re:skin

edited by Mary Flanagan and Austin Booth

ARTECA
From the MIT Press

This book was set in Janson and Rotis by Graphic Composition, Inc. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

Re : skin / edited by Mary Flanagan and Austin Booth.
p. cm.
ISBN-13: 978-0-262-06260-2 (alk. paper)
ISBN:10: 0-262-06260-7 (alk. paper)
1. Skin—Fiction. 2. American fiction—21st century. 3. Canadian fiction—21st century. 4. Skin—Psychological aspects. I. Flanagan, Mary, 1969– II. Booth, Austin.
PS648.S5R4 2007
813'.609353—dc22

2006056675

10 9 8 7 6 5 4 3 2 1

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SEMINAL SPACE: GETTING UNDER THE DIGITAL SKIN

Alicia Imperiale

Mapping the Living Body: Artistic Strategies

The human body is extraordinarily complex. The skin is not a straightforward simple surface that covers our interiority. Rather, the skin is an organ, divided internally into differentiated and interpenetrating strata. The skin or the surface of the body is a surface of maximum interface and intensity, a space of flux, of oscillating conditions. The "surface" is more slippery than it might first appear. Questions regarding the surface of the body, it turns out, are not superficial, but quite profound. By its very nature, a surface is in an unstable condition. For where are its boundaries? What is its status? Is it exterior or interior or both? The skin is a surface that is continuous in its depth and slips from outside to inside in a continuous surface.[1] What does this mean for us in terms of mapping? How can we move past the surface of the body to the hidden depths of the body's interior?

In order to visualize the somatic, new developments in digital cartographic and imaging techniques used by geographers and other scientific disciplines are coming into play. These digital techniques permit us to visualize the complexity of the body in new representational modes. Artists are at the cutting edge of finding where these slippages occur. By customizing diverse software packages, artists are able to put them to uses that were not previously anticipated. This lifting, borrowing, or crossing of disciplines is endemic to artistic practice. This reciprocity between applied science and artistic musings has opened up new channels of communication among vastly separated disciplines. One could say that this kind of interdisciplinarity is symptomatic of our times. The digital has lead to the breakdown between previously separate analog disciplines that are now coordinated in the seamless communication of zeros and ones. While Leonardo da Vinci only imagined the depth behind the surface of the body, contemporary digital scanning and mapping techniques reveal the hidden depths and relations behind the surface of the earth or the body. These scanning techniques are used by artists to not

only document the existing (cell, body, landscape, world), but to allow for the reconstitution and recombinative possibilities afforded by working within the projective space of the digital. It permits artists to take from the world as we know it to propose new bodies, new worlds, new ways of seeing—all in the fluid, slippery, seamless space of the computer.

Our bodies are, on the surface, so smooth, so simple. Our facial features, which make up our "identity," are the most complex aspects of our body's surface. Our relatively simple surface covers our complex interior. Our hides hide our complexity.[2] Look within—our surface simplicity is betrayed by internal complexity. Lymphatic systems, renal, sanguine, digestive, neural systems are complex parallel labyrinths, layered one upon the other. These separate yet coordinated systems are compressed into the most compressed of spaces. Our bodies are astoundingly asymmetrical, astoundingly complex, and efficient. One may imagine the body as a series of separate systems, with each system vying for maximum singularity in its complexity. The body is a layered, four-dimensional labyrinth that moves seamlessly from the interior to the exterior. The body evades our attempts to describe it—representationally. It is only by a complex understanding of mapping that we can begin to grasp and visualize this complexity.

How do we, from childhood on, inhabit, pierce, penetrate, visualize, see, and touch the voids that pierce and make up our opacity, our corporeality? This is an elusive endeavor. The body's smooth surface hides blind passages that evade our conceptual grasp—they are perhaps only understood in the most visceral, corporeal way. We can touch it. This privileges the haptic, the somatic boundary, over the visual or the representational. Artist Mona Hatoum, in her video installation *Corps étranger*, brings another dimension to mapping the human body, *her* body. This installation touches on issues of privacy, territory, and gender. Hatoum had a tiny endoscopic camera (a kind of foreign body) inserted into her body, and the resulting video shows the travels (in full color) through the terrain of her body: smooth and rough, wet and dry, spacious and constricted. This trajectory through her body places the act of mapping in the line itself, the line that the camera routes through the thickness of her body. The video was then projected onto a circular screen placed horizontally at floor level within a cylindrical enclosed space, itself an interior body.

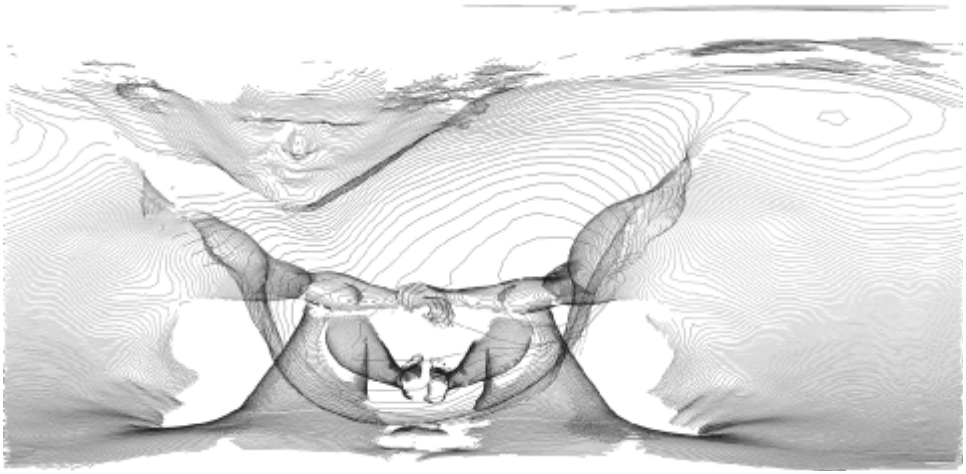
Tim Hawkinson begins with the surface of his body and, through a series of cuts, translates that surface into a series of trajectories, by which he is able to propose new body surfaces. In his works, *Skin Spin* and *Lingum*, Hawkinson casts his entire body in latex. He then translates the complex surface by cutting the latex cast into a series of strips (lines). He uses these strips as a roller to create the striations of the final print in ink on paper. In *Taper*, a tapering self-portrait, the artist maps his body from his finger-

tip out. He imagines a gridded surface thrown over his body and uses this grid as a way to measure distortion in the cartographic surface in relation to the tip of his finger as origin point. His map diminishes in size as the portion of the body is further away from this point. Hawkinson, using analog means, sets the tone for the digital work of Lilla LoCurto and Bill Outcault. Hawkinson translates the surface of the body into a potentially infinite series of recombinations, much as LoCurto and Outcault do in their self-portraits.

LoCurto and Outcault employ a full-body scanner to capture the surfaces of their bodies. The laser scanner is in fact a line that passes on and over the contours of the surface of their bodies to create a map of pure digital data. The artists are then able to manipulate this information in infinite variations. LoCurto and Outcault have worked with a team of mathematicians to develop complex cartography software that permits them to project the data into a series of flat map projections that are photographic self-portraits (figure 13.1).

In a parallel body of work developed from the same digitally scanned data, LoCurto and Outcault have worked to develop a unique software interface that enables them to take the complex information from the body scan and break down the information into a series of horizontal lines that describe the outer contour of the body. These drawings are topographical explorations of the surface of the body. The flexibility afforded by working in digital space permits the artists to display the information from any point of view. The layers are separated out and become a series of glyphs or marks that seem to describe a new typographic font. Most recently, they have developed a digital interface that animates the contour lines. In this piece, there is a constant movement between the contour lines, as lines, and a movement toward building up the lines, layer by layer to recreate the surface of their scanned bodies. The digital has permitted the artists to create constantly changing maps that navigate the complexity of their skin, their surface (figure 13.2).

