The Solaris Mirror

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INTRODUCTION

Contemporary architecture is in the middle of an extended shift from drawing to computation as the foundation of design practice. This new set of disciplinary questions has arguably led architecture into what Rosalind Kraus calls a "post-medium condition." In this context, how can architecture establish new critical models for computational design practice?

The first generation of digital architects focused on exposing the underworld of the design process. By designing controls rather than specific solutions, design became a meta-process. These practices shared one constant: the underworld of control was conceived as a circuit (of arbitrary complexity) in which the information flow remained unbroken: every data set mapping linearly between connected nodes. Today, some computational architects are starting to dismantle the linearity and cleanliness of such digital processes. For this shift, chance and time-based artistic practices have provided precedents for possible approaches to non-linear systems. Rather than linear controls, computational design can focus on environments and behaviors. The resulting forms are irreducible, as their specifics are inextricably linked to the contingencies of a unique runtime.

Automatism has emerged as a central question in many of these new practices. How should automatic design environments be structured? Can we establish new criteria for judgment and constraint, beyond an endless quest for novel forms?[1] To address this question, I propose a return to a past vision of the future: Solaris. In his 1961 science fiction classic, Polish author Stanislaw Lem establishes three distinct form generation paradigms which provide relevant models for post-medium computational architecture.[2]

PLOT

To begin, we will briefly review the plot of Solaris. The book is set in the future on the distant planet Solaris. This planet is home to a single organism: a giant ocean which covers the entire surface of the planet and exhibits protean form-generation on a massive scale. Initially, this ocean generated intense scientific interest. Yet despite decades of research and the loss of hundreds of lives, this research made no progress and interest in Solaris gradually dissipated. At the start of the book, only three scientists are left on the Solaris research station.

In response to several odd reports, a psychologist, Kris Kelvin, is sent from Earth to investigate the station. After landing, Kelvin gradually discovers that the three scientists conducted a rogue experiment beaming high powered x-rays at the ocean. This experiment triggered unprecedented behavior from the ocean, which Kelvin himself begins to experience: in their sleep, the ocean creates an apparently human "visitor" for each scientist based on his unconscious. These visitors are not hostile, but they are indestructible and have an intense desire to stay close to their companion. Kelvin's visitor, Rheya, is modeled on his former lover, who killed herself ten years earlier after an argument.

The presence of these visitors isolates the scientists, with each individual coping differently. The first, Gibarian, commits suicide just before Kelvin's arrival. The second, Snow, launches his visitors off the station at regular intervals, finding relief until the next one appears. The third, Sartorius, conceals his visitor in his laboratory. Kelvin's response is quite different. With his first visitor, he panics and launches her off the station; with his second visitor, he relaxes and accepts her companionship. While Kelvin acknowledges this version of Rheya is objectively a product of his own consciousness, he decides this doesn't really matter. Meanwhile, the other two remaining scientists secretly develop a weapon to destroy their visitors. Their weapon is ultimately successful, and all the visitors are destroyed, including Rheya. At the end of the book Kelvin decides to remain on the station and wait for the potential return of another Rheya.[3]

SYMMETRIADS

In Solaris, the ocean's form generating activities can be sorted into three paradigms relevant for contemporary architectural practice. The first Solaris form generation paradigm is the "symmetriad." These are abstract formations common on the surface of the ocean which "bear no resemblance whatsoever to anything on Earth."[4] Initially, a large area of the ocean tens of square miles wide becomes glassy and glowing without any change to its typical surface wave pattern. This lasts for about an hour, until the area suddenly erupts into a large flaming ball projecting away from the ocean's surface. Fully extended from the surface, the ball and its supports rapidly reconfigure into a column of "mind-bending architecture" which spawns supports and tendrils.[5] Then, the next phase starts:

> The symmetriad now begins to display its most exotic characteristic – the property of 'illustrating,' sometimes contradicting, various laws of physics. (Bear in mind that no two symmetriads are alike, and that the geometry of each one is a unique 'invention' of the living ocean.) The interior of the symmetriad becomes a factory for the production of 'monumental machines,' as these constructs are sometimes called, although they resemble no machine which it is within the power of mankind to build: the designation is applied because all this activity has finite ends, and is therefore in some sense 'mechanical.'[6]

Symmetriads exhibit perfect symmetry across their vertical axis. During the final half hour of their development, their rate of change subsides as this axis of symmetry slowly tilts off center. Finally, the partially submerged symmetriad stabilizes itself and stops changing. It rests like this for two to three hours, until it is violently swallowed back into the ocean. The asymmetriads are related, but less common forms. These appear in a similar fashion to the symmetriads, but are not symmetrical and last for a much shorter duration.

