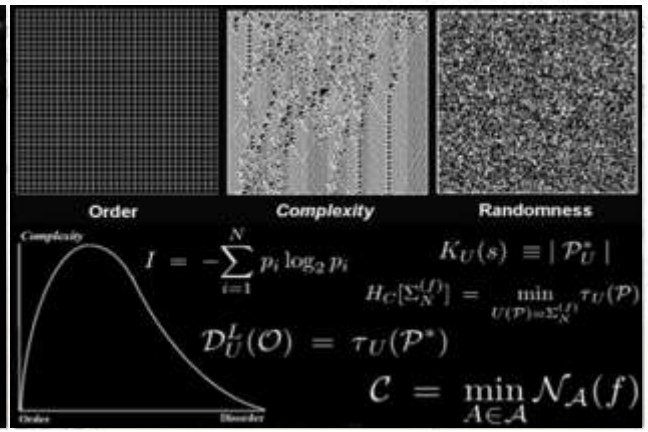
Photography, Physics, and Complexity:

Strange Bedfellows or a New Aesthetic?

Morrison House Presentation, August 2011



…with just a little bit of ***tao*** sprinkled in!

Andy Ilachinski

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http://www.sudden-stillness.com

http://tao-of-digital-photography.blogspot.com

Preamble

What am I here to talk about?

http://www.creativecriminals.com/images/mercedesleftrightbrain1.jpg

By day…

I am a physicist, specializing in chaos, complex systems. and mathematical modeling

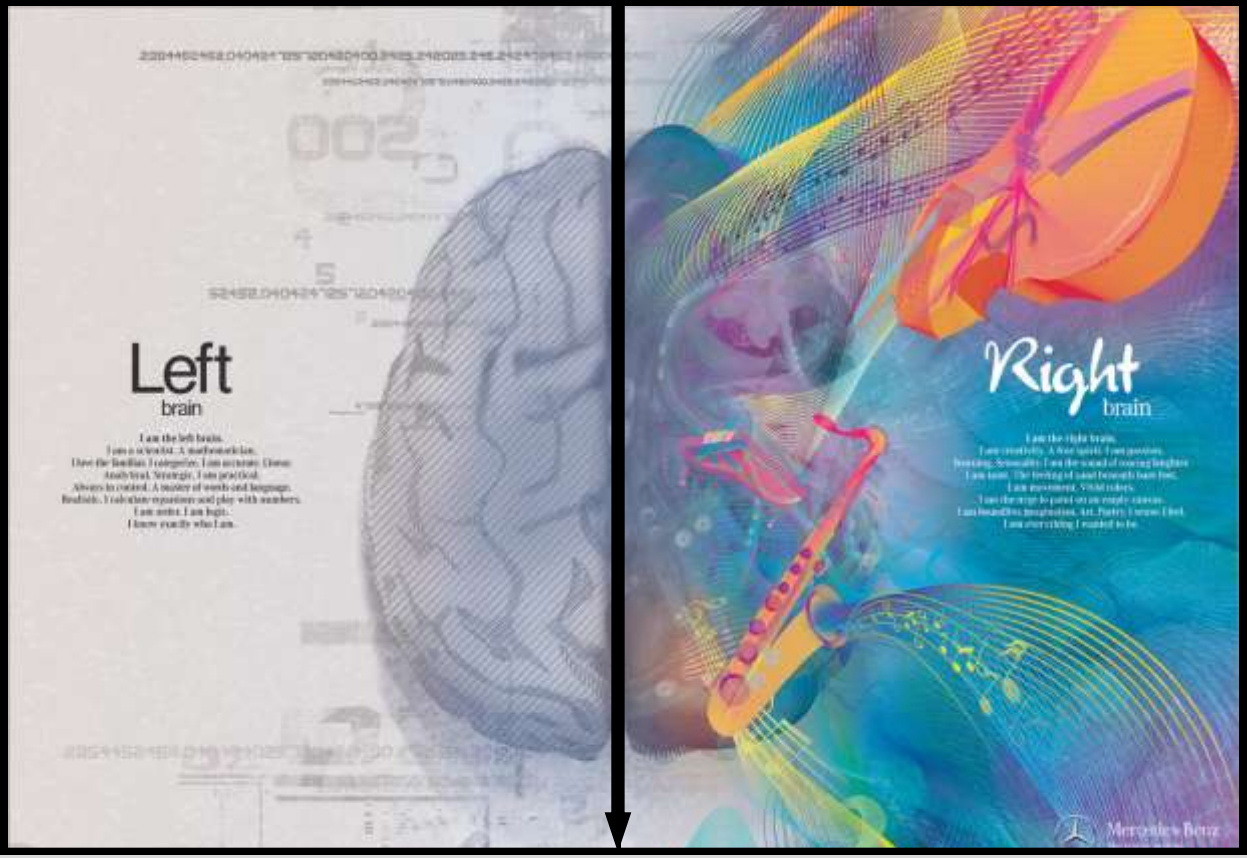
At all other times

(that often intrude on the day)…

I am a photographer, who forgets all about physics, complexity, photography, even my “I”

Preamble

What am I here to talk about?

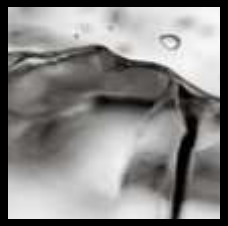


http://www.creativecriminals.com/images/mercedesleftrightbrain1.jpg

I'm here to (attempt to) describe what the world that exists at the cusp of these two realms looks like from the ***point of view of one ineffable "I"***

(and to show a few photographs along the way ;-)

What is this talk about?



Photography

The art of capturing what a "thing" ***is*** to communicate ***what else*** a thing is

Physics

The science of distilling perceived order into simplest possible form

Complexity

Self-organized emergence of global order that arises from local simplicity

Themes / Questions

- Who decides what is "order"?
- Aesthetics ("order principle"), patterns, emergence local vs. global, self-reference/organization, dynamics, multidimensional spaces, objective vs. subjective
- ***What does observed order say about the observer?***

Let's cut right to the chase

Physics and photography both define and revel in *categories*, *divisions*, *groupings*, *labels*, *orders*, and *partitions*;

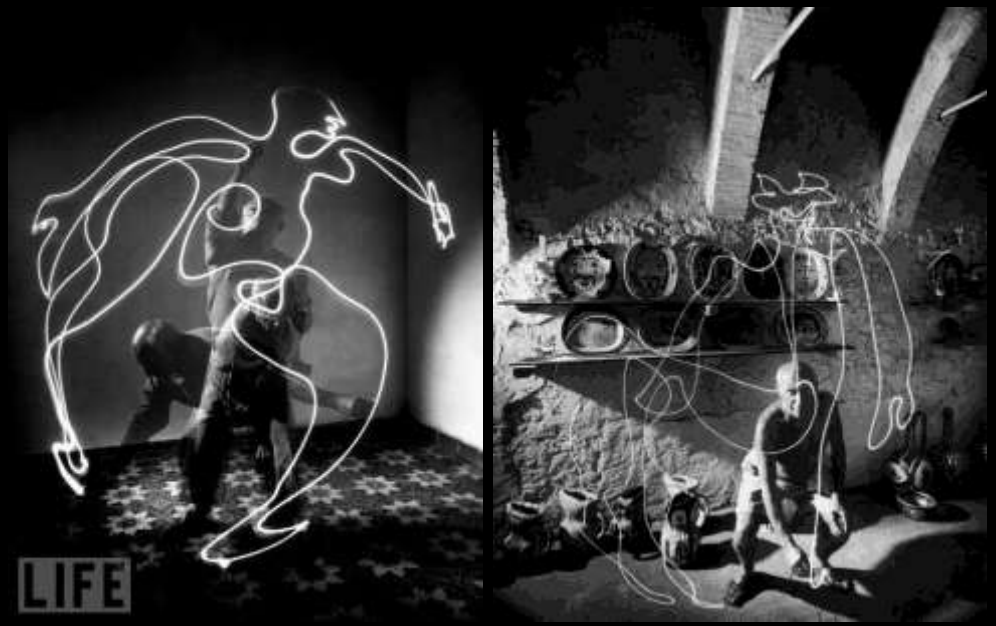
In a certain Chinese encyclopedia called
the *Heavenly Emporium of Benevolent Knowledge*,
(perhaps imagined, perhaps real),
Jorge Luis Borges writes that

"...animals are divided into:
(a) those that belong to the emperor;
(b) embalmed ones; (c) those that are trained;
(d) suckling pigs; (e) mermaids;
(f) fabulous ones; (g) stray dogs;
(h) those that are included in this classification;
(i) those that tremble as if they were mad;
(j) innumerable ones;
(k) those drawn with a very fine camel's-hair brush;
(l) etcetera; (m) those that have just broken the flower vase;
(n) those that at a distance resemble flies."

Let's cut right to the chase

Physics and photography both define and revel in *categories*, *divisions*, *groupings*, *labels*, *orders*, and *partitions*;

An artist is a *meta*-pattern of subjective order



Gjon Mili, *Life Magazine* (1949)

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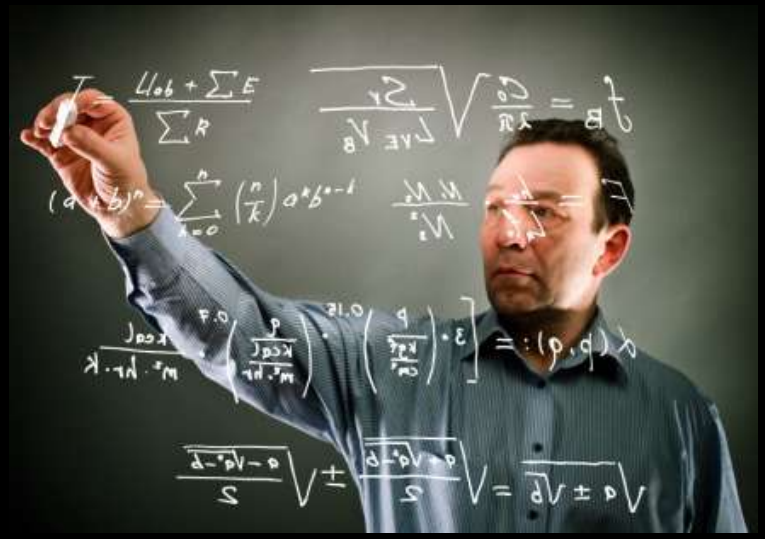

A physicist is a *meta*-pattern of "objective order"

http://insidetheclassics.myminnesotaorchestra.org/wp-content/uploads/2011/01/formulas_440.jpg

Let's cut right to the chase

Physics and photography both define and revel in *categories*, *divisions*, *groupings*, *labels*, *orders*, and *partitions*;

Art is the transcendence of subjective categories

Kandinsky, "First Abstract Watercolor" (1910 / 1911 ?)

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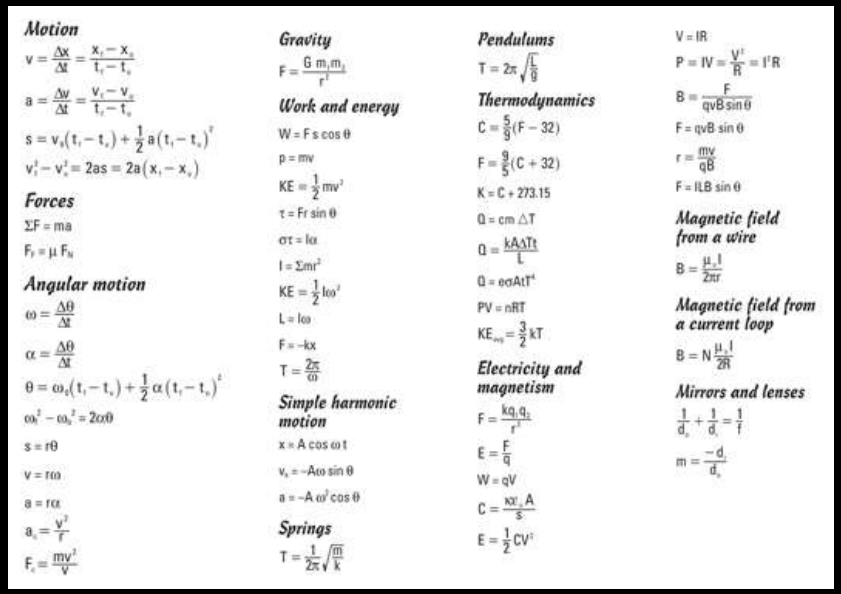


Motion

$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_o}{t_f - t_o}$

$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_o}{t_f - t_o}$

$s = v_o(t_f - t_o) + \frac{1}{2}a(t_f - t_o)^2$

$v_f^2 - v_o^2 = 2as = 2a(x_f - x_o)$

Forces

$\Sigma F = ma$

$F_f = \mu F_N$

Angular motion

$\omega = \frac{\Delta\theta}{\Delta t}$

$\alpha = \frac{\Delta\theta}{\Delta t}$

$\theta = \omega_o(t_f - t_o) + \frac{1}{2}\alpha(t_f - t_o)^2$

$\omega_f^2 - \omega_o^2 = 2\alpha\theta$

$s = r\theta$

$v = r\omega$

$a = r\alpha$

$a_c = \frac{v^2}{r}$

$F_c = \frac{mv^2}{r}$

Gravity

$F = \frac{G m_1 m_2}{r^2}$

Work and energy

$W = F s \cos\theta$

$p = mv$

$KE = \frac{1}{2}mv^2$

$\tau = Fr \sin\theta$

$\sigma\tau = I\alpha$

$I = \Sigma mr^2$

$KE = \frac{1}{2}I\omega^2$

$L = I\omega$

$F = -kx$

$T = \frac{2\pi}{\omega}$

Simple harmonic motion

$x = A \cos\omega t$

$v_x = -A\omega \sin\theta$

$a = -A\omega^2 \cos\theta$

Springs

$T = \frac{1}{2\pi}\sqrt{\frac{m}{k}}$

Pendulums

$T = 2\pi\sqrt{\frac{L}{g}}$

Thermodynamics

$C = \frac{5}{9}(F - 32)$

$F = \frac{9}{5}(C + 32)$

$K = C + 273.15$

$Q = cm\,\Delta T$

$Q = \frac{kA\Delta Tt}{L}$

$Q = e\sigma At^4$

$PV = nRT$

$KE_{avg} = \frac{3}{2}kT$

Electricity and magnetism

$F = \frac{kq_1q_2}{r^2}$

$E = \frac{F}{q}$

$W = qV$

$C = \frac{\kappa\varepsilon_o A}{s}$

$E = \frac{1}{2}CV^2$

$V = IR$

$P = IV = \frac{V^2}{R} = I^2R$

$B = \frac{F}{qvB\sin\theta}$

$F = qvB \sin\theta$

$r = \frac{mv}{qB}$

$F = ILB \sin\theta$

Magnetic field from a wire

$B = \frac{\mu_o I}{2\pi r}$

Magnetic field from a current loop

$B = N\frac{\mu_o I}{2R}$

Mirrors and lenses

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

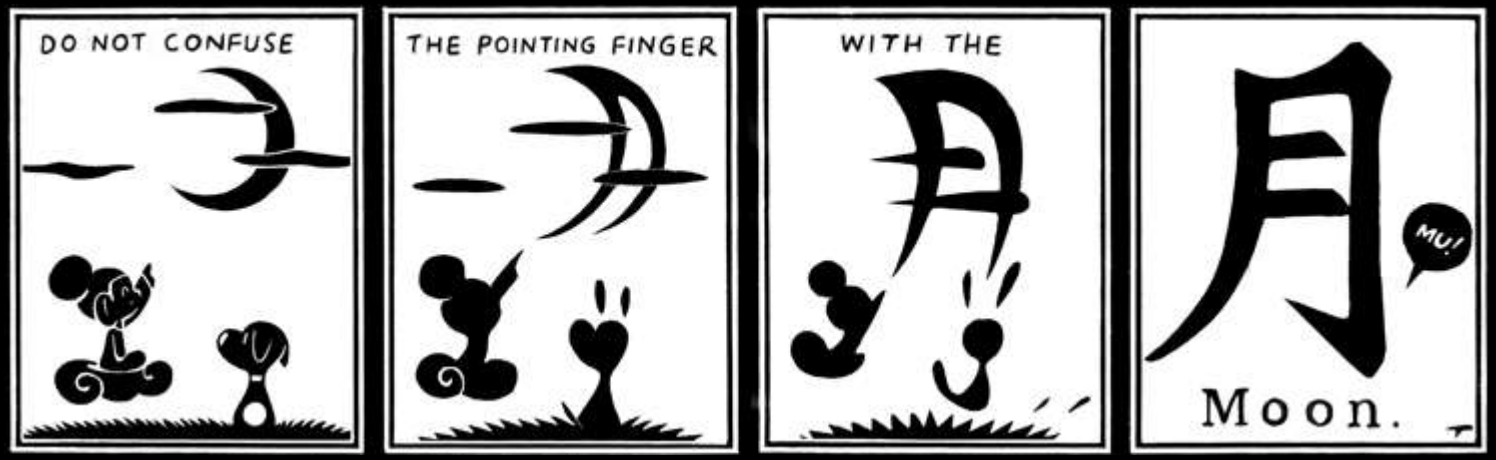
$m = \frac{-d_i}{d_o}$

Physics is a reduction / distillation of "objective categories"

Let's cut right to the chase

Physics and photography both define and revel in *categories*, *divisions*, *groupings*, *labels*, *orders*, and *partitions*;

Complexity and Tao
remind us of the
absurdity of dividing
the world in this way! ☺



Tatsuya Ishida (http://sinfest.net/comikaze/comics/2010-02-01.gif)

What Do I mean by "New" Aesthetic?

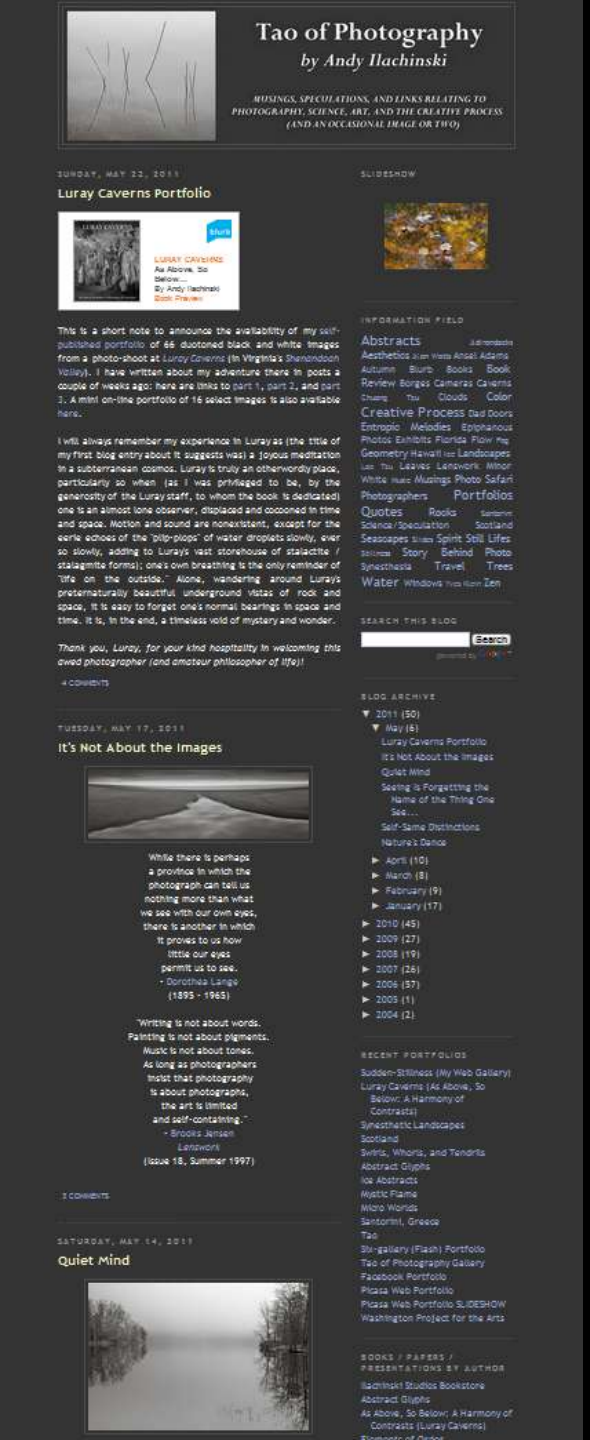
Speculations spurred by a provocative question by a blogger friend

Q: How does solving a difficult problem is physics compare to capturing a great image in photography?

A: The *experience* – in each context – is *exactly* the same !

Half the talk is a discussion about what I mean by "exactly the same"

The other half is about the potential implications if this is really so; *psychologically*, *creatively*, and *spiritually*



http://tao-of-digital-photography.blogspot.com

Most popular entries…

- *Ergodicity and (Abstract) Art*
  May 2006
- *Learning to See from the Blind*
  January 2009
- *Unconscious Influence and the Creative Process*
  February 2009
- *Sting, Goethe, and the Creative Process*
  August 2010
- *Implicate Order, Enfolded Centers*
  January 2011
- *Toward an Aesthetic Grammar*
  April 2007
- *Traversing an N-Dimensional Aesthetic Space*
  March 2009
- *The Click of the Shutter Button... and A Deep Mystery*
  November 2008

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Part 1: Andy as photographer-*physicist*

- Who am "I" – Take #1 / Take #2
- A few lessons from a physicist, photographer, and taoist
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- Who am "I" – Take #3

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A sampling of portfolios: examples of how one "photographic eye" is informed / shaped by physics, complexity, and Tao

- *Chaos, Order, Complexity, Entropy* ("Sudden Stillness" book)
- *Micro Worlds*
- *Abstract Glyphs*
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- *"As Above; so Below"* (latest project: Luray caverns, VA)

Physics, Complexity, and Photography: One Last Take

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Physics, Complexity, and Photography: One Last Take

Who Am I? – *Take #1*

Whatever I may know about light, tone, texture, form, and composition I learned by watching ***my dad***

He was not a photographer, But was an artist *par excellence*

- 1960: Born / Glen Cove, Long Island, NY
- 1970: First camera
  Polaroid instamatic / Christmas gift
  First picture: *(abstract?) closeup of my right toe*
- 1978: First encounter with Tao
  Chuang-Tzu: Inner Chapters
- 1982: First "serious" camera
  Canon AE-1
- 1988: Ph.D. / theoretical physics
  Discrete Complex Systems
- 1998: First digital camera
  Nikon Coolpix 950
- 2001: First published book
  Cellular Automata (physics)
- 2002: First "serious" DSLR
  Canon D60
- 2007: First Solo Show
  Coral Gables, Florida
  First *Lenswork* portfolio
  DVD Edition #71 / July-August
- 2008: First self-published book
  Hawaii, Blurb.com (photography)
  First art co-op
  One of 14 founding members of *Lorton Arts*, Occoquan, VA

Who Am I? – *Take #2*

Who am I ?

