorce itself '*from the concrete forms of social intercourse*', rather its '*meaning is created through complex semiotic interactions*' (VAN LEEUWEN 2005: 4). As a methodology for understanding graphic design, typography and related visual ephemera, social semiotics provides the researcher with a substantial and relevant 'kit of parts' for visual analysis. For the

PHASE 2

A LASER CUTTER WAS USED TO CUT THE TYPEFACE'S THIN STROKE WEIGHTS INTO A PIECE OF WOOD WITH EXTREME PRECISION. INDIVIDUAL TYPEFACE BLOCKS AFTER TRIMMED FROM THE MAIN BLOCK.



design practitioner-researcher, this form of enquiry is also valuable. This is exemplified by van Leeuwen's focus on the work of British typographer Jonathan Barnbrook whose work, he argues, is a form of semiotic research.

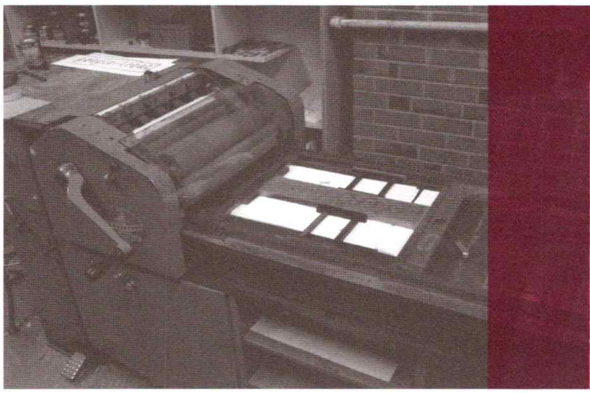
> *'...Barnbrook has turned this kind of analysis of writing into a new writing practice and disseminated it to a wider audience. The audience may not understand it in words as I try to do here—and why should they, it is typographic, not verbal communication. But they will certainly be aware of the novelty and relevance of this kind of design, and will respond to it with intuitive understanding'*
> (VAN LEEUWEN 2005: 43).

Typography in this case is understood as a form of 'text' not in the conventional sense of writing, but as semiotics defines 'text' as anything that can be read for meaning. In other words typography is a system of signs to be read just as we might explore meaning in for example, photographs, comic books, animation, advertisements, magazines, or film.

There are various ways in which meaning might be read in Barnbrook's work. As a designer of typefaces, Barnbrook embeds meaning into the letterform through its appearance but also in the naming of his typefaces. His interest in wordplay is evident. For example the Emigre-released font MASON (1992) attracted international press attention in its renaming from MANSON (after the mass murder Charles MANSON). His most recent release **$+A+E MACHINE** (2004) is created from the lettering off of Russian and American military vehicles with '**S**' fashioned as a **U$** dollar **$**ign and the '**+**' as a medical cro**$$**. **+**he**$**e **$**ymbol**$** are in and of **+**hem**$**elve**$**, already laden wi**+**h **$**ignifican**+** meaning (E.G. U**$** DOLLAR **$**IGN = **+**HE MILI**+**ARY INDU**$+**RIAL COMPLEX). By combining le**++**erform**$** in**+**o word**$**, ano**+**her layer of meaning is added **+**o Barnbrook'**$** work **$**ugge**$+**ing **+**ha**+** **+**he word is both a form of repre**$**en**+**a**+**ion and a **+**ypographic image. **+**hese words **+**hen appear in **$**pecific con**+**ex**+$** and create **$+**ruc**+**ural rela**+**ion**$**hip**$** (**+**hrough **$**CALE, HIERARCHY, u**$**e of **boldface**, *i+alic*, etc.) from which meaning is al**$**o conveyed. **+**he **+**ypographic form a**$** image-word may appear wi**+**hin **+**he con**+**ex**+** of a 'page' ranging from prin**+**ed adver**+**i**$**emen**+$** in magazine**$** **+**o billboard**$** in public environmen**+$** and beyond. Barnbrook'**$** work is poli**+**ically charged. He u**$**e**$** vi**$**ual me**+**aphor**$**

PHASE 3

THE BLOCKS ARE LOCKED IN THE BED OF THE VANDERCOOK PRESS AND INKED ACCORDING TO THE ORIGINAL DIGITAL SEPARATIONS.



PHASE 4

THE POSTERS ARE PRINTED AFTER SEVERAL PASSES THROUGH THE PRESS TO CREATE A SERIES OF OVERLAYING VARNISHES AND COLORS.

and language as tools for challenging readers' expectations, values and critical understanding. **Herein lies the semiotic interaction.**

Social Semiotics is only one way in which graphic design research might be undertaken or used in terms of analysis. Graphic Design research may also involve legibility and readability studies where user interaction is tested more formally or, even human-centred research that takes the context of its use into consideration. Materials research might also be a focus especially in that which involves design and sustainability. Graphic Design research is still in its early developmental stages whether considered research through practice or research about practice.

So the next time you're at that cocktail party, and you're asked about research try not to bore your questionner to death. **BUT DO HAVE THE CONFIDENCE TO LET THEM KNOW WHAT YOU THINK.**

TEAL TRIGGS IS PROFESSOR OF GRAPHIC DESIGN AT THE LONDON COLLEGE OF COMMUNICATION, UNIVERSITY OF THE ARTS LONDON AND IS HEAD OF RESEARCH FOR THE SCHOOL OF GRAPHIC DESIGN. AS A GRAPHIC DESIGN HISTORIAN, CRITIC AND EDUCATOR SHE HAS AUTHORED SEVERAL BOOKS, AND HER WRITINGS HAVE APPEARED IN NUMEROUS INTERNATIONAL DESIGN PUBLICATIONS. SHE IS CO-EDITOR OF THE ACADEMIC JOURNAL *VISUAL COMMUNICATION* (SAGE PUBLICATIONS). TEAL IS ALSO CO-FOUNDER OF THE WOMEN'S DESIGN + RESEARCH UNIT (WD+RU) WHICH WAS ESTABLISHED IN 1995 TO RAISE AWARENESS OF WOMEN WORKING IN VISUAL COMMUNICATION AND RELATED AREAS.

ALLISON, BRIAN (1988) 'Research in Art and Design: Research Problems, Programmes and Databases' in Jeni Bougourd, Stuart Evans and Tag Gronberg (eds) *The Matrix of Research in Art and Design Education*. London: The London Institute. pp. 26-34.

BUCHANAN, RICHARD AND TIM SMITHERS (2004) 'Directions of Inquiry in PhD Research' PhD Design@ JISCMAIL.AC.UK (accessed 21 December).

CROTTY, MICHAEL (2004) *The Foundations of Social Research: Meaning and Perspective in the Research Process*. London: Sage Publications.

EMMISON, MICHAEL AND PHILIP SMITH (2000) *Researching the Visual: Introducing Qualitative Methods*. London: Sage Publications.

EVANS, STUART AND IAN PADGETT (1995) 'Research and Practice in Design' in Stuart Evans, Joanna Greenhill and Ingrid Swenson (eds) *Sculpture Method Research*. London: The Lethaby Press. pp. 114-121.

FRAYLING, CHRISTOPHER (1993) 'Research in Art and Design', *Royal College of Art Research Papers 1, No. 1*. London: RCA.

GRIX, JONATHAN (2001) *Demystifying Postgraduate Research From MA to PhD*. Birmingham: University of Birmingham Press.

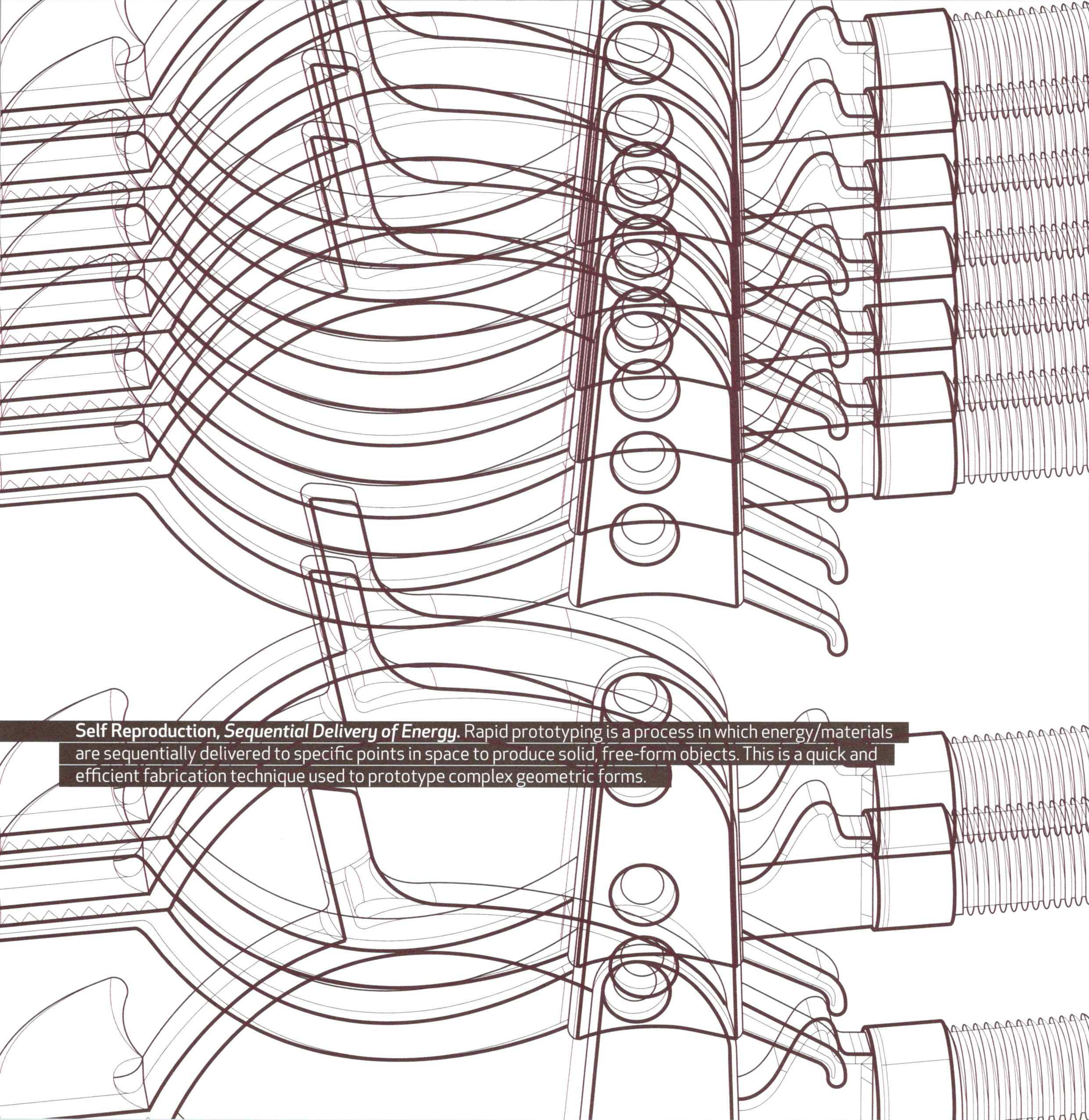
GROCOTT, LISA (2003) 'Speculation, Serendipity and Studio Anybody' in Brenda Laurel (editor) *Design Research: Methods and Perspectives*. Cambridge: The MIT Press, pp. 83-93.