In Solaris, Lem presents a range of competing scientific interpretations of the symmetriads. One theory is that they are the spatial analogue of a transcendental equation:

> It is commonplace that any equation can be expressed in the figurative language of non-Euclidean geometry and represented in three dimensions. This interpretation relates the symmetriad to Lobachevsky's cones and Riemann's negative curves, although its unimaginable complexity makes the relationship highly tenuous. The eventual form occupies an area of several cubic miles and extends far beyond our whole system of mathematics. In addition, this extension is four-dimensional, for the fundamental terms of the equations use a temporal symbolism expressed in the internal changes over a given period.[7]

A rival theory is that the various phases of development of a symmetriads illustrate an evolving architectonic history:

> Austerity of line gives way to a riot of exploding lines and shapes, and the Baroque runs wild. If the progression continues – and the successive mutations are to be seen as stages in the life of an evolving organism – we finally arrive at the architecture of the space age, and perhaps too at some understanding of the symmetriad.[8]

The related asymmetriads are described as housing "bewildering operations performed at a speed which defies the laws of physics and which are dubbed 'giant quantic phenomenon.'"[9] Ultimately, none of these various scientific descriptions are quite satisfactory: there is no legible human meaning to the symmetriad forms.

The symmetriads display several characteristics relevant for computational architecture. They are animate, complex, and abstract. ANIMATE. The Solaris ocean is an animate form, its production restless, constantly varied, and conceptually endless. As such, the symmetriads provide an early fictional example of animate form as a model for architecture. In *Animate Form*, Greg Lynn argued for design spaces to extend beyond Cartesian coordinates to include dynamic forces and time.[10] Today, it has become typical for computational design spaces to include time based processes like cellular automata, gravity simulations, growth simulations, and mathematical patterns. Of course, it remains an open question how best to reconcile the animation of design spaces with the reality that built architecture, for the most part, is static. In their speed and protean volatility, the symmetriads remain a provocative model of the aspirations of an animate architecture. COMPLEX. The geometry of the symmetriads is "mind-bendingly" complex. Ultimately, it is "incomprehensible."[11] Complexity is a central theme in much contemporary computational architecture. Recently, Sean Keller has traced a link between complexity in computational architecture and Kant's concept of the "mathematical sublime."[12] The Solaris model similarly points towards a sublime complexity beyond our mental grasp.

ABSTRACT. Lem is resolutely negative regarding the various scientific interpretations of the symmetriads. They are all inconclusive. Solaris simply is – a protean process without human meaning. Again, we observe a common theme in contemporary computational practices. Peter Eisenman's early houses enacted a transformational design process which established the practice of abstract, process-based architecture within the discipline. A more recent example, albeit not computational, is Roxy Payne's *Skumak* machine – which expresses nothing beyond the physical forces of its own self-making. Many critics have observed the inhumanity of language. Language precedes us, and yet we construct our individual identities within it. Symmetriads are models for the development of an inhuman architecture – projects aiming towards total geometric abstraction, indifferent to human legibility, scale, meaning, and the like.

MIMOIDS

The second Solaris form generation paradigm is the "mimoid." Like symmetriads, mimoids also appear on the ocean surface. Their base form is a cluster of polyps on a crater within the larger ocean. These clusters generally lie dormant. Undisturbed, they are only activated by passing clouds. When a cloud passes overhead the polyps excrete a dust which quickly produces "an astonishing imitation of the volutes of a cloud."[13] The mimoids can also be stimulated to reproduce non-organic human objects:

> The reproduction process embraces every object inside a radius of eight or nine miles. Usually the facsimile is an enlargement of the original, whose forms are sometimes only roughly copied. The reproduction of machines, in particular, elicits simplifications that might be considered grotesque – practically caricatures. The copy is always modeled in the same colorless tegument, which hovers above the outcrops, linked to its base by flimsy umbilical cords; it slides, creeps, curls back on itself, shrinks or swells, and finally assumes the most complicated forms.[14]

Figure 1. *Delaunay Lattice*, San Francisco, 2009. Facade lattice generated by self-avoiding agents and triangulation algorithm.

