Design and the Elastic Mind

Paola Antonelli

History is punctuated by uproariously wrong predictions made by savvy individuals blindsided by progress: Ferdinand Foch, Marshal of France in the early part of the twentieth century, stated in 1911 that airplanes were interesting toys of no use for the military; movie producer Darryl F. Zanuck forecast in 1946 the demise of television; and Ken Olsen, of Digital Equipment Corporation, dismissed in 1977 the idea that anyone would want to keep a computer at home. Revolutions are not easy on us, especially when they occur as rapidly and as frequently as they have in the past 150 years. A few exceptional individuals are already wired for change, and the masses have a tendency to either admire them as visionaries or burn them at the stake as witches and heretics. However, these individuals do not represent the majority. In order to step boldly into the future, the majority needs design.

Adaptability is an ancestral distinction of human intelligence, but today's instant variations in rhythm call for something stronger: elasticity. The by-product of adaptability + acceleration, elasticity is the ability to negotiate change and innovation without letting them interfere excessively with one's own rhythms and goals. It means being able to embrace progress, understanding how to make it our own. One of design's most fundamental tasks is to help people deal with change. Designers stand between revolutions and everyday life. They study and appreciate

people's strengths and insecurities, their need for easy access to objects and systems and their cautiously adventurous wishes—a little frisson a day is acceptable but anything more becomes overwhelming. Designers have the ability to grasp momentous changes in technology, science, and social mores and to convert them into objects and ideas that people can understand and use. Without designers, instead of a virtual city of home pages with windows, doors, buttons, and links, the Internet would still be a series of obscure strings of code,[1] all cars would look like technologically updated Model Ts, and appliances would be reduced to standardized skeletons. Without a visual design translation, many fundamental concepts—such as the scope of the human genome or its comparison with that of other primates (see p. 142)—would remain ungraspable by most. Designers give life and voice to objects, and along the way they manifest our visions and aspirations for the future, even those we do not yet know we have.

Each new technological era brings its own malady, a sense of displacement that inevitably accompanies innovation—that is why innovation is often disruptive. Like East Germans after the fall of the Berlin Wall, some feel nostalgia for a more comfortable, albeit less progressive, past. Let's count today's disruptions: We routinely live at different scales, in different contexts, and at different settings—Default, Phone-only, Avatar On, Everything Off—on a number of screens, each with its own size, interface, and resolution, and across several time zones. We change pace often, make contact with diverse groups and individuals,

sometimes for hours, other times for minutes, using means of communication ranging from the most encrypted and syncopated to the most discursive and old-fashioned, such as talking face-to-face—or better, since even this could happen virtually, let's say nose-to-nose, at least until smells are translated into digital code and transferred to remote stations. We isolate ourselves in the middle of crowds within individual bubbles of technology, or sit alone at our computers to tune into communities of like-minded souls or to access information about esoteric topics.

Over the past twenty-five years, under the influence of such milestones as the introduction of the personal computer, the Internet, and wireless technology, we have experienced dramatic changes in several mainstays of our existence, especially our rapport with time, space, the physical nature of objects, and our own essence as individuals. In order to embrace these new degrees of freedom, whole categories of products and services have been born, from the first clocks with mechanical time-zone crowns to the most recent devices that use the Global Positioning System (GPS) to automatically update the time the moment you enter a new zone. Our options when it comes to the purchase of such products and services have multiplied, often with an emphasis on speed and automation (so much so that good old-fashioned cash and personalized transactions—the option of talking to a real person—now carry the cachet of luxury). Our mobility has increased along with our ability to communicate, and so has our capacity to influence the market with direct feedback, making us all into arbiters and opinion makers. Our idea of privacy and private property has evolved in unexpected ways, opening the door

top: James Powderly, Evan Roth, Theo Watson, and HELL. Graffiti Research Lab. **L.A.S.E.R. Tag.** Prototype. 2007. 60 mW green laser, digital projector, camera, and custom GNU software (L.A.S.E.R. Tag V1.0, using OpenFrameworks)

New forms of communication transcend scale and express a yearning to share opinions and information. This project simulates writing on a building. A camera tracks the beam painter of a laser pointer and software transmits the action to a very powerful projector.

bottom: James Powderly, Evan Roth, Theo Watson, DASK, FOXY LADY, and BENNETT4SENATE. Graffiti Research Lab. **L.A.S.E.R. Tag graffiti projection system.** Prototype. 2007. 60 mW green laser, digital projector, camera, custom GNU software (L.A.S.E.R. Tag V1.0, using OpenFrameworks), and mobile broadcast unit

for debates ranging from the value of copyright to the fear of ubiquitous surveillance.[2] Software glitches aside, we are free to journey through virtual-world platforms on the Internet. In fact, for the youngest users there is almost no difference between the world contained in the computer screen and real life, to the point that some digital metaphors, like video games, can travel backward into the physical world: At least one company, called area/code, stages "video" games on a large scale, in which real people in the roles of, say, Pac Man play out the games on city streets using mobile phones and other devices.