Physicist

Andy

?

Complexicologist

Photographer

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1970: First camera
Polaroid instamatic / Christmas gift
First picture: *(abstract?) closeup of my right toe*

1978: First encounter with Tao
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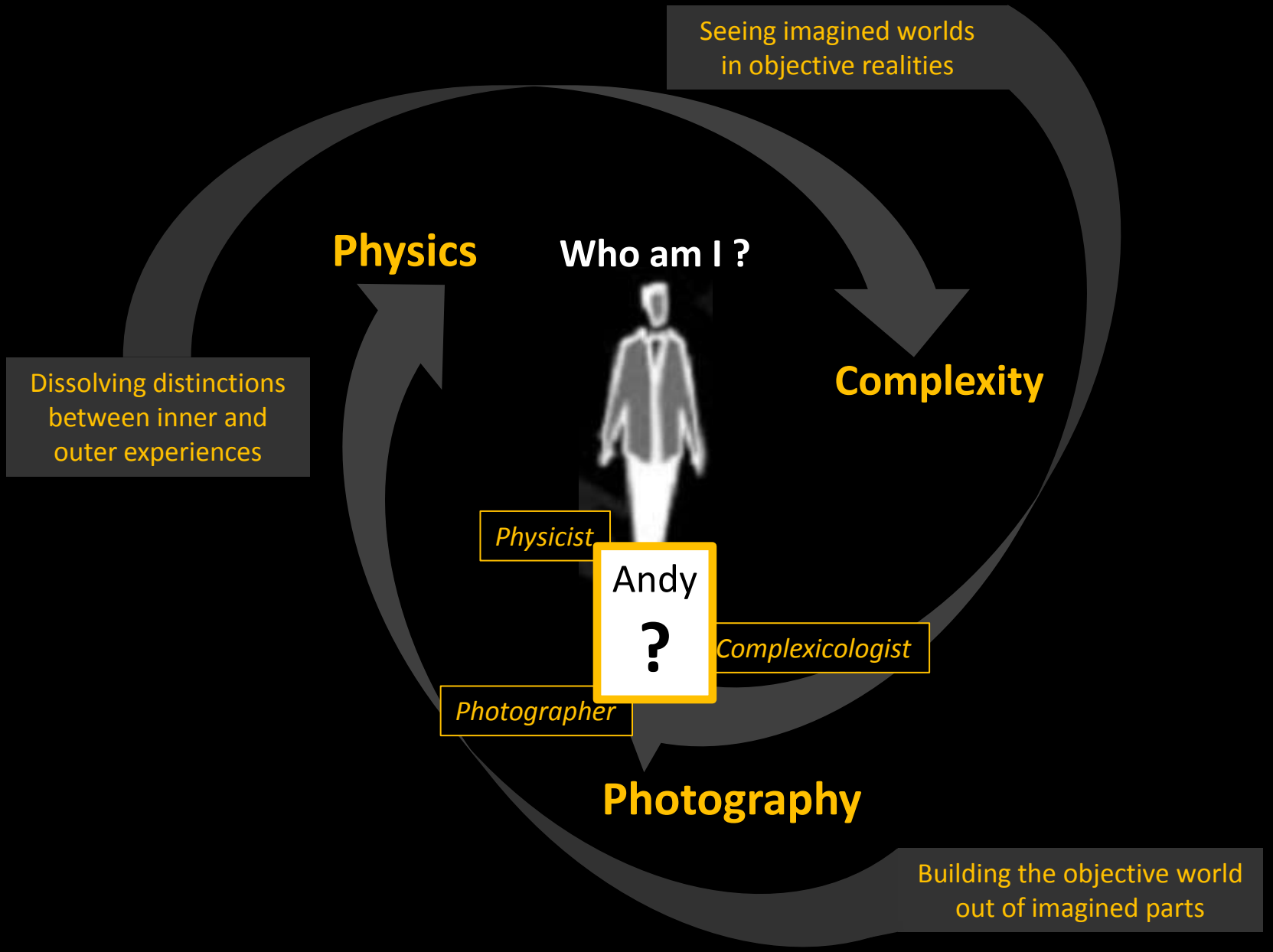
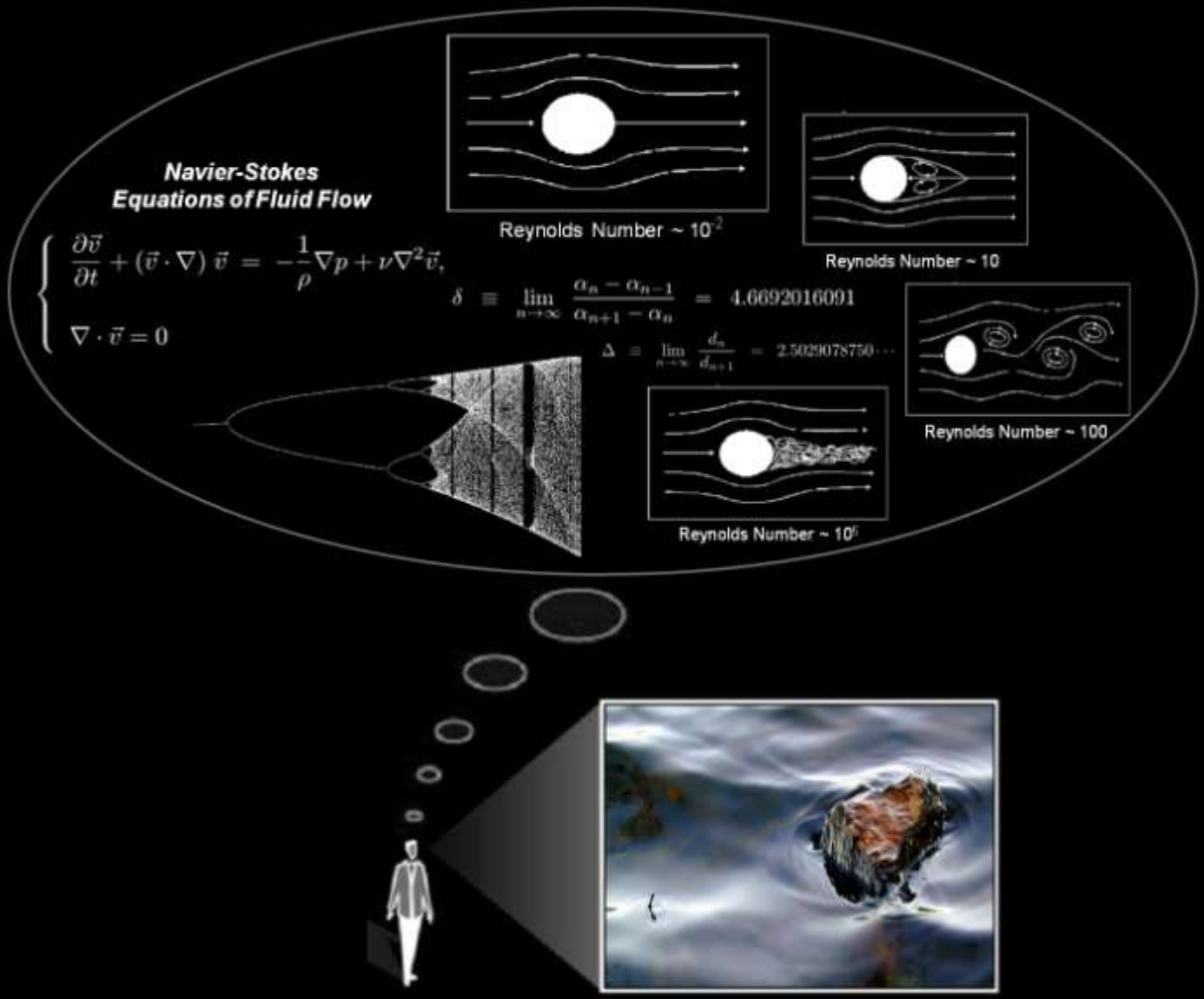
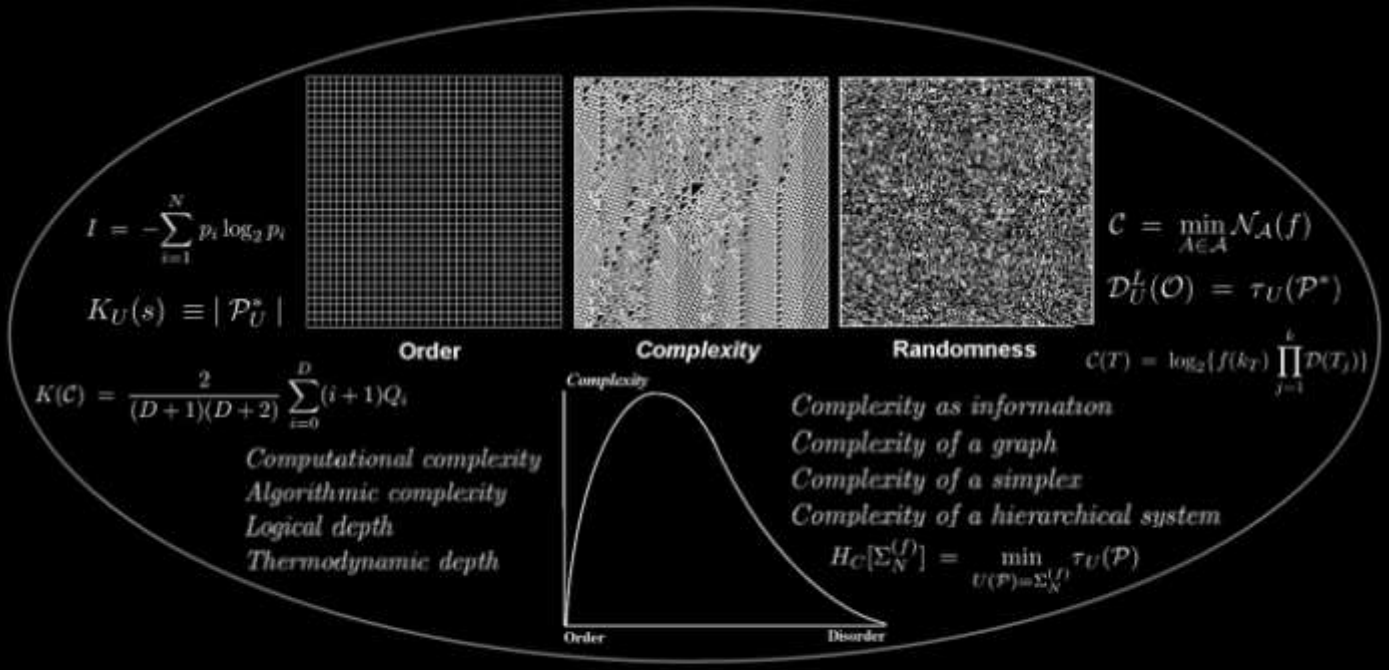
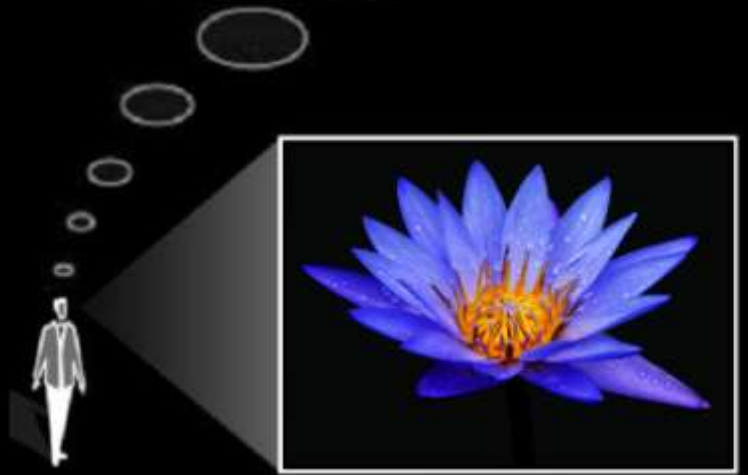


Sometimes I ***ponder about physics*** when something catches my eye

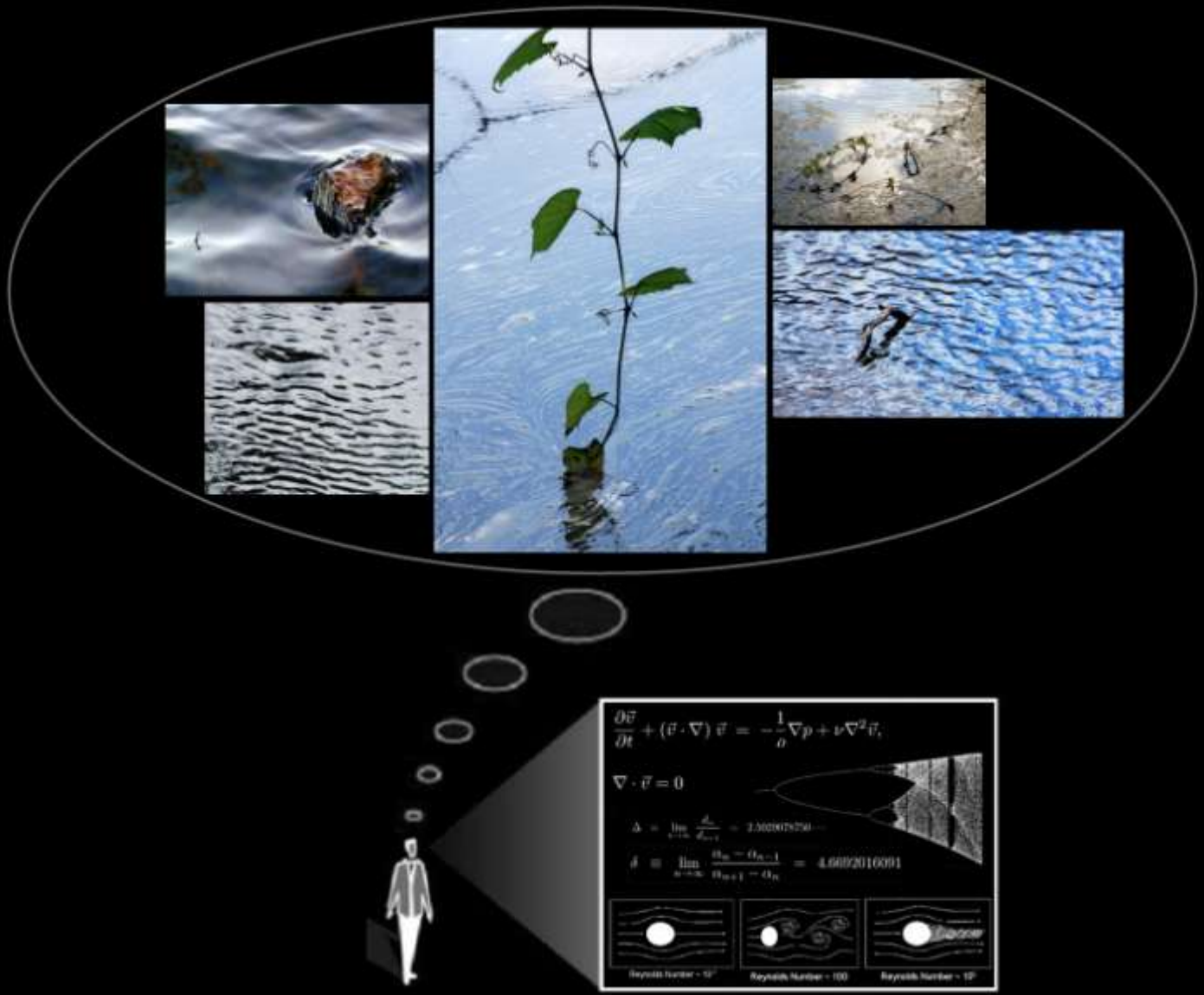


Sometimes I ***ponder about complexity …***

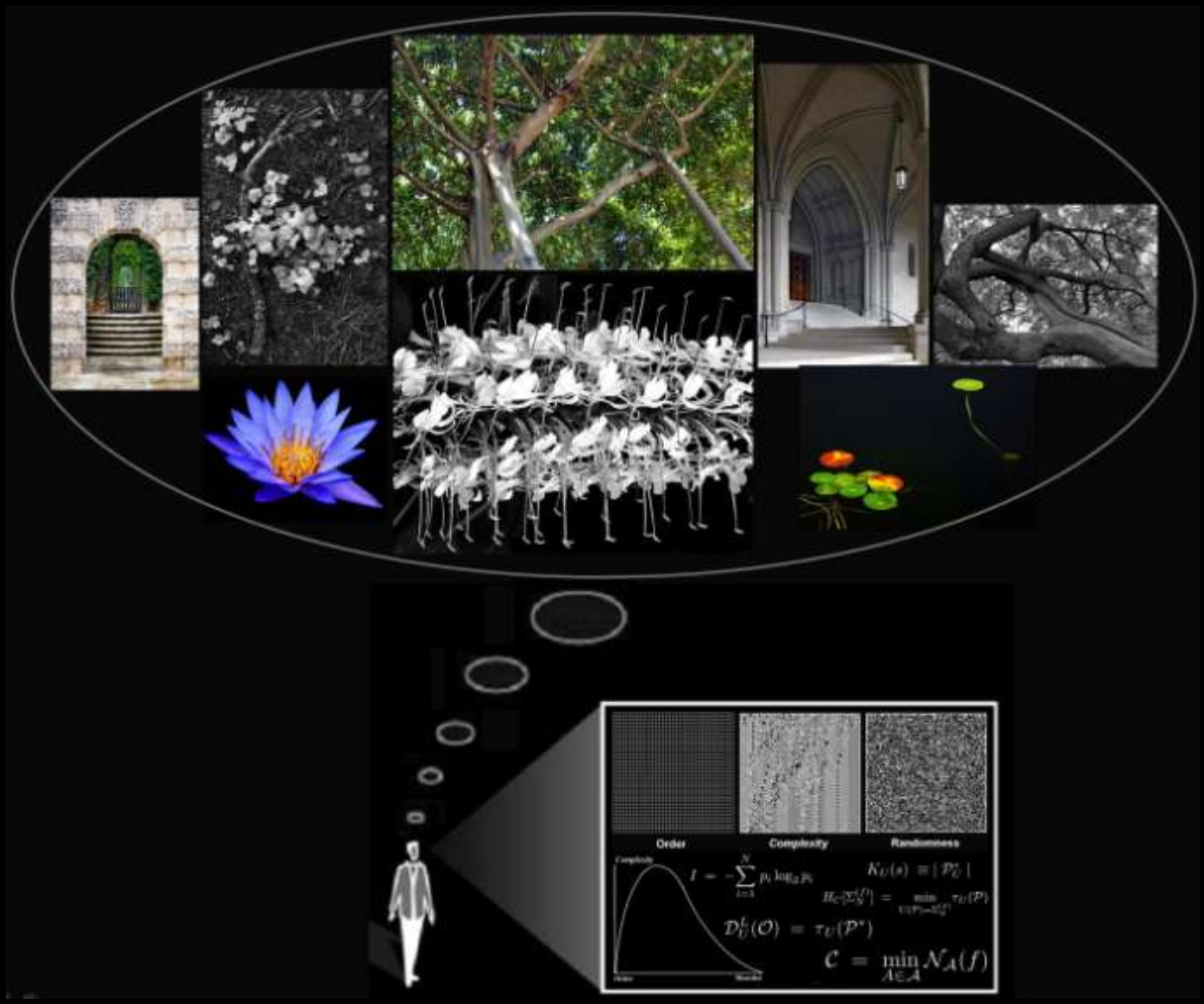




Sometimes I use my physics to ***steer my eye / camera***



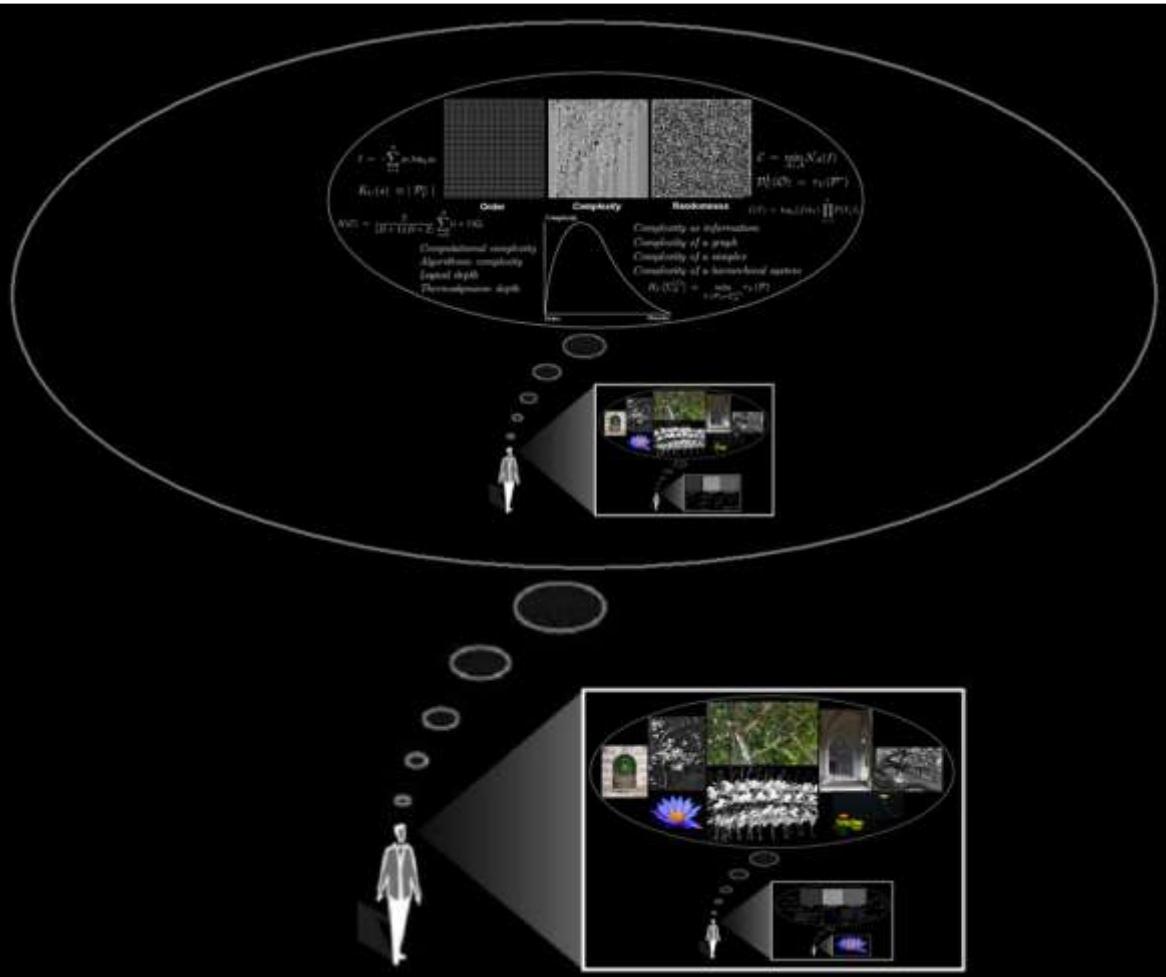
Sometimes I use my complexity to ***steer my eye / camera***



In truth, the core "Andy" is a "complex" ***nested creative process***…

[Art is a process] "…in which we give ourselves so deeply to our seeing that we take things right into ourselves and then give forth a new version of them from inside, tinted by all of the possibilities within us, transformed the way an oyster takes grit and makes a pearl."