JONES, J. CHRISTOPHER (1984) *Essays in Design*. New York: John Wiley & Sons.

KRESS, GUNTHER AND THEO VAN LEEUWEN (1996) *Reading Images: The Grammar of Visual Design*. London: Routledge.

NELSON, HAROLD AND ERIK STOLTERMAN (2000) 'Design as being in service' in David Durling and Ken Friedman (eds) *Foundations for the Future: Doctoral Education in Design*. Staffordshire: Staffordshire University Press, pp. 23-33.

ROSE, GILLIAN (2001) *Visual Methodologies*. London: Sage Publications.



Self Reproduction, *Sequential Delivery of Energy.* Rapid prototyping is a process in which energy/materials are sequentially delivered to specific points in space to produce solid, free-form objects. This is a quick and efficient fabrication technique used to prototype complex geometric forms.

With clients ranging from major research universities to artists, from industrialists to inventors, the emerging work of the young design shop, Tackle Design, is demanding attention in an oversaturated market of consumer and corporate consulting.

Located in a renovated shop in downtown Durham, N.C., their accomplishments include the design of several solutions to improve non-invasive cardiovascular surgery, the concept development and prototyping for consumer electronics devices, and the launch of web initiatives such as a patent database and an open-source prosthetic research web site.

Defining themselves as a research and development firm of industrial designers, they have experience in industrial design, biomedical engineering, software development, robotics, information technology, manufacturing process design, ergonomics, cartography and environmental design. Their varied work is unified by the simplest of missions—support innovation and pursue the unknown with the fearless determination that 'design' can provide the answers. Rising against the polarization between discipline and profession, the partners at Tackle are using smart, productive design and technology solutions to bridge the gap between design and engineering. Refusing the simple definition of "industrial designers," Tackle Design is a new breed of designers interested in the merger of science, culture, art, and technology.

Never ones to give themselves credit, Tackle Design is the model of a 21st century design firm. They vehemently encourage the merging of disciplines and dismiss the notion that specialization must include compartmentalization, isolation, and a disregard for collaboration. They see design as a consultancy that is innately understood through invention and making. Yet, while highly educated and skilled, they are simple futurists who embrace the pursuit of technological discovery.

One such pursuit is Tackle Designs' open-source web project in the burgeoning field of hardware design. Citing the desire to unconstrain the flow of information between designers and the users of prostheses, The Open Prosthetics Project was launched in the winter of 2005 at *openprosthetics.org*. By focusing the collaboration of ideas outside the constraints of academic, professional, or manufacturing boundaries, new innovations and technology on prosthetic devices (once unavailable to many users) is made readily available to users across the globe.

Besides the ability to share, customize, download, or improve any designs, the site facilitates a new type of dialog within the field of industrial design. With the elimination of financial interests or profit margins, the goal of the project is clear—create innovative and cost efficient designs out of commonly available materials. With little to no profitability in the small prosthetic market (and thus, limited new research or technology in prosthetic manufacturing) Tackle has effectively focused design on solutions rather than profits. By facilitating dialog on collaborative solutions, and public need, rather than corporate profits, their designs address the needs of a society rather than the commercialization and profitability of design.

Specifically, Tackle Design's research centers around the benefits of rapid manufacturing (RM). The following is an explanation by partner Jesse Crossen:

> *"Before the industrial revolution, all products were produced by their users or by local artisans, and many products were what we would today call "custom." Using traditional fabrication processes like blacksmithing, it was pretty easy to produce a single copy of something, unlike many of today's manufacturing processes, like injection molding, which can only produce everyday objects economically in the hundred-thousands or millions. One blacksmith could not realistically make enough copies of something to supply a nation, and so there was no harm in letting other blacksmiths copy a good design idea, because everyone's business benefitted."*

So, in pre-industrial times, peacetime technologies like agricultural implements were based on widely shared designs that were modified and improved over the years by their builders and users. This led to some very highly adapted designs (some that were useful everywhere and others that were tuned to a specific place or task). This was a successful implementation of "open source" ideals that predated computers by many centuries.

Industrial production methods are different; they tend to encourage "one size fits most" designs, making customized products comparatively expensive. However, recent advances in computer-controlled manufacturing are making custom high-tech parts substantially cheaper. Powerful yet easy-to-use CAD software has substantially reduced the labor cost of designing and specifying a part, and CNC machining and rapid prototyping are making custom parts ever cheaper and more straightforward to obtain.

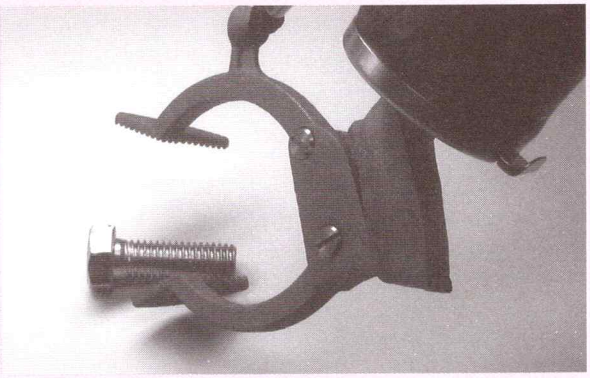
Rapid prototyping is a way of building complex shapes from layers of material, and it will be how many things are made in the future. What's most interesting about this technology for prosthetics is not the "rapid" part, it's the fact that you can make things in very small quantities at a reasonable cost. In the prosthetics industry, this means that very small groups of users, like extreme skateboarders missing one foot, can have products made just for them at a reasonable cost. RM also makes it cheap to introduce new products.

Perhaps it's time to bring the practices of pre-industrial blacksmiths into the modern age. With a global communications system and the application of specialized areas of knowledge, we have the potential to make collaborative innovation faster and cheaper than ever before. This can create new classes of problems that it makes sense to solve, for instance filling the needs of niche communities like amputees or developing technologies that are societally beneficial but were previously considered unprofitable. *The goal of this project is to make that idea a reality.*

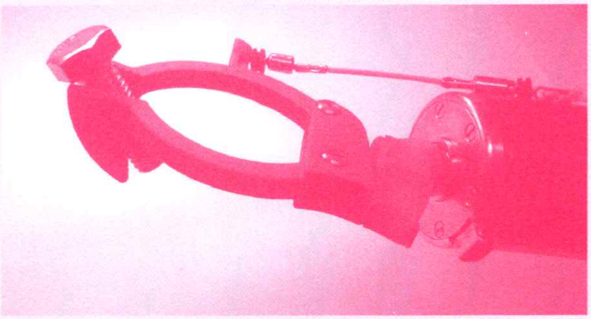
TACKLE DESIGN, INC. IS JESSE CROSSEN, JONATHAN KUNIHOLM, CHUCK MESSER, AND KEVIN WEBB. JESSE (MID 2004), JONATHAN (MS 2003 MECH ENG AND MID 2003), AND CHUCK (MID 2004) ARE ALL GRADUATES OF THE INDUSTRIAL DESIGN PROGRAM AT NC STATE.

IMAGES AND EXCERPT BY JESSE CROSSEN

THE TRAUTMAN HOOK IS AN UPPER-EXTREMITY TERMINAL DEVICE THAT WAS INVENTED IN THE 1920S OR 1930S AND PRODUCED UNTIL THE COMPANY WENT OUT OF BUSINESS A FEW YEARS AGO.



Kenneth Heide, CPO brought this device to our attention in the interests of getting it produced again, and generously loaned us two used devices and two unused devices for reverse engineering. The Trautman Hook backlocks when closed, uses fewer rubber bands than other models, and packs a high mechanical advantage into a small package. Its simplicity, at three metal parts and two screws, makes it a promising platform for customization.



We reverse engineered the old hooks and made a CAD model in Alibre Design. We made some small changes to the design based on the areas where the used hooks had been broken and welded back together, and there are probably more opportunities for strengthening and weight reduction. As soon as we had finished the model, we emailed it to Bill Watson at Anvil Prototype & Design, who printed it on his Z Corp rapid prototyping machine and filled it with cyanoacrylate (super glue) for strength. We we able to assemble the parts into a moving model to test the design.

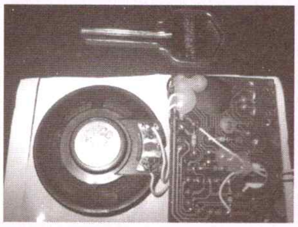
The next step was to try to get the device made without investing a lot in tooling. The best option seems to be rapid manufacturing, so we got the device quoted for different processes and quantities. We're working on getting the device back into production using one or more of these processes. The next step is to test it with a body-powered harness, then we'll try to break it to see where the it needs to be stronger. Also, we're already planning on making a few revisions that would make the device more durable. The cost of this prototype was $500 (ProMetal's min. order) plus about $50 for finishing tools. Thanks to Kenneth Heide, CPO for funding.