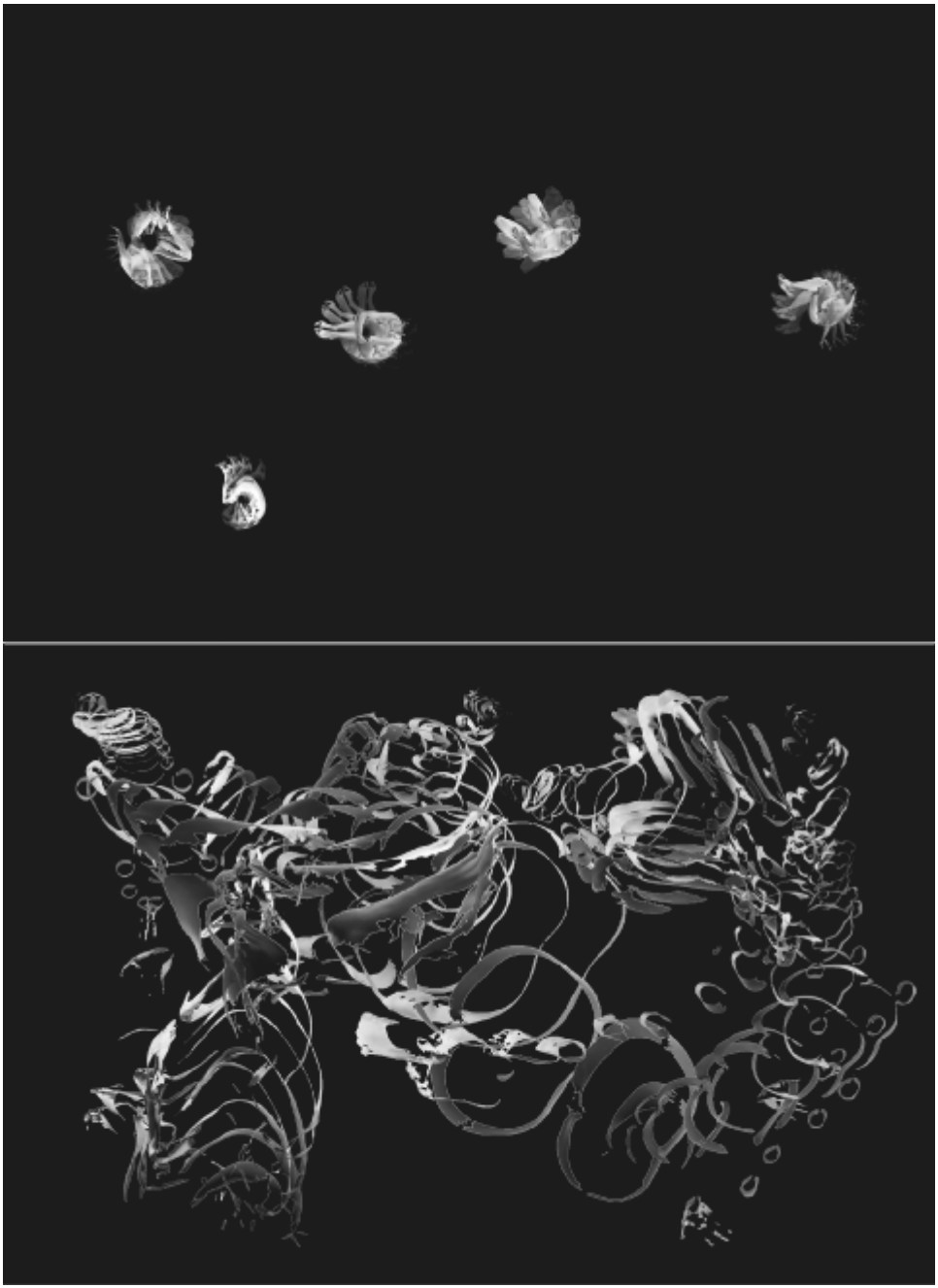
A common theme for all four artists is the elusiveness of mapping the skin and the body. This seemingly simple task is complicated by the inability to point to the boundary where the body's surface ends and where its interior begins. As the artists map their bodies, there is a process of movement from surface to depth, a movement from line to surface, and back again. What we see most strikingly in the work of LoCurto and Outcault is that the digital liberates the act of mapping in a profound way. The surface is translated into a flexible network of points that can be combined in infinite ways in movement and through time. Beginning with the work of Hatoum and ending with the work of LoCurto and Outcault, we see the artists working with dynamic lines and dynamic constellations of information. Gilles Deleuze develops an idea about dynamic



| **Figure 13.1** |
LoCurto and Outcault, *Topography*

mapping that is useful in expanding our notion of the virtual in the act of mapping. We might think of a map as a registration of "dynamic trajectories" that in turn open up and initiate other trajectories. The notion of dynamic trajectories and its parallel, maps of "intensities," is how Deleuze breaks down the potential of maps: "Maps should not be understood only in extension, in relation to a space constituted by trajectories. There are also maps of intensity, of density, that are concerned with what fills space, what subtends the trajectory."[3] This is a compelling idea that seems to be investigated intuitively in the movement from line to surface in these artists' works.

There is, in the act of making a map and in the act of reading a map, a very strong sense of the interdependence of the real and the imagined. Pierre Lévy, in his work *Becoming Virtual: Reality in the Digital Age*, provides us with a road map, if you will, to negotiate the notion of virtuality and its impact on mapping. He focuses on the Latin root *virtualis*, meaning "strength" or "power," to emphasize that the virtual has potential rather than actual existence and that the virtual "tends towards actualization without concretization."[4] Lévy states that the virtual follows a line that ruptures classical ideas of space and time. Things can exist in parallel and "distributive systems."[5] If space and time are no longer coexistent, then the act of mapping can be liberated from these constraints. Synchronic events that occur in diverse (or nonexistent) places can be related and mapped. The events can be shown as a network of relations. This is what we see in



| **Figure 13.2** |
LoCurto and Outcault, sculptural forms

parametric design, in point clouds, or very simply in the distribution of digital information that is generated when a physical object is scanned. The digital information can then be reconfigured in new and ever-changing combinations. The potential for infinite combinations is the virtual in mapping. We might say that to map is to document the existence of real phenomena, but it is perhaps more correct to say that to map is to write, to negotiate, to travel, to narrate without a fixed conclusion. We must acknowledge that to map is to work with the idea of continual flux. A map's reading is never the same.

Architecture and the Metaphor of Skin

Architects are deeply influenced by the new emphasis on surface and skin. In the early twentieth century, it was the task of modernism to convey the tension between deep space and the surface of architecture, often through the use of glass and other transparent surfaces.[6] This set up a dialectical division between the interior and exterior of the building. Today, some architects compress allusions to the depth of the interior into the surface or skin of the building by using skins, layers, shells, and wraps in their architecture. Exterior skins of buildings are built up through layers of veiling, translucent materials or are inscribed with figurative imagery, denoting what might lie behind the surface. Skin is in a constant state of evolution—shedding itself and regenerating itself. The living skin varies dramatically as it adapts to the exigencies of the body—thick where the skeleton needs some padding to soften contact, hardened in response to friction. If eyelids were opaque, we would lose a critical mechanism in the waking up process. The skin of architecture can also be highly differentiated. Skin in a building can peel away or be built up as a series of differentiated masks and layers. There is not a definite exterior or interior to the building, but a gradual movement from outside to inside through the ensemble of inflected parts.

With the increased use of digital computation in architecture, the issue of skin has been magnified. Contemporary architecture is now intensely engaged with digital processes and their overlap with biological models for the production and organization of form. Over the past decade, significant digital research has emphasized the development of smooth, voluptuous architectural objects with attention to topological surfaces and skins. Smooth exchanges, flows, continuousness, performative surfaces, skins, membranes—these concepts have suffused contemporary culture. They signal a dramatic shift in the problematic relationship between "bodies" and technology.

The design tools used in film, architecture, and product design have amplified and accelerated our ability to represent the collapse of nature into technology. Digital 3-D modeling software uses algorithmic formulas to generate form in a kind of autocatalytic system that resembles genetic mutation. Digital technologies that were once used to

image an already existing opaque object have been appropriated by designers to project new bodies, new spaces, and new architectures. Forms designed within the space of the computer are analogous to bodies moving in time. The design of smooth form has been facilitated by architects' access to time-based NURBS (Non-Uniform Rational Bézier Spline) modeling software such as *Alias* and *Maya*,[7] which allow designers to create new "bodies" and to work with complex curvatures in real time.[8] Algorithmic formulas allow the lines and surfaces to be adjusted and recalculated continuously. A line, or a surface, "flows" between different weights and forces. A surface is created by the buildup of these splines, and the curved surface is constantly recalculated in relation to these points. Although the spline points are located in three-dimensional space, we can switch to working on the surface. New surfaces are embedded and developed in relation to the existing one. Similarly, the geometry itself is defined relative to the surface. If we change scale in a part of the surface, the entire surface is rescaled and recalculated. NURBS programs are based on an inherently dynamic system: surfaces and objects are developed in a shifting relation to a surface. Rather than conceiving of form as a static condition, the new 3-D modeling software programs allow the designer to work on a form that is constantly evolving, smoothly registering the continuously changing algorithmic parameters in 3-D topological[9] surfaces before the designer's eye and through the designer's intervention. When using NURBS-based software, we design surfaces and create an object by connecting one surface to another. The surface, skin, and interface of architecture are emphasized.