Design and the Elastic Mind considers these changes in behavior and need. It highlights current examples of successful design translations of disruptive scientific and technological innovations, and reflects on how the figure of the designer is changing from form giver to fundamental interpreter of an extraordinarily dynamic reality. Leading up to this volume and exhibition, in the fall of 2006 The Museum of Modern Art and the science publication Seed launched a monthly salon to bring together scientists, designers, and architects to present their work and ideas to each other. Among them were Benjamin Aranda and Chris Lasch, whose presentation immediately following such a giant of the history of science as Benoit Mandelbrot was nothing short of heroic, science photographer Felice Frankel, physicist Keith Schwab, and computational design innovator Ben Fry, to name just a few.[3] Indeed, many of the designers featured in this book are engaged in exchanges with scientists, including Michael Burton and Christopher Woebken, whose work is influenced by nanophysicist Richard A. L. Jones; Elio Caccavale, whose interlocutor is Armand Marie Leroi, a biologist from the Imperial

College in London; and the designers from Loop.pH, who are working on a project with John Walker, the winner of the 1997 Nobel Prize for Chemistry.[4]

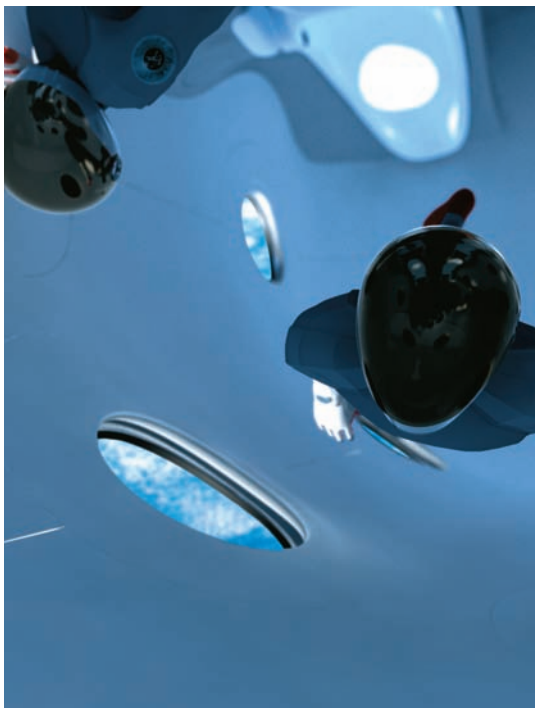
As Hugh Aldersey-Williams discusses in his essay in this volume, the exploration of the promising relationship between science and design is of particular relevance. While technology still traditionally acts as the interface, the conversation between design and science has become more direct and focused. What the computer has done for designers, the nanoscale is doing for scientists: It is giving them a whole new taste of the power of unobstructed design and manufacture. In an outstanding essay in the 2006 book Sensorium: Embodied Experience, Technology, and Contemporary Art, Peter Galison introduces the concept of "nanofacture": "Nanoscientists want to know what devices they can make....In the halls of 'pure' science, such a pragmatic stance toward the real is still relatively new. Indeed, it is an extraordinary and extraordinarily disturbing alteration of the practice of research, and in the very self-definition of what it means to be a scientist."[5] Scientists Thomas G. Mason and Carlos J. Hernandez, architecture firm Aranda/Lasch, nanotechnologist Paul W. K. Rothemund, and designer James King are examples of those engaging in an embryonic dialogue between design and science that is bound to change the world.

Fundamental to this dialogue is the appreciation of the role of scale in contemporary life. Two essays, the first by nanophysicist Ted Sargent and the second by visualization design expert Peter Hall, describe the ways in which scientists and designers tackle the extremely small and the extremely large in order to bring them to a human scale. Last comes my own essay about scale, albeit of the social kind, which discusses the remarkable new relationship between the individual and the collective sphere and the effects it is having on the theory and practice of our built environment.

All of these essays are accompanied by examples

below and bottom: Dick Powell and Richard Smith. Seymourpowell. **SpaceShipTwo: Interior for Virgin Galactic Spaceship.** Concept. 2006

Steamships, trains, telephones, and airplanes changed our sense of scale and our rapport with time and space. Suborbital flight will soon push us even farther.