The mimoids only copy inorganic matter. These copies are vast in scale, and somewhat inconsistent in their production. Some days the mimoids will not be active. On other days the activity is intense:

> On gala days (for the scientist as well as the mimoid), an unforgettable spectacle develops as the mimoid goes into hyperproduction and performs wild flights of fancy. It plays variations on the theme of a given object and embroiders 'formal extensions' that amuse it for hours on end, to the delight of the non-figurative artist and the despair of the scientist, who is at a loss to grasp any common theme in the performance. The mimoid can produce 'primitive' simplifications, but is just as likely to indulge in 'baroque' deviations, parox-

> ysms of extravagant brilliance. Old mimoids tend to manufacture extremely comic forms.[15]

Mimoids enact two themes central to much current computational architecture: mimicry and variation. MIMICRY. Whereas the symmetriads are abstract and mathematical, the mimoids are always based on recognizable objects. Formal distortions of scale and complexity do not entirely mask their reference to a spawning object. Recently, Jesse Reiser and Nanako Umemoto have argued that "using the same diagram at different scales can produce drastically different effects" as they "resist traditional architectural arrangements and tectonics at these scales."[16] The scale shift of the mimoids anticipates this trope of familiar objects copied to the wrong scale. Some specific recent architectural examples include fish (Ghery), foam (PTW), nests (Herzog and deMeuron), goo (Jürgen Mayer H), and coral (R&Sie).[17] In such projects, computation is often used to simulate the structure of smaller scale objects, adapting them for human occupation. In "Cardboard Architecture", Peter Eisenman critiqued the traditional privileging of buildings over models. For Eisenman, each model is simply another aspect of the same project.[18] Formal mimicry extends this logic outside the conventional disciplinary bounds of drawing-to-building to alternative sources.

Figure 2. *Omphalos*, San Francisco, 2009. Sink based on the form of a human navel.

VARIATION. In an odd sense, Lem anticipates some of the current disciplinary anxieties inherent in the shift to computational design. The implication of the mimoid's open-ended production of formal variants is that the Solaris ocean is developing an underworld encapsulating the range of possibilities inherent in the source object. In today's language, such variations might be parametric controls applied to the source form. Certainly, there is an eerie similarity between the mimoid process and a starch 3d print. Today, architects understand that anything that can be digitally modeled as a watertight volume can be printed at a range of scales: from a hand held model to a vast building. Such digital models can be parameterized to create an open-ended series of formal variants. The ocean's crude approximations and baroque deviations anticipate the contemporary architect's anxiety of selection. When it is just as easy to produce 1,000 design variants as one, how does one choose? How important is a specific selection relative to the articulation of difference?[19] A recent project exploring this question is Michael Hansmeyer's *Ornamented Columns* (2010). Traditional column capitol and flutes are computationally modified through subdivision algorithms in an open-ended series of variants.

VISITORS

The third and final Solaris form generation paradigm is the "visitor." As described in the plot synopsis, several days after the unauthorized experiment, each scientist encounters a visitor upon waking. These visitors, which appear human, are created by the ocean while the scientists sleep. The visitors are physicalized mirrors of an aspect of each scientist's unconscious. [20] Snow, who never reveals anything about his own visitor, reflects:

> "What is a normal man? A man who has never committed a disgraceful act? Maybe, but has he never had uncontrollable thoughts? Perhaps he hasn't. But perhaps something, a phantasm, rose up from somewhere within him, ten or thirty years ago, something which he suppressed and then forgot about, which he doesn't fear since he knows he will never allow it to develop and so lead to any action on his part. And now, suddenly, in broad daylight, he come across this thing… this thought embodied, riveted to him, indestructible."[21]

At one point, Snow tells Kelvin to "remember that she [Rheya] is a mirror that reflects part of your mind. If she is beautiful, it's because your memories are. You provide the formula."[22] Lem never reveals the ocean's motives for producing the visitors nor the exact mechanisms that trigger them. The visitors are totally accurate human simulations down to a molecular level. At an atomic scale there is just emptiness.[23] Each of Kelvin's visitors arrives believing themselves to be the original Rheya. As the second Rheya discovers her identity as a creature formed by the ocean, she attempts unsuccessfully to kill herself several times. Gradually, both Kelvin and his Rheya-visitor adapt to the circumstances of Solaris and settle in together until the final experiment destroys her. Kelvin's reaction suggests that at some level the original real Rheya was always already operating as a mirror for his consciousness.