The use of digital technologies has had a liberating effect on architectural form. Architects have been able to design organic, body-like architectures that register the infinite variations and mutations from its evolutionary growth stage in topological surfaces. These sinuous curvatures and warped surfaces wrap around the inhabitant like a second skin. What results is an emphasis on the intimate interface between technology and the living body. It is as if the terror of the technological is softened through smooth contours between our hands and the objects we use and the architectures and urban surfaces that surround us. This smoothing between the inhabitant and the architecture, between the object and the user, the landscape and building, is symptomatic of our time. As the smoothing reduces our sense of terror of the technological, other issues are raised.

In computation, a smooth surface is mathematically smooth; however, in visualizing smoothness, a curved surface must be broken down into polygonal figures. Paradoxically, the smoother an object appears, the more the surface is broken into smaller and smaller units. A digitally produced form is made up of smaller units of NURBS primitives: predefined curves, shapes, and surfaces. In the animation program *Maya*, these NURBS primitives are the sphere, cube, cylinder, cone, plane, torus, circle, and

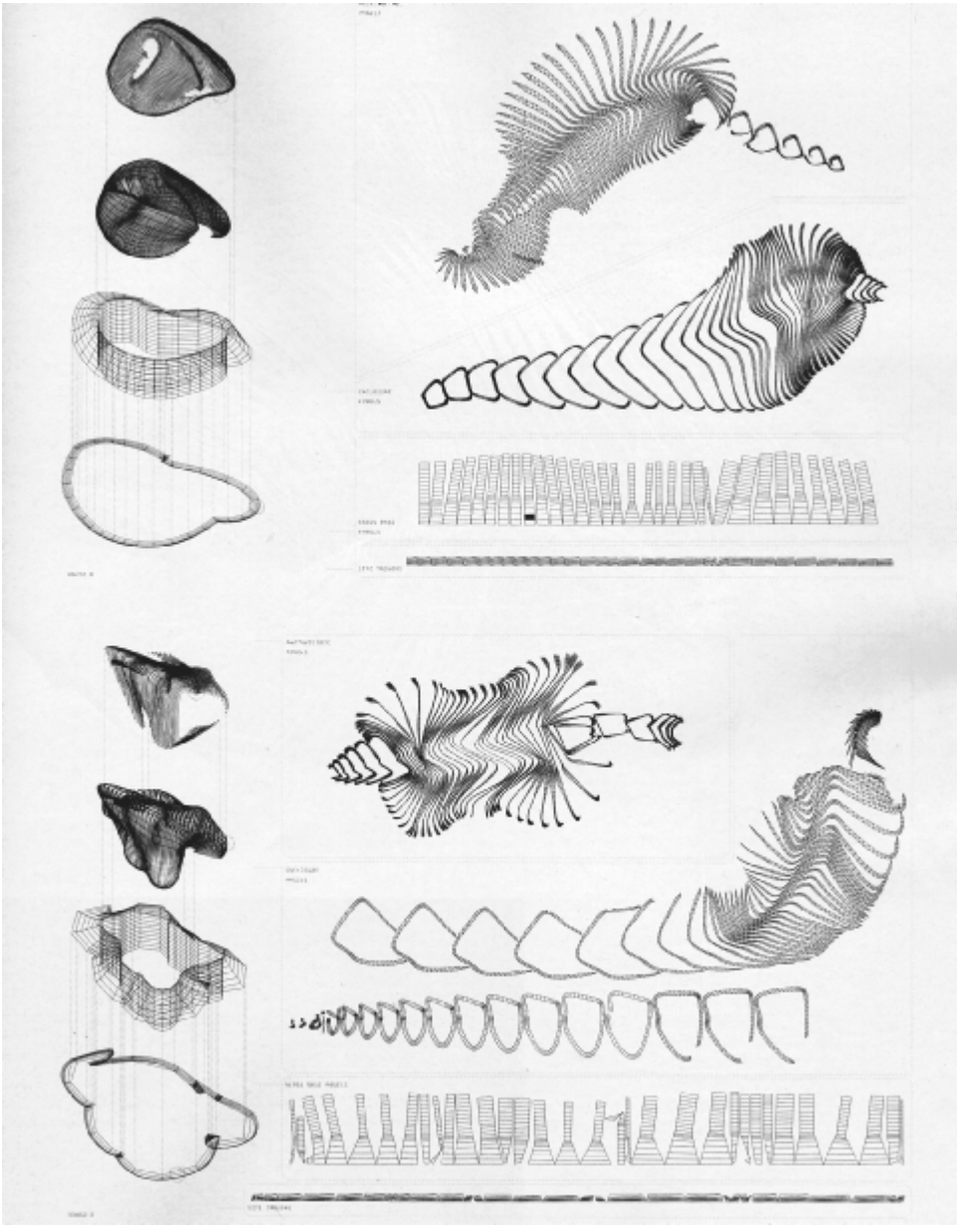
square. These forms are then made up of a mesh or underlying wire frame. The mesh is made up of faces, edges, and vertices that help define the shape of the object and can each be manipulated individually in order to give the designer precise control over the design of the object. As a designer works with these forms in an animation program, the mesh is in constant agitation, pulsating and throbbing. The mesh alternates between projections and invaginations, in a continual oscillation between projective and receptive form. The surface simultaneously penetrates and yields to penetration. Does this speak to the relationship between form and space or matter and pneuma as being copresent?

In order to visualize the final form, the designer can add a skin over the mesh, ascribing material qualities and lighting effects. The final effect is the glossy, sexy final form. We must question the issue of the intersection of the grid and the erotic body. A grid or mesh allows us to map space. A grid speaks of extensivity, endlessness, sameness, and the potential to calculate and define the indefinable. Could the grid, when laid over the smooth contours of a body, shape and discipline the unruliness of the growth of form? The grid monitors. The grid disciplines. The grid imposes a phylum on a growing ontology. The grid seeks relationships. The grid enmeshes the instrumental into the social. The mesh seeks networks of relationships on the surface of the moving and dynamically growing "digital flesh."