Johan Liden and aruliden. **Motorola Sparrow RFID (Radio Frequency Identification) scanning device.** Concept. 2006–ongoing. Injection-molded plastic, glass, and aluminum, 2 3/4 × 2 3/4 × 1/2" (7 × 7 × 103 cm)

The time has come to take control of the dozens of features available for portable devices. Getting more information on the surrounding context—whether commercial, cultural, or geographic—is a function that will presumably become more and more important.

of singular design creativity that introduce new areas of study and influence as well as the new types of functional gradients that designers are trying to endow objects with, taking their cues from sources as varied as nanostructures, biological systems, topography, and cosmology. The goal is to facilitate as seamless a movement as possible from fast to slow, virtual to physical, cerebral to sensual, automatic to manual, dynamic to static, mass to niche, global to local, organic to inorganic, and proprietary to common, to mention just a few extreme couplings. Some examples are by bona fide designers, others by scientists and artists who have turned to design to give method to their productive tinkering, what John Seely Brown has called "thinkering."[6] They all belong to a new culture in which experimentation is guided by engagement with the world and open, constructive collaboration with colleagues and other specialists.

Design 1:1

Today, many designers have turned several late twentieth-century infatuations on their heads, for instance with speed, dematerialization, miniaturization, and a romantic and exaggerated formal expression of complexity. After all, there is a limit beyond which micro-keyboards are too small for a person's fingers and complexity simply becomes too overwhelming. Examples abound in all fields of people's desire to return to what is perceived as a human dimension, including gastronomy (the Slow Food movement), agriculture (organic produce), travel (ecotourism), production of energy (distributed generation), economic aid (microinvestment), and politics (the town hall meeting), to name just a few.[7] These all revolve around the idea that global issues should be tackled bottom-up and that an individual or local spark can start a powerful chain reaction with global implications.

The most contemporary of design theory is devoted to the quest for an environment, whether virtual

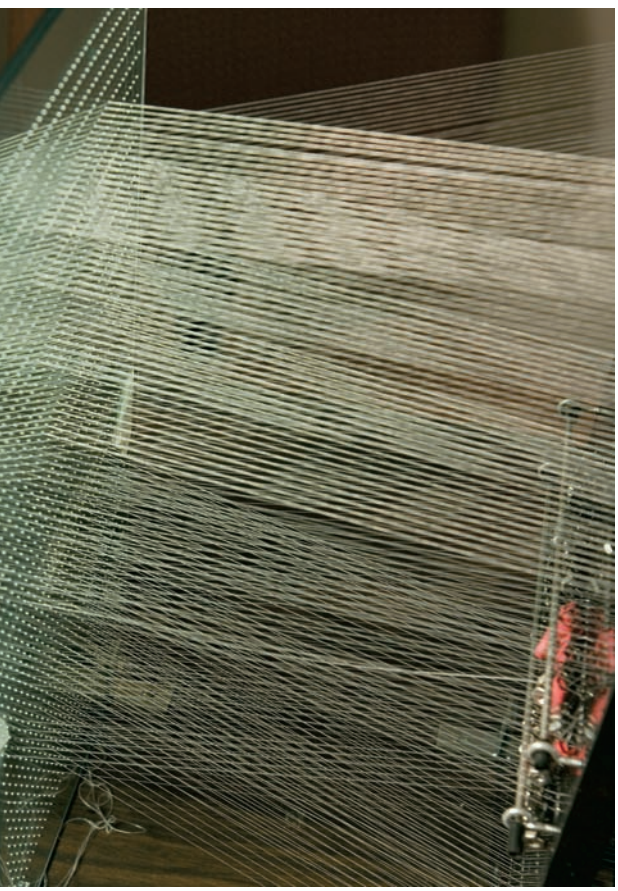
or physical, built in human proportion—much the way in architecture a hypothetical 1:1 model would represent buildings as life size. Designers who believe in this preach simplicity, and they labor to give objects souls and personality and to ease their communication with people and with other objects.[8] They apply the same bottom-up methodology to spawn innovations that are organically attuned to human nature and to the world, and they rework priorities so that human beings always come before any celebration of progress, as in the project One Laptop per Child or in Jonathan Harris's moving Internet interface We Feel Fine. These designers domesticate innovation and make sure that objects will deliver value and meaning and therefore justify their presence in people's lives, as with Mathieu Lehanneur's delicately high-tech Elements. And out of consideration for people's well-being, they help us incorporate healthy behaviors within our frenetic habits, as seen in Marie-Virginie Berbet's Narco office capsule.