Figure 3. *Solaris*, directed by Andrei Tarkovsky. Kelvin and Rheya mirrored.

What do the Solaris visitors suggest for computational architecture? The ocean acts as a mirror for Kelvin, bringing to life an aspect of his mind as an autonomous being (Rheya). Kelvin is an architect. Solaris is a computer and Rheya his project – the externalization of an aspect of his mind through computation. It is Kelvin's unconscious and Rheya's autonomy that mark an important shift in the computational paradigm.

UNCONSCIOUS. To begin, it is crucial to note that Rheya is a projection of Kelvin's unconscious. She is totally intimate and specific to Kelvin. Rheya is Kelvin's lover, she is a representation of his desire made manifest. In the Tarkovsky film, in addition to Rheya, Kelvin also projects a complete environment: his childhood home, his father, etc.[24] These projections are all unique to Kelvin. What is interesting is that the visitors are not entirely under their author's control. As such, each scientist has a different reaction to meeting their personal projection. For the most part, architects act either like Gibarian, Snow, or Sartorius in terms of their unconscious projections. Gibarian, unable to deal emotionally with his visitor, kills himself. Snow repeatedly kills his visitors and only contacts the other scientists when his visitor is gone or hidden. Sartorius lives a double life: in one, he lives privately with his child-size visitor; in the other, he adopts a formal public persona, scrupulously concealing his visitor from the other scientists and typically hiding himself behind various screens. Both Snow and Sartorius scrupulously conceal their private projections from others. Only Kelvin accepts his visitor without judgment, allowing her to stay with him both privately and in the presence of the other scientists. Such an acceptance and exposure of the unconscious is a productive model for computational architecture.

AUTONOMY. For computational architecture, the visitor paradigm suggests a focus on autonomous behavior rather than parametric relationships. For some time, computational architecture has been generating a smooth world in which various parameters blend together into a kind of easy synthesis. Contingencies are ultimately absorbed into smooth, efficient surfaces. How can we use the computer to create autonomous architecture capable of internal self-differentiation and even inconsistency? It is a received idea that one of the fundamental rules of architecture is internal consistency. Alberti believes all good design has a harmony in which a single component cannot be added or removed.[25] At this moment, the fragility and relative simplicity of our computational solutions lend themselves easily to this model. But the human mind hardly shares this type of consistency. Freud once compared the human mind to Rome, where the monuments and fabric of different eras overlap to create a complex, highly differentiated environment.[26] This seems like a much richer model for computation – an architectural project in which inconsistent and contingent behavior is a fundamental aspect of the computational model.

Computationally, the visitor paradigm triggers an extremely difficult set of programming issues. In particular, defining the computational problems become rather slippery. Indeed, to a large extent they become the project. This is quite different from our current model, where the computational problems are generally clearly defined, while the solutions may be arbitrarily difficult. Such programming complexity suggests why there are so few current examples of this type of work. Architects do not yet have the programming skills to create computational projects which escape self-referential computationally-related issues. In a traditional design space, architects use various strategies to access unconscious design: sketches and study models, both physical and digital. Ultimately, computation should be there, one step upstream in the design process from its current location – externalizing the specific moment of synthetic decision which establishes a design approach.

What might such projects actually look like? We will consider two examples, neither one computational, as models for a future computational practice based on the Solaris visitors. The first example is Piranesi's *Campo Marzio* project. Having spent so much time documenting the ruins of the city, Piranesi internalized these forms. The resulting project is a complex combination of both remembering and forgetting. Fragments of his personal memory are recombined and reconfigured to create an entirely new condition. This system seems at the same time both in and out of Paranesi's control, as if the system's autonomous logic could continue without him.

Figure 4. Giovanni Piranesi, *Campo Marzio dell'antica Roma*, 1761. Experimental city masked as archeological reconstruction.

A second, more recent example is Valerio Olgiati's *Swiss Visitor's Center* (2003). The mirrored stairs thematize the narcissistic doubling of the visitors. In addition, there is a dreamlike quality to the space, as if it is already eerily familiar and simply being remembered from the past. Architecturally, the promise of the visitors is the provocation of fantasies about space, in addition to fantasies about form.

Figure 5. Valerio Olgiati, *Swiss National Park Visitor's Center*, Zernez, 2003. The mirrored stair.