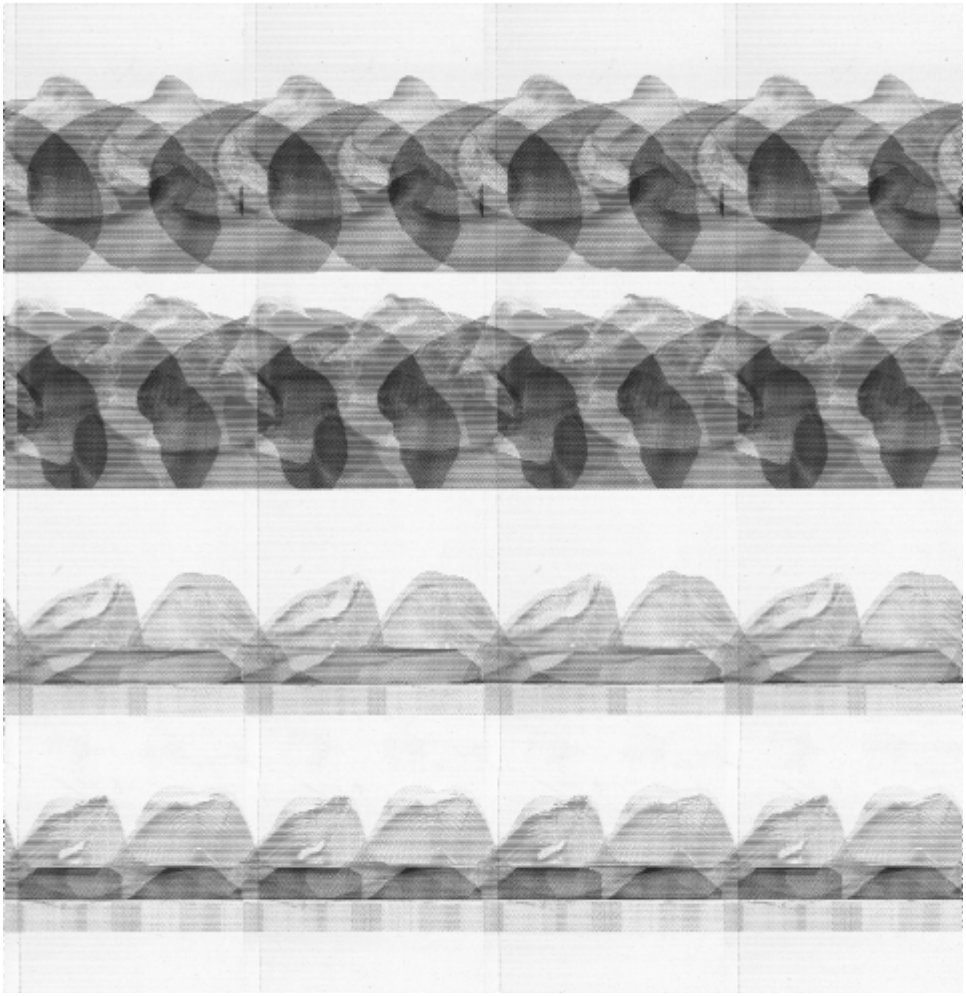
There is an ambiguity in our attraction to these forms that exhibit qualities of being simultaneously male and female (gender + n). Is attraction, is the erotic, is the sexual tied into questions of the digital skin? Are these objects ersatz stand-ins for ourselves and our sexuality?[10] Is attraction necessarily tied into reproduction? What models of reproduction may we look to in order to shed light on to these questions in relation to the evolution of architectural form? Can we conceive of the production of architectural form as no longer tied into dichotomous binaries (skin vs. structure, receptive vs. projective, inseminator vs. inseminated . . .)? How can the bridging of traditional categories of heterosexuality, homosexuality, or transsexuality be superceded in a model of architectural engendering?

Architect Greg Lynn addressed the issue of a networked skin in his project for *Embryologic Housing* (figure 13.3). This is a morphodynamic approach in which dynamic processes act upon a form and promote infinite change. Lynn's project proposes a prefabricated housing prototype that consists of a networked skin composed of over three thousand individual panels. Because the system is networked, any change in any part of the system is registered in other parts of the skin (figure 13.4).

The surfaces are designed with 3-D modeling software to attain a fluid form. Study models and the full-scale panels are manufactured utilizing computer-controlled milling and cutting machinery with the same digital data. This coordinated design and



| **Figure 13.3** |
Lynn, *Embryologic House* drawings



| **Figure 13.4** |
Lynn, *Embryologic House* drawings

manufacturing system has the advantage of generating maximum differentiation in the simple configuration of the surface, since a real skin would deform and change in an animate body—a theme also evident in his design for the Eyebeam headquarters. The internal organs of the body push to the surface of the body's skin.

José Salinas investigates the creation of synthetic architectural bodies that are reactive to external forces. His first approach in the project *Topological Diagrams* is to start with a simple 3-D volumetric form or geometric primitive and apply external forces in order to have the form mutate and develop its constantly changing and unique topology. His second approach is in the *Hermeneutic Topologies* sequence that shows the formation of a synthetic body through the process of applying external fields of forces to a flat surface. In the evolution of the flat surface to the skin and volume of the form, the attribution of the character of the synthetic body occurs. Salinas believes that this body is developed through an asexual processing of information and that the body is constructed through machinist operations. The form is not gendered in its evolution, nor is it after its completion. It is an interesting point that could be further developed as it pertains to the evolution and eventual deterioration of bodies and form.

These projects point to a departure from the metaphors of smoothness and organic shapes as merely representations of the biological to a development of architecture through processes that are fundamentally more biological. Architects work with raw computational power to evolve "self-generating" architectural scenarios. This has led to a move away from the interest in smooth surfaces with an emphasis on the interaction of individual cellular elements. It is essential to note, however, that the smooth and the discrete are merely understood at the level of scale. This is especially the case in architecture. In a smooth model of skin, at the level of the glossy rendered image, the architecture is luminous, luscious, reflective, and absolutely seamless—just like bodies. But architecture is made of smaller discrete units that must come together to make surfaces. We can think of the skin as a parametric system that is continuous in the change from one area to another but also discrete because it is made up of individual cells or elements. If we are to map the surface or skin (of a body) in detail, then we must engage the discrete and cellular phenomena that produce it. At the same time, if we are to appreciate what these phenomena produce, then we must reengage the topological identities that emerge from them. What are the ways by which architecture can engage this copresence of the smooth and the discrete?[11]

Genetic Algorithms and the Evolution of Architectural Skins

So much of the digital project in architecture has emphasized smoothness, continuity, and flow. At the same time, there would be no "digital" without the principle of

discreteness. It is through a model of discreteness that architectural rules and forms evolve. Genetics is based upon a similar premise, where information is contained in small units of code that are syntactically connected and interrelated through combinatorial rules. Sherry Turkle spells out a history of artificial life scenarios that have been influential in recent work in rule-based computation in architectural design. In 1954 mathematician John von Neumann began to speculate on a machine that could self-replicate, inspired by Alan Turing's "universal Turing machine." Von Neumann imagined the creation of artificial creatures that would have the genetic code necessary to replicate. Turkle believes that von Neumann's ideas were instrumental in anticipating the discovery of DNA. She states that as a model of artificial life, "life was grounded not only in information but in complexity."[12] Von Neumann sensed that once a certain critical mass of complexity was reached, objects would reproduce in an open-ended fashion, evolving by parenting more complicated objects than themselves." She discusses his design of the first cellular automaton:

> It contained a cell structure embedded on a grid and a rule table that told each individual cell how to change its state in reference to its state and those of its neighbors. As time went on, the original cell structure transformed its neighboring cells into the states that had made it up originally. In other words, the original cell structure (or organism) eventually duplicated itself on the grid. In a further development of the idea, small random changes, analogous to mutations, were allowed to occur. These changes might be passed on to future generations. If a given change increased the organism's fitness, that mutation would flourish and something like evolution would have begun."[13]

In the late 1960s, mathematician John Conway created the *Game of Life* in order to visualize the rule-based structure of von Neumann's cellular automaton. In the *Game of Life*, a simple matrix of black and white squares shows the progression of simple operations into complex patterns. These patterns perform as objects: they are made up of a changing array of cells known as an "emergent object."[14] Richard Dawkins, picking up on von Neumann's *Game of Life*, wrote a simple program called *The Blind Watchmaker* and was in awe at how he was able to evolve generations of biomorphic organisms, exhibiting what he termed "unnatural selection" because the generations of form were adapting according to editorial adjustments by the programmer based on a filtered set of performance or "fitness" criteria.