The idea of human scale has changed since Charles and Ray Eames's famous 1968 film Powers of Ten because human perception has been expanded and augmented by technology. Distance is not what it used to be, and neither is time: Not only does it range from the attosecond (10^{-18} seconds, or the time it takes for light to travel the length of three hydrogen atoms) to the Long Now, the concept that inspired Danny Hillis to establish a foundation whose goal is to promote thinking for the next ten thousand years,[9] but some professionals' routine commute is a twice-a-month Tokyo–New York round-trip while others work across several time zones without a need to state their position at any time. Indeed, where and when have become hard to pin down on any who.[10] There is a standoff between the two ancient Greek notions of time: chronos, the shared convention of sequential time marked by the sundial, and kairos, the subjective moment that allows an individual to adapt and evolve with circumstances. While no one would argue that we are beholden to the former, the shift toward the latter is seen in the urge to record and share personal, life-defining moments that is at the source of the proliferation

Farshid Guilak and Franklin Moutos. Orthopaedic Bioengineering Laboratory, Duke University School of Medicine. **3-D woven scaffolds for tissue regeneration.** 2001–07. Poly(glycolic acid) fibers or poly(e-caprolactone) fibers, woven fiber scaffold: 1 1/8 × 11 3/4 × 1/32" (3 × 30 × 0.1 cm); weaving machine: 23 5/8 × 39 3/8 × 39 3/8" (60 × 100 × 100 cm)

Scientists study textile weaving and other crafts techniques in order to better design and perform their experiments.

of Weblogs and other tagged and mapped meta-diaries. This obsessive chronicling of personal information online—from pets' names to breakfast preferences, the phenomenon of over-sharing is frequent and is the subject of several etiquette-themed discussions—points to people's attempts to share their epiphanies and impose their own individual experiences of time, memory, and life over the global network that runs on conventional time. Counting on extraordinary advances in data storage capacity and on new, easy-to-use software, we can finally sit back and remember everything.[11] From the revelation that women do not need to have menstrual periods to studies whose goal is to dramatically reduce the amount of sleep needed in order to be perfectly functional and even the debate on human lifespan—which some say soon could be stretched at least half again as long as current expectations—the focus now is on ways to break the temporal rhythms imposed by society in order to customize and personalize them.