IF YOU WANT TO EXPERIMENT WITH THIS DESIGN OR YOU WANT TO GET YOUR OWN QUOTES, YOU CAN DOWNLOAD THE MODEL OR THE STL FILES FROM THE OPEN PROSTHETICS WEBSITE, OPENPROSTHETICS.ORG

IMAGES AND EXCERPT BY JESSE CROSSEN

THIS PROJECT IS CREATING AN ADD-ON TO A PEDIATRIC BODY-POWERED ARM THAT WOULD HELP CHILDREN LEARN TO USE THEIR PROSTHESES FASTER.

The idea comes from Robert Haag, whose two-year old son Michael uses a body-powered gripper. Rob's idea is to build a small device that would measure the tension in the cable and make friendly sounds to tell Michael that the gripper is opening and closing. Now, instead of just being in short sessions, the feedback would be instantaneous and constant, hopefully helping him learn faster and better.

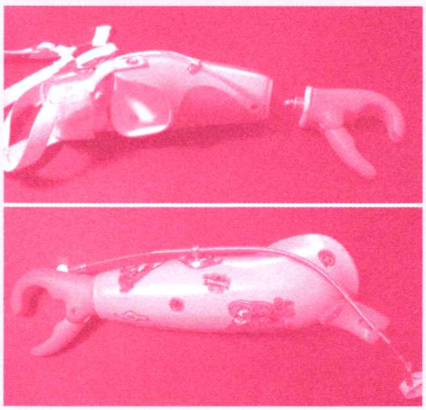


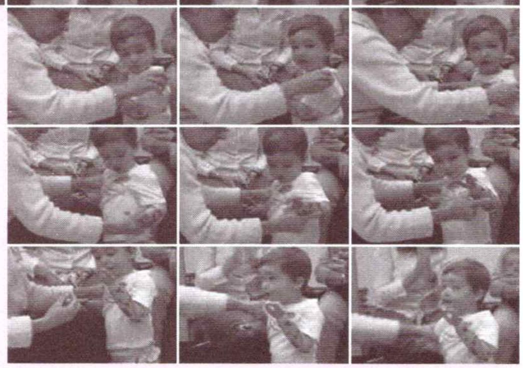
The device will essentially consist of a sound chip that can play audio samples, a sensor that measures tension on the cables, and possibly some component that sits between them and handles the logic. With the right kind of switch, it might be possible to make the logic mostly mechanical.

The following comments are excerpts from a conversation between Rob and Tackle Design concerning the mechanics of Michael's prosthetic arm and some sound chips from AGC Sound:

Ideally the new device would be located close to the hook. Limiting any improvements we make to the terminal end of the device will result in more people taking advantage of the trainer without consulting their prosthetist. I wouldn't know how to measure force to close the hook—it has to be enough pressure to overcome the elastic that holds it open and can still hold something. In the future we may want to make that threshold adjustable or make it more than binary (the more strain the louder the sound, for instance).

The chips pictured here are samples sent to me by Les Zubli at AGC Sound. They are currently activated by closing the connection. The 1301 is the most attractive because of it's small size. It's also the least versatile (oh well, it's a first prototype, right?) The TAS can be re-recorded by the user. The metal disk on the bottom of the 1301 distributes the sound. If you hold it with your fingers, you can barely hear it. Lay it on a resonator like a table top and it's sounds nice and loud.

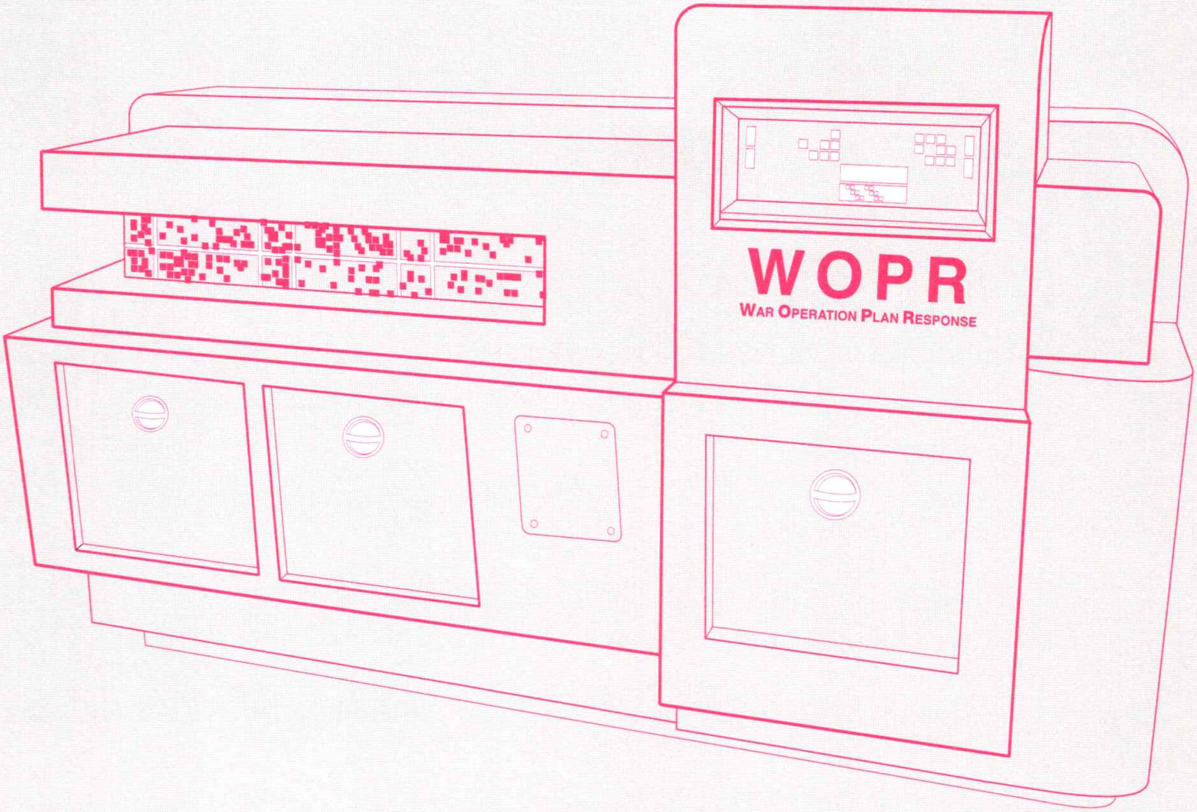




THERAPY SESSION WITH MICHAEL

In the video, you can see the adults giving Michael positive feedback when he does the right thing. This is essential to learning; the quantity, quality, and promptness of feedback directly affects the development of a skill. Rob's idea is to build a small device that would measure the tension in the cable on Michael's prosthetic and make friendly sounds to tell him that the gripper is opening and closing. Now, instead of Michael's training being limited to his short sessions with the therapists, he receives instant and sustained training from the sound chip. And similar to his therapists, this device provides him with positive feedback, helping him learn more quickly and memorably..

Performance, *Computational Speed.* The performance equation is used to measure the amount of calculations a computer performs within a given time period. Similar to measuring human brain activity, computer speeds indicate the rate at which bytes of information are processed.



GAMING AS A TECHNIQUE FOR ANALYSIS

A.M. Mood
and R.D. Specht

Introduction by Katie Salen

1954.

West Germany gains an unexpected 3-2 victory over Hungary in the World Cup, known from then on as The Miracle of Bern. Officials announce that an American hydrogen bomb test had been conducted on Bikini Atoll in the Pacific Ocean. Marilyn Monroe weds Joe DiMaggio. The Geneva Conference partitions Vietnam into North Vietnam and South Vietnam. Mathematician Alan Turing commits suicide.

When viewed from this perspective, 1954 was a year of conflict, a year filled with instability and transformation on the world stage. THIS INSTABILITY WAS MIRRORED BY A CHANGE IN THE WAY MAN REGARDED MACHINE, AIDED BY A REALIZATION OF THE IMMENSE POTENTIAL OF HIGH-SPEED COMPUTERS TO ASSIST IN DECISION-MAKING PROCESSES. The digital age was in its infancy, and in texts like "*Gaming as a Technique of Analysis*" we catch a glimmer of the computational future as it was once conceived. Yet at the same time, despite its wrapping in an era of atomic optimism, we see computer scientists turning to the expressly human element of games, to the role of man the player, explicitly perceived.

As analysts, Mood and Specht are concerned with the human qualities of judgment and intuition, and the way the process of decision-making can be modeled by a machine, in this case a game, "*...a black box into which we crank inputs and out of which are ground outputs.*" While we might not naturally think about games as machines—THEY HARDLY SEEM SO IN THEIR SPONTANEOUS AND IMPROVISATIONAL EXPRESSION OF PLAY—games can be understood as state machines, or models of behavior composed of states, transitions, and actions. As game designer Warren Robinett points out, "*A video game is a simulation, a model, a metaphor.*" THIS DEFINITION OF GAMES AS MODELS IS IMPORTANT TO NOTE, FOR IT POINTS TO THEIR STATUS AS ARTIFICIAL SYSTEMS, SYSTEMS THAT REFLECT THE VALUES AND EXPERTISE OF THEIR DESIGNERS. As designed models then, games embed man in both their creation and in their play, as Mood and Specht are quick to point out.

Presented as part of a symposium on the use and value of war game methods, "*Gaming as a Technique of Analysis,*" argues for gaming as a strategy for discovering optimal choice within a system of complex possible outcomes. They characterize gaming as "*the use of a model with a human decision link,*" which is simply a fancy way of saying that games have players. These players are bound by the rules of the game, act within these constraints, and tend to optimize their choices in pursuit of the best possible outcome. Yet rules never solely determine the play of a game, and are always set into motion by players with their own wants, skills, and expectations.

But of even greater importance to analysts of the time, *gaming* as defined by Mood and Specht provided an observable and repeatable system where multiple scenarios could be quantitatively assessed and tested, by players who despite their fallibility as humans, carried with them the power of creative thought, intuition, and speculation, For the authors, this power is what set gaming apart from pure mechanic calculation. "*To sit down and play through a game is to be convinced as by no argument, however persuasively presented.*" Man-machine reigned supreme, and more than 50 years after this text was written, the world of players would be hard-pressed to disagree.