CONCLUSION

Each of the three form generation paradigms on Solaris is a different type of mirror. First, the symmetriads are mirrored through axial symmetry. Here, the mirroring is embedded in the morphology of the form itself. Second, the mimoids are distorted copies of source objects. This type of mirroring is mimetic. Importantly, the copy is thematically static: monochrome, immobile, etc. This mirroring is legible only in terms of the mimetic process. Finally, the visitors are autonomous mirrors of their source's unconscious mind. As such, these autonomous copies are both in and out of control. Each Solaris mirror provides a productive model for post-medium architecture.

To some extent, symmetriads and mimoids are already active models for computational architecture. The next step is to introduce visitors: autonomous agents spawned from an architectural unconscious. Our goal might be to program personal visitors – imperfect mirrors of our own inchoate desires. *In The City of the Captive Globe*, Rem Koolhaas describes a city "devoted to the artificial conception and accelerated birth of theories, interpretations, mental constructions, proposals and their infliction on the World."[27] For Koolhaas, the city is a mechanism to both produce and reconcile conflicting architectural fantasies. Today, this mechanism is computation.

ENDNOTES

1 Manfredo Tafuri comprehensively critiques this impasse, which remains an intractable issue within architecture today. See Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development* (Cambridge, 1976) pp. 181-182.

2 This paper focuses primarily on the book rather than either film version. The first film version was directed by Andre Tarkovsky in 1972. A second version was made by Stephen Soderbergh in 2002. Both films largely omit two of the three form generation paradigms, significantly modifying the focus of the original novel.

3 Both film versions end quite differently from the book. In the films, Kelvin creates a home on the ocean surface where he settles. In the Tarkovsky version, this house is a mirror of his childhood home. In the Soderbergh version, it is a generic urban city. But in both cases, the Solaris-Kelvin combination produces both Rheya and a complementary physical environment. In the book, Lem releases information about the ocean's form generation gradually. The book is nearly half done before there is a comprehensive description, and these descriptions invariably occur through Kelvin's review of scientific papers when he is in the library. It is of course ironic that Kelvin is actually on Solaris, but his knowledge of the ocean's morphology comes primarily from the ship's library which is a windowless chamber at the center of the station. For a more detailed description of Lem's projection of this library see: Frederick Jameson, *Archaeologies of the Future* (New York, 2005) p. 108.

4 Stanislaus Lem, *Solaris* (New York, 1961) p. 116.

5 Lem, p. 118.

6 Lem, p. 118.

7 Lem, p. 119.

8 Lem, p. 120.

9 Lem, p. 123.

10 Greg Lynn, *Animate Form* (New York, 1999) p. 10.

11 Lem, p. 120.

12 Sean Keller, "Antinomic Beauty" (Stanford lecture notes, 2010) p. 14.

13 Lem, p. 114.

14 Lem, p. 115.

15 Lem, p116.

16 Reiser + Umemoto, *Atlas of Novel Tectonics* (New York, 2006) p. 118.

17 FISH. Frank Gehry, *Fishdance*, Kyoto, 1986. FOAM. PTW and Arup, *Watercube*, Beijing, 2002. NESTS. Herzog and DeMeuron, *Olympic Stadium*, Beijing, 2002. GOO. Jürgen Mayer H., *Mensa Karlsruhe*, 2005. CORAL. R&Sie*, I've Heard About*, 2005.

18 Peter Eisenman, "Cardboard Architecture" in *Eisenman Inside Out: Selected Writings 1963-1988* (New York, 2004) pp. 28-39.

19 For an early attempt at computationally modeling the design process see Christopher Alexander, *Notes on the Synthesis of Forms* (Cambridge, 1964).

20 Such unconscious creation may, of course, occasionally produce monsters. For a classic example see: Francisco Goya, The Sleep of Reason Produces Monsters (1797).

21 Lem, p. 71.

22 Lem, p. 154.

23 Lem, p. 98.

24 Mark Wigley has observed a structural link between the uncanny and our image of the house. For the complete argument see: Mark Wigley, *The Architecture of Deconstruction* (Cambridge, 1993) pp. 110-121.

25 Leon Battista Alberti, *On the Art of Building in Ten Books*, trans. Joseph Rykwert, Neil Leach, Robert Tavernor (Cambridge, 1988) pp. 301, 312.

26 Sigmund Freud, *Civilization and its Discontents*, trans. James Strachey (New York, 1961) pp. 16-20.

27 Rem Koolhaas, *Delirious New York* (New York, 1972) p. 294.