— SEAN KERNAN, *Photographer* (*Lenswork*, May 2004)



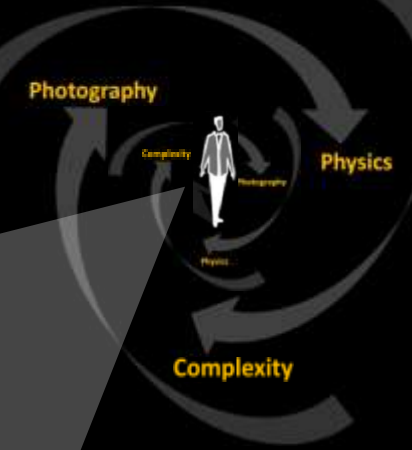
Who Am I? – *Take #2*

Seeing imagined worlds in objective realities

Physics

Who am I ?

Dissolving distinctions between inner and outer experiences



Complexity

Hypothesis

The best way to discover this "I" is to examine what it has spent a lifetime ***creating***

"I" am a creature on a creative journey, whose path is both *informed by* – and *shapes* – many "subjective" and "objective" categories

Photography

Building the objective world out of imagined parts

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Physics, Complexity, and Photography: One Last Take

A Lesson from a *Physicist*

"We are not only observers.
We are participators.
In some strange sense this is
a participatory universe...

...no phenomenon is a real
phenomenon until it is
an *observed* phenomenon."

— JOHN ARCHIBALD WHEELER
Physicist (1911 - 2008)

A Lesson from a *Complexicologist*

"There is a constant and intimate contact among the things that coexist and coevolve in the universe;

A sharing of bonds and messages that makes reality into a stupendous network of interaction and communication."

— ERVIN LASZLO
Philosopher & Systems Theorist (1932 -)

A Lesson from a *Photographer*

"There is no closed figure in nature
Every shape participates with another.
No one thing is independent of another,
and one thing rhymes with another,
and light gives them shape."

— HENRI CARTIER-BRESSON, *Photographer / Artist* (1908 - 2004)

A Lesson from *Taoist Master*

"Before I had studied Zen for thirty years,
I saw mountains as mountains, and waters as waters...

When I arrived at a more intimate knowledge, I came to the point where I saw that mountains are not mountains, and waters are not waters.

But now that I have got its very substance I am at rest.
For it's just that I see mountains once again as mountains,
and waters once again as waters."

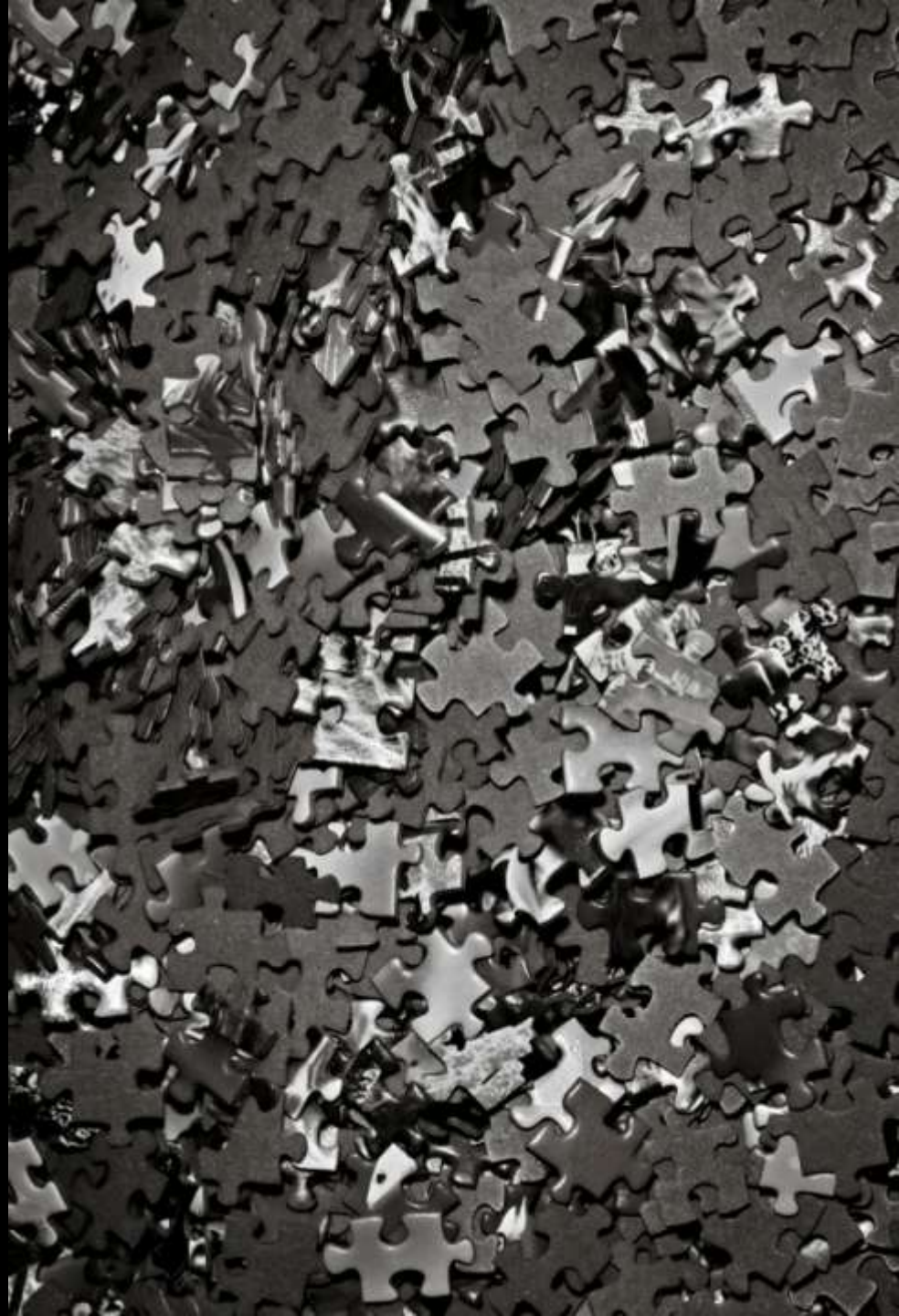
— Ching-te Ch'uan Teng-lu *("Transmission of the Lamp")*

Takeaway #1

All partitions are arbitrary

"The division of the perceived universe
into parts and wholes is convenient
and may be necessary,
but no necessity determines
how it shall be done."

— GREGORY BATESON
(*Anthropologist*, 1904 – 1980)



Takeaway #2

There are no things, just processes

"All is process. That is to say, there is 'no thing' in the universe. Things, objects, entities, are abstractions of what is relatively constant from a process of movement and transformation.

They are like the shapes that children like to see in clouds.."

— DAVID BOHM
(*Physicist*, 1917 – 1992)

Takeaway #3

All is organized energy

"Science shows us that
the visible world is
neither matter nor spirit;
the visible world is the
invisible organization of energy."

— HEINZ PAGELS
(*Physicist*, 1939 – 1988)

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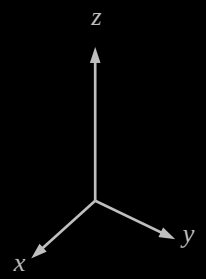
What Does a Physicist Do?

The multidimensional "art" of selection / pattern spaces



Dimensions of Reality

Dimensions of Physicist

(Local) Order Dimensions

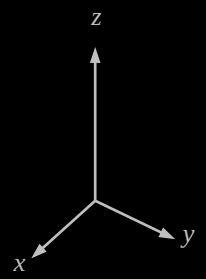
Dimensions of Reviewer

(Global) Order Dimensions

- **Experience / view the world – *experiment / interact***
- **Find "something" interesting**
  … in the given context, for a particular reason(s)
- **Select "something of that something"**
  … deliberately excluding everything else
- **Focus *re*viewer's attention (peer review)**
  … on the message you wish your physics to communicate
- **How does this "something" fit into whole body of work?**
  … that the physicist has produced over a lifetime

What Does a Photographer Do?

The multidimensional "art" of selection / aesthetic spaces



Dimensions of Reality

Dimensions of Photographer

(Local) Aesthetic Dimensions

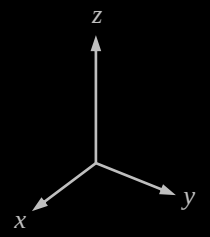
Dimensions of Viewer

(Global) Aesthetic Dimensions

- **Experience / view the world – *experiment / interact***
- **Find "something" interesting**
  … in a given context, for a particular reason(s)
- **Select "something of that something"**
  … you wish to capture, deliberately excluding everything else
- **Focus viewer's attention**
  … on the message you wish your photograph to communicate
- **How does this "something" fit into whole body of work?**
  … that the photographer has produced over a lifetime

What Does a Photographer Do?

The multidimensional "art" of selection / aesthetic spaces



Aesthetic

An artist's pattern of selections

(in some *n*-dimensional feature space)

Core of Creative Process Is ***Selection***

- Selecting ***where to look***
- Selecting ***what to take a picture of***
- Selecting ***camera, lens, aperture, exposure, …***
- Selecting ***what to emphasize in post-processing***
- Selecting ***who / where to show***
- Selecting ***what to keep in (long-term) portfolio***

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- *Swirls, Whorls, and Tendrils*
- *Tao*
- *"As Above; so Below"* (latest project: Luray caverns, VA)

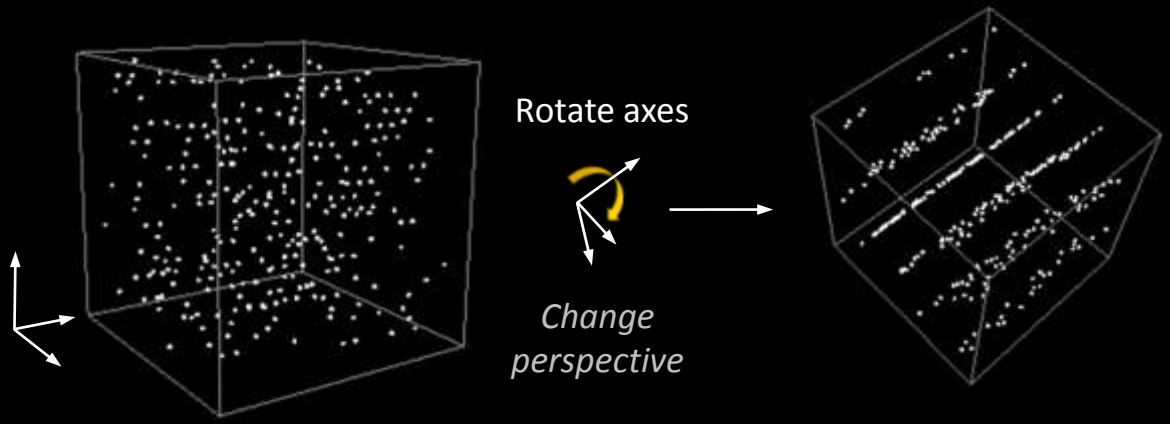
Physics, Complexity, and Photography: One Last Take

Aesthetics (a Physicist's Take… ;-)

"To me, photography is an art of observation.
It's about finding something interesting in an ordinary place…
I've found it has little to do with the things you see
and everything to do with the way you see them."

- Elliot Erwitt, *Photographer* (1928 -)

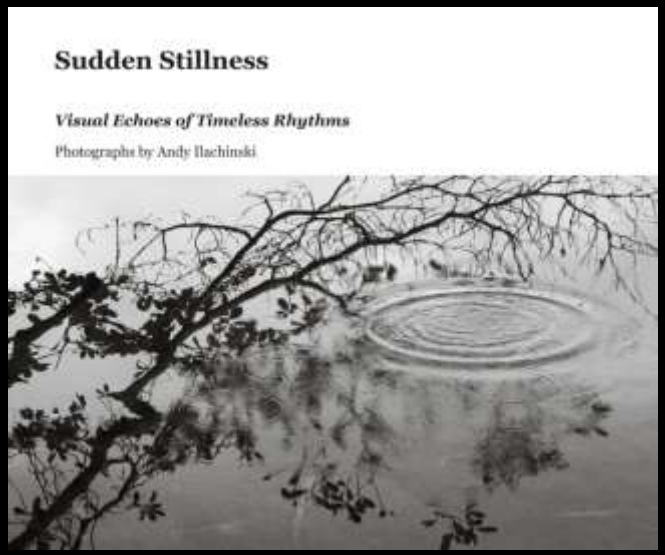
- Why ***this*** instead of that?
- An ordering principle



Is this really random?

Seeing with a new "aesthetic"

A “Baby Step” Experiment



http://www.blurb.com/bookstore/detail/245471

Chaos

Order

Complexity

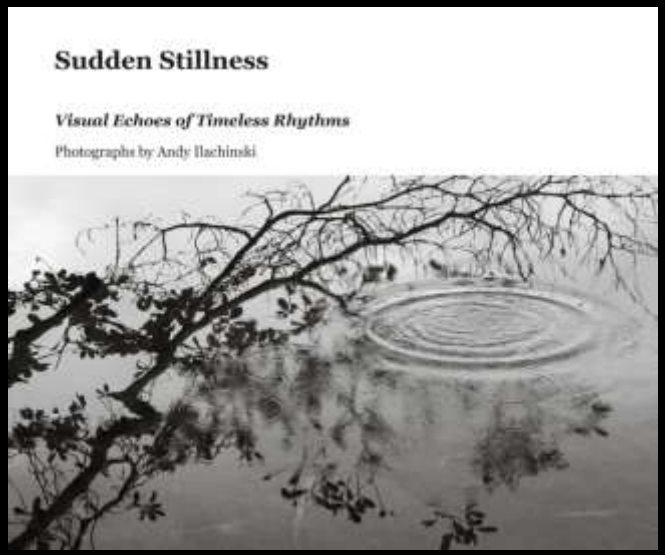
Entropy

Dialectic
Transition
Figure / Ground
Repetition
Distinction
Stability
Balance
Organization
Coherence
Geometry

ARCHITECTONIC MYSTERY
(See entry in "Notes" section on page 258)

Dialectic, Transition, Figure/Ground, Repetition, Distinction, Stability, Balance, Organization, Coherence, Geometry

A “Baby Step” Experiment



http://www.blurb.com/bookstore/detail/245471

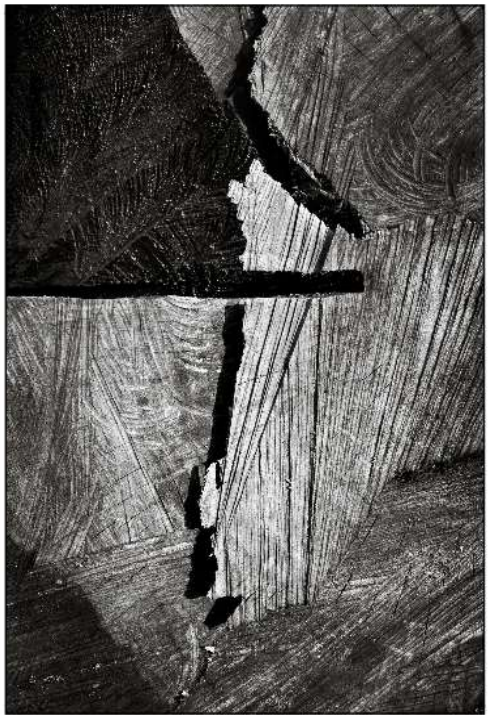
Chaos

Order

Complexity

Entropy

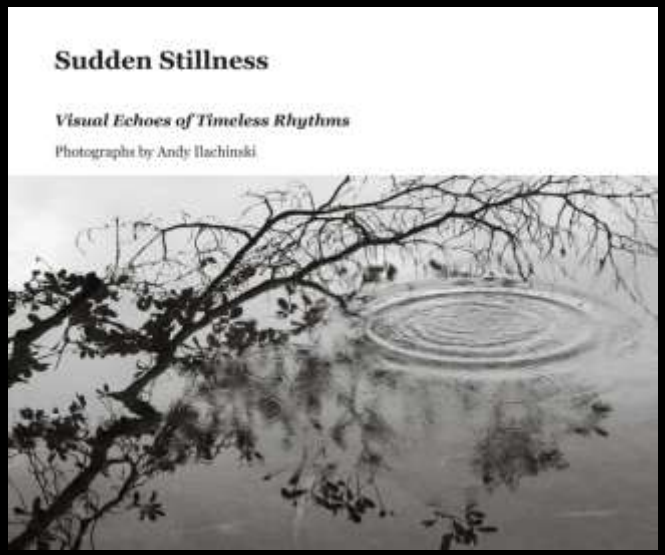
Extrusion
Fine / Course
Dislocation
Stability
Modularity
Planarity
Opposition
Overlap
Geometry
Proximity



COSMIC MYSTERY 2

Extrusion, Fine/Coarse, Dislocation, Stability, Modularity, Planarity, Opposition, Overlap, Geometry, Proximity

A “Baby Step” Experiment



http://www.blurb.com/bookstore/detail/245471

Chaos

Order

Complexity

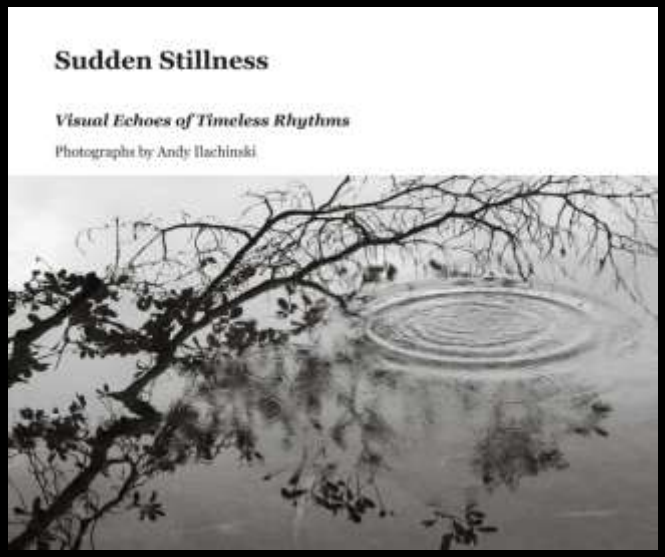
Entropy

Geometry
Gestalt
Dissonance
Dominance
Organization
Interlock
Assembly
Connection
Angularity
Scale

FROZEN SPIRIT
(See entry in "Notes" section on page 260)

Geometry, Gestalt, Dissonance, Dominance, Organization, Interlock, Assembly, Connection, Angularity, Scale

A “Baby Step” Experiment



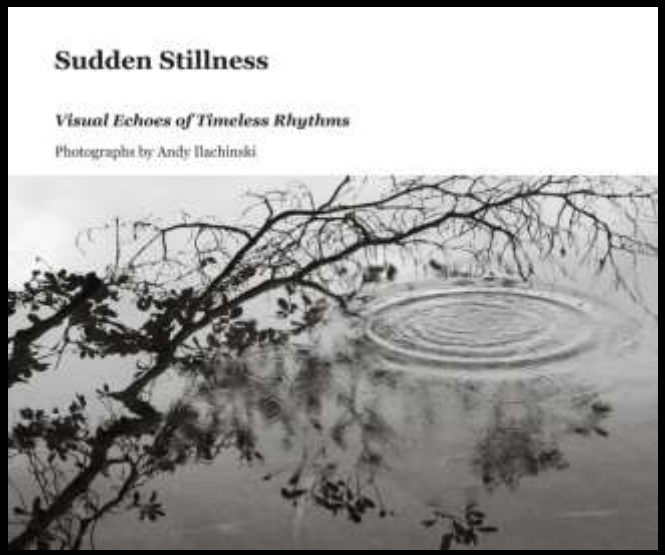
http://www.blurb.com/bookstore/detail/245471

Most Common Features

Harmony
Interlock
Interpenetration
Stillness
Unity

Chaos	*Order*	*Complexity*	*Entropy*
Analogy	Dominance	Interpenetration	Scale
Angularity	Dynamics	Interrelation	Separability
Assembly	Enfolding	Intersection	Sequential
Asymmetry	Equilibrium / Disequilibrium	Mixture	Similarity
Attraction	Equivalence	Modularity	Space
Balance	Extrusion	Negative / Positive	Stability
Boundary	Field	Neutrality	Stillness
Centeredness	Figure / Ground	Opposition	Stress
Clusteredness	Fine / Coarse	Organization	Subtraction
Coherence	Geometry	Orientation	Superposition
Coincidence	Gestalt	Overlap	Surface
Combination	Gradient	Parallel	Symmetry
Compound	Group	Partition	Synergy
Connection	Harmony	Penetration	Synesthesia
Convergence	Heterogeneity	Perspective	System
Cooperation	Hierarchy	Planarity	Tension
Coordination	Holarchy	Position	Tonality
Dialectic	Homogeneity	Process	Topology
Diffusion	Imitation	Proportion	Transformation
Direction	Influence	Proximity	Transition
Dislocation	Instability / Stability	Randomness	Transparent / Opaque
Dissimilarity	Integration	Redundance	Unfolding
Dissonance	Interaction	Reflection	Unity
Distinction	Interdependence	Repetition	Unpredictability
Diversity	Interlock	Resonance	Variety