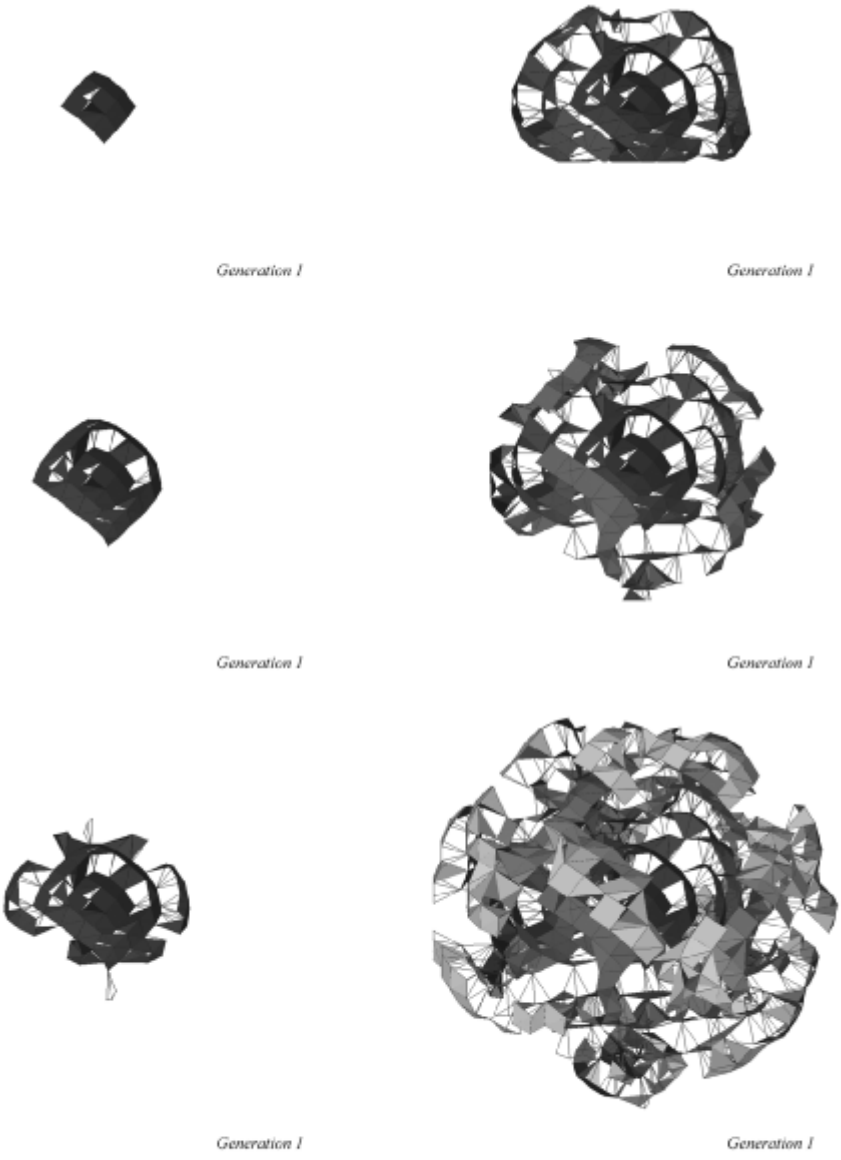
The interest in complexity and emergence that we see in the scientific community and hence in culture at large has also been investigated in architecture through rule-

based systems of computation by the creation of algorithmic growth scripts for the development of a "morphogenetic" architecture. The use of algorithmic scripts is synonymous with advances in the human genome project. As such, architects act as the initial progenitor of a "self-evolving genetic" code for the "autonomous growth" of architecture.

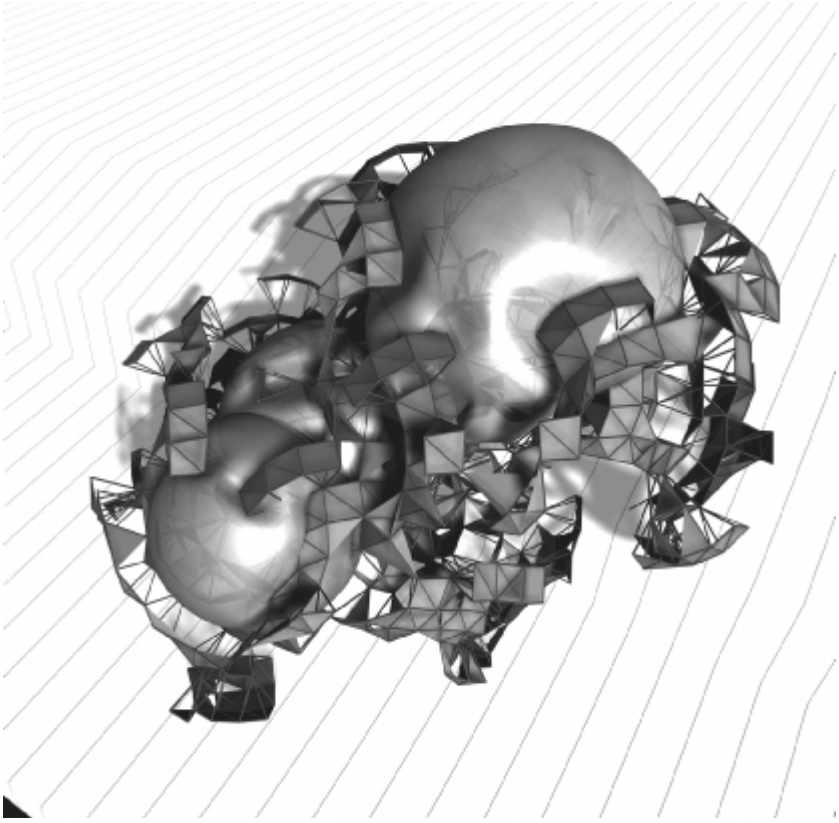
One computational model that has been adopted by architects is that of *cellular automata*. Cellular automata are computational systems that model complex adaptive systems and are usually represented by discrete elements in a two-dimensional matrix. The elements, similar to the binary logic of computation, are either on (0) or off (1) and are represented by black and white dots in a grid. Each unit has a determined state that changes in patterns across the entire field based upon a simple set of rules. The rules are specific to the local conditions and in relationship to a similar set of rules of conduct of adjacent cells. What is interesting is that very simple local conditions create a field of unpredictable behavior that is manifested in complex patterns of behavior and potentially of form.

Cory Clarke[15] grows a "menagerie" of architectural organisms that are generated from an eight-gene "genome" using a recursive growth algorithm (figure 13.5). This algorithm takes into consideration factors that are typically viewed as natural to architecture: space and structure. Clarke uses a variant of a spatial logic based on a 3-D cellular automata. Clarke uses this system in order to create a set of rules that act "as a starting point for a morphology in that the rules allow for the spontaneous creation, and destruction, of voids and boundaries—a fundamental requirement for the description of space." Just as the human genome can produce infinite variations, Clarke's recursive growth algorithmic system can produce a potential of 1.68×10^{23} or 168,000,000,000,000,000,000,000 possible architectural structures, and as many possible space descriptions. The structures result in different arrangements of framework and void. In the examples shown, the structural framework was coupled with a pneumatic fabric enclosure that was inflated within the different voids produced by the exclusionary program fitness tests (figure 13.6).

Clarke's system is interesting because there are scalar uses of the cellular automata system: at the level of the individual structural and spatial units, and at the level of the program itself. These larger systems then operate upon each other to break down and encourage constant growth and change. The thought is that genetic algorithms, which are fragments of computer code, are able to cross-breed, mutate, and reproduce, emulating the processes of life itself. In Clarke's case, he takes the evolutionary metaphor one step further as the forms that are evolved from the system are tested for their fitness