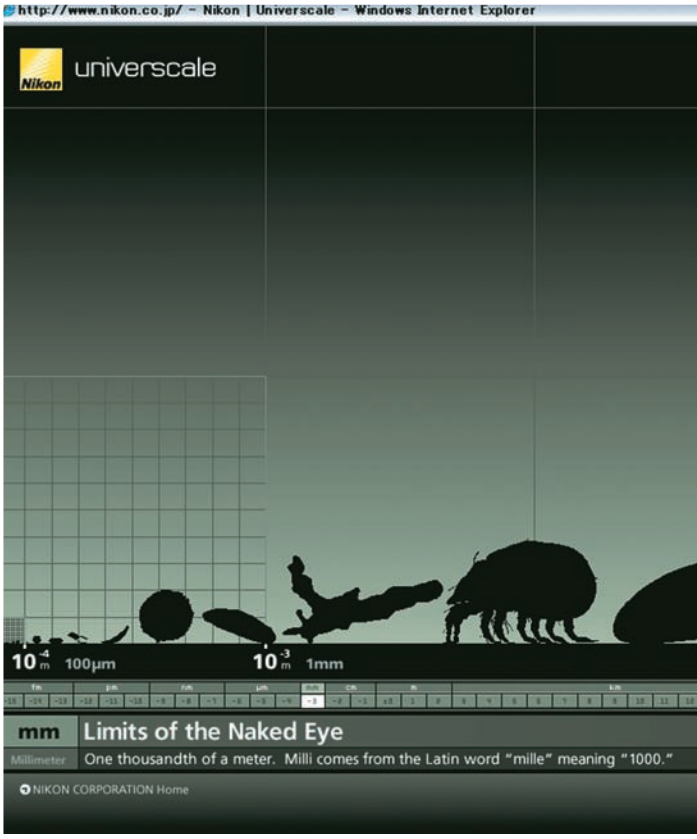


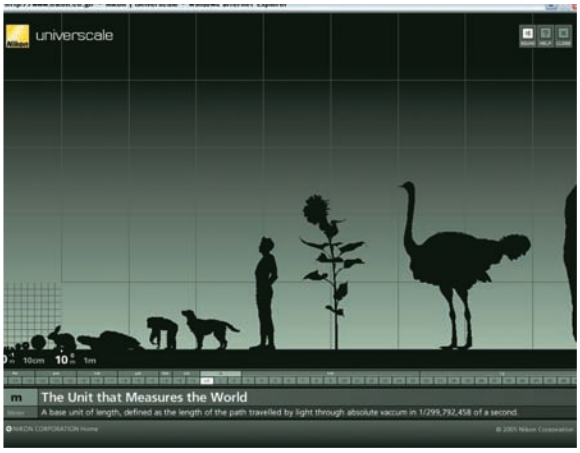
If design is to help enable us to live to the fullest while taking advantage of all the possibilities provided by contemporary technology, designers need to make both people and objects perfectly elastic. It will entail some imaginative thinking—not simply following a straight line from A to C passing through B. Several design principles can be used to accomplish this. One recurrent theme in design today is a stronger involvement of the senses to both enhance and integrate the delivery of high-tech functions, as in James Auger and Jimmy Loizeau's and Susana Soares's scent-based projects or in the synesthesia-inspired work of Eyal Burstein and Michele Gauler—both of which demonstrate technology's ability to deepen our sensorial awareness and spectrum.[12] Similarly, an appeal to people's sense of identity and place can be found in many projects included here, such as in the bioengineering of "love moles" and "bone rings," or in those that address memory in a literal way, such as Michele Gauler's Digital Remains.

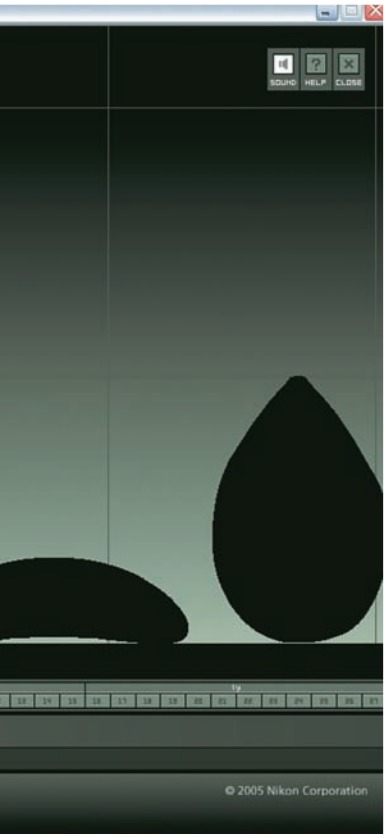
Design schools like the Academy of Art and Design in Eindhoven, The Netherlands (offering, for instance, postgraduate courses in Humanitarian Design and Sustainable Style and Interior, Industrial, and

Identity Design), or the Royal College of Art, London, focus their courses on senses and sensuality, identity, memory, and on other staples of human life that are as old as humankind—birth, death, love, safety, and curiosity—yet are rendered urgent by the speed with which technology is moving. These principles differ from the so-called human-centered design that functionalist industrial designers of the past fifty years have employed to shift their attention from the object to the "user";[13] they are reminders of the great responsibility that comes with design's new great power of giving form and meaning to the degrees of freedom opened by the progress of technology. Such a holistic approach calls for the development of well-honed analytical and critical muscles and for a new, self-assured theory of design. At the Royal College of Art, for instance, Anthony Dunne, head of the Design Interactions Department, preaches the importance of "critical design," which he defines as "a way of using design as a medium to challenge narrow assumptions, preconceptions, and givens about the role products play in everyday life."[14] "Design for Debate," as this new type of practice is also called, does not always immediately lead to "useful" objects but rather to servings of exotic food for thought whose usefulness is revealed by their capacity to help us ponder how we really want our things to fit into our lives. Noam Toran's Accessories for Lonely Men and IDEO's Social Mobiles comment on, respectively, solitude and the need for a new etiquette in the age of wireless communication. And we certainly need such meditation more than we need another mobile phone design.

Indeed, even as technology offers us more and more options, many agree that we in fact require fewer—not more—objects in our lives. This very simple belief unites the diverse and yet similarly idealistic efforts of many designers worldwide who are trying to inform our lives with the same economy of energy and materials as found in nature. In addition to balancing our lives with the imperatives of new technology, designers today must also consider the impact of their creations on the environment. Organic design has had many different connotations in history, but in its most contemporary meaning it encompasses not only the enthusiastic exploration of natural forms and structures but also interpretations of nature's







Business Architects Inc. for Nikon Corporation. **Universcale, Web application describing the size of things in the universe.** 2005. Illustrator, Photoshop, Flash, and VxEditor software