A “Baby Step” Experiment



http://www.blurb.com/bookstore/detail/245471

Most Common Feature-Feature Pairs

Figure-Ground / Geometry
Coherence / Harmony
Dialectic / Gestalt
Dynamics / Stillness
Distinction / Interpenetration

Chaos

Order

Complexity

Entropy

Analogy	Dominance	Interpenetration	Scale
Angularity	Dynamics	Interrelation	Separability
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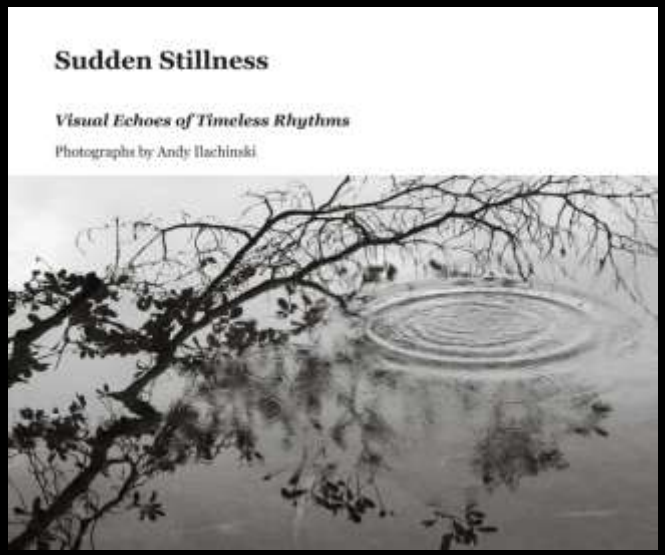
A “Baby Step” Experiment



http://www.blurb.com/bookstore/detail/245471

Most Common Feature-Feature Triplets

Balance / Coherence / Synergy
Dialectic / Gestalt / Resonance
Interlock / Unity / Unfolding
Dynamics / Stillness / Process
Balance / Interpenetration / System

Chaos

Analogy
Angularity
Assembly
Asymmetry
Attraction
Balance
Boundary
Centeredness
Clusteredness
Coherence
Coincidence
Combination
Compound
Connection
Convergence
Cooperation
Coordination
Dialectic
Diffusion
Direction
Dislocation
Dissimilarity
Dissonance
Distinction
Diversity

Order

Dominance
Dynamics
Enfolding
Equilibrium / Disequilibrium
Equivalence
Extrusion
Field
Figure / Ground
Fine / Coarse
Geometry
Gestalt
Gradient
Group
Harmony
Heterogeneity
Hierarchy
Holarchy
Homogeneity
Imitation
Influence
Instability / Stability
Integration
Interaction
Interdependence
Interlock

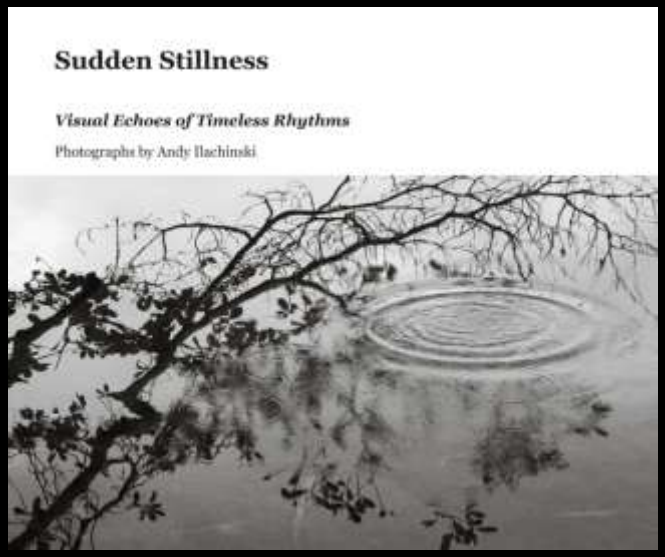
Complexity

Interpenetration
Interrelation
Intersection
Mixture
Modularity
Negative / Positive
Neutrality
Opposition
Organization
Orientation
Overlap
Parallel
Partition
Penetration
Perspective
Planarity
Position
Process
Proportion
Proximity
Randomness
Redundance
Reflection
Repetition
Resonance

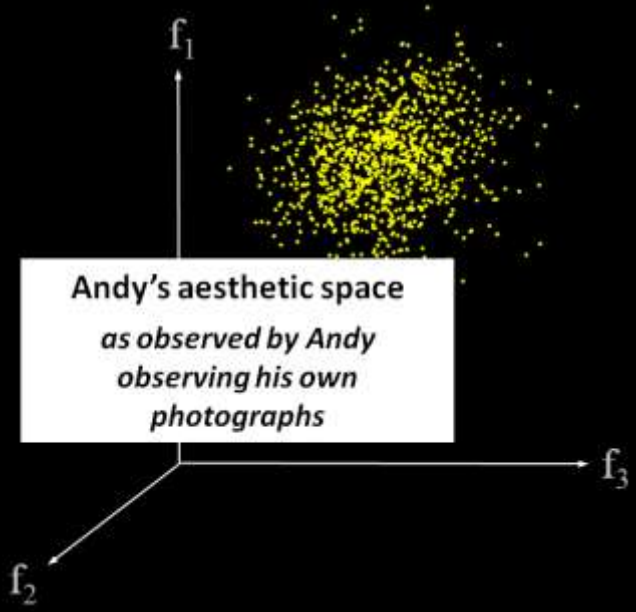
Entropy

Scale
Separability
Sequential
Similarity
Space
Stability
Stillness
Stress
Subtraction
Superposition
Surface
Symmetry
Synergy
Synesthesia
System
Tension
Tonality
Topology
Transformation
Transition
Transparent / Opaque
Unfolding
Unity
Unpredictability
Variety

A “Baby Step” Experiment



http://www.blurb.com/bookstore/detail/245471



Chaos	*Order*	*Complexity*	*Entropy*
Analogy	Dominance	Interpenetration	Scale
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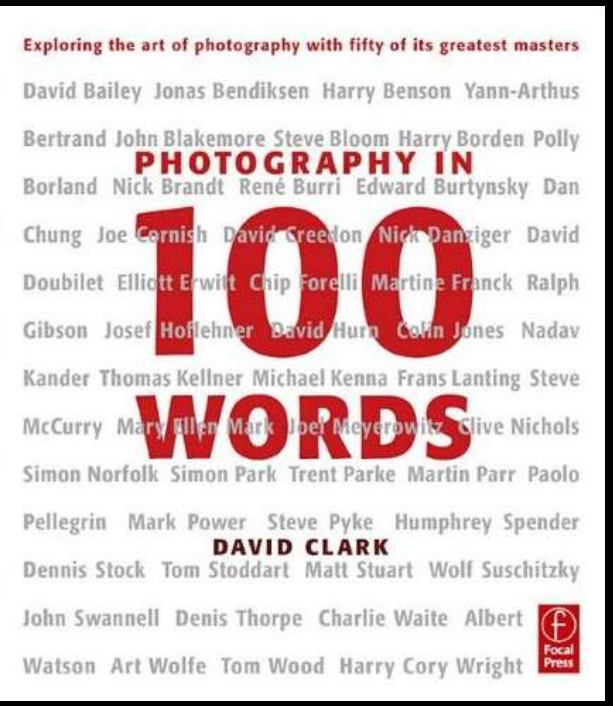
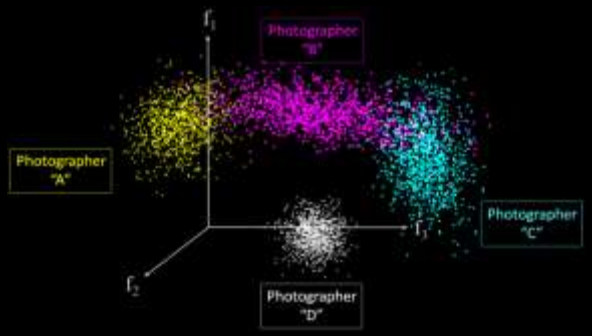
Dissonance	Interaction	Reflection	Unity
Distinction	Interdependence	Repetition	Unpredictability
Diversity	Interlock	Resonance	Variety

Photography in 100 Words: David Clark

…ideas … stories … motion …crisis … wonder …provoke … metaphor …exploration … emotional …challenge … truth …seredipitous … inquisitive …





David Bailey	… simplicity … accident …
Henry Benson	… motion … crisis …
Y.-A. Bertrand	… wonder … provoke …
Steve Bloom	… emotion … challenge …
Nick Brandt	… mythic … elegy …
Joe Cornish	… atmosphere … connection …
David Doubilet	… otherwordly … addictive …
Elliot Erwitt	… humor … observation …
Ralph Gibson	… signature … subtractive …
David Hurn	… culture … memory …
Michael Kenna	… suggestion … abstract …
Steve McCurry	… compelling … insight …
J. Meyerowitz	… awakened … delight …
Martin Parr	… recognition … ambiguity …
Paolo Pellegrin	… witness … signal …
Dennis Stock	… preconception … improvisation …
Denis Thorpe	… distance … geometry …
Charlie Waite	… recognition … ambiguity …
Art Wolfe	… moment … vision …

Outline

Part 1: Andy as photographer-*physicist*

- Who am "I" – Take #1 / Take #2
- A few lessons from a physicist, photographer, and taoist
- What a physicist does vs. what a photographer does
- Aesthetics – a physicist's take; a "baby step" experiment
- Evolving landscapes (take #1 / #2 / #3)
- Complexity – a gentle introduction
- Steps Towards a Universal Language of Aesthetics?
- Who am "I" – Take #3

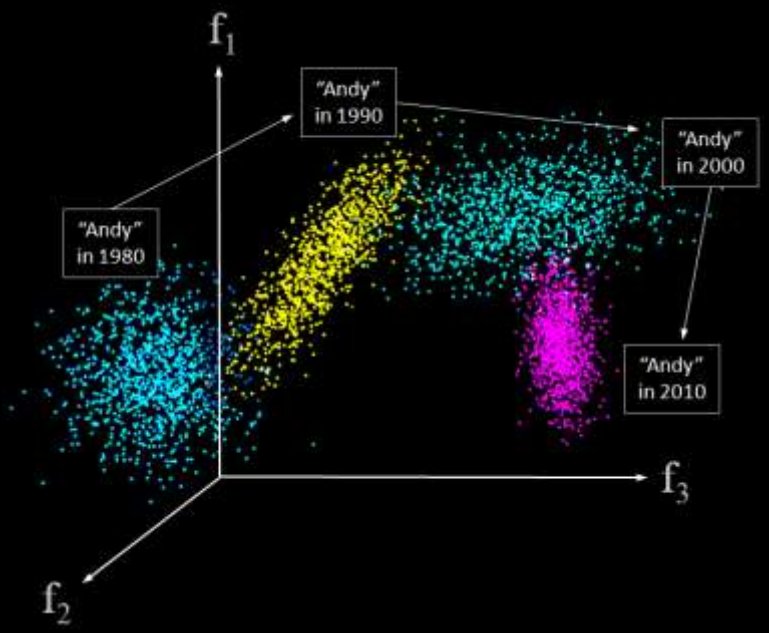
Part 2: Andy as physicist-*photographer*

A sampling of portfolios: examples of how one "photographic eye" is informed / shaped by physics, complexity, and Tao

- *Chaos, Order, Complexity, Entropy* ("Sudden Stillness" book)
- *Micro Worlds*
- *Abstract Glyphs*
- *Swirls, Whorls, and Tendrils*
- *Tao*
- *"As Above; so Below"* (latest project: Luray caverns, VA)

Physics, Complexity, and Photography: One Last Take

Evolving Landscapes: *Take #1*



- 1960: Born / Glen Cove, Long Island, NY
- 1970: First camera
  Polaroid instamatic / Christmas gift
  First picture: *(abstract?) closeup of my right toe*
- 1978: First encounter with Tao
  Chuang-Tzu: Inner Chapters
- 1982: First "serious" camera
  Canon AE-1
- 1988: Ph.D. / theoretical physics
  Discrete Complex Systems
- 1998: First digital camera
  Nikon Coolpix 950
- 2001: First published book
  Cellular Automata (physics)
- 2002: First "serious" DSLR
  Canon D60
- 2007: First Solo Show
  Coral Gables, Florida
  First *Lenswork* portfolio
  DVD Edition #71 / July-August
- 2008: First self-published book
  Hawaii, Blurb.com (photography)
  First art co-op
  One of 14 founding members of *Lorton Arts*, Occoquan, VA

B&W / Darkroom

Photography: *Everything (that catches the eye)*

Transition #1

Color Slides

Transition #2

B&W / Photoshop
"Serious" printing: *outsourced*

Photography: *Things* / *Places*

Transition #3

B&W / Photoshop
"Serious" printing: *self*

Photography:
Feelings / Mood / Projects

Started entering juried contests

Evolving Landscapes: *Take #2*

Stage 1: Joyful snapshots of anything and everything

→ *First camera, excited about anything & everything*

Stage 2: A passive stirring of aesthetic value

→ *Certain objects draw a deeper attention than others*

Stage 3: Willful engagement of the aesthetic environment

→ *Photographer actively seeks out images of interest*

→ *Both difficult to see "from the outside" and dramatic*

Stage 4: Recognition of the power of expression

→ *Photographer discovers how to express not the object itself, but what draws attention to the object*

Stage 5: One picture is not enough

→ *Photographer begins to see the world as a patchwork; a tapestry of images*

Stage 6: Need to tell a story

→ *Focus on portfolios of interrelated images as elements of narrative*

→ *Interested in telling a story about what the eye (and heart) is drawn to, and why*

Stage 7: Portfolios of Portfolios

→ *Work begins to transcend a "mere" aesthetic impression of the world to an imprint of a deeper aesthetic order of the external world*

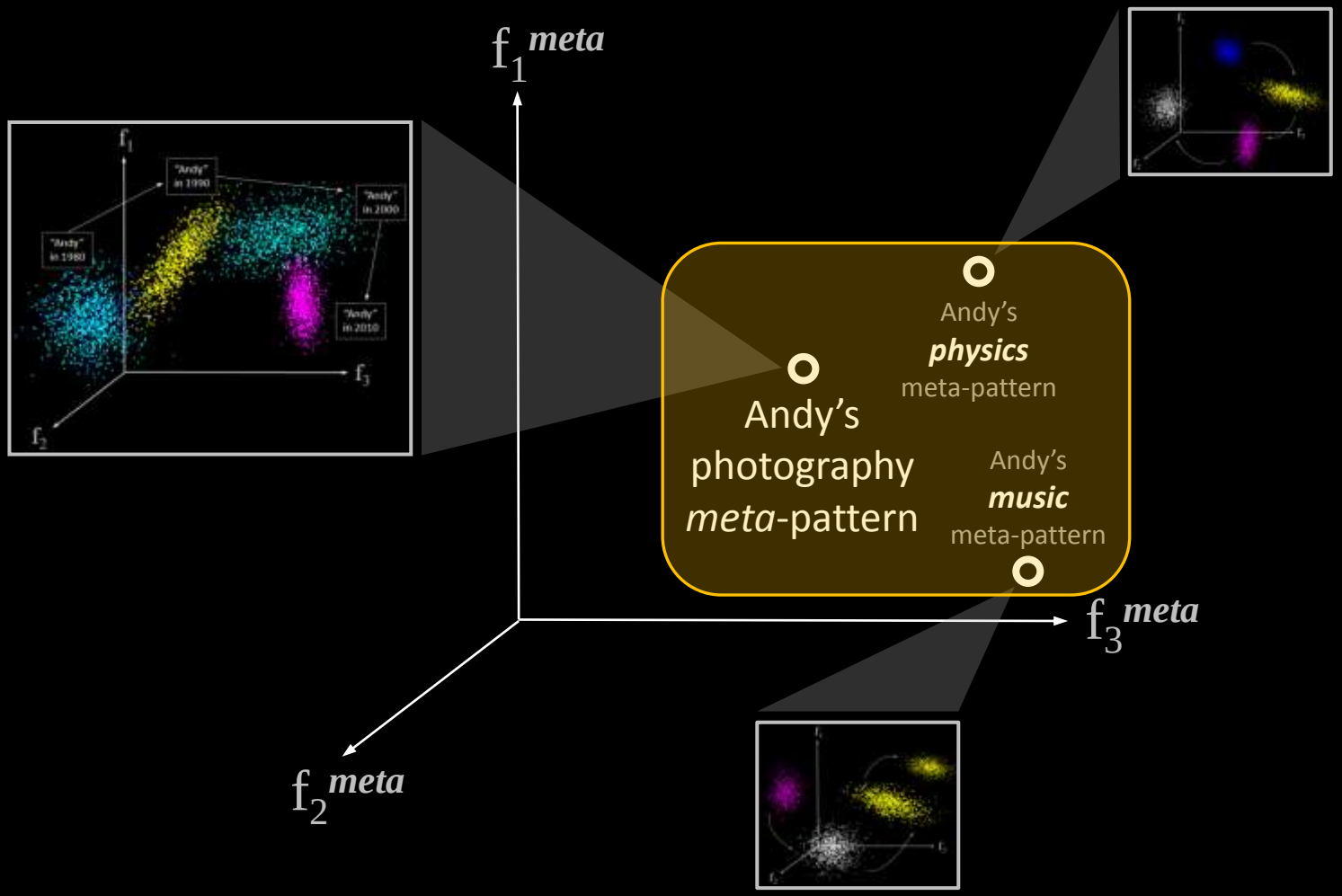
→ *Photographer "discovers" the patterns of the world by observing her own work*

Stage 8: Self-discovery

→ *Outwardly similar to Stage-7 (to others)*

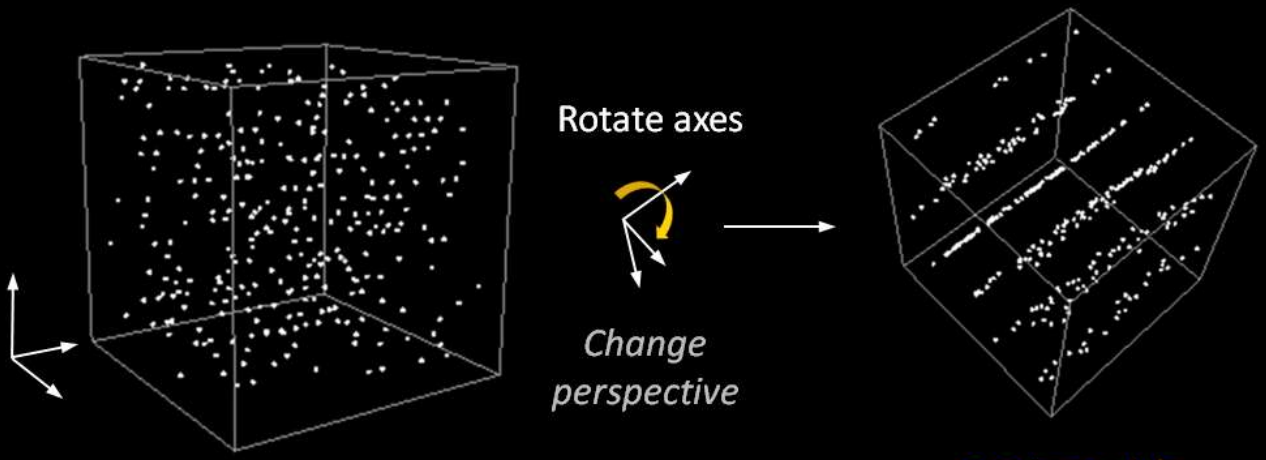
→ *Inwardly, photographer "discovers" truths about her own soul*

Evolving Landscapes: *Take #3*



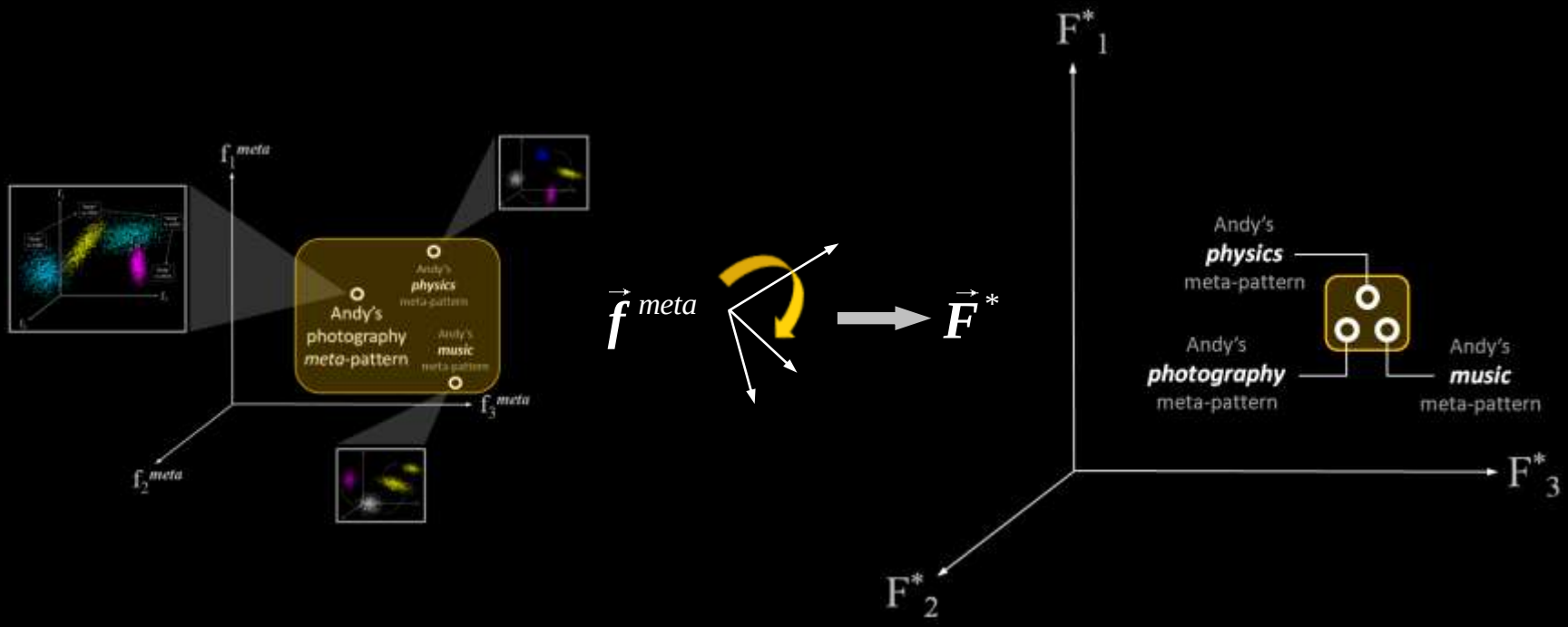
Evolving Landscapes: *Take #3*

Remember earlier illustration?