KATIE SALEN IS A PROFESSOR, GAME DESIGNER, INTERACTIVE DESIGNER, AND THE ACTING DIRECTOR OF THE DESIGN AND TECHNOLOGY DEPARTMENT AT PARSONS SCHOOL OF DESIGN. HER ACCOMPLISHMENTS INCLUDE: WORKING AS AN ANIMATOR ON THE FILM, WAKING LIFE, WRITING A CHAPTER ON "MACHINIMA" (DIGITAL FILMS MADE WITH GAME ENGINES) IN THE DFILM ANTHOLOGY, AND CO-AUTHORING THE BOOK, *RULES OF PLAY: GAME DESIGN FUNDAMENTALS.*

GAMING AS A TECHNIQUE FOR ANALYSIS

REPRINTED FROM VOLUME 5 , THE STUDENT PUBLICATION OF THE COLLEGE OF DESIGN, 1956, COPYRIGHT , THE RAND CORPORATION

THIS IS THE AGE OF THE HIGH-SPEED COMPUTER, OR MORE POPULARLY, THE GIANT BRAIN. Whether or not we can really breed intelligence into our high-speed digital computers, however, is not a question that will concern us here. We are interested, in fact, not in the digital but rather in analog computers and, in fact, in one element of the many that go to make up an analog device. Our analog element is not a differentiator or integrator or multiplying circuit, but a human, homo sapiens we hope. That is, our concern here is not with computing machines that think, but rather with the thinker as part of a computing machine.

Now there is nothing new in solving a problem by asking an expert in the subject—OR EVEN AN OPERATIONS RESEARCHER—to think about the problem. This process goes back at least to the first caveman who asked his neighbor's opinion concerning the optimum tactics for tracking tigers. What does have a certain air of novelty, however, is the growing practice of imbedding a sapient human in a machine and acquiring thereby a new and different sort of machine—one whose capabilities and limitations are today understood somewhat less than perfectly.

In speaking of a "*machine*" we may take the word literally and understand by it a device begotten of vacuum tubes, potentiometers, and associated hardware. On the other hand, our machine may be a logical structure represented only by symbols on a piece of paper. The machines in which we are interested, however protean in form, have all of them similar functions—each is used to help solve problems connected with some decision process.

To change the terminology, our machine is a *model* in the sense in which that word is used in scientific theory—a *model* of that part of the real world with which our decision problem must deal. It is a black box into which we crank inputs and out of which are ground outputs. From these outputs we seek guidance in our decision problem.

The traditional relation of man to model is threefold. In the *first place* man designs the machine. That is, he decides what factors are relevant to the problem and what the interactions between these factors are to be in the machine. In particular, he decides what variables are to be inputs, what are to be outputs of the black box. In the *second place*, the user of the model, who may not be identical with the *onlie begetter* of the black box, decides the numerical values of the input variables fed into the machine. And, *finally*, man inspects, analyzes, interprets the results, the outputs of the model.

The human qualities of judgment and intuition are essential to all three of the activities just mentioned: The design of the model, the choice of input values, the analysis of outputs. But within the black box no meditation goes on. The machine may contain random elements—DICE CUP AND ROULETTE WHEEL MAY BE AMONG ITS COMPONENTS—or, on the other hand, it may be completely deterministic. But in either case the operation of the model, the passage from inputs to outputs, does not involve the attributes of judgment and intuition that we found necessary for the invention of the model.

Now we change radically the nature of the machine by imbedding a man (OR SEVERAL MEN) within it. We can, for example, insert our man into the black box by giving him a potentiometer to twist and dials from which to read the values of variables in the machine, thus setting up a feedback loop.

In a symposium organized to discuss the use and value of war game methods, it is fitting that we take a war game as an example of a model. In order that our example set no foot on terrain labeled secure, we choose it from the military activities of an earlier century. Putting behind us the temptation to discuss the war games conducted by *Uncle Toby* and *Corporal Trim*, together with the reconnaissance campaign of the *Widow Wadman*, we consider instead the *American Krigsspiel* as played by the Volunteer Militia of Rhode Island in the years following the Civil War.

In the conventional war game of that period, the Red and Blue teams play through a military campaign in detail over a map of the theater. One or both players may follow a scenario, or each may be free to plan his tactics and attempt to carry them out under the impact of his opponent's actions. The results of the players' moves are adjudicated (AFTER A CERTAIN AMOUNT OF DEBATE) by the umpire. For example, the umpire decides whether Red succeeded or failed in establishing a bridgehead, whether Blue was able to hold his strong point or was forced to withdraw. So far we appear to have only thinkers, not a machine or quantitative model. But let us turn to the *American Kriegsspiel* and the Volunteer Militia.

The *American Kriegsspiel* was developed from its Prussian counterpart, the latter having been introduced into this country about 1865. The interactions of the elements, from the effect of musketry fire to the velocity effects of a cavalry charge, were spelled out quantitatively, the rules were formalized, and the umpire's functions could be limited to the determination of random numbers for those cases in which the rules prescribed probability distributions. Major Livermore, author of "*The American Kriegsspiel*," described the game as follows.

> "*The Kriegsspiel is played upon a topographical plan, with small blocks representing the troops, which are proportional to the scale of the map… When the position of the blocks indicates that the hostile troops are within sight and range of each other, they may be supposed to open fire, if the players desire it, and in this case, it becomes the umpire's duty to decide the result upon the basis of experience. The rules of the game explain to him how to estimate the loss from this fire; for example, it may have been found that in similar circumstances, the number of killed and wounded has varied from ten to twenty; by throwing a common die he decides whether to assign a greater or less result to the case in view.*"

From this quotation it is evident that the *American Kriegsspiel* came closer to resembling a parlor game than did those war games in which the experienced military judgment of the umpire provided the link between the tactics chosen by Red and Blue and the results of the engagement as measured by movement and attrition of forces. In the language we used earlier, the *Kriegsspiel* constitutes a model, a black box in which the Red and Blue players are integral parts together with the mechanical elements as constituted by the formal rules of the game and the random number generators. The judgment and intuition of the players are used at each stage of the game to make decisions as to allocation, deployment, and operation of forces. These decisions are made under the constraints imposed by the rules, and the interactions of the various elements of the game are determined by the rules together with the random numbers generated.

This resemblance to a parlor game is essential if gaming is to be used as a technique of analysis. The game representing the problems must be easily playable and must be played numerous times by the same players so that they can develop a knowledge of the structure of the game and a feel for good strategies. A game that is to be replayed many times needs a fixed set of rules so that experience gained in one play is valid in other plays.

Our example, the *American Kriegsspiel*, has illustrated the more or less traditional use of the human computer as employed in a war game. This use of gaming can be extended to those non-military situations that involve elements of conflict too important to be ignored. That is, gaming may be used to study situations in which there are elements having a significant effect but which are in the control of a competitor or opponent. Such elements can be neglected only when the opponent's strategy is clearly fixed and known—a condition which sometimes obtains in the case of those simple problems which can be factored out of their context and treated as component problems, but rarely in the case of the more complex systems problems with which we are concerned.

Having thus dropped the word "*war*" from war gaming, we can continue and abandon the gaming as well. That is, our man-machine computer may very well find employment in the study of problems in which no element of conflict occurs. The computation of the transportation capacity of a complex rail network may be a case in point. Other examples of a different character arise in which the responses and interactions of the humans in our man-machine model are themselves the principal object of study. The *Systems Research Laboratory* at RAND has studied man-machine problems involving "*the interactions between a group of… people, associated machines and communications network working against a system criterion.*"

But if the characteristic of war gaming which is important for operations research has neither to do with war nor with gaming but rather with the man-machine computer, then the name "*war gaming*" may be something of a misnomer. Morse has used variously the labels "*simplified gaming,*" "*the gaming technique,*" and "*simulated operational experiment*" to refer to the use of the human as part of the model. As Morse says,

> "*Simplified gaming furnishes another means of operational experiment. Sometimes it is not sufficient to provide the random processes and then just compute the consequences; human judgment or human competition may also enter. In this case we may simplify the operation down to a specialized game* (TWO-PERSON OR SOLITAIRE AS THE CASE MAY BE) *with the random evens and other rules devised to provide a close analogue with the actual operation. By observing a reasonably intelligent person learn to play such a game we can often learn a great deal about an actual operation that is far too complicated to be analyzed by theoretical means.*"

Morse goes on to describe the solution of antisubmarine air-search problem by this gaming technique and says,

> "*Within these few weeks we learned more about the more complicated problems of submarine search than 6 months of analytic work had taught us. Search theory could work out the simple cases well enough; the complex cases, when there were not enough planes, or when delays occurred in starting the search, had to be worked out by gaming.*"

What about the difficulties that attend the use of gaming. There is no need to dwell here upon those stumbling blocks that are ever with us regardless of the technique of solution. The central problem—THAT THE WISE SELECTION OF CRITERION OR PAYOFF—is just as important and no easier of solution, whether gaming is used or no. The related questions of adequate measures of cost and effectiveness, of loss and profit, are still essential, and these measures are not always easy to arrive at. As in any operations research project, we must decide how much context is to be provided as a necessary background for our problem, how extensive a slice of the real world is to be modeled. If the *Volunteer Militia* uses the *American Kriegsspiel* to study new tactics proposed for the horse artillery, then it may be that little additional context is needed. A game may be designed with few elements other than those directly and obviously concerned with the horse artillery. If, on the other hand, the game is called upon for assistance in deciding proper budget for the horse artillery, then far more context is required. This is a system problem rather than a component problem; it is a problem that can not be detached from its natural context, that can not be factored out and treated separately from all the other military and economic factors that are entangled with it.

Another vexing problem, but again one not unique to gaming, is that of the proper amount of fine structure to be included in the model. In our attempt to be realistic, how much detail must be preserved, how much can be sloughed off or aggregated. The player of *American Kriegsspiel* can even dispatch a cavalry charge and take into account the aversion of the horses to tread upon prone infantrymen.