Charles and Ray Eames's 1968 film Powers of Ten was particularly representative of scale as related to the human dimension. New applications relying on updated technologies attempt the same feat.

economical frameworks and systems. It emerges from the rapidly growing realization that we need to learn to use less matter and energy and to be more efficient. Several factors make contemporary organic design radically different from its past expressions. Towering among these is the computer, whose capacity to master complexity has, perhaps surprisingly, allowed a closeness to the forms and structures of nature never achieved before. Moreover, the urgent need to manage nature's resources more thoughtfully and economically has provoked a sense of responsibility that is felt—or at least worn as a badge—by contemporary thinkers and doers. This trend can be seen in the pervasive use of the term DNA and the suffix –scape to describe any kind of organically integrated context (e.g., "homescape") and of biologically inspired attributes, such as "cellular," to describe the organic skeleton of such entities as the organization of new religious sects, lighting systems, and buildings. Even "viral" has taken on a positive meaning by indicating successful infectious and self-replicating design and communication phenomena.

When it comes to design, however, a badge is not enough: According to an annual review by Britain's Design Council, eighty percent of the environmental impact of the products, services, and infrastructures around us is determined at the design stage.[15] Design needs to engage directly and develop further some of the tools it is currently experimenting with, such as biomimicry,[16] algorithms and other forms of computational design, and nanotechnology. Nanotechnology, in particular, offers the promise of the principle of self-assembly and self-organization that one can find in cells, molecules, and galaxies; the idea that you would need only to give the components of an object a little push for the object to come together and reorganize in different configurations could have profound implications for the environment, including energy and material savings. "In nanotechnology, new materials and structures can be built atom-by-atom or molecule-by-molecule," explains the introduction to the course "Nano and Design" taught by engineer extraordinaire Cecil Balmond at the University of Pennsylvania, while algorithms are described by architects Chris Lasch and Benjamin Aranda as "a macro, a series of steps, a recipe for making bread." In the blog that complements his book Soft Machines, Richard Jones extols the potential of nanotechnology

in several areas, among them medicine, and talks about "persuading...cells to differentiate, to take up the specialized form of a particular organ," listing several reasons why nanotechnology would be beneficial to a sustainable energy economy.[17]

All these tools are about giving objects basic yet precise instructions and letting them fully develop and connect in networks and systems, and this is where one of the most powerful new directions for design lies. While traditional design is often about cutting existing materials to shape or, in the best cases, taming and adapting them, computational design and nanodesign are about generating objects, as can be seen in embryonic and conceptual examples such as Christopher Woebken's New Sensual Interfaces, and also about seeing them adapt to different circumstances, as in Chuck Hoberman's Emergent Surface responsive architecture.

As they advocate and obtain roles that are more and more integral to the evolution of society, designers find themselves at the center of an extraordinary wave of cross-pollination. Design-centered interdisciplinary conferences have existed for decades,[18] traditionally initiated by designers. Only recently have other communities started to seek designers' contributions, but this is only the beginning. To adapt and master new technologies and directions, design has branched out into dozens of specialized applications, from communication to interaction and from product design to biomimicry. On the other hand, in order to be truly effective, designers should dabble in economics, anthropology, bioengineering, religion, and cognitive sciences, to mention just a few of the subjects they need today in order to be well-rounded agents of change. Because of their role as intermediaries between research and production, they often act as the main interpreters in interdisciplinary teams, called upon not only to conceive objects, but also to devise scenarios and strategies. To cope with this responsibility, designers should set the foundations for a strong theory of design—something that is today still missing—and become astute generalists. At that point, they will be in a unique position to become the repositories of contemporary culture's need for analysis and synthesis, society's new pragmatic intellectuals. Like stones thrown in a large pond, we hope that the ideas advanced in this book will make waves, and that the waves will ripple into an irresistible discussion on the future role and responsibility of designers.

Hussein Chalayan. **Mechanical dress** from the **One Hundred and Eleven collection.** Prototype. 2006. Digitally printed cotton, metal plates with Swarovski crystals, organza, electric mechanisms, and electronic circuits, dimensions variable. Prototype by 2D3D, UK (2006)

As a metaphor for the need to have fewer, more elastic objects in our lives, Chalayan's convertible dress could inspire nanodevices and building facades alike.

Notes

1.
Mosaic, developed by Marc Andreesen and Eric Bina for the National Center for Supercomputing Applications and released in 1993, was the World Wide Web's first popular browser. Its success was due to its clear graphic user interface, which made it approachable and easy to use.