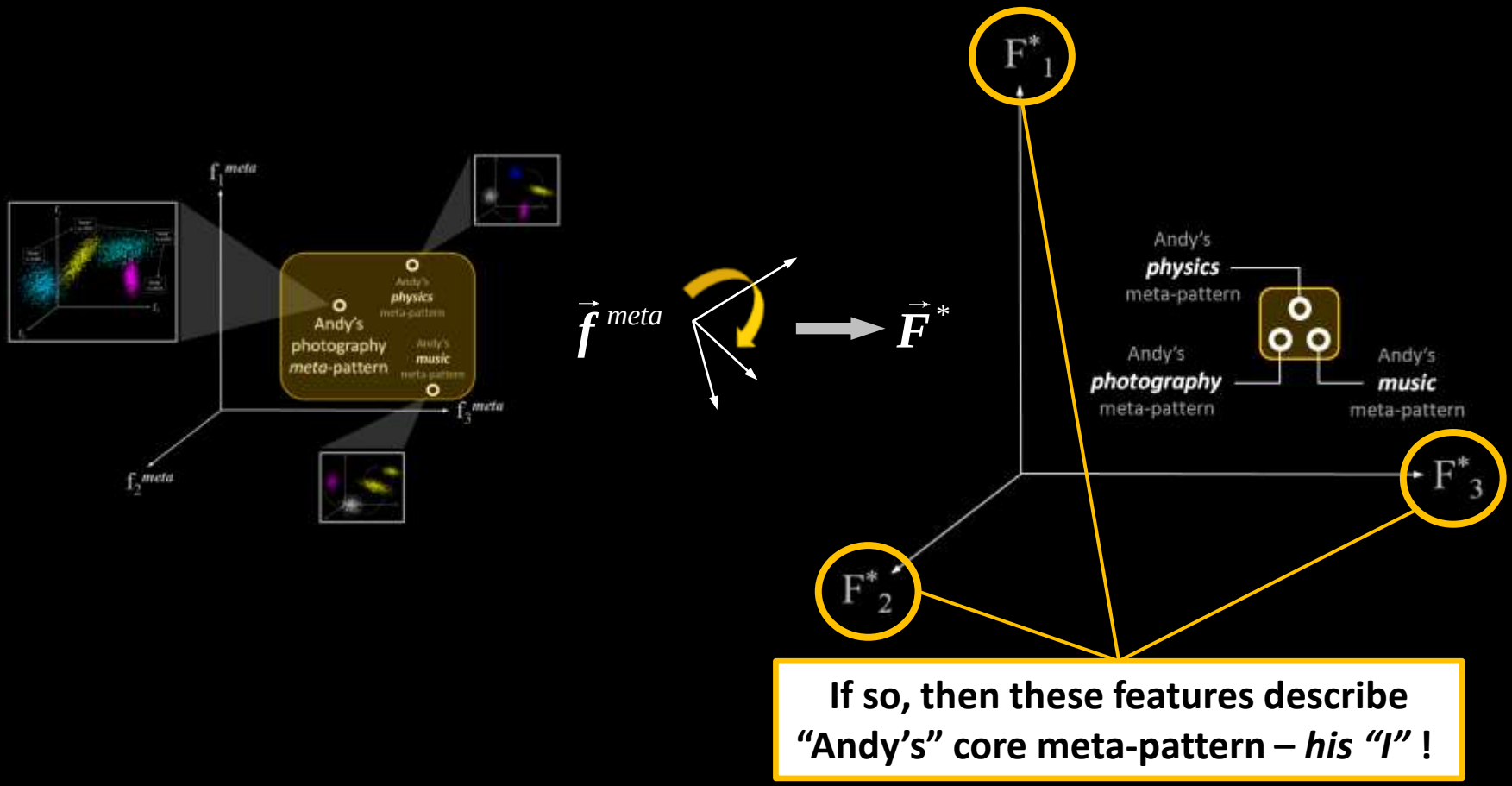
Evolving Landscapes: *Take #3*

Is there a way to “rotate the aesthetic axes” so that …



Evolving Landscapes: *Take #3*

Is there a way to "rotate the aesthetic axes" so that …



If so, then these features describe "Andy's" core meta-pattern – *his "I"* !

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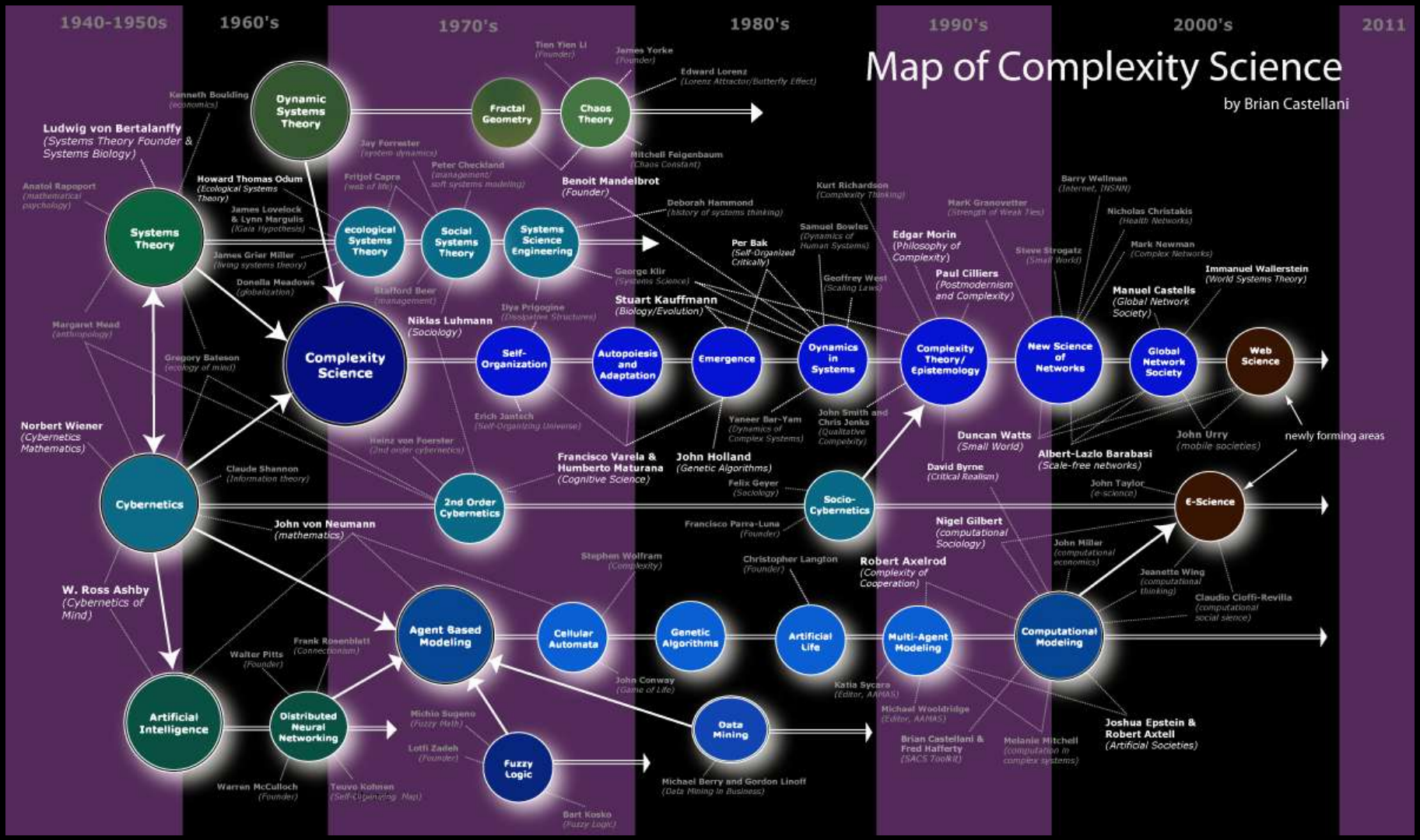
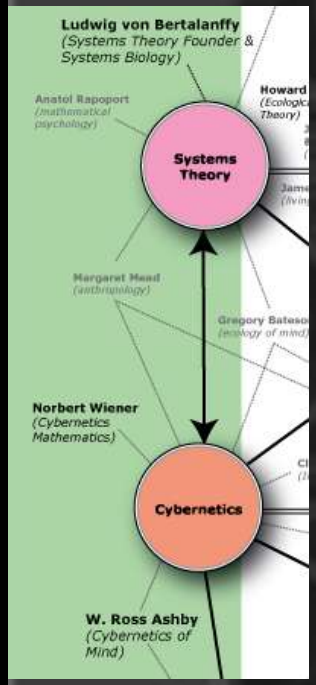
Physics, Complexity, and Photography: One Last Take

Complexity: *Timeline*



Interactive Map → http://www.art-sciencefactory.com/complexity-map_feb09.html

Complexity: *Timeline*



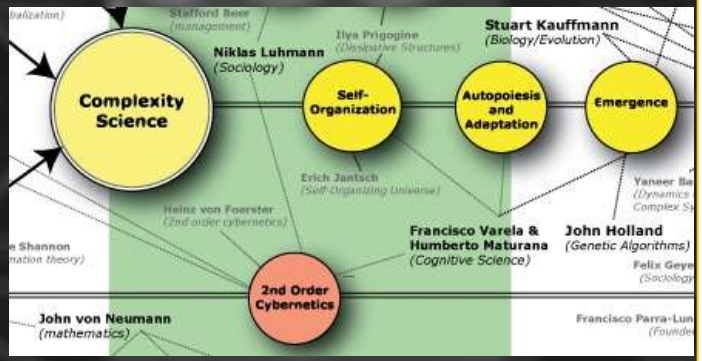
Bertalanffy / Wiener / Ashby / …
(*Cybernetics* & *Systems Theory*, 1940s-1950s)

Shifted focus from mass, energy, and force to *feedback*, *control*, *information*, and *communication*

→ ***Introduced new "aesthetic" components for a new (and still evolving) worldview of nature***

Interactive Map → http://www.art-sciencefactory.com/complexity-map_feb09.html

Complexity: *Timeline*



Varela / Maturana / Kauffman / …
(*Complexity Science*, 1970s-1990s)

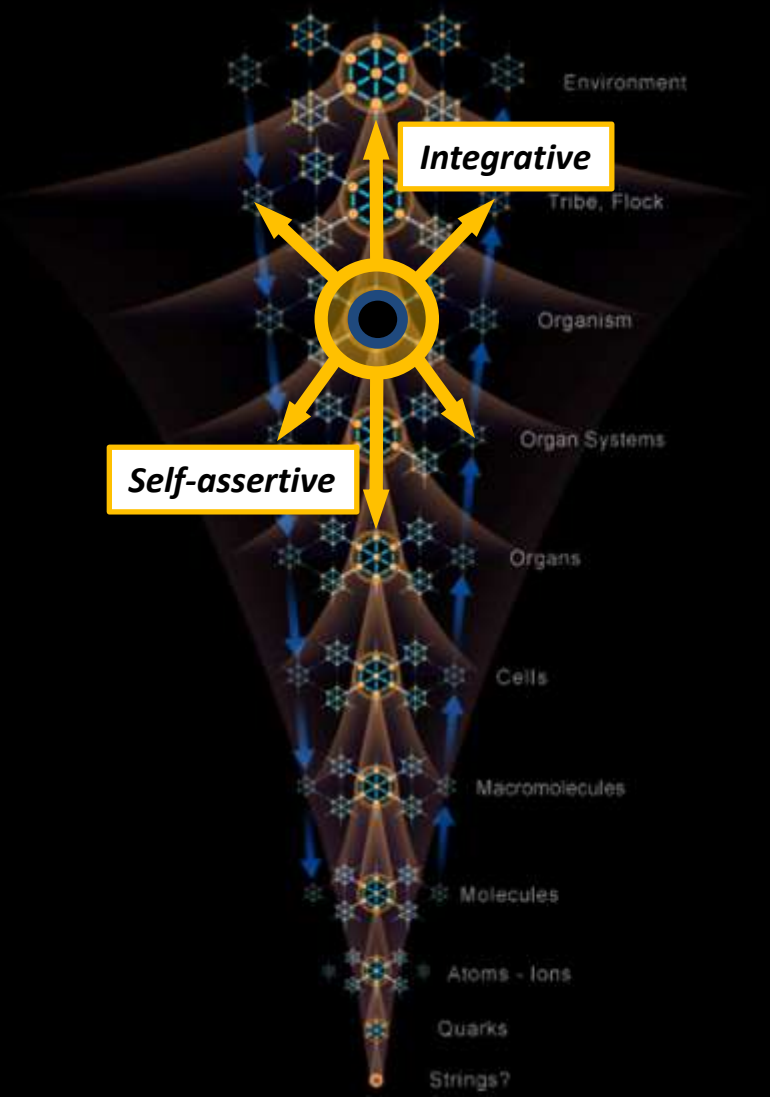
Autopoiesis = *Self-Creation*

(Greek: *auto* = "self" and *poiesis* = "creation)

1. ***Dynamic form is only incompletely specified by properties of "objects"***
2. ***Systems defined by self-referential form-preserving transformations***

Interactive Map → http://www.art-sciencefactory.com/complexity-map_feb09.html

Complex Systems: A Gentle Introduction



http://www.idiagram.com/examples/complexity.html

Arthur Koestler (1967)
The Ghost in the Machine

Holons

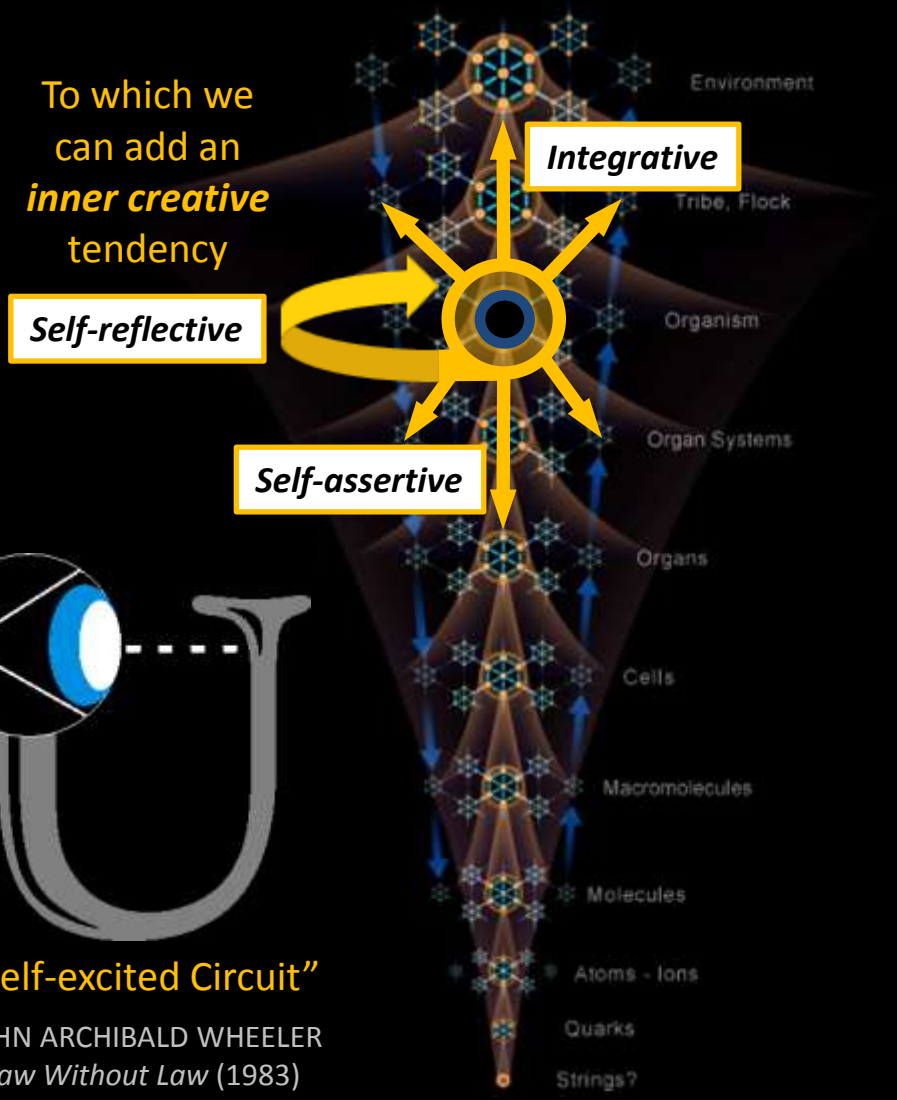
Individual components on various levels of a system are simultaneously…

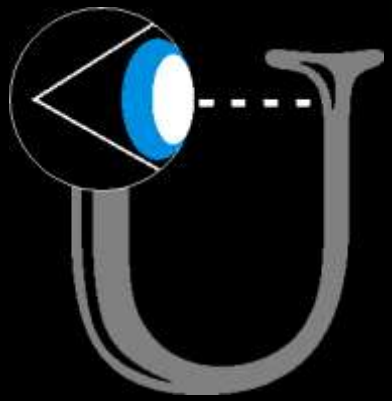
wholes
(*self-assertive*)

and *parts*
(*integrative*)

Complex Systems: A Gentle Introduction

To which we can add an ***inner creative*** tendency





"Self-excited Circuit"

JOHN ARCHIBALD WHEELER
Law Without Law (1983)

Arthur Koestler (1967)
The Ghost in the Machine

Holons

Individual components on various levels of a system are simultaneously…

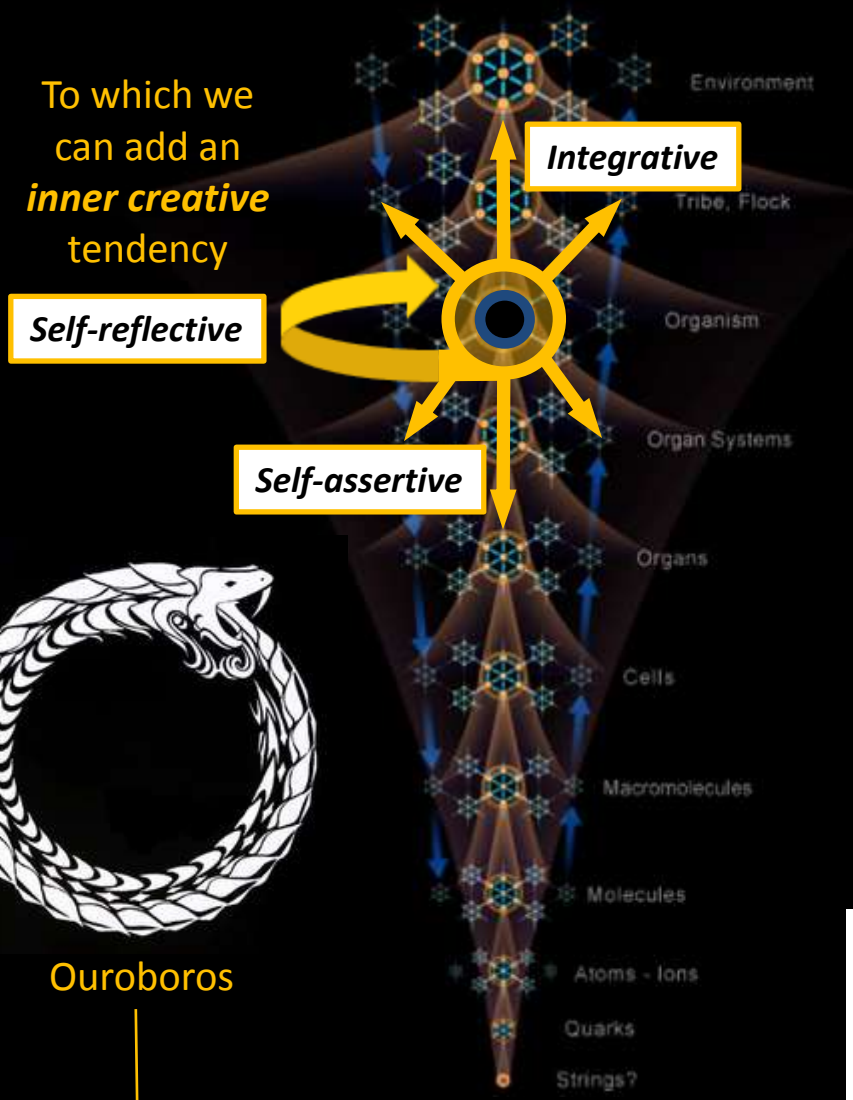
wholes
(*self-assertive*)

and *parts*
(*integrative*)

http://www.idiagram.com/examples/complexity.html

Complex Systems: A Gentle Introduction

To which we can add an ***inner creative*** tendency



Ouroboros

http://www.idiagram.com/examples/complexity.html

Arthur Koestler (1967)
The Ghost in the Machine

Holons

Individual components on various levels of a system are simultaneously…

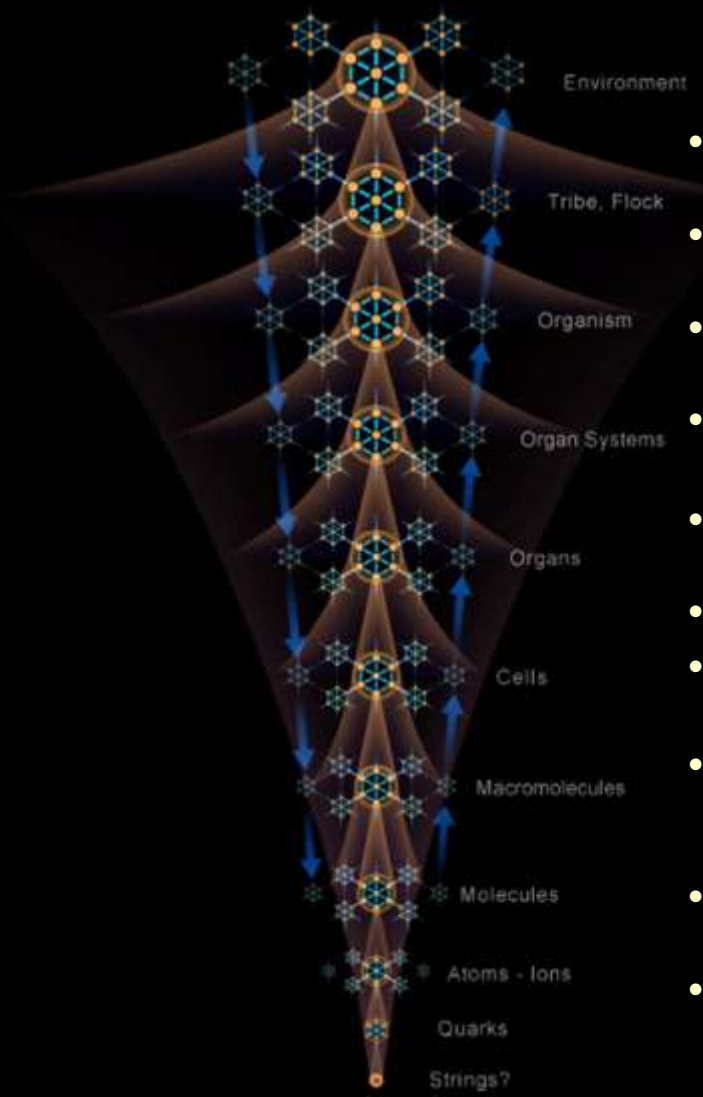
wholes
(*self-assertive*)

and *parts*
(*integrative*)

"Your vision will become clear only when you can look into your own heart. Who looks outside, dreams; who looks inside, awakens."