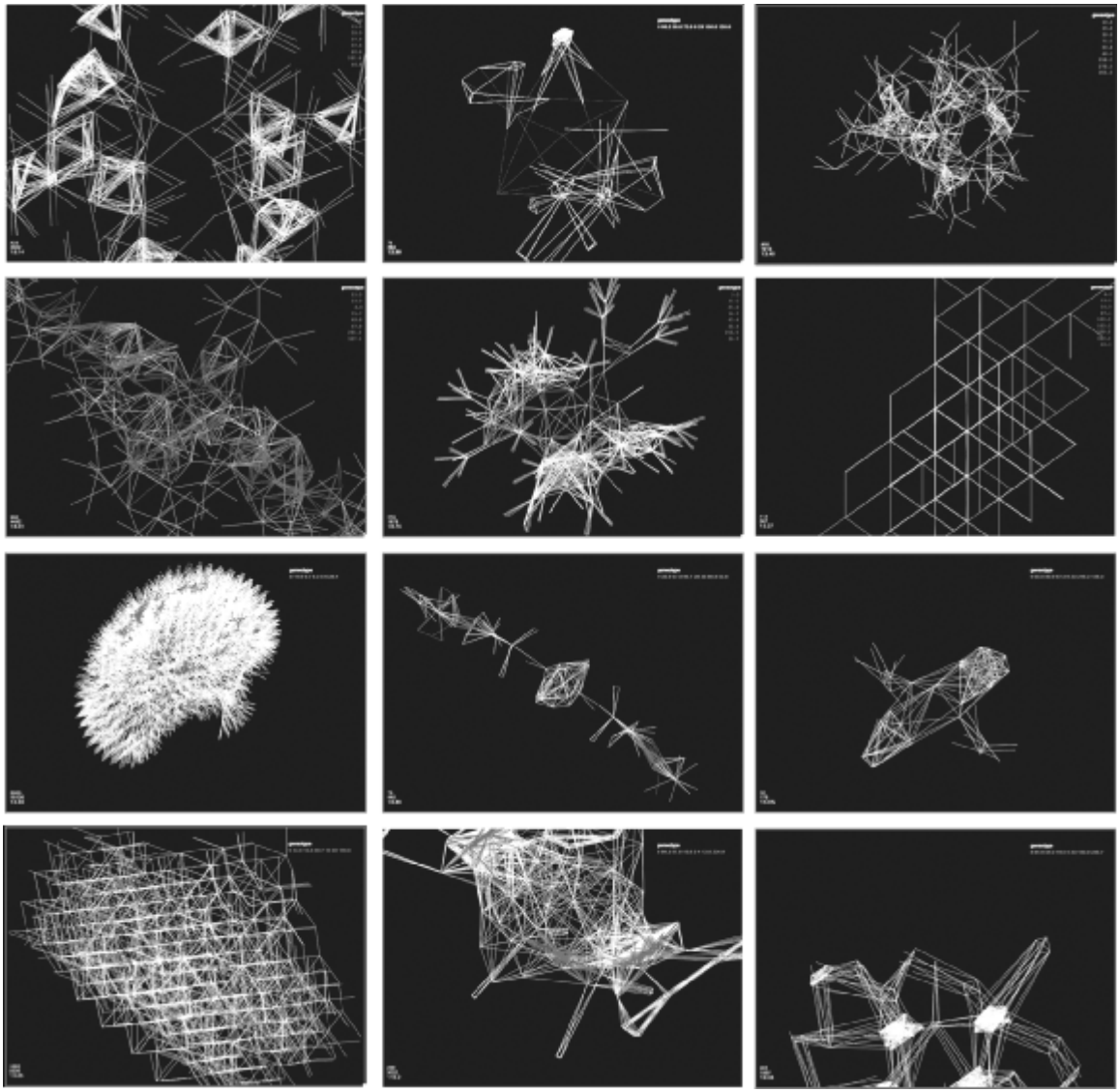
| **Figure 13.5** |
Clarke's growth algorithm



| **Figure 13.6** |
Clarke's double forms

for survival. The fittest forms survive and their genetic material is passed on to cross-breed with other survivors to parent other generations of form (figure 13.7). Clarke describes the process as follows:

Each generation starts with four parents (that are all "sexless") that are cross-bred with each other to produce twelve offspring—often mutation occurs during the cross-breeding, ensuring continual variation in new generations. The twelve offspring are tested for fitness (the fitness criteria is determined by similarities of spatial attributes of the evolving "organism" to predetermined limits of what constitutes the shape and size of rooms), determining their survival in the "bioreserve." The four most successful offspring go on to produce a second



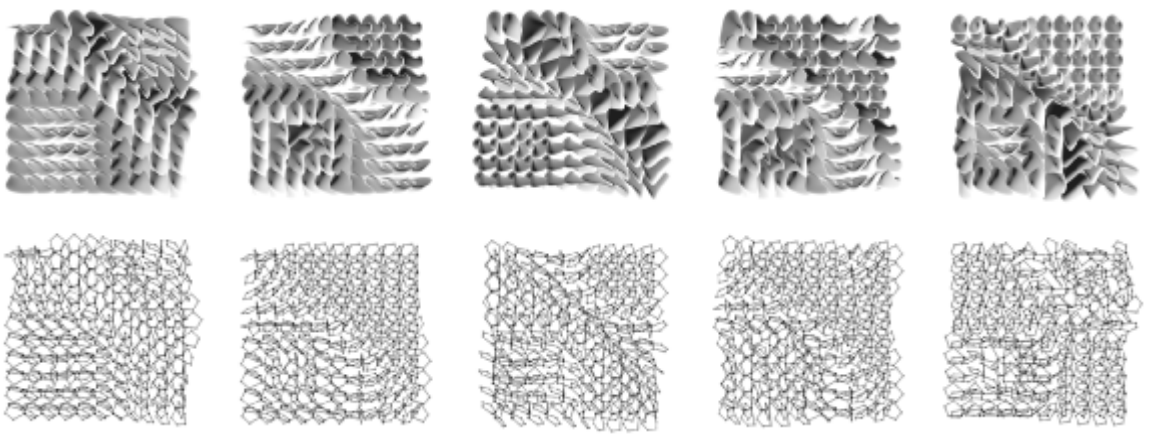
| **Figure 13.7** |
Clarke's menagerie

generation, [then] those are in turn tested and the top four are parents to the next generation. This evolutionary process can continue ad infinitum."

Alisa Andrasek[16] proposes a self-breeding skin system that changes over time. Rather than being a proposal for architecture in a conventional sense, she proposes an artificial organism that is first of all a computational model that then could propose an installation environment that operates as an artificial synesthesia. Her project for *ghost patch* is a model for a cellular skin that undergoes continual transformation (figure 13.8).

The skin is really a composite of a layer of structure and a soft skin. Andrasek begins with a field of cells and adds three attractor cells that cause all of the individual cells to begin to move at different speeds in relation to the attractors. While these metaphors seem completely embedded in speaking about the material, the project questions the fundamental question of materiality looking toward skin a cultural phenomena that can take on various materialities and form.

Jason Vigneri-Beane[17] discusses the status of material in relation to the arbitrariness of rule-based systems. He emphasizes the independence of organizational strategies of coded information that precedes architectural material. Because there is a logic on the local level of the microscale of individual cellular units, this does not assure that there is the same focus on the macroscale. He speaks of an arbitrariness of the information generated by rule-based scripting and the tendency to evolve a complex adaptive



| **Figure 13.8** |
Andrasek's cell transformations

behavior. At a certain point, the architect must make decisions whereby the data is given geometric form. This form is applied to the entire formation and gives unpredictable results or a kind of uselessness in relation to conventional notions of architecture. He believes that this could lead to a kind of "architectural identity in formation. Radical uselessness, then, is a productive breech of contract in the immanent relationship between rules and outcomes that occurs when computational logics are marshaled toward the (politicized) upheaval of architectural convention."[18]

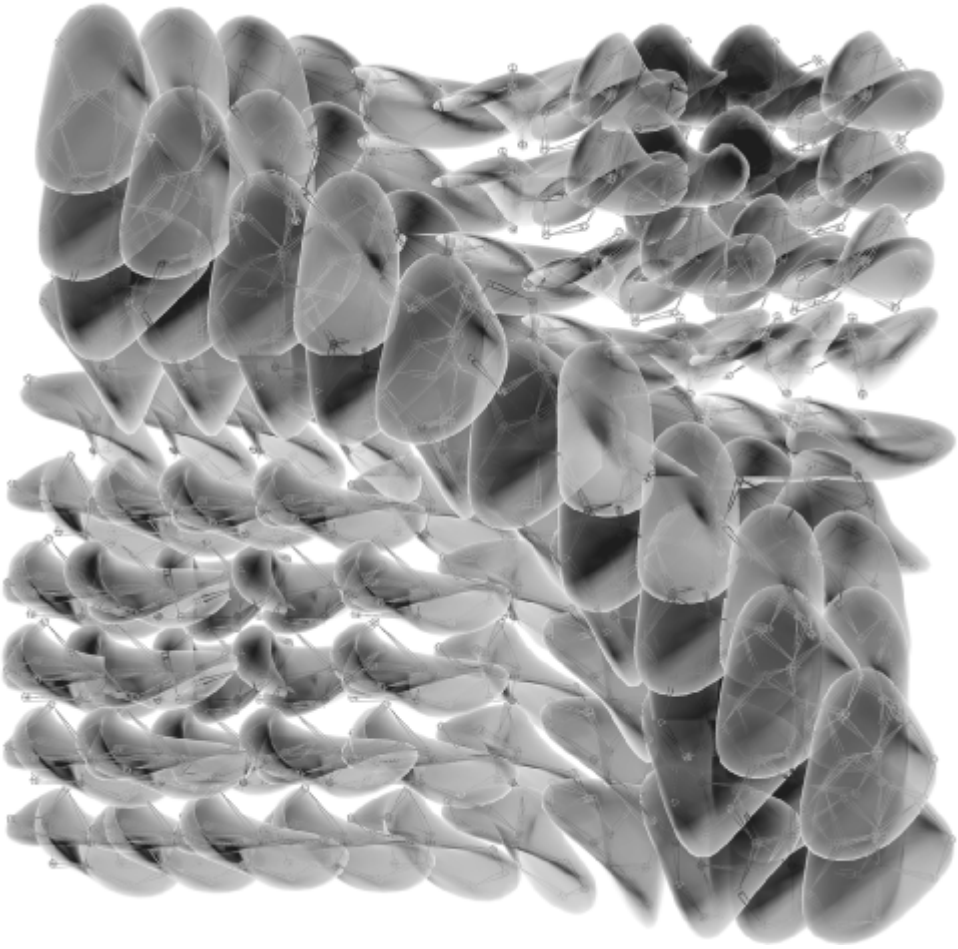
There is, in the genetic code, the intelligence that can be actualized in various forms. The genetic code is an invisible energy or information that affects material. In self-breeding, artificial life scenarios, the information or the gene is the most critical (and most ephemeral) element. This is what Richard Dawkins speaks of, in post-Darwinian terms, as "the selfish gene."[19] The intelligence of the gene is not intent on the fittest form of the organism in terms of the perfection of the organism in the organism's own terms. Instead, from the gene's point of view, the goal is to pass on the continuity of the intelligence of the genetic information, in the most efficient manner, regardless of the form. Now this has some interesting implications for architecture. It plays against architecture's stability and insistence upon stasis in form.