These problems of suitable criterion, adequate measures of cost, proper amount of context, necessary level of detail are important problems; they deserve all the study and need all the help the *Operations Research Society of America* can give them. But they are not unique to gaming; on the contrary, the analyst must contend with them however he may choose to make his analysis. On the other hand, gaming does aggravate some of these knotty points and may even introduce a few of its own. Consider the matter of evaluating the sensitivity of the results of an analysis to parameter values, to model structure, to payoff. In the simplest of models it may be possible to make sensitivity tests analytically. More complex models may demand extensive numerical computation, particularly if random elements are present. The sensitivity problem becomes even harder to handle if human decision links are used in the model, that is, if the analysis employs gaming. A partial solution lies in the direction of making the game easily playable and hence repeatable.

A second apparent drawback to gaming is that it discards the possibility of analytical optimization. The theory of games has developed a considerable body of clarifying ideas and technique which can analyze simple economic and tactical questions. In particular, the theory of games may furnish solutions to some factorable component problems and these suboptimizations may be built into our machine. However, the theoretical techniques now available are not even remotely capable of dealing with complex systems problems.

The last difficulty attendant upon gaming to be mentioned here is that playing a game may be too easy and too attractive. That is, the temptation is great to devote too much effort to play, to little effort to good design of play and of the game itself to the end that desired results may be achieved. An allied point is that of achieving good play, or insuring, for example, that a player's decision is made in accordance with the specified criterion or payoff of the game and not dictated merely by the quirks and crotchets of the individual human player, bedeviled as he is by the accumulated prejudices of a life time. However, this is less of a stumbling block for gaming than might first be supposed. The human decision link in our machine is not free but is rather bound by all the constraints of the machine, constraints that express the structure of the model and that have been arrived at by combining the knowledge and experience of many experts. So, while irrational play may be present in either the gaming situation of a problem or in a solution arrived at by a round-table discussion among experts, the gaming technique does have some built-in safeguards.

We have characterized gaming as the use of a model containing a human decision link. Now this man inside the machine is not a hypothetical Maxwell's demon with that character's attribute or infallibility. On the contrary, we have a real and therefore fallible human. What can we possibly gain by adding to our machine an element whose unreliability and predictableness exceed that of our electronic gear. In other words, why game?

The construction of a game involves judgment at every turn: in the scope of the game, the level of detail, the content of the rules, the adequacy of its representation of reality, the opinions of players as to what are good strategies. Why not just answer the questions the game is supposed to analyze by referring to an expert in the area of the given problem? What does the game do that an expert cannot do?

The expert, of course, is not the only alternative to the use of the man-machine computer in studying complex problems. Instead of dispensing with the machine we can dispense instead with the man. The former choice corresponds to the use of the expert—or a committee of experts. The later course is the usual scientific model-building of the operations researcher. This modeling of the real world by a machine has been a patent tool in the study of component problems. For the more complex systems problems that cannot be factored out of their context, however, analysis by a model, but a pure machine, is usually feasible only if the real world is ruthlessly simplified with the accompanying sacrifice of elements that may be essential.

A game pools the knowledge of numerous expects. The more complex a problem is, the less the likelihood that a person can be found who is an expert in all its facets. And even if such a person could be found, he would himself have to integrate in his mind all this special knowledge into one coherent structure and analyze that structure.

Having just disposed of the catholic expert, we must now admit that we have been too glib—that we can not really dispense with him completely, although we can make his job a finite and feasible one. For recall that the man within the machine is not the only human involved in the game. As we saw earlier in talking of scientific model building and using, man designs the model, chooses input values, and analyzes the results. The designing of a model, the writing of a set of rules for a game is a major project. Decisions must be made as to the amount of context to be included. Those aspects which are retained in the game must be simplified and combined into easily manipulable factors in the interest of having a playable and understandable game. Planning factors must be compiled, the interactions of various factors spelled out, and side studies made to fill in areas where rules are necessary but knowledge lacking.

In the language of our computer analogy, the great advantages of the man operating within the machine is that he is not free. He is bound by the constraints of the model, constraints that have been built into the machine to represent the results of component studies on various pieces of the problem, and the pooling of experience and judgment concerning portions of the problem.

Gaming, like all model building, has another paramount advantage of unbuttoned judgment—it forces the explicit recognition and statement of assumptions. Intuition and instinct are indispensable to the operations researcher; abandon them and he abandons the power of creative thought. But however important are suggestions and suppositions, speculation, and surmise, it is equally important that these things be clearly recognized and labeled.

A virtue of gaming that is sometimes overlooked by those seeking grander goals—THE SOLUTION OF ALLOCATION PROBLEMS OR THE STUDY OF THE MILITARY WORTH CONCEPT, FOR EXAMPLE—is its unparalleled advantages in training and educational programs. A game can easily be made fascinating enough to put over the dullest facts. To sit down and play through a game is to be convinced as by no argument, however persuasively presented.

But to return to our discussion of the use of man-machine as opposed to machine alone or man alone. For a very complex problem it certainly is necessary to combine the knowledge and experience of many experts. It is a plausible assumption that a carefully organized combination of their knowledge into a single self-consistent whole would provide a much firmer basis for decisions than, say, a round-table discussion among experts. Of course, it is a great deal more trouble too, but we face many problems that justify the effort.

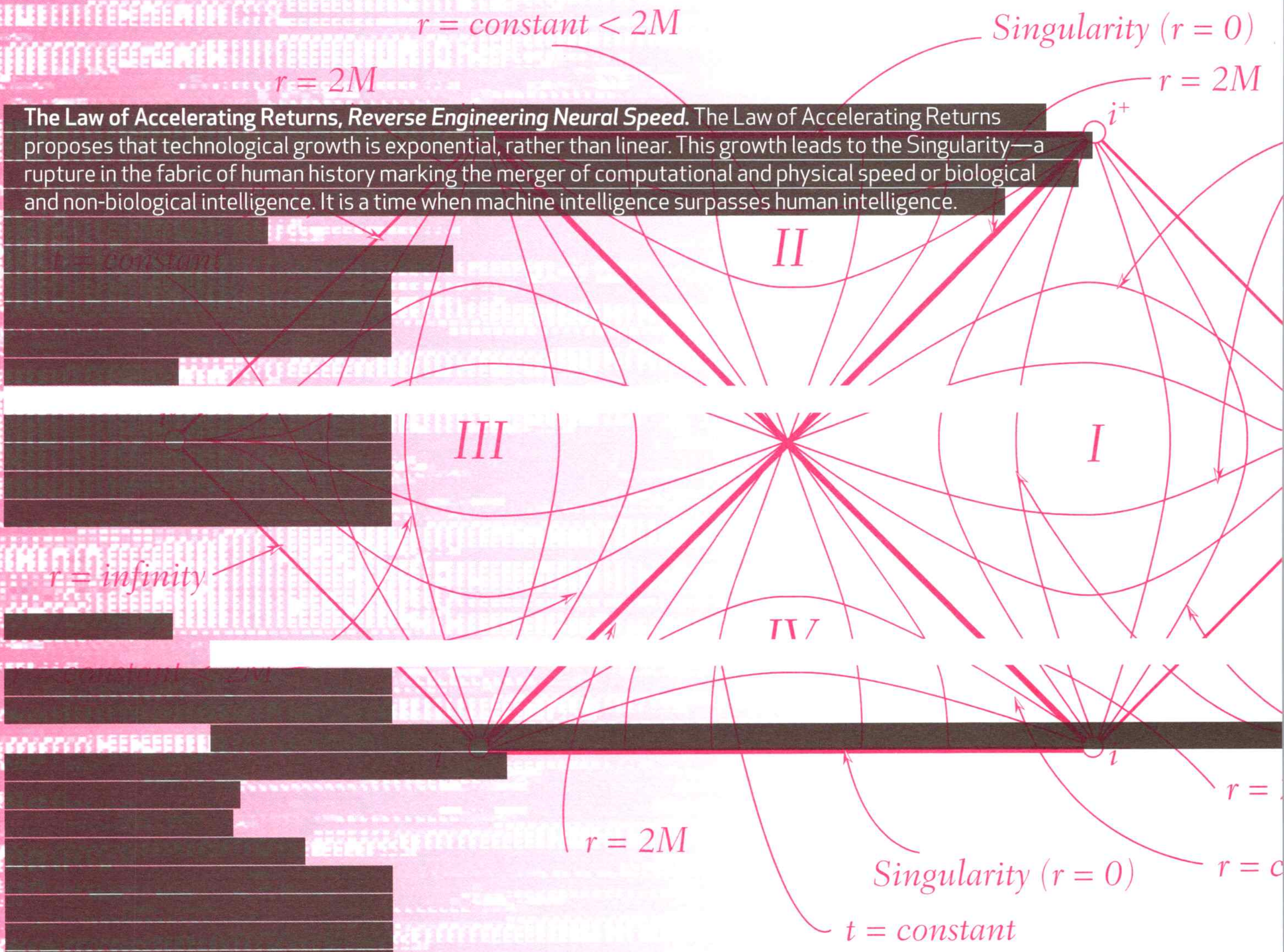
A game is an endeavor to put down in writing a basic structure which must necessarily be a part of an intelligent consideration of any nonfactorable problem. People can then see it and study it and debate it, and over a period of time arrive at some sort of general agreement about it. Even when that has been accomplished, gaming is admittedly an inexact analytical tool beside the methods that chemists and physicists use, for example. But it is a wide step beyond armchair judgment in the sense that it provides an operational and roughly verifiable (REPEATABLE BY OTHER PERSONS) technique for dealing with problems not otherwise amenable to quantitative analysis.

W.R. LIVERMORE, "The American Kriegsspiel. A Game for Practicing the Art of War Upon a Topographical Map," W.B. Clarke Co., Boston, rev. ed., 1898.

J.L. KENNEDY, "The Uses and Limitations of Mathematical Models, Game Theory and Systems Analysis in Planning and Problem Solution," RAND Corp. Paper P-266, 11 February 1952.

P.M. MORSE, "Trends in Operations Research," *Journal of the Operations Research Society of America, Vol. 1, No. 4*, August 1953, pp. 159-156.

The Law of Accelerating Returns, *Reverse Engineering Neural Speed.* The Law of Accelerating Returns proposes that technological growth is exponential, rather than linear. This growth leads to the Singularity—a rupture in the fabric of human history marking the merger of computational and physical speed or biological and non-biological intelligence. It is a time when machine intelligence surpasses human intelligence.