— CARL JUNG

Complex Systems: A Gentle Introduction

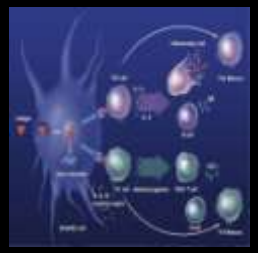


http://www.idiagram.com/examples/complexity.html

Properties

- **Diverse heterogeneity**
  - → *Components defined by many properties and behaviors*
- **Nonlinear interactions**
  - → *Small perturbations may cause a large effect*
- **Local information processing / decentralized**
  - → *Components only know a small "part" of the system*
- **Relationships contain feedback loops**
  - → *Both negative (damping) and positive (amplifying) feedback*
- **Multiple simultaneous scales of resolution**
  - → *Agents, meta-agents, ... system*
- **Self-organization & phase transitions**
- **Emergent behavior**
  - → *Global patterns cannot be deduced from local behavior*
- **Open to the environment**
  - → *Nonequilibrium patterns & order; boundaries difficult to define; observer dependent*
- **Adaptive**
  - → *Prior states influence present states; learning*
- **Understanding requires both analysis & synthesis**
  - → *Components may themselves be "complex systems"*

Complex Systems: A Gentle Introduction





Examples

- Brain / nervous system (Kandel & Squire, 2000)
- Biological cells, organisms
- Biosphere (Levin, 1998)
- Combat dynamics (Ilachinski / CNA, 2000+)
- Communication networks (Barabasi, 2000)
- Economies / financial markets (Arthur, 1994)
- Ecosystems (Sigmund 1993)
- Gene-regulatory networks (Kauffman, 1993)
- Global climate (Lovelock, 1995)
- Human culture (Luhmann, 1984)
- Immune system (Segel, 2000)
- Insect colonies (Bonabeau, 1999)
- Internet / WWW (Mayer-Kress,1995)
- Natural evolution (Smith & Szamary, 1995)
- Organizations (Forrester, 1960s)
- Pedestrian / vehicular flow (Still, 2000)
- Social networks (Wasserman & Faust, 1994)
- Terrorist networks (Ilachinski / CNA, 2007+)

A “simple” demonstration of how complexity arises from simplicity…

1-Dimensional Cellular Automata

Using very simple "agents" (building blocks) to generate complexity…

- **Consider a one-dimensional row of cells:**

1-Dimensional Cellular Automata

Using very simple "agents" (building blocks) to generate complexity…

- Consider a one-dimensional row of cells:

- **Suppose each cell is either *on* ( ) or *off* ( )**

1-Dimensional Cellular Automata

Using very simple "agents" (building blocks) to generate complexity…

- Consider a one-dimensional row of cells:

- Suppose each cell is either *on* ( ) or *off* ( )

- **Suppose each cell turns *on* or *off* depending on whether it was on or off before and whether its *left* and *right neighbors* were on or off**

1-Dimensional Cellular Automata

Using very simple "agents" (building blocks) to generate complexity…

- Consider a one-dimensional row of cells:

- Suppose each cell is either *on* (■) or *off* (□)

- Suppose each cell turns *on* or *off* depending on whether it was on or off before and whether its *left* and *right neighbors* were on or off

- **Choose a specific rule for this (out of a total of 2^8=256 possible rules):**

1-Dimensional Cellular Automata

Using very simple "agents" (building blocks) to generate complexity…

- Consider a one-dimensional row of cells:

- Suppose each cell is either *on* ( ) or *off* ( )

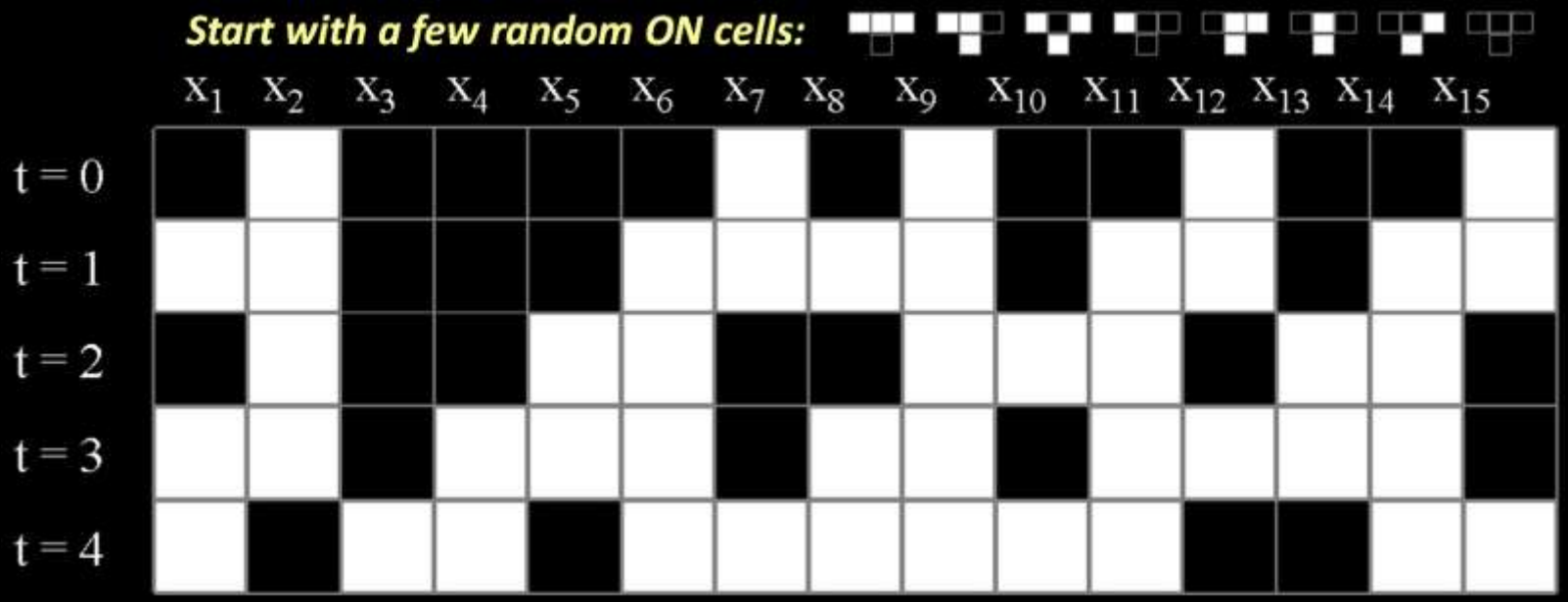
- Suppose each cell turns *on* or *off* depending on whether it was on or off before and whether its *left* and *right neighbors* were on or off

- **Choose a specific rule for this (out of a total of 2^8=256 possible rules):**

Pretty simple!

But, what happens after a row of random cells "evolves" in time?

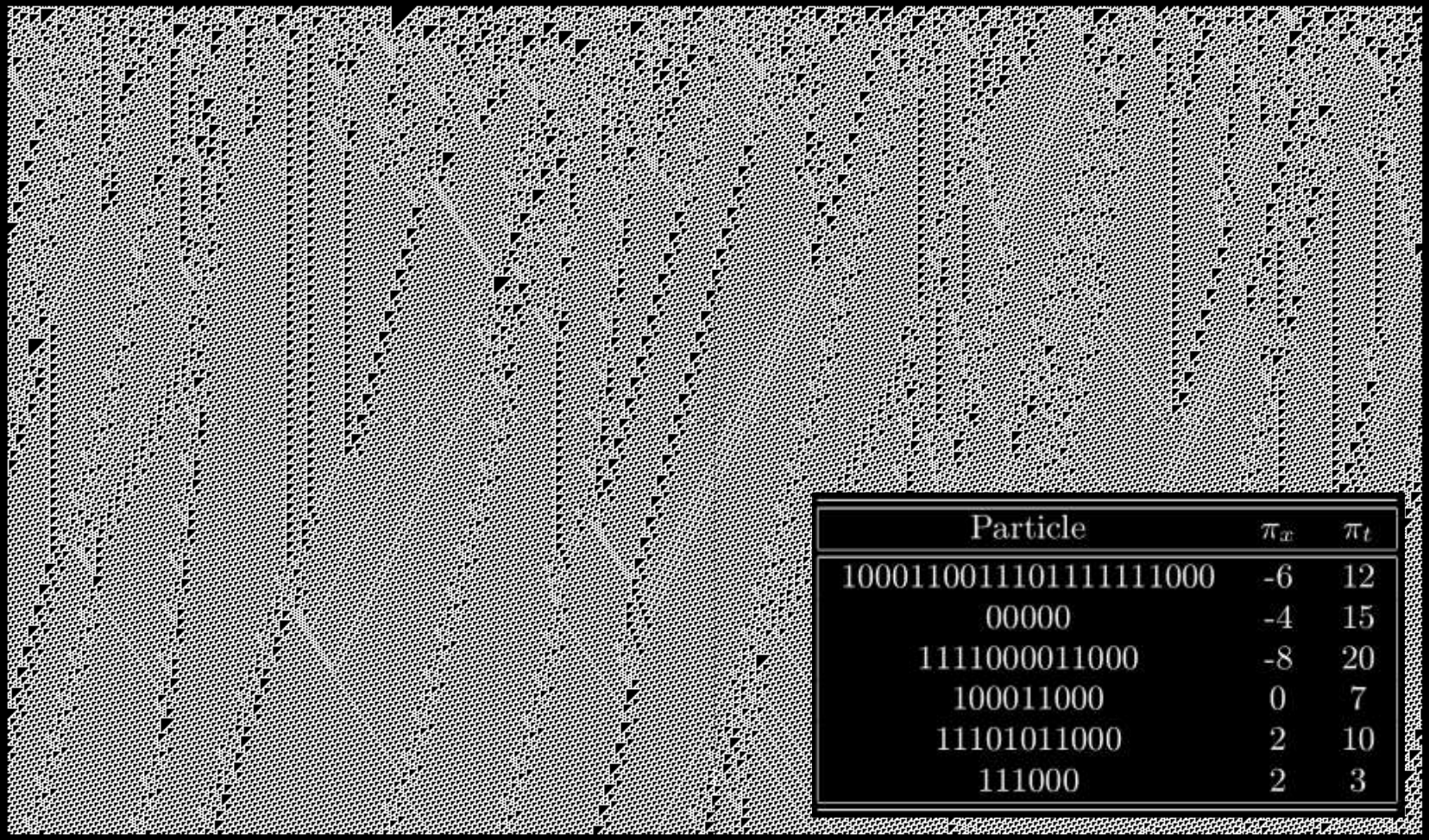
Let's Look at a Few Steps ...



Still pretty simple..nothing interesting yet!

What if we look at many cells evolving for longer times?

Simplicity Breeds Complexity!

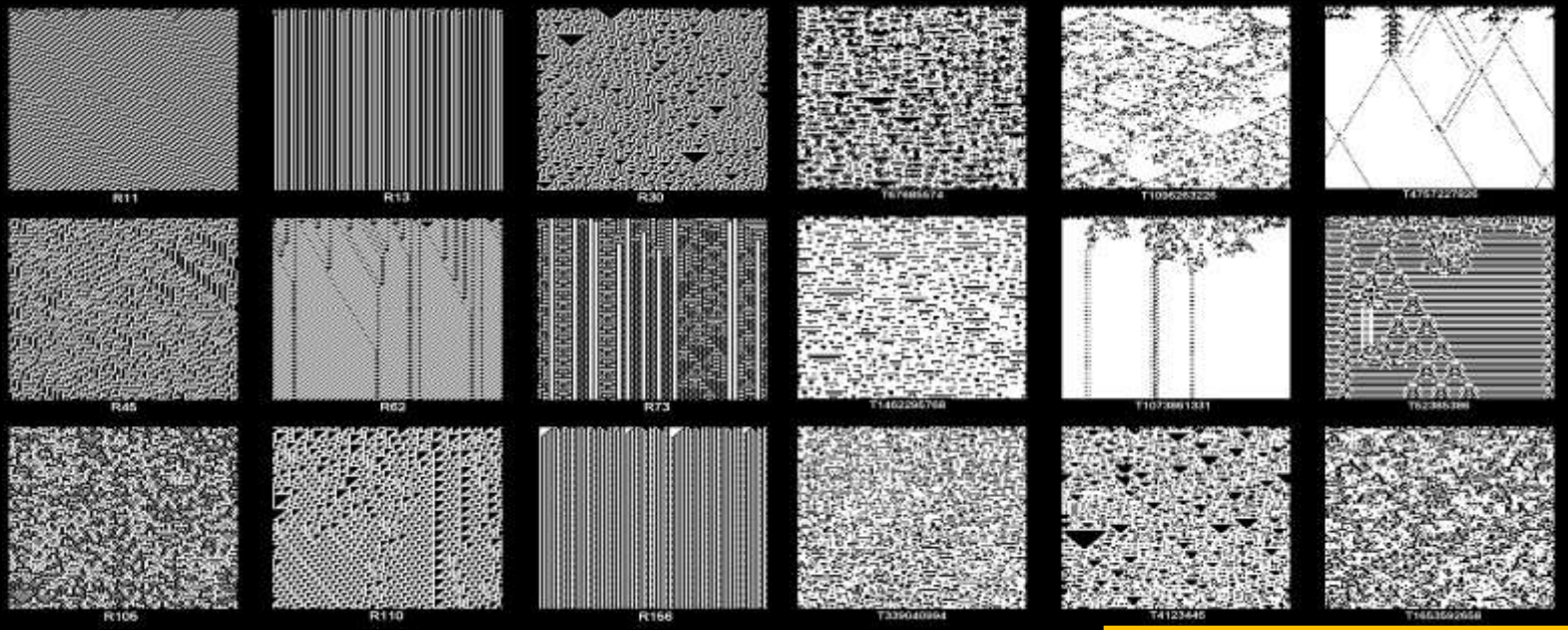


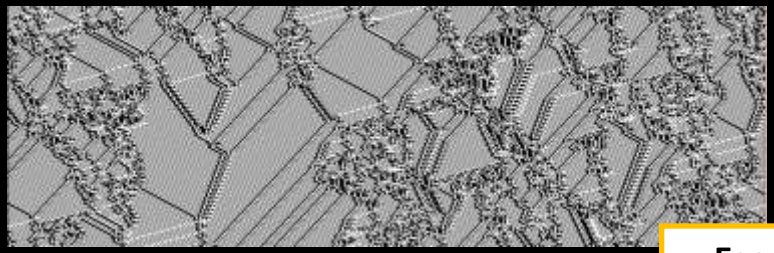
Particle	π_x	π_t
10001100111011111111000	-6	12
00000	-4	15
1111000011000	-8	20
100011000	0	7
11101011000	2	10
111000	2	3

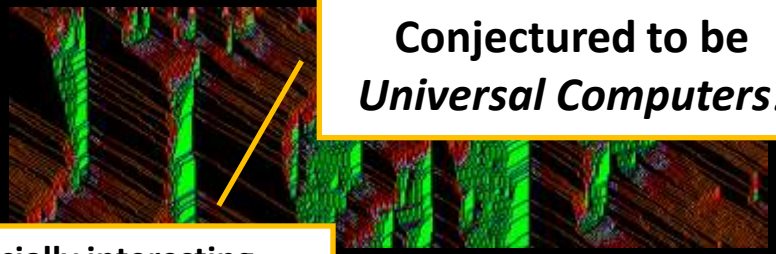
Alternative "explanation" $\rightarrow$ *Particles* of form…

$$\cdots \mathrm{BBBB}\mathbf{P}\mathrm{BB} \cdots \mathrm{BB} \cdots \mathrm{BBB}\mathbf{P}'\mathrm{BB} \cdots \mathrm{BBB}\mathbf{P}''\mathrm{BBB} \cdots$$

Other Rules: A Universe in 1-Dimension…





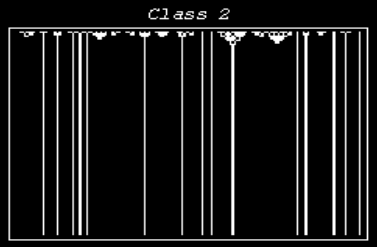


Conjectured to be *Universal Computers!*

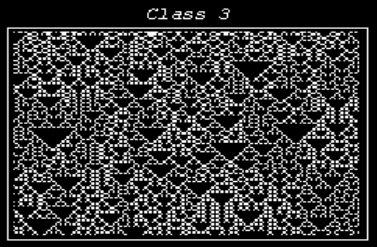
Especially interesting…

Wolfram CA-Classification:

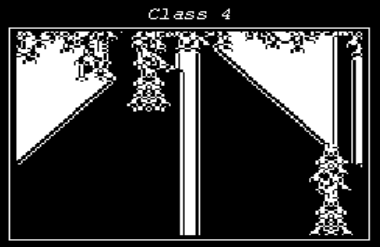
Fixed State



Periodic State



Chaotic State

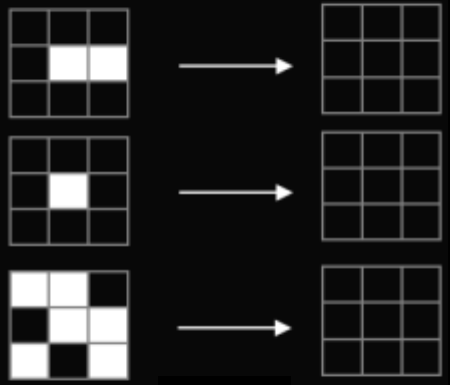


Complex State

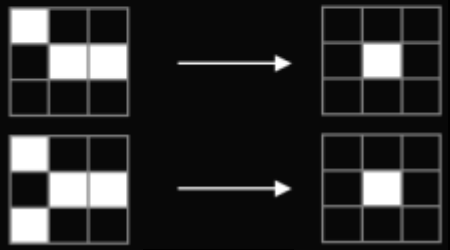
Other Rules: A Universe in 2-Dimensions

John Conway's *Life* Rule

"Birth"

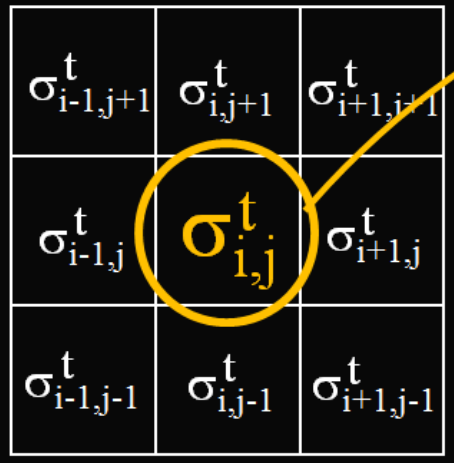


"Death"

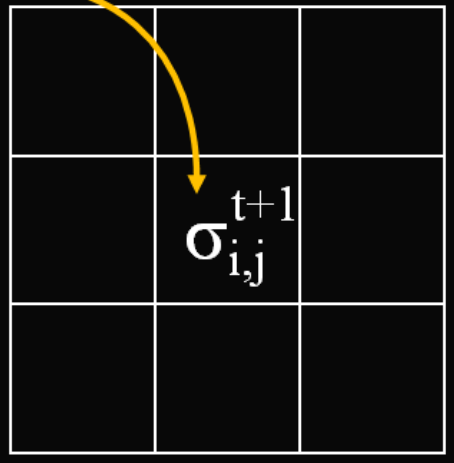


"Survival"

$$\sigma_{i,j}^{t+1} = f\left(\sigma_{i,j}^{t}, \sigma_{i-1,j-1}^{t}, \sigma_{i,j-1}^{t}, \sigma_{i+1,j-1}^{t}, \sigma_{i-1,j}^{t}, \sigma_{i+1,j}^{t}, \sigma_{i-1,j+1}^{t}, \sigma_{i,j+1}^{t}, \sigma_{i+1,j+1}^{t}\right)$$



time = t



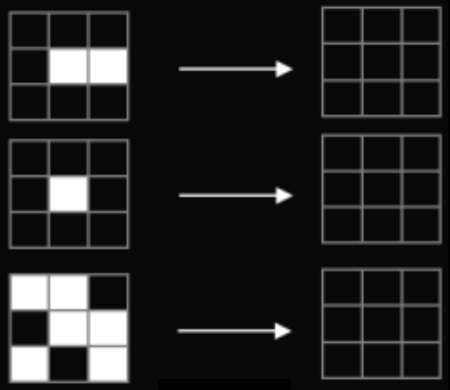
time = $t+1$

Consider **<u>one particular rule</u>**
out of $2^{512} \sim 10^{154}$ possible rules !