There are important questions to ask in relation to the use of artificial life computational scenarios for the design of architecture. All of these processes, as they move through possible combinations, tend to move toward stasis unless the system becomes regenerated by the programmer or architect. What is curious is that architecture, built architecture, in its nature is thought to be static, so to propose the possibility of an endlessly changing and iterative model for design destabilizes the very status of the architectural object. Where is architecture situated, in the changing possibilities of form in digital space or the built form, or both? What is the role of the architect in the design process? The architect is normally assumed to have an active role in the evolution of architectural form. In the design of self-evolving systems, the architect as programmer determines the "genetic code" and builds into the code a system that runs autonomously. These are fundamental questions facing a contemporary architecture that has its roots in a postmodern destabilization of the metanarrative. For the moment, the architects have focused attention on the role of the author in relation to an "autonomous system" and on how to avoid stasis in the system. Clarke proposes a model of establishing two competing systems that coevolve in a predator-prey relationship to constantly avoid stasis. Vigneri-Beane discusses a substitution method whereby random substitution of information constantly refigures relationships. Last, Andrasek discusses her role in establishing performance criteria of the evolving skin/system. If the system runs for a long enough time, the legible pattern of the skin is lost and the information becomes

too "noisy" to be productive. At this point she selects a legible pattern from the possible patterns and has the system "reincarnate" itself, maintaining and depositing the genetic information for the next generation of mutations. A self-generating system is used to evolve ever-changing and novel form, yet the architect intervenes at the level of establishing fitness criteria. In the impulse to create unique form is the desire to avoid stasis. This is comprehensible in relation to the digital model but raises questions regarding the movement toward a built architecture (figure 13.9).

We may take, by analogy, the figure of the Chimera. The Chimera is a mythological figure with an identity that is paradoxically both unique and infinite. She is born of the line of the marriage between the Mother Earth and her son, the Sea, of the "fruitful earth and the unfruitful sea," which produces "a line of monsters and prodigies, of brothers and sisters, along a horizontal axis dominated by two factors: seriality and hybridization."[20] The Chimera is uncertain of form (except in language, in description) yet holds the potential for every possible hybrid: her nature is more of language than of form. She is a multiple entity. She is both the question and the answer to the question of form; she is not form, yet is, momentarily. She provides us with both the mode in which to view our questioning of form and endless hybridity, by negating any possible understanding of the potential of form and in and of herself advocating for the importance of form. She is indecipherable.[21]

The metaphor of the Chimera provides us with a glimpse of the paradox at the heart of the evolution of genetic architecture. Architecture aspires simultaneously to form and to represent the impossibility of form. The constantly evolving digital chimera that are formed in rule-based computation would seem to be able to address the notion of the virtual in architecture. The virtual as described by theorist Brian Massumi is understood as a simultaneity and multiplication of images. These images are not in a stable form, but are in a series of evanescent overlapping images. No single image can render the virtual. By folding back on to itself topologically, the single is multiple and the superimposition of such images is the unity. By its nature, these processes are self-referential transformations and are more analogical than descriptive.[22] Massumi offers a word of caution regarding digital processes. He states that the evolution of infinite possibilities through the digital can indicate a quantitative rather than a qualitative sense about the virtual. Digital processes point to the possibility of alternate states and to a machinic process that moves through programmed steps. While Massumi later mentions certain exceptions (adaptive neural nets, other systems that generate non-precoded results based on feedback and recursivity, a machined self-referentiality, interaction between the analog and digital circuits), he believes in the "superiority of the analog."[23] He is concerned that the digital could lead to a systemization of the possible



| **Figure 13.9** |
Closeup of Andrasek's cells

and be a simulation rather than something real. The analog is a self-referenced process that is in tune to its own variations. What is key in his description is that the analog is able not only to be self-referential, but to cross from one medium to another. The analog can provide a qualitative transformation of code into other forms. He discusses the potential of the analog as the translation of the digital outside the machine and the screen experience: "Seeds of screened potential sown in nonsilicon soil. Relay to the world at large."[24] The lesson is this: the notion of the analog can translate the digital material and code to the material of the built architecture. The translation is by its nature going to effect changes. It will not be a smooth, but translation is a necessary one. The translation could be the intensities and flows that are not involved with the stasis of one manifestation or incorporation of form, but in the openness of the occupation of architecture. Social and cultural changes in societies change the reception and use of form. The inhabitation of architecture is an endless series of "couplings and matings" of endlessly changing images and incorporations.

Gender and Biology in Self-generating Computational Models

Both sexual and asexual models of engendering exist in the organic. We can look past the sexuality of engendering and focus on the issue of sameness and difference in terms of the interaction of the cells that lead to the development of new organisms. This point is critical and is reinforced by the contemporary emphasis on difference and gender as culturally grounded notions that have a fragile connection and contract with the biological.[25]

Theorist Elizabeth Grosz opens many important directions for a discussion of engendering and a more nuanced notion of sexual difference that could be of great assistance in trying to tackle the notion of the "sexless" engendering of architecture. Grosz writes, "The task, then, is not to establish a neutral or objective perspective on the question of sexual difference but to find a position encompassing enough for a sexually specific perspective to be able to open itself up to, meet with, and be surprised at (the reciprocal) otherness of the other sexes. Sexual difference entails the existence of a sexual ethics, an ethics of the ongoing negotiations between beings whose differences, whose alterities are left intact but with whom some kind of exchange is nonetheless possible."[26] Grosz invites us to think past a dichotomous rendering of difference (off/on, male/female . . .) to include other kinds of bodies, difference, and discussion. Gender can be seen as a cultural construct, yet underneath any model of sameness is the notion of difference. At the moment that we identify the "same," its uniqueness is undone by the inclusion of its opposite, difference. This invites us to speak, even if immaterially, of the binary, of the open or closed, of oscillating, shifting alliances. Just as cellular

automata or other artificial life scenarios create great complexity and unpredictable behaviors from the singular element that is alternately in one state and then another, the sum total of two other individual cells is much more than the sum of its parts.

Let us look for a moment at the biological sexual model. In a biological model for mammals, we look to the codependence on male semen and the female egg to spark embryologic development and differentiation. They are ontologically discrete entities that are different and complete—yet in relation to their program of reproduction, they are incomplete. There is an interesting question that arises if we consider a material understanding of these phenomena as compared with the ephemeral and abstract nature of the generation of digital bodies. Aristotle wrote of the ephemeral nature of the matter of semen and questioned its corporeal existence.[27] Grosz posits another reading of semen: "Seminal fluid is understood primarily as what it makes . . . a causal agent and thus a thing, a solid. Its fluidity . . . its formlessness is displaced for its capacity to produce an object."[28] This is of interest since so many of the metaphors that arise in connection with the creation of or the engendering of a "biological" or "embryological" architecture is detached from its connection to the potential of the immaterial to construct materially. The digital model of generation uses identical cells that alternately take on nuanced differences with adjacent identical cells. While there is a clear polarity between black cells and white cells in a cellular automata model, the relationships between the identical cells are fleeting and changing. I would posit, however, that these cells, even if they are no longer "sexless," are inherently diverse, and this speaks to the difference that drives the generative process. That this relationship is more subtle than the model of male semen + female egg = new organism is clear, yet the dismissal of the subtleties of sexual generation can be used to enrich the discussion.