2.
For a fuller discussion of copyright issues, see my note 5 on p. 160 of this volume.

3.
Aranda/Lasch and Mandelbrot made their presentations at the second salon, on January 8, 2007. Mandelbrot is the mathematician who gave the strongest impetus to fractal geometry by linking it to nature and transformed it into a cultural phenomenon.

4.
Jones, a professor at England's University of Sheffield's Department of Physics and Astronomy, has written several books, among them Soft Machines: Nanotechnology and Life (London: Oxford University Press, 2004). Leroi's best-known book is the influential Mutants: On the Form, Varieties and Errors of the Human Body (New York: Harper Collins, 2003).

5.
Peter Galison, "Nanofacture," in Sensorium: Embodied Experience, Technology, and Contemporary Art, ed. Caroline A. Jones (Cambridge, Mass.: MIT Press, 2006), pp. 171–73. Galison is an esteemed historian of science and physics and a professor at Harvard University.

6.
Dan E. Atkins, John Seely Brown, and Allen L. Hammond, "A Review of the OEal Resources (OER) Movement: Achievements, Challenges, and New Opportunities," Report to The William and Flora Hewlett Foundation, February 2007. OER stands for Open Educational Resources. Brown, chief scientist at Xerox until 2002 and director of the legendary Xerox Palo Alto Research Center (Xerox PARC) until 2000, is among the foremost experts on technology and innovation.

7.
The Slow Food movement was launched in Italy in 1986 to restore the pleasure of "real" food. It was so successful that it contributed to the "slow" concept now spreading to all dimensions of life, from cities to schools and even to money.

8.
Graphic designer and computer scientist John Maeda, who is also associate director of research at the MIT Media Lab, has translated his commitment to the ease of communication between people and objects into a full-fledged platform based on simplicity that involves the Media Lab as well as corporations like the Dutch electronics giant Philips. In this same vein, James Surowiecki's May 28, 2007, article in the New Yorker, titled "Feature Presentation," discusses the decline in popularity of objects encumbered by too many features, a phenomenon called "feature creep."

9.
According to its Web site, "The Long Now Foundation was established in 01996* to...become the seed of a very long-term cultural institution. The Long Now Foundation hopes to provide counterpoint to today's 'faster/cheaper' mind-set and promote 'slower/better' thinking. We hope to creatively foster responsibility in the framework of the next 10,000 years." ("*The Long Now Foundation uses five-digit dates; the extra zero is to solve the deca-millennium bug which will come into effect in about 8,000 years.")

10.
When going to Dubai, make sure you bring not only your bathing suit but also your favorite ski goggles, because chances are you will visit the Snow Dome for a quick downhill race on the perfect powdery slope, in order to escape the 110-degree temperature outside; and when ordering at a McDonald's drive-thru, don't be fooled into thinking that your interlocutor is in the booth—she might be in Mumbai. The outsourcing of call centers and customer service centers has greatly contributed to the establishment of our new time-space proportion.

11.
In the May 28, 2007, issue of the New Yorker, an article by Alec Wilkinson titled "Remember This? A Project to Record Everything We Do in Life" reported that the great computer scientist Gordon Bell had in 1998 set out to digitize and archive his whole life, from childhood pictures and health records to coffee mugs. The project is still in process.

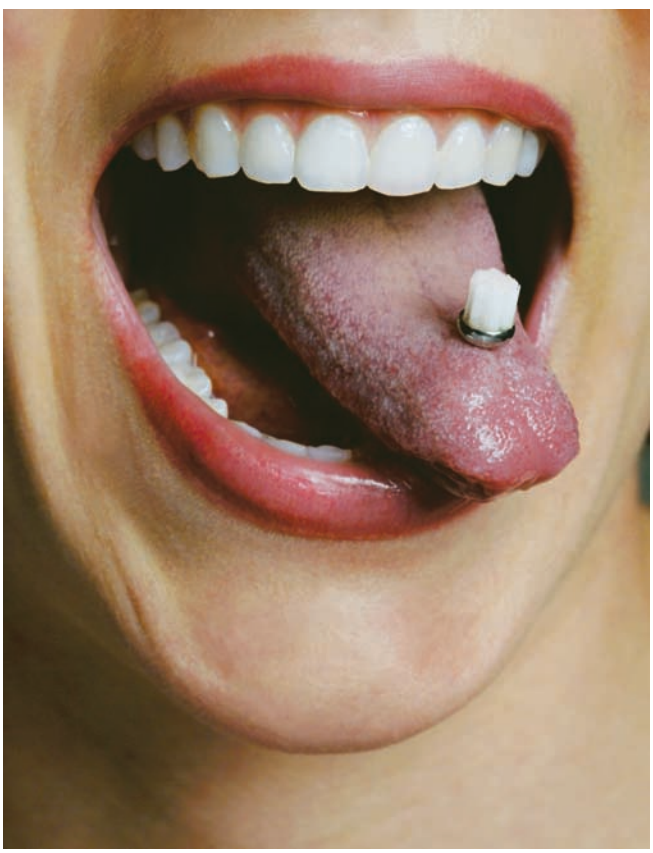
12.
Amazing things are happening in the realm of the senses. Scientists and technologists are focusing on hearing, for instance, and on its untapped potential. Several researchers are experimenting on sonocytology, a way to diagnose cancer by listening to cells—or better, by reading sonograms. Professor James K. Gimzewski and Andrew E. Pelling at the UCLA Department of Chemistry