[redacted]

THE LAW OF ACCELERATING RETURNS [EXCERPTS]

Ray Kurzweil

THE SOFTWARE OF INTELLIGENCE So far, I've been talking about the hardware of computing. The software is even more salient. One of the principal assumptions underlying the expectation of the *Singularity* is the ability of nonbiological mediums to emulate the richness, subtlety, and depth of human thinking. Achieving the computational capacity of the human brain, or even villages and nations of human brains will not automatically produce human levels of capability. By human levels I include all the diverse and subtle ways in which humans are intelligent, including musical and artistic aptitude, creativity, physically moving through the world, and understanding and responding appropriately to emotion. The requisite hardware capacity is a necessary but not sufficient condition. The organization and content of these resources—*the software of intelligence*—is also critical.

= *constant*

r = *infinity*

i^0

r = *infinity*

constant > 2*M*

nt < 2*M*

Before addressing this issue, it is important to note that ONCE A COMPUTER ACHIEVES A HUMAN LEVEL OF INTELLIGENCE, IT WILL NECESSARILY SOAR PAST IT. A key advantage of nonbiological intelligence is that machines can easily share their knowledge.

If I learn French, or read War and Peace, I can't readily download that learning to you. You have to acquire that scholarship the same painstaking way that I did. My knowledge, embedded in a vast pattern of neurotransmitter concentrations and interneuronal connections, cannot be quickly accessed or transmitted. But we won't leave out quick downloading ports in our nonbiological equivalents of human neuron clusters. WHEN ONE COMPUTER LEARNS A SKILL OR GAINS AN INSIGHT, IT CAN IMMEDIATELY SHARE THAT WISDOM WITH BILLIONS OF OTHER MACHINES.

As a contemporary example, we spent years teaching one research computer how to recognize continuous human speech. We exposed it to thousands of hours of recorded speech, corrected its errors, and patiently improved its performance. Finally, it became quite adept at recognizing speech (I dictated most of my recent book to it). Now if you want your own personal computer to recognize speech, it doesn't have to go through the same process; you can just download the fully trained patterns in seconds. Ultimately, billions of nonbiological entities can be the master of all human- and machine-acquired knowledge.

In addition, computers are potentially millions of times faster than human neural circuits. A computer can also remember billions or even trillions of facts perfectly, while we are hard pressed to remember a handful of phone numbers. The combination of human-level intelligence in a machine with a computer's inherent superiority in the speed, accuracy, and sharing ability of its memory will be formidable.

There are a number of compelling scenarios to achieve higher levels of intelligence in our computers, and ultimately human levels and beyond. We will be able to evolve and train a system combining massively parallel neural nets with other paradigms to understand language and model knowledge, including the ability to read and model the knowledge contained in written documents. Unlike many contemporary "*neural net*" machines, which use mathematically simplified models of human neurons, some contemporary neural nets are already using highly detailed models of human neurons, including detailed nonlinear analog activation functions and other relevant details. Although the ability of today's computers to extract and learn knowledge from natural language documents is limited, their capabilities in this domain are improving rapidly. COMPUTERS WILL BE ABLE TO READ ON THEIR OWN, UNDERSTANDING AND MODELING WHAT THEY HAVE READ, BY THE SECOND DECADE OF THE TWENTY-FIRST CENTURY. We can then have our computers read all of the world's literature—books, magazines, scientific journals, and other available material. Ultimately, the machines will gather knowledge on their own by venturing out on the web, or even into the physical world, drawing from the full spectrum of media and information services, and sharing knowledge with each other (which machines can do far more easily than their human creators).

REVERSE ENGINEERING THE HUMAN BRAIN

The most compelling scenario for mastering the software of intelligence is to tap into the blueprint of the best example we can get our hands on of an intelligent process. THERE IS NO REASON WHY WE CANNOT REVERSE ENGINEER THE HUMAN BRAIN, AND ESSENTIALLY COPY ITS DESIGN. Although it took its original designer several billion years to develop, it's readily available to us, and not (*yet*) copyrighted. Although there's a skull around the brain, it is not hidden from our view.

The most immediately accessible way to accomplish this is through **destructive scanning**: we take a frozen brain, preferably one frozen just slightly before rather than slightly after it was going to die anyway, and examine one brain layer—one very thin slice—at a time. We can readily see every neuron and every connection and every neurotransmitter concentration represented in each synapse-thin layer.

But scanning a frozen brain is feasible today, albeit not yet at a sufficient speed or bandwidth, but again, the law of accelerating returns will provide the requisite speed of scanning, just as it did for the human genome scan. Carnegie Mellon University's Andreas Nowatzyk plans to scan the nervous system of the brain and body of a mouse with a resolution of less than 200 nanometers, which is getting very close to the resolution needed for reverse engineering.

We also have noninvasive scanning techniques today, including *high-resolution magnetic resonance imaging* (MRI) *scans*, *optical imaging*, *near-infrared scanning*, and other technologies which are capable in certain instances of resolving individual somas, or neuron cell bodies. Brain scanning technologies are also increasing their resolution with each new generation, just what we would expect from the **law of accelerating returns**. Future generations will enable us to resolve the connections between neurons and to peer inside the synapses and record the neurotransmitter concentrations.

We can peer inside someone's brain today with *noninvasive scanners*, which are increasing their resolution with each new generation of this technology. There are a number of technical challenges in accomplishing this, including achieving suitable resolution, bandwidth, lack of vibration, and safety. For a variety of reasons it is easier to scan the brain of someone recently deceased than of someone still living. It is easier to get someone deceased to sit still, for one thing. BUT NONINVASIVELY SCANNING A LIVING BRAIN WILL ULTIMATELY BECOME FEASIBLE AS MRI, OPTICAL, AND OTHER SCANNING TECHNOLOGIES CONTINUE TO IMPROVE IN RESOLUTION AND *SPEED*.

SCANNING FROM INSIDE

Although noninvasive means of scanning the brain from outside the skull are rapidly improving, the most practical approach to capturing every salient neural detail will be to scan it from inside. BY 2030, "NANOBOT" (I.E., NANO ROBOT) TECHNOLOGY WILL BE VIABLE, AND BRAIN SCANNING WILL BE A PROMINENT APPLICATION. Nanobots are robots that are the size of human blood cells, or even smaller. Billions of them could travel through every brain capillary and scan every relevant feature from up close. Using high-speed wireless communication, the nanobots would communicate with each other, and with other computers that are compiling the brain scan data base (in other words, the nanobots will all be on a wireless local area network).

This scenario involves only capabilities that we can touch and feel today. We already have technology capable of producing very high-resolution scans, provided that the scanner is physically proximate to the neural features. The basic computational and communication methods

HUMAN BRAIN SCANNING HAS ALREADY STARTED. A CONDEMNED KILLER ALLOWED HIS BRAIN AND BODY TO BE SCANNED AND YOU CAN ACCESS ALL 10 BILLION BYTES OF HIM ON THE INTERNET HTTP://WWW.NLM.NIH.GOV/RESEARCH/VISIBLE/VISIBLE_HUMAN.HTML.

HE HAS A 25 BILLION BYTE FEMALE COMPANION ON THE SITE AS WELL IN CASE HE GETS LONELY. THIS SCAN IS NOT HIGH ENOUGH IN RESOLUTION FOR OUR PURPOSES, BUT THEN, WE PROBABLY DON'T WANT TO BASE OUR TEMPLATES OF MACHINE INTELLIGENCE ON THE BRAIN OF A CONVICTED KILLER, ANYWAY.

are also essentially feasible today. The primary features that are not yet practical are nanobot size and cost. As I discussed above, we can project the exponentially declining cost of computation, and the rapidly declining size of both electronic and mechanical technologies. We can conservatively expect, therefore, the requisite nanobot technology by around 2030. Because of its ability to place each scanner in very close physical proximity to every neural feature, nanobot-based scanning will be more practical than scanning the brain from outside.

HOW TO USE YOUR BRAIN SCAN

How will we apply the thousands of trillions of bytes of information derived from each brain scan?

One approach is to use the results to design more intelligent parallel algorithms for our machines, particularly those based on one of the neural net paradigms. With this approach, we don't have to copy every single connection. There is a great deal of repetition and redundancy within any particular brain region. Although the information contained in a human brain would require thousands of trillions of bytes of information (on the order of 100 billion neurons times an average of 1,000 connections per neuron, each with multiple neurotransmitter concentrations and connection data), the design of the brain is characterized by a human genome of only about a billion bytes.

Furthermore, most of the genome is redundant, so the initial design of the brain is characterized by approximately one hundred million bytes, about the size of *Microsoft Word*. Of course, the complexity of our brains greatly increases as we interact with the world (by a factor of more than ten million). BECAUSE OF THE HIGHLY REPETITIVE PATTERNS FOUND IN EACH SPECIFIC BRAIN REGION, IT IS NOT NECESSARY TO CAPTURE EACH DETAIL IN ORDER TO REVERSE ENGINEER THE SIGNIFICANT DIGITAL-ANALOG ALGORITHMS. WITH THIS INFORMATION, WE CAN DESIGN SIMULATED NETS THAT OPERATE SIMILARLY. There are already multiple efforts under way to scan the human brain and apply the insights derived to the design of intelligent machines.

The pace of brain reverse engineering is only slightly behind the availability of the brain scanning and neuron structure information. A contemporary example is a comprehensive model of a significant portion of the human auditory processing system that Lloyd Watts (WWW.LLOYDWATTS.COM) has developed from both neurobiology studies of specific neuron types and brain interneuronal connection information. Watts' model includes five parallel paths and includes the actual intermediate representations of auditory information at each stage of neural processing. Watts has implemented his model as real-time software which can locate and identify sounds with many of the same properties as human hearing. Although a work in progress, the model illustrates the feasibility of converting neurobiological models and brain connection data into working simulations. Also, as Hans Moravec and others have speculated, these efficient simulations require about 1,000 times less computation than the theoretical potential of the biological neurons being simulated.

DOWNLOADING THE HUMAN BRAIN

A more controversial application than this *scanning-the-brain-to-understand-it* scenario is *scanning-the-brain-to-download-it*. Here we scan someone's brain to map the locations, interconnections, and contents of all the somas, axons, dendrites, presynaptic vesicles, neurotransmitter concentrations, and other neural components and levels. Its entire organization can then be re-created on a neural computer of sufficient capacity, INCLUDING THE CONTENTS OF ITS MEMORY.