The generative process can be looked at from multiple viewpoints that link this discussion to broader cultural and gender issues. An ambiguity is apparent in the socially enforced role of the woman's body as the site of conception. Rather than be understood as difference, the sexual act may be viewed as essentially homoerotic, between the mutual stimulation of like parts in the mimetic fit of the penis to the vagina—that women have "a topological inversion of the male penis within them, or the female penis, the clitoris on the exterior.[29] This is countered by the idea that a woman's sexuality is already dual and complete in itself.[30] Even if one were to posit a position of "sameness" in speaking of topologically or typologically similar entities, the basis of the ontology of form still lies in the fact that two strands of DNA are brought together to allow for the possibility of engendering. This exists a priori to the notion of the binary nature of sexuality that would seem to be necessary in the copulation of man and woman (or egg and sperm) to create life. This is not a static system and does call for some notion of dif-

ference or acceptance of the other. But these assumptions are called into question through genetic engineering that may circumvent the necessity for the combination of female and male genetic material to create a new organism to allow for, in the absence of a female (or her egg), the generation of a new organism from the genetic material of the male only,[31] and it could be this model of sui generis that is unconsciously the drive behind architectural engendering at the moment.

Disembodied Engagement

What constitutes a body? Deleuze and Guattari have discussed the body as a discontinuous series of flows, energies, substances, and events that exist outside of binary oppositions. The body is not seen as a closed system, but as an open-ended biological system. Rather than thinking about the generative act as being a result of a lack or want or desire for completion in the other, desire is seen as an active productive force that aims at its own self-proliferation in an act of becoming.[32] This may be what is forming the basis of "genetically evolved" architectural form. It is as if, in its autogeneration, in its autonomous self-generation, that the invisible forces resemble those of the Aristotlean view of the semen as an invisible, noncorporeal life force. Yet in the potential of a translation to built architectural form there is an unacknowledged return to the notion of form or material itself as the feminine. This is an important point to make. Grosz guides us in the discussion again: "What happens in the bifurcation of sexed bodies—which is, in my opinion, an irreducible cultural universal—that is inevitably part of our understanding of bodies? If mind or subjectivity can be adequately and without reduction explained in terms of bodies, bodies understood in their historiocultural specificity, does this mean that sexual specificity—sexual difference—will be finally understood as a necessary (even if not sufficient) condition of our subjectivity?"[33] Does eliminating gender differences, as Grosz points out, play into the male model of subjectivity by eliminating a feminist position? Were Deleuze and Guattari conscious of their own gendered subjectivity when they wrote to eliminate "identity" and perhaps unconsciously advocate for a dispersed polysexuality that at its base is a very masculine move?

There is no material in digital computation, or at least not in the typical consideration of the material. What is digital material? Two such bodies can merge, get entangled, but does some element leave one form to engender another? Does a self-generating system diversify to form only one body, which then goes on to autogenerate another individual in its image in the form of cloning or of natural selection? Could a field of self-generating automata form polarized molecular entities that could then come into contact with each other to form a third entity? What would occur and what guidance toward

materiality could the ephemeral digital technique suggest? These are questions that beg to be addressed. The iterative, creative power of digital "engendering" of architectural form is still latent in relation to the possibilities in the material. The return to materiality invites the feminine back into the discussion. Perhaps there is another way to think about self-generation of form that does not follow the model of *sui generis* only, a predominantly male model of self-sufficiency. In the biological model of *parthenogenesis*, the Phallic Mother, in the prolonged absence of a male inseminator, will, following the drive of a life force, spontaneously produce her opposite, a male that will enable the differentiation that is essential to creation through insemination.

The danger is that if we are working with a technique of making architecture that doesn't lead to its expression in physical matter but allows the architectural work to remain in a constantly changing form, metaphorically and instrumentally detached from full embodiment, this could lead to a barrenness of matter *and* concept. Using the metaphor of self-generating and biological processes for the design of architecture poses a danger that we could remain in a reverie or dream state about the biology of architecture. We could inhabit the dream and not the reality that is metaphorically connected to the imagined nondirected impulse of the spermatozoa to search for the egg. It is only in the penetration of the egg that the nondirected generating energy or life force of the semen gets directed and makes a commitment to form (and perhaps to consciousness). We can view semen as the intuitive, as seeds of form (and ideas). In the continual and unfocused searching, there is a promiscuous and perhaps superficial relationship to form and matter that offers a cautionary discussion for the generation of architecture.

Profound issues are developing in the field of architecture that are caught up in the notion of autonomy, self-generating fields, and pulsating, changing "form." Is this just the reverie of technology that prevents us from the materialization of form, wherein the world of infinite projection and possibility is the norm? We can think about this in a different way. In a historical sense, the idea of the technological being embodied with biological capabilities is not new. The automaton has a direct connection with the investigation of the digital model of thought and matter. In some ways, the automaton suggests a superiority of thought over body. It is a way of speaking of chimera, of the polymorphic perversity in the ever-changing and combining body. It does not surprise me then that a tool that many architects are using to give a "visible body" to the genetic code is *Maya*, an animation software program. Maya is the goddess of illusion. The illusion is endlessly forming, and in that unfixed imagination is the erotic. It is this same shifting, placeless eroticism that I ascribe to the throbbing meshes of sensual form made visible, but not yet corporeal.

Notes

1. The discussion of bodies arises from the Deleuzian discussion of the layering and folding of matter that forms all bodies as discussed in Deleuze, *The Fold*, and Cache, *Earth Moves*.
2. Taylor, *Hiding*, 18.
3. Deleuze, *Essays Clinical and Critical*, 64.
4. Lévy, *Becoming Virtual*, 23.
5. Lévy, *Becoming Virtual*, 29.
6. On depthlessness of surface, see Jameson, *Postmodernism, or, The Cultural Logic of Late Capitalism*.
7. See Lynn, *Animate Form*.
8. See Lynn, *Animate Form*, and Farin, *NURB Curves and Surfaces from Projective Geometry to Practical Use*. This section is also based on an interview by the author with Cory Clarke.
9. Topology is the study of the behavior of a surface structure under deformation.
10. The thoughts regarding *Throbbing Meshes* were developed with Maria Siera in response to a University of Pennsylvania conference on digital techniques in architectural design and construction in the spring of 2002.
11. This paragraph is co-authored with Jason Vigneri-Beane and is from an unpublished manuscript "Paradox: Smooth><Discrete" 2003.
12. Turkle, *Life on the Screen*, 304.
13. Turkle, *Life on the Screen*, especially 304–305n12. Her account is based on Levy, *Artificial Life*, and Waldrop, *Complexity*.
14. Turkle, *Life on the Screen*, 154.
15. Cory Clarke and Philip Ang.
16. Alisa Andrasek, *biothing*.
17. Jason Vigneri-Beane, *splitspace*.
18. Jason Vigneri-Beane, "Agents."
19. Dawkins, *The Selfish Gene*.,
20. Bompiani, "The Chimera Herself," 365.
21. Bompiani, "The Chimera Herself," 398.
22. Massumi, "The Superiority of the Analog," 134.
23. Massumi, "The Superiority of the Analog," 134.
24. Massumi, "The Superiority of the Analog," 141.
25. Grosz, *Volatile Bodies*.
26. Grosz, *Volatile Bodies*,192.
27. Sissa, "Subtle Bodies," 135–141.
28. Grosz, *Volatile Bodies*, 199.
29. Laqueur, "Amor Veneris, Vel Dulcedo Appelatur," 105.

30. Irigaray, "This Sex Which is Not One," 23–33. Originally published as "Ce sexe qui nen est pas un," in *Cahiers du Grif*, no. 5. English translation: "This Sex Which is Not One," trans. Claudia Reeder, in *New French Feminisms*, ed. Elaine Marks and Isabelle de Courtivron (New York: Pantheon, 1981), 99–106.
31. Weiss, "The Dureé of the Techno-body."
32. See Grosz, *Volatile Bodies*, 165.
33. Grosz, *Volatile Bodies*, 160.

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