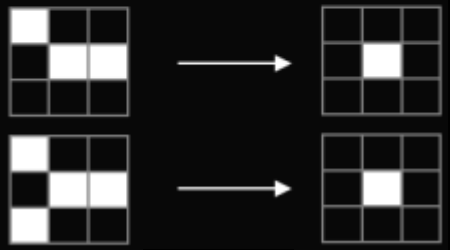
Other Rules: A Universe in 2-Dimensions

John Conway's *Life* Rule

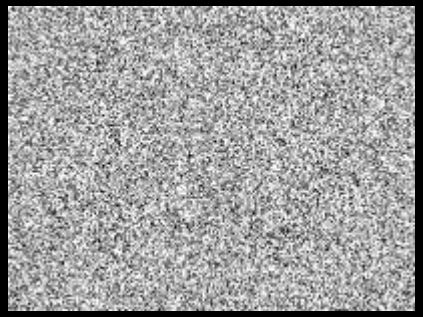
"Birth"



"Death"

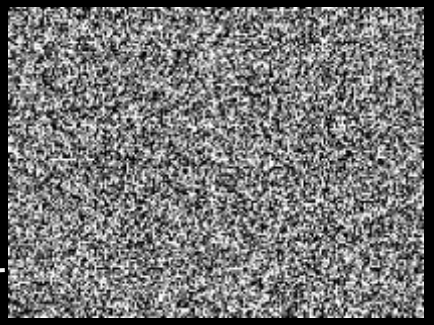


"Survival"

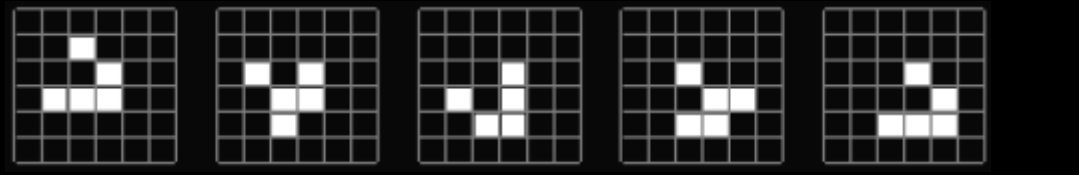


time = 0

100 time steps

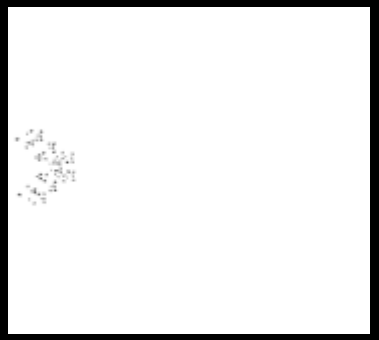


"Gliders"



Glider-Gun

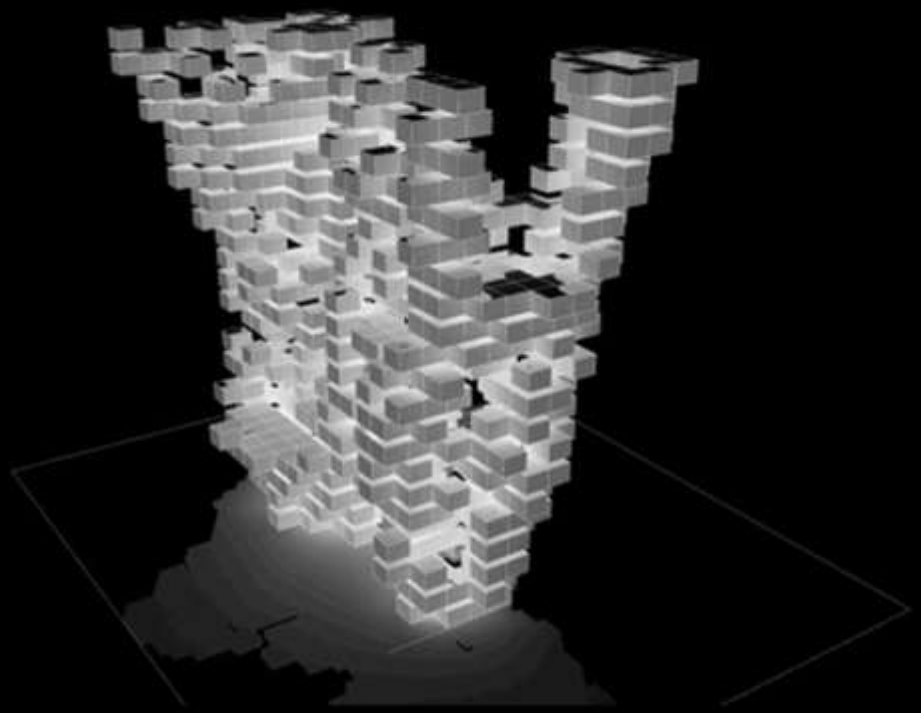
Puffer Train



Breeder

Conway's "Life" is a general purpose computer → *Halting Theorem* holds!

Self-enlightenment from a humble automaton?



http://farm3.static.flickr.com/2038/1603390142_e641501dfa_o.gif

"If patterns of ones and zeroes were
'like' patterns of human lives and deaths,
if everything about an individual could be
represented in a computer record
by a long string of ones and zeroes,
then what kind of creature could be
represented by a long string
of lives and deaths?"

— Thomas Pynchon, Vineland

Outline

Part 1: Andy as photographer-*physicist*

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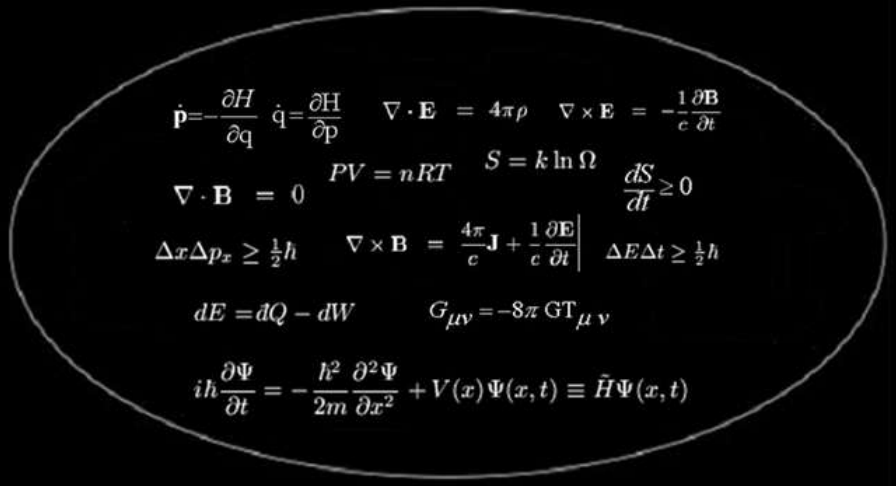
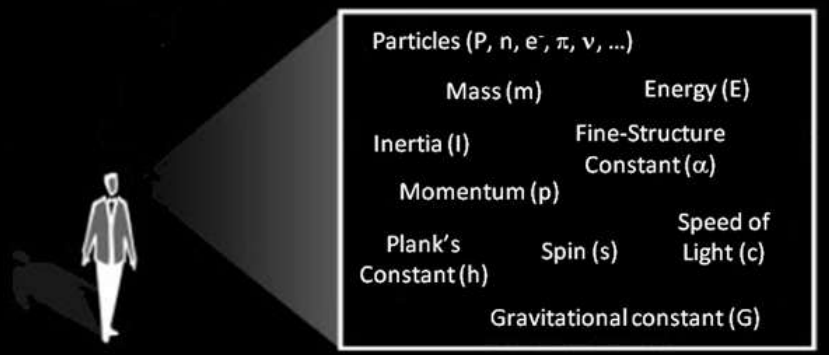
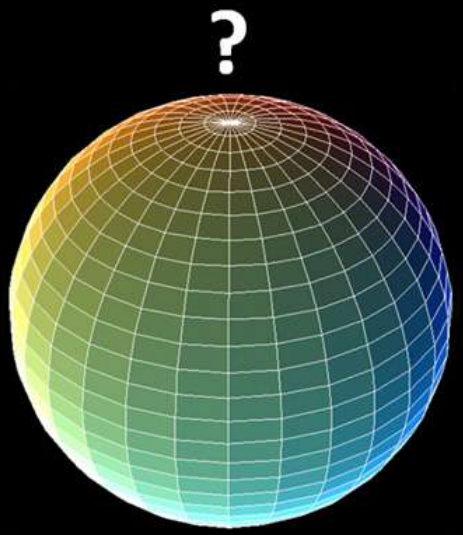
Physics, Complexity, and Photography: One Last Take

Language of Physics





Traditional Physics



Reality

Parts
(Conceptual Building Blocks)

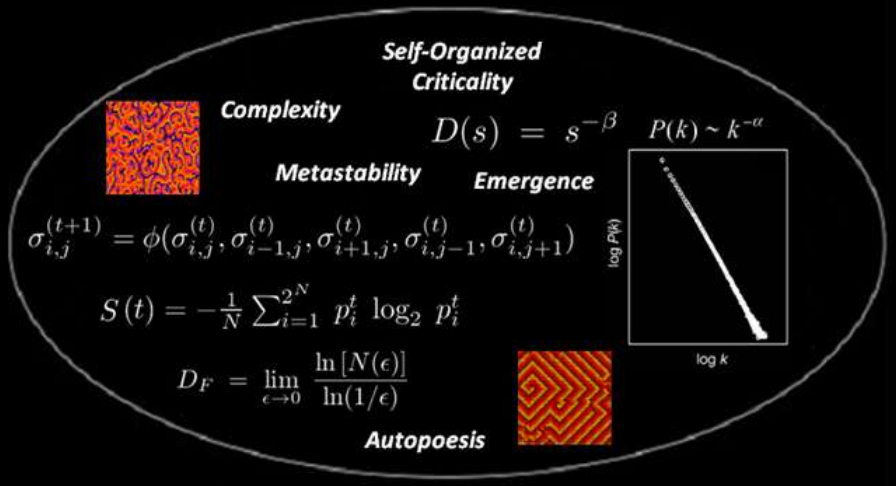
Syntax

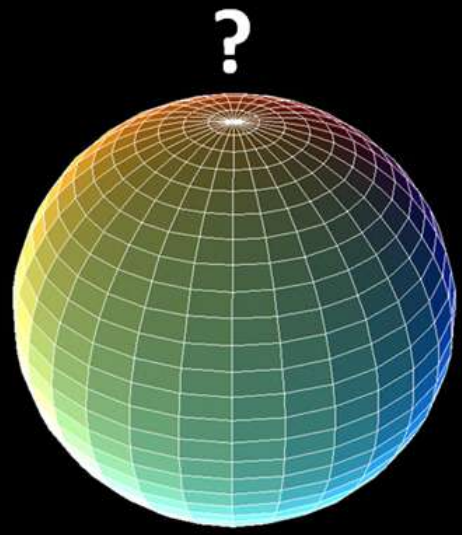
Grammar

Language

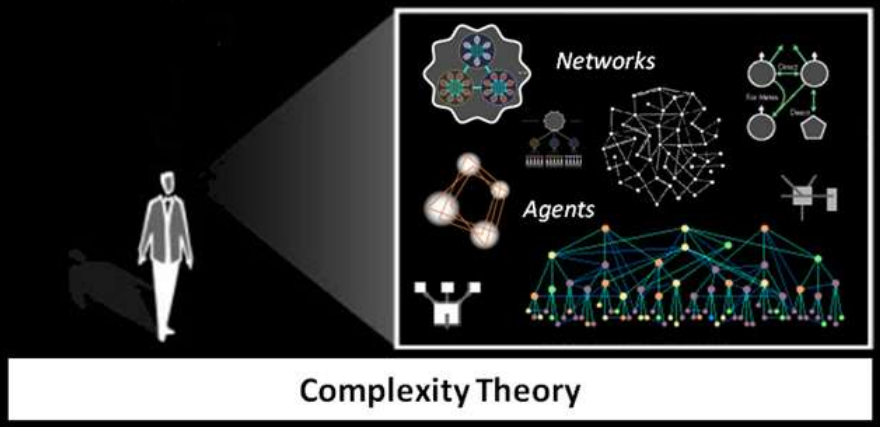
Graphical elements adapted from www.idiagram.com

Language of Complexity





Reality



Complexity Theory

Parts
(Conceptual Building Blocks)

Syntax

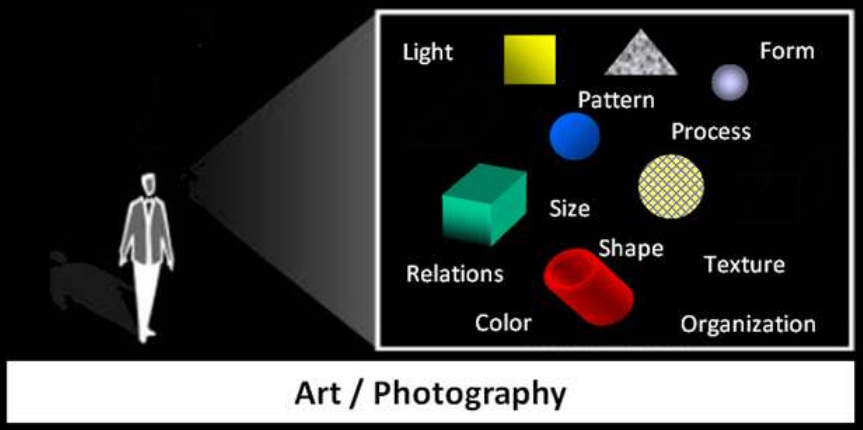
Grammar

Language

Graphical elements adapted from www.idiagram.com

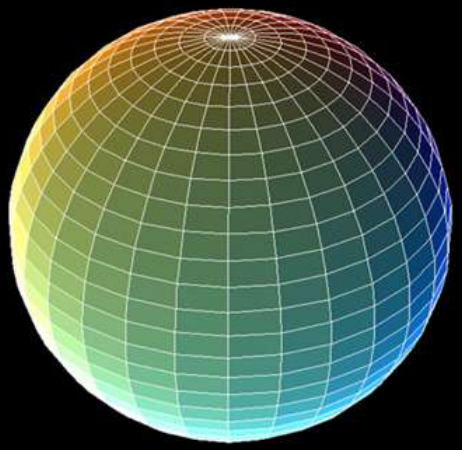
Towards a Universal Language of Aesthetics?

1. Levels of Scale
2. Strong Centers
3. Boundaries
4. Alternating Repetition
5. Positive Space
6. Good Shape
7. Local Symmetry
8. Deep Interlock & Ambiguity
9. Contrast
10. Gradients
11. Roughness
12. Echoes
13. The Void
14. Simplicity / Inner-Calm
15. Not-Separateness



Graphical elements adapted from www.idiagram.com

?



Reality

Parts
(Conceptual Building Blocks)

Syntax

Grammar

Language

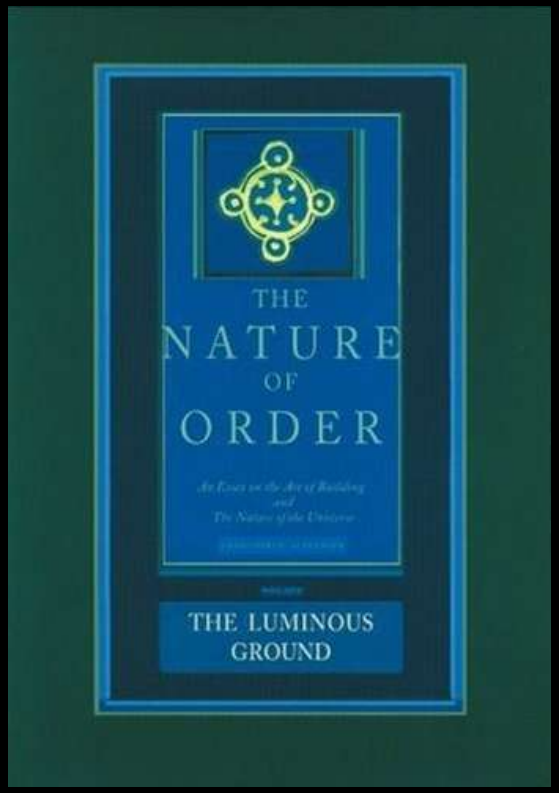
Laws of Beauty?

Christopher Alexander, *Nature of Order*

Nature of Order

Everything is alive, it is only a matter of degree

Christopher Alexander, *Architect* (1936 -)



"Space itself, matter itself,
has life in varying degrees.

There is a consequence of function,
geometry, and feeling in space;
this space is conceived as a living fabric that
- through its structure - encompasses these things.

Space does not merely contain living structure.

Space has life, to a greater or lesser degree.

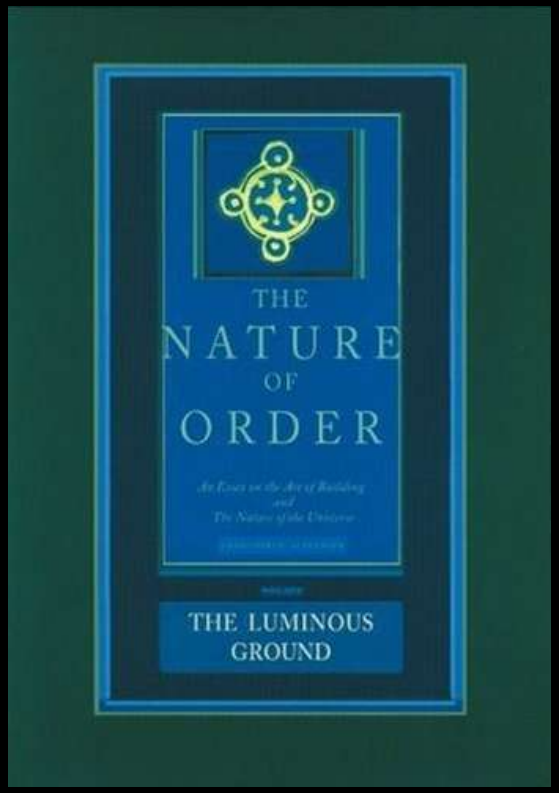
It is the space itself which resembles self,
which functions, which works,
which has living structure in it,
and which has life."

The life which appears is an attribute of space itself.

Nature of Order

Everything is alive, it is only a matter of degree

Christopher Alexander, *Architect* (1936 -)



- There is a structure – called *wholeness* - visible in any given part of the world
- The wholeness is an abstract mathematical structure that exists at many levels of scale, and covers the interrelationships of the configurations at different scales
- The primary entities of which the structure is built are centers (which become activated in the space as a result of the configuration as a whole)
- Centers have different levels of strength or coherence, depending on relationships with other centers
- There are fifteen types of relationships among centers which increase or intensify the strength of any given center

Nature of Order

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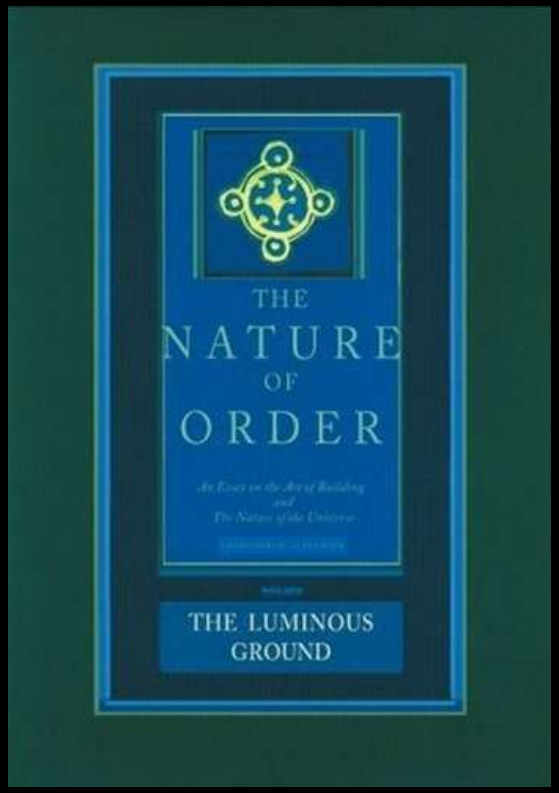
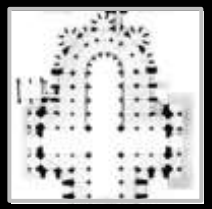


Strong centers

Levels of scale

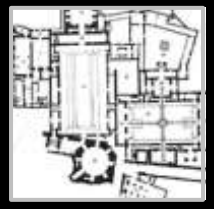


Boundaries

Alternating repetition

Positive space

Good shape



Local symmetries

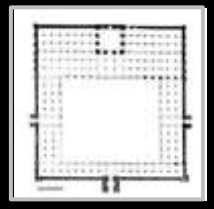
Deep interlock & ambiguitiy

Contrast

Gradients

Roughness

Echoes



The Void

Simplicity & inner calm

Non-seperateness

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Physics, Complexity, and Photography: One Last Take