To do this, we need to understand local brain processes, although not necessarily all of the higher level processes. Scanning a brain with sufficient detail to download it may sound daunting, but so did the human genome scan. All of the basic

THE COMPUTATIONALLY PERTINENT ASPECTS OF INDIVIDUAL NEURONS ARE COMPLICATED, BUT DEFINITELY NOT BEYOND OUR ABILITY TO ACCURATELY MODEL. FOR EXAMPLE, TED BERGER AND HIS COLLEAGUES AT HEDCO NEUROSCIENCES HAVE BUILT INTEGRATED CIRCUITS THAT PRECISELY MATCH THE DIGITAL AND ANALOG INFORMATION PROCESSING CHARACTERISTICS OF NEURONS, INCLUDING CLUSTERS WITH HUNDREDS OF NEURONS.

CARVER MEAD AND HIS COLLEAGUES AT CALTECH HAVE BUILT A VARIETY OF INTEGRATED CIRCUITS THAT EMULATE THE DIGITAL-ANALOG CHARACTERISTICS OF MAMMALIAN NEURAL CIRCUITS.

technologies exist today, just not with the requisite speed, cost, and size, but these are the attributes that are improving at a double exponential pace.

A recent experiment at San Diego's Institute for Nonlinear Science demonstrates the potential for electronic neurons to precisely emulate biological ones. Neurons (biological or otherwise) are a prime example of what is often called "chaotic computing." Each neuron acts in an essentially unpredictable fashion. When an entire network of neurons receives input (from the outside world or from other networks of neurons), the signaling amongst them appears at first to be frenzied and random. Over time, typically a fraction of a second or so, the chaotic interplay of the neurons dies down, and a stable pattern emerges. This pattern represents the "decision" of the neural network. If the neural network is performing a pattern recognition task (which, incidentally, comprises the bulk of the activity in the human brain), then the emergent pattern represents the appropriate recognition.

So the question addressed by the San Diego researchers was *whether electronic neurons could engage in this chaotic dance alongside biological ones*. They hooked up their artificial neurons with those from spiny lobsters in a single network, and their hybrid biological-nonbiological network performed in the same way (I.E., CHAOTIC INTERPLAY FOLLOWED BY A STABLE EMERGENT PATTERN) and with the same type of results as an all biological net of neurons. Essentially, the biological neurons accepted their electronic peers. It indicates that their mathematical model of these neurons was reasonably accurate.

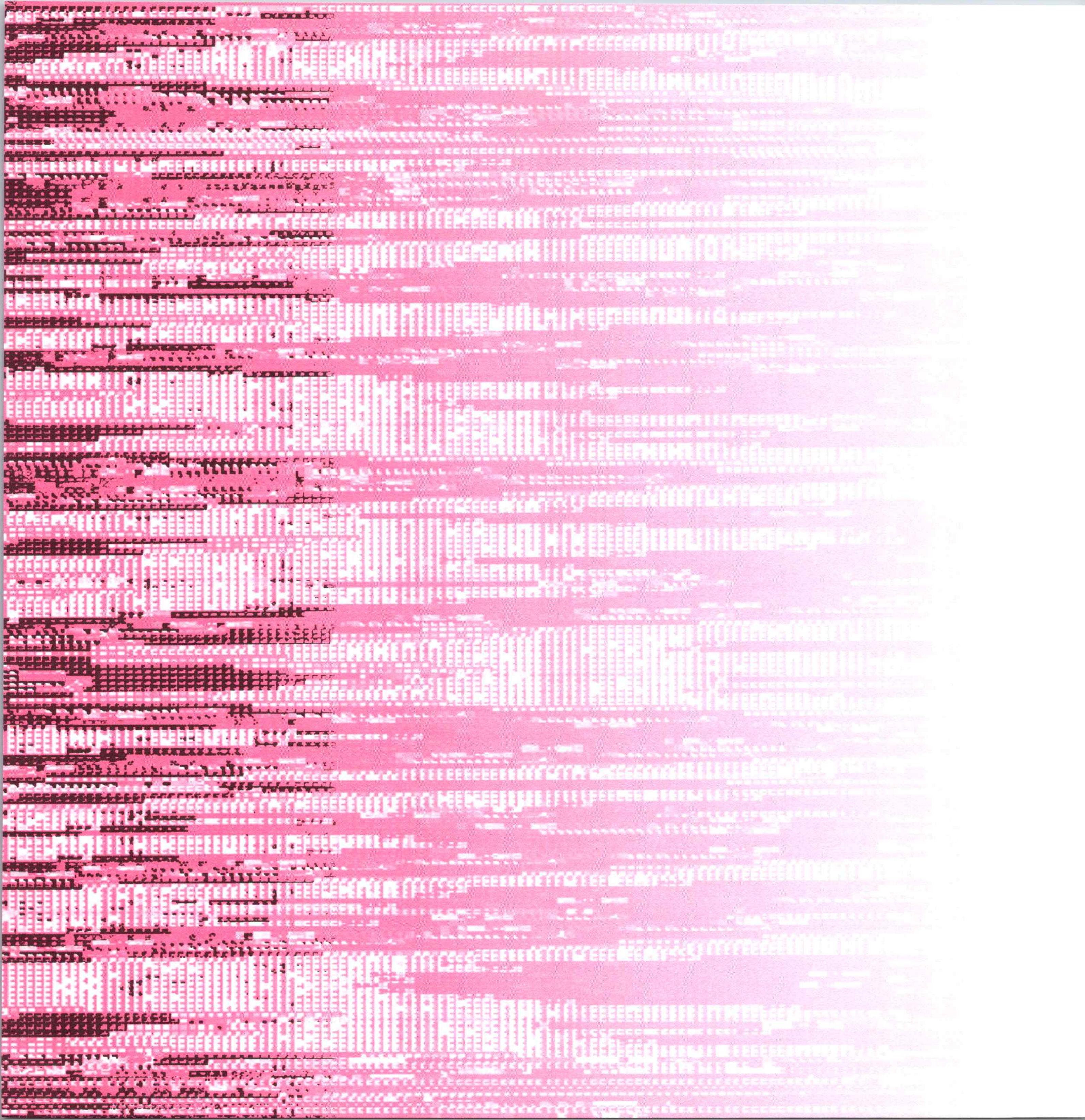
There are many projects around the world which are creating nonbiological devices to recreate in great detail the functionality of human neuron clusters. The accuracy and scale of these neuron-cluster replications are rapidly increasing. We started with functionally equivalent recreations of single neurons, then clusters of tens, then hundreds, and now thousands. Scaling up technical processes at an exponential pace is what technology is good at.

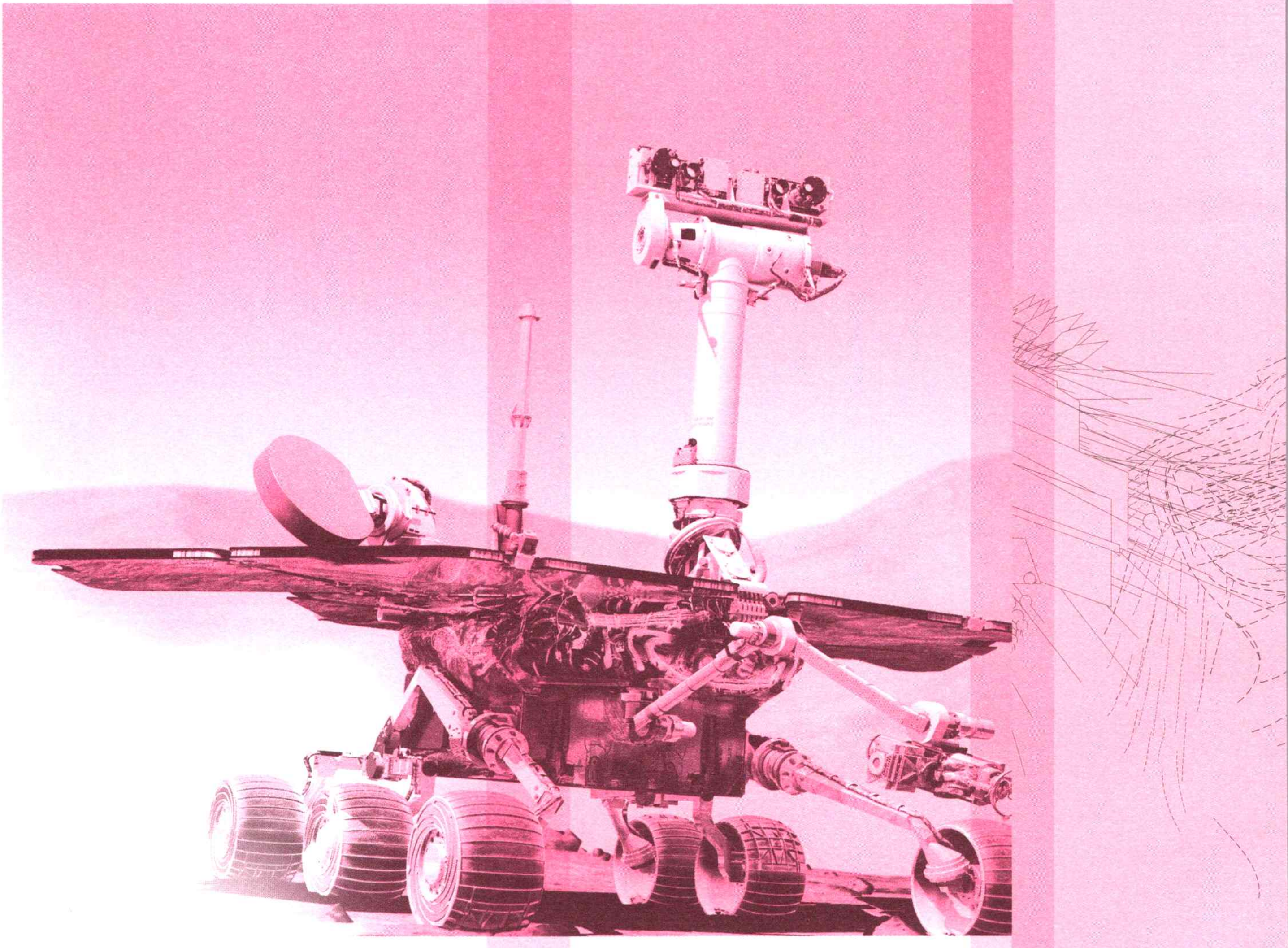
AS THE COMPUTATIONAL POWER TO EMULATE THE HUMAN BRAIN BECOMES AVAILABLE—*we're not there yet, but we will be there within a couple of decades—*

PROJECTS ALREADY UNDER WAY TO SCAN THE HUMAN BRAIN WILL BE ACCELERATED, WITH A VIEW BOTH TO UNDERSTAND THE HUMAN BRAIN IN GENERAL, AS WELL AS PROVIDING A DETAILED DESCRIPTION OF THE CONTENTS AND DESIGN OF SPECIFIC BRAINS.