Scott Wilson. **iBelieve lanyard for iPod Shuffle.** 2005. ABS plastic, 3/8 × 4 3/4 × 3" (0.8 × 12 × 7.5 cm). Manufactured by National Electronic, China (2005)

It is an irresistible send-up of the public's fanatical adoration of Apple products and at the same time a pensive reminder of the growing importance of the spiritual sphere in a world rife with technology and ideology.

Moloudi Hadji. École cantonale d'art de Lausanne (écal). **Pierce'n Brush.** Prototype. 2003. Stainless steel and nylon, 1 1/4 × 1/4" (3.1 × 0.6 cm) diam.

Multifunctional objects for multitasking citizens of the world. Why waste the opportunity for a flexible-use tongue stud?



first made the discovery that yeast cells oscillate at the nanoscale in 2002. Amplifying this oscillation results in a sound that lies within the human audible range. As far as olfaction is concerned, one study has explored how certain dogs can sniff cancer in a person's breath (Michael McCulloch, Tadeusz Jezierski, Michael Broffman, Alan Hubbard, Kirk Turner, and Teresa Janecki, "Diagnostic Accuracy of Canine Scent Detection in Early- and Late-Stage Lung and Breast Cancers," Integrative Cancer Therapies 3 (March 2006): pp. 30–39).

13.
The champion of this attitude is renowned design critic Don Norman, whose work is directly aimed at product designers.

14.
Anthony Dunne, interview in Domus 889 (February 2006): p. 55. Moreover, the Web page introducing the college's Design Interactions Department reads: "Designers often refer to people as 'users,' or sometimes as 'consumers.' In Design Interactions, we prefer to think of both users and designers as, first and foremost, people. That is, we see ourselves as complex individuals moving through an equally complex, technologically mediated, consumer landscape. Interaction may be our medium in this department, but people are our primary subject, and people cannot be neatly defined and labeled. We are contradictory, volatile, and always surprising. To remember this is to engage fully with the complexities and challenges of both people and the field of interaction design."

15.
Design Council, Annual Review 2002, London: 2002, p. 19.

16.
As the Biomimicry.net Web site reads, "Biomimicry (from bios, meaning life, and mimesis, meaning to imitate) is a design discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems." The Biomimicry Institute and its president, Janine M. Benyus, author of the 1997 book Biomimicry (New York: William Morrow), which popularized this field of study, is a resource for designers and companies interested in learning to observe nature and apply the same type of economical wisdom to issues ranging from mundane to existential, such as how to reduce our erosion of the world's resources.

17.
Engineer Cecil Balmond (of Arup), assisted by Jenny Sabin, teaches in the University of Pennsylvania's School of Design, in the Department of Architecture. The quotation was taken from a description of the course for the spring 2007 semester. It continues, "The nano prefix means one-billionth, so a nanometer is one-billionth of a meter. Just as antibiotics, the silicon transistor and plastics... nanotechnology is expected to have profound influences in the twenty-first century, ranging from nanoscopic machines that could for instance be injected in the body to fix problems and the creation of artificial organs and prosthetics, all the way to self-assembling electronic components that behave like organic structures and better materials that perform in novel ways." Chris Lasch and Benjamin Aranda, in a conversation with the author on March 14, 2007, talked about the role of algorithms in architecture, also well explained in their incisive volume Tooling (New York: Princeton Architectural Press, 2005). Richard A. L. Jones's blog is a precious resource for all those who want more information on the potential practical applications of nanotechnology in our future (see also note 4). See www.softmachines.org.

18.
A few of my personal favorites: the historical International Design Conference in Aspen, now defunct, the ongoing TED (Technology, Entertainment, Design, founded by Richard Saul Wurman and now run by Chris Anderson), and Doors of Perception (founded and still run by John Thackara).