By the third decade of the twenty-first century, we will be in a position to create highly detailed and complete maps of all relevant features of all neurons, neural connections and synapses in the human brain, all of the neural details that play a role in the behavior and functionality of the brain, and to recreate these designs in suitably advanced neural computers.

RAYMOND KURZWEIL IS A TECHNOLOGIST, LEADING INVENTOR, ENTREPRENEUR, WRITER AND FUTURIST. AN INDUCTEE INTO THE NATIONAL INVENTOR HALL OF FAME IN 2002, HIS WORK AND WRITING REGARDING THE RELATIONSHIP BETWEEN HUMANS AND MACHINES IS EARNED HIM GLOBAL ACCLAIM. HIS WEB SITE, KURZWEILAI.NET, IS REPORTED TO HAVE BEEN READ BY OVER 1 MILLION VISITORS.





ALL WATCHED OVER BY MACHINES OF LOVING GRACE

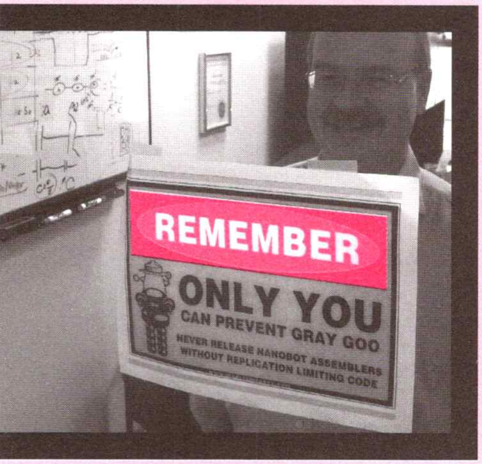
Richard Brautigan

1967

I like to think (and
the sooner the better!)
of a cybernetic meadow
where mammals and computers
live together in mutually
programming harmony
like pure water
touching clear sky.

I like to think
(right now, please!)
of a cybernetic forest
filled with pines and electronics
where deer stroll peacefully
past computers
as if they were flowers
with spinning blossoms.

I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace.


REMEMBER
ONLY YOU
CAN PREVENT GRAY GOO
NEVER RELEASE NANOBOT ASSEMBLERS
WITHOUT REPLICATION LIMITING CODE

The Editor would like to personally thank:

I would like to give a heartfelt thank you to all the faculty, students, and classmates who directly contributed to this publication through their writings, advice, and use of imagery. Your time and dedication to making this publication a priority and a necessary outlet of critique demonstrates that this is an institution of influence. In particular, I would like to thank Lee-Anne Milburn, Martha Scotford, Vita Plume, Teal Triggs, Katie Salen, Jesse Crossen, Chuck Messer, and Wendy Redfield for their writings, but more importantly, for our conversations and the encouragement and patience you supplied throughout this process. I would also like to thank my professor and friend, Tony Brock, whose service, commitment, and mentorship to this publication and my growth as a designer and person cannot be measured. And finally, I thank my lovely wife, who has sacrificed much of her time and dreams to allow me the opportunity to pursue my own.

The publication would like to thank:

Dean Malecha for his leadership, direction, and support of the student body. Sherry O'Neal for her assistance in all aspects of the publication process. Frank Pulley for his printing expertise and generosity in helping the students at the College of Design fulfill their projects. The Department Heads within each of the disciplines and all those faculty members who allowed me the time to discuss my ideas and provide me insightful feedback. Robert Campbell, Sander Olson, Ray Kurzweil, and William Gibson for granting us permission to print their marvelous works.

AND FINALLY, THE ITALIAN FUTURISTS FOR THEIR UNWAVERING DEDICATION TOWARDS THE PROMOTION OF ART AND DESIGN BY EXPERIMENTATION AND EXPLORATION OF THE UNKNOWN.

THE STUDENT PUBLICATION OF THE
COLLEGE OF DESIGN
VOLUME 32

EDITOR: D. JASON TOTH
FACULTY ADVISOR: TONY BROCK, ASSISTANT PROFESSOR
DESIGN AND ART DIRECTION, D. JASON TOTH

PUBLICATION COMMITTEE MEMBERS
Denise Gonzales Crisp, Associate Professor of Graphic Design
Sherry O'Neal, Director of Communications
Michael Pause, Professor of Art + Design and Director of Design Fundamentals Program
Art Rice, Professor and Associate Dean for Graduate Studies, Research and Extension

This volume was printed and bound in the United States by Theo Davis Printing in Zebulon, N.C. The primary typefaces used are Apex New designed by Chester and *Fairfield*, designed by Alex Kaczun and Rudolph Ruzicka.

IMAGE CREDITS

Unless otherwise noted, every reasonable effort has been made to identify owners of copyrighted materials. Errors or omissions will be corrected in subsequent additions. If not listed below, image credits for published images are found beside the corresponding image.

PAGE
8, 10, 106 PAUL VENUTO, ILLUSTRATION, *Shattered Glass*
9 LIBRARY OF CONGRESS
20 FLICKR MEMBER, KEN MCCOWN
21 FLICKR MEMBER, PING PING
22 FLICKR MEMBER, ANSELOR
23 FLICKR MEMBER, IRONMANIXS
24 FLICKR MEMBER, BROKENLENS
25 FLICKR MEMBER, XERONES
26, 28, 30, 108 FLICKR MEMBER JURVETSON
33 FLICKR MEMBER, STSTEV
34 FLICKR MEMBER, BERZOWSKA
41 FLICKR MEMBER, THE DEPARTMENT
41 (INSET) FLICKR MEMBER, LAUGHING SQUID
42 NASA LANGLEY RESEARCH CENTER
43 IBM
46 (INSET) FLICKR MEMBER, BEAR69DESIGNS
46 ESSAIE SUR l'ARCHITECTURE, MARC-ANTOINE LAUGIER, 1753
52 GAIL PETER BORDEN
57 JENNA BAILEY, ILLUSTRATION
64 FLICKR MEMBER, DOVIENDE
107 NASA LANGLEY RESEARCH CENTER

ENDSHEETS MATTHEW PETERSON, ILLUSTRATION

NC STATE UNIVERSITY COLLEGE OF DESIGN
PUBLICATION CAMPAIGN

The College of Design wishes to thank the following donors for their generous support of The Student Publication Campaign. Without their commitment we would not be able to revive this important publication.

These gifts and pledges were inspired by a substantial challenge bequest from FRED AND BOBBIE ADAMS.

$100,000
NC Architectural Foundation

$10,000 – $25,000
Joel Clancy
Clearscapes
Perkins & Will
Sherwood L. Webb and Roberta Softy Webb

$5,000 – $9,999
Clancy & Theys Construction
Cort Architectural Group, pa
CT Wilson Construction Company
Dixon Weinstein Architects
Ligon B. Flynn
McClure Hopkins Architects
Ramseur-Peterson Architects, pc
Skanska USA Building, inc.
Walter Robbs Callahan & Pierce, Architects
Lloyd G. Walter Jr.

$2,500 – $4,999
Flad & Associates
JDavis Architects, pllc
Henry W. Johnston
Little & Little
Marvin Malecha
Hunt McKinnon
Metrocon, inc.
Skinner, Lamm & Highsmith, pa

$1,000 – $2,499
Abee Architect, PA, Dallas Abee
Randolph R. Croxton
Reginald Cude
DTW Architects & Planners, ltd.
Harry Ellenzweig
Roland Gammon
Howard Garriss
W. Easley and Suzanne L. Hamner
Jeffrey Huberman
G. Daniel Knight Jr.
Prime Building, inc.
Ramsay GMK Associates, inc.
John Sawyer Architects
Stec & Company Architects
Rodney Swink
Troxell Associates Architecture, inc.
William E. Valentine
Walter Vick, The LSV Partnership Architects/Planners, aia
W.R. Watkins Architecture

$100 – $999
Fred and Sherry Abernethy
Boney, pllc
Charles H. Boney
David Burney
Sloan Burton Jr.
CBSA Architects
Cothran Harris Architecture
Bertram Ellentuck
Irwin E. Jones
Don Kunze
Elizabeth B. Lee
Bruno Leon, Architect
Lucien Roughton Architects
Michael Moorefield Architects, pc
Murray Whisnant Architects
Sherman Pardue
J. J. Peterson Jr.
Charles M. Sappenfield
James Stevenson
Charles H. Winecoff
Winstead Wilkinson Architects, pllc

Special thanks as well to the Publication Campaign Committee led by Steve Schuster, aia, (1973) of Clearscapes and David Ramseur, aia, (1968) of Ramseur-Peterson Architects.

The committee included:
John Cort, aia (1967)
Ligon Flynn, faia, (1959)
Don Lee, faia, (1961)
Wes McClure, faia, (1969)
Lloyd Walter, faia, (1960)

IF YOU WOULD LIKE TO MAKE A GIFT TO THE STUDENT PUBLICATION ENDOWMENT PLEASE CONTACT CARLA ABRAMCZYK, DIRECTOR OF DEVELOPMENT FOR THE COLLEGE OF DESIGN AT (919) 513-4310 OR CARLA_ABRAMCZYK@NCSU.EDU.

All one can do is open the way and
I think I have done this, a little.

— BRUNO CORRA, "ABSTRACT CINEMA, CHROMATIC MUSIC" 1912