At first, the *photographer* finds the *picture*…

Something about the *photographer* draws him to it

At first, the *photographer* finds the *picture*…

Something about the *photographer* draws him to it

Physicist

Light,
Entropy,
Geometry

Poet

Romance,
History,
Culture

Photographer A

Textures,
Landscape

Photographer B

Dilapidated door,
Contrast

Photographer C

Tones,
Forms

…the *pictures* discover a *path*…

Color

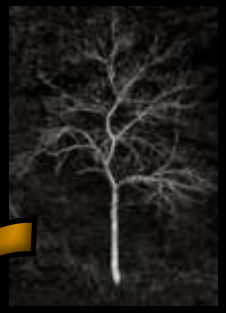
Tao

Abstraction

Leaves

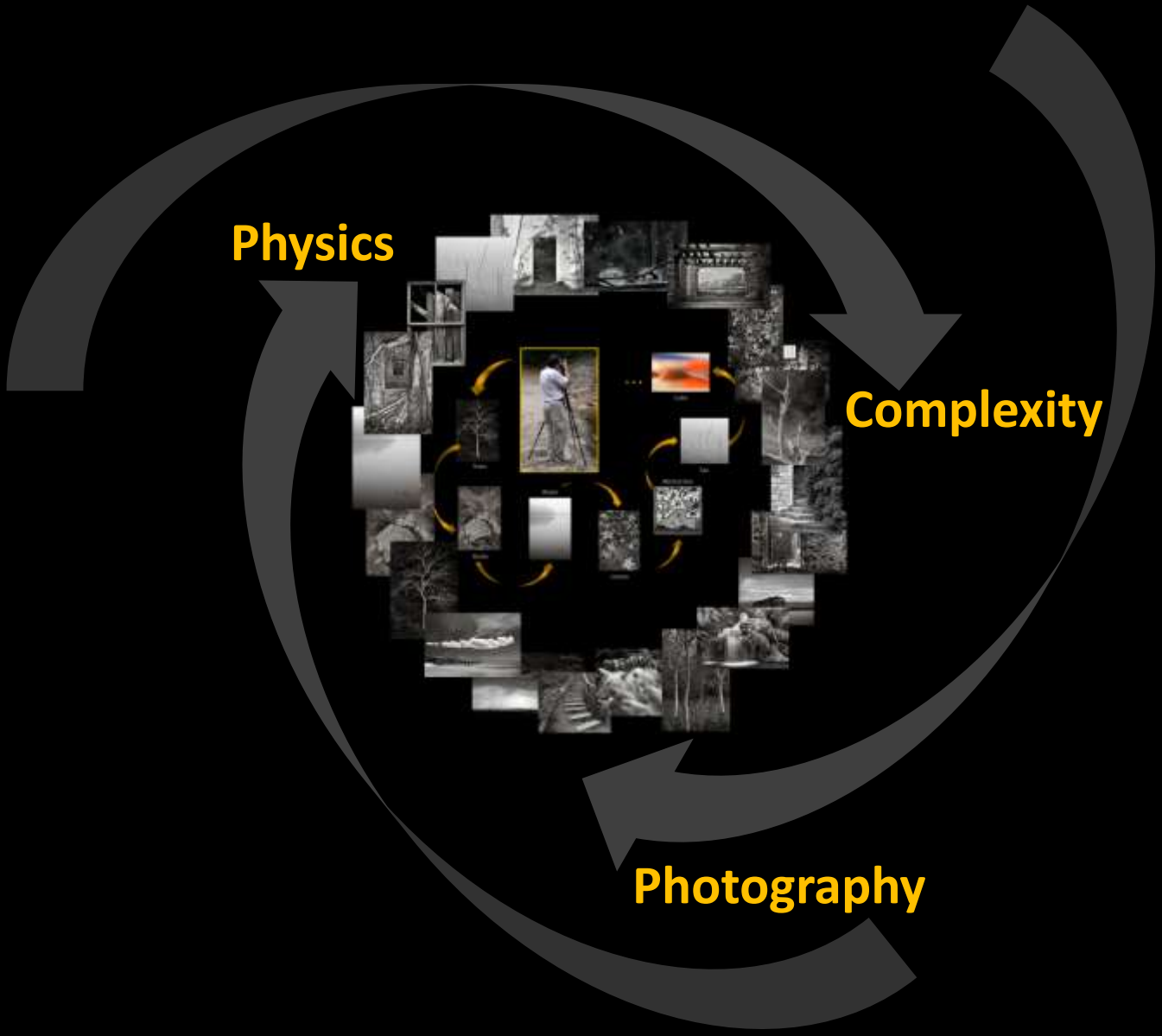
Water

Rocks



Trees

…the path *assembles* itself…



Common Theme

Relationship between the Whole and its Parts

Physics

Patterns ↔ Order

Complexity

Micro ↔ Macro

Photography

Compositional Elements ↔ *Image / Meaning*

Emergence, Transcendence

Eventually, the *path* defines the *photographer*

"Through the years,
a man peoples a space with images
of provinces, kingdoms, mountains,
bays, ships, islands, fishes, rooms,
tools, stars, horses and people.

Shortly before his death,
he discovers that the
patient labyrinth of lines traces
the image of his own face."

— JORGE LUIS BORGES
(1899-1986)

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Physics, Complexity, and Photography: One Last Take

My creative process is very simple:
I take pictures of what calms my soul.

There may be other, more poetic words
that may be used to define the "pattern"
that connects my images, but the
simplest meta-pattern is this:

I capture moments in time and space
in which a peace washes gently over me,
and during which I sense a deep
interconnectedness between
my soul and the world.

Not Cartier-Bresson's
"Decisive Moment,"
but rather a…

Sudden Stillness

Sudden Stillness / U.K. Black & White Magazine Book Contest (2007)

Chaos

Order

Complexity

Entropy

The book is a meditation on using photographs as tokens of a visual grammar to communicate one photographer's fragmentary impressions of some of nature's basic patterns; partly as a physicist (with a physicist's eye and understanding of chaos, order, complexity and entropy), and partly as an artist (with an appreciation of the subjective character of each of these four rhythms).

I am hoping that the book can also serve as a palimpsest of the author's – and reader's – process of self discovery: as nature is quietly revealed, through four "movements" of snapshots of its timeless rhythms, the reader will discover visual echoes of herself experiencing nature, as *sudden stillness*.

http://web.mac.com/ephraums/Whats_your_book/Home.html

Chaos

"To divine the significance of pattern is the same as to understand beauty itself."
— Yanagi Soetsu, *Philosopher* (1889 – 1961)

Order

"We have to remember that what we observe is not nature in itself but nature exposed to our method of questioning." — W. Heisenberg, *Physicist* (1901 – 1976)

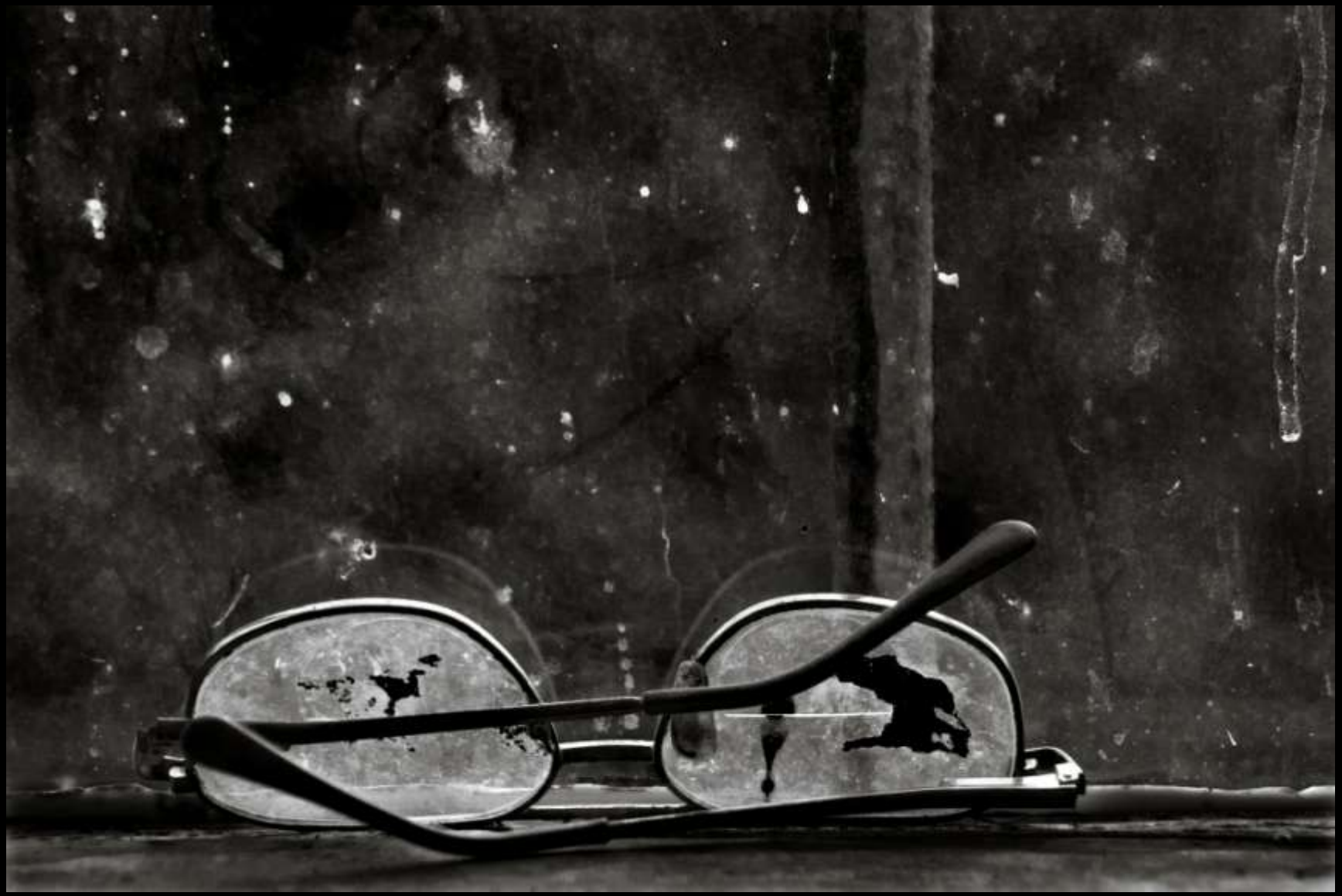
Complexity

"I've always been fascinated with the idea that complexity can come out of such simplicity. "

— Will Wright, *Game Designer / Systems Theorist* (1960 –)

Entropy

"Only entropy comes easy." — Anton Chekov, *Author* (1860 – 1904)



Outline

Part 1: Andy as photographer-*physicist*

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Physics, Complexity, and Photography: One Last Take

A “planned” day of rocks & water variety

Came home from a long photo-safari at Great Falls, during which I took many soon-to-be-forgotten photos of the usual rocks-and-water variety

Sat down to dinner with my family

As my fork was about to pierce the skin of a potato, my wife nonchalantly placed two small acrylic candle holders with *trapped air bubbles inside* on the table

My “eye” was consumed for the next 4 months

↓

“Micro Worlds” portfolio

Lenswork, Issue #76
(May-June, 2008)

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Physics, Complexity, and Photography: One Last Take

Abstract Glyphs

"Everything in the world
has a hidden meaning. . ..
Men, animals, trees, stars,
they are all hieroglyphics.

When you see them
you do not understand them.
You think they are really
men, animals, trees, stars.

It is only years later
that you understand."

— NIKOS KAZANTZAKIS
(1883 - 1957)

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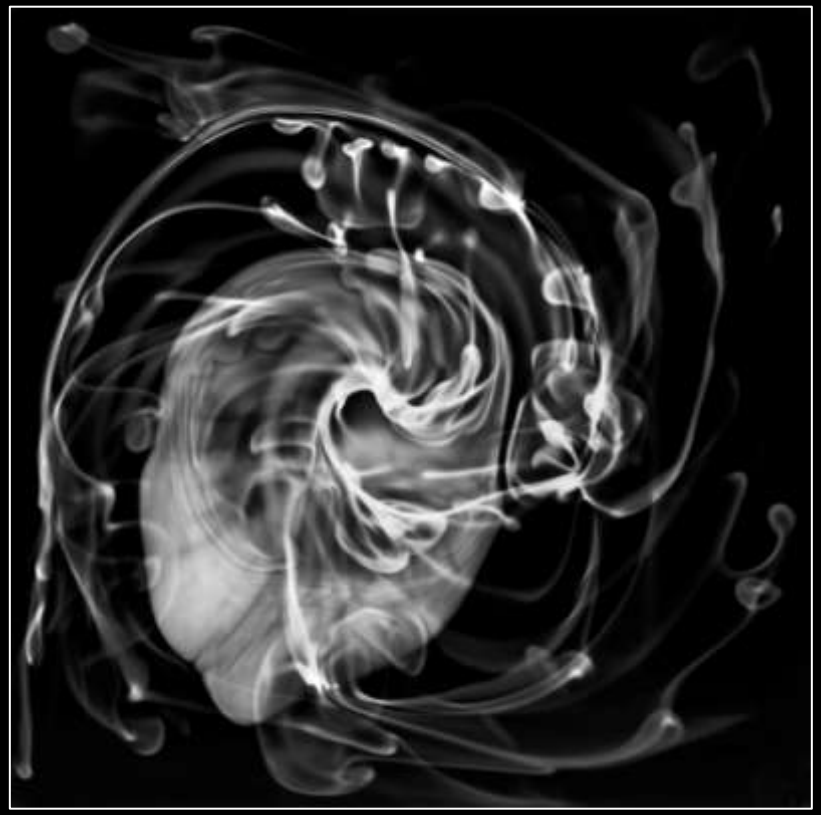
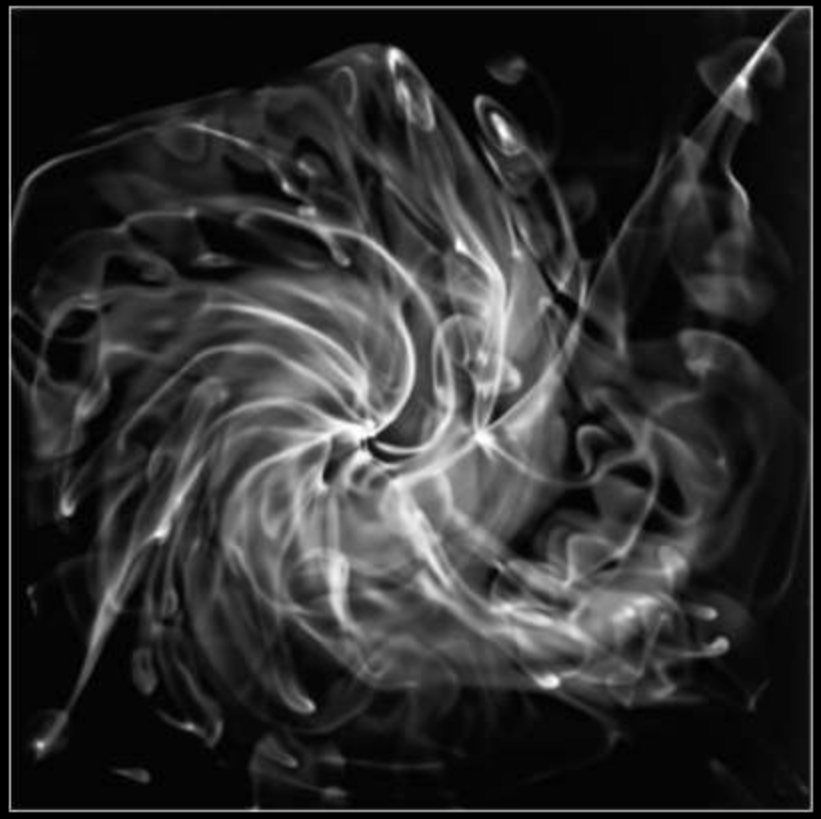
Physics, Complexity, and Photography: One Last Take

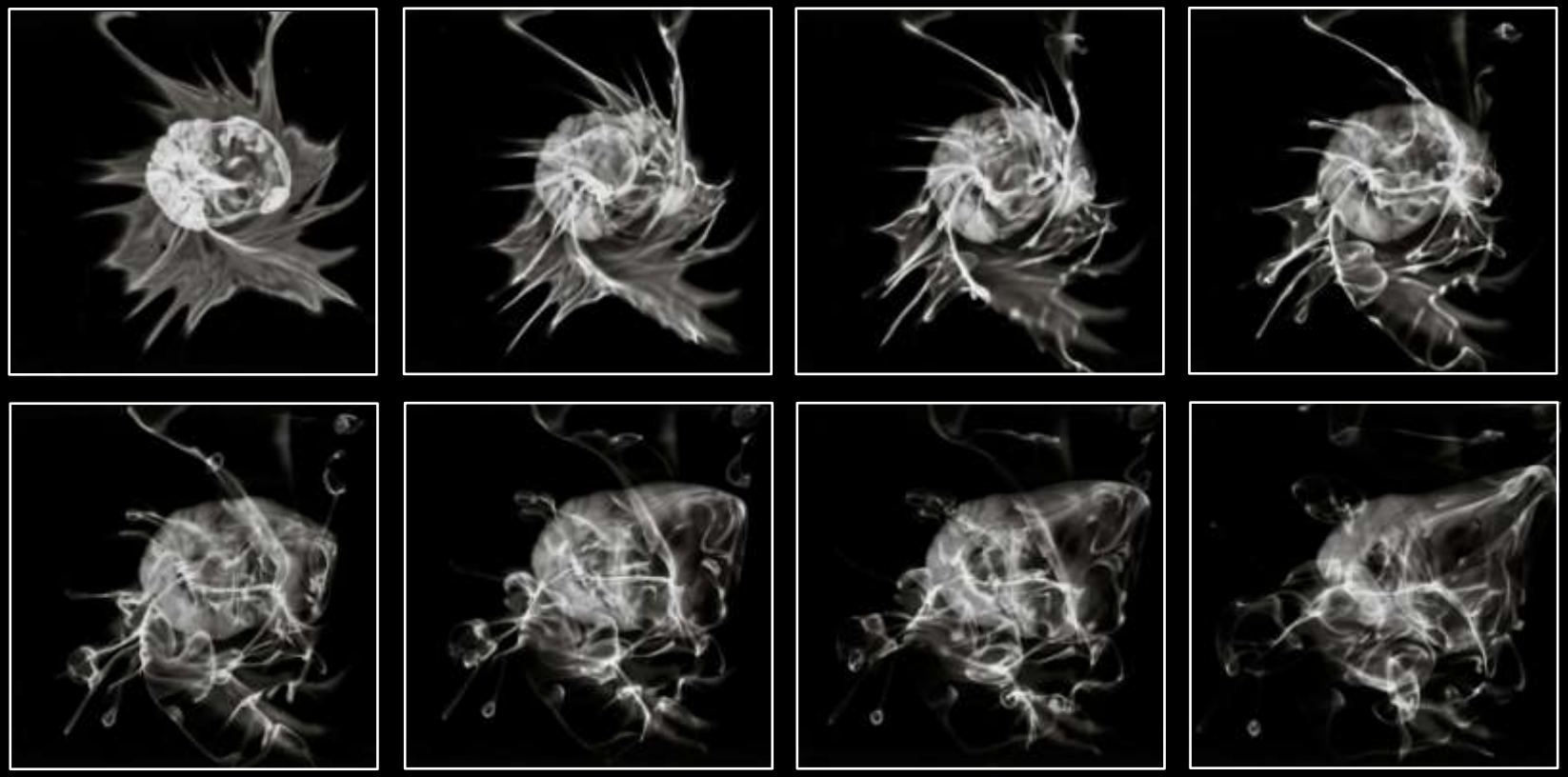
“Swirls, Whorls, and Tendrils”

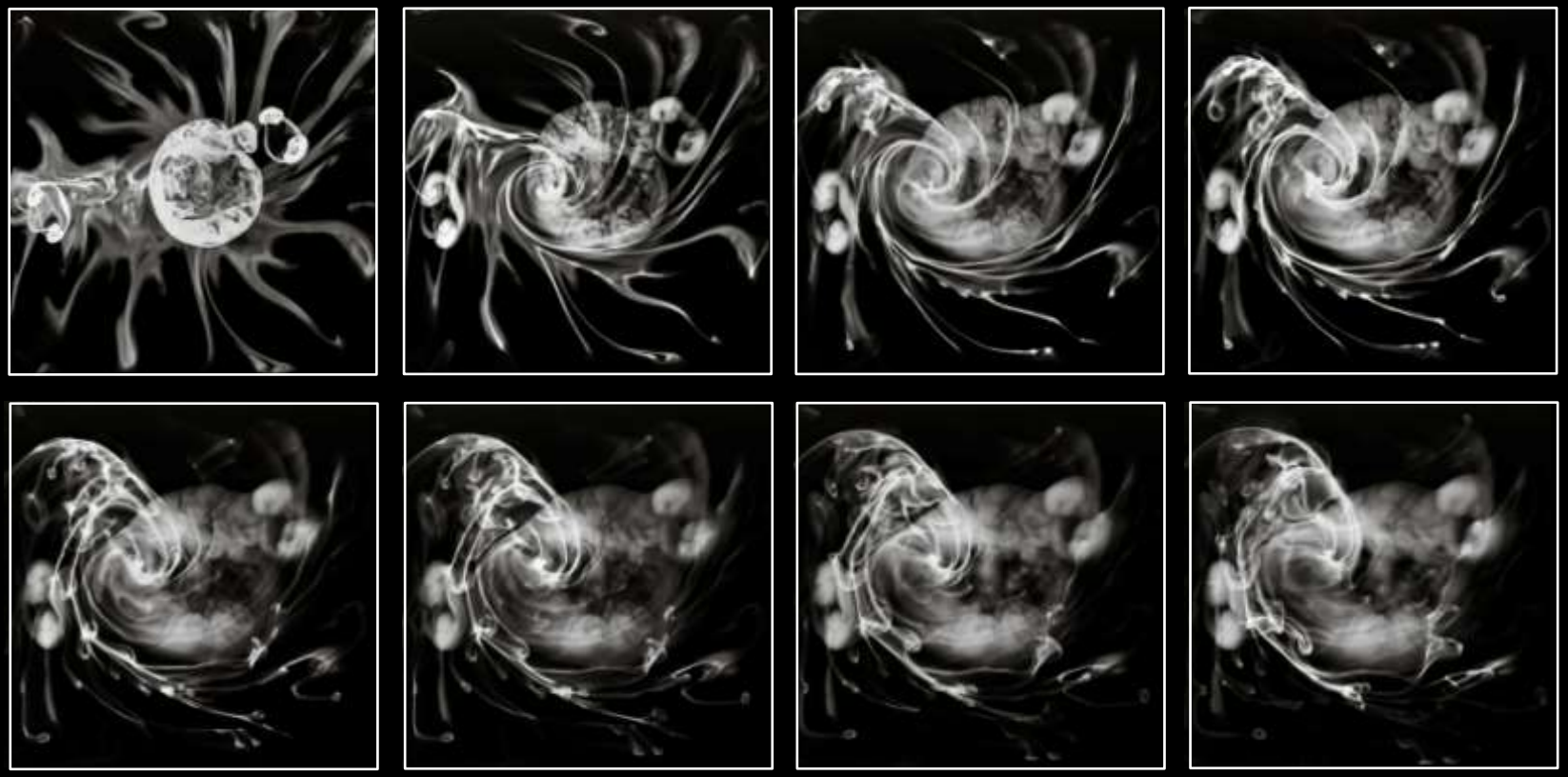
My younger son (Josh, 7) accidentally dropped a newspaper that I had written something on with a fountain pen into the sink

I noticed an interesting pattern …









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Physics, Complexity, and Photography: One Last Take

Tao

"The use the order of words to try to explain life is really as clumsy an operation as trying to drink water with a fork."

— ALAN WATTS, Philosopher (1915 – 1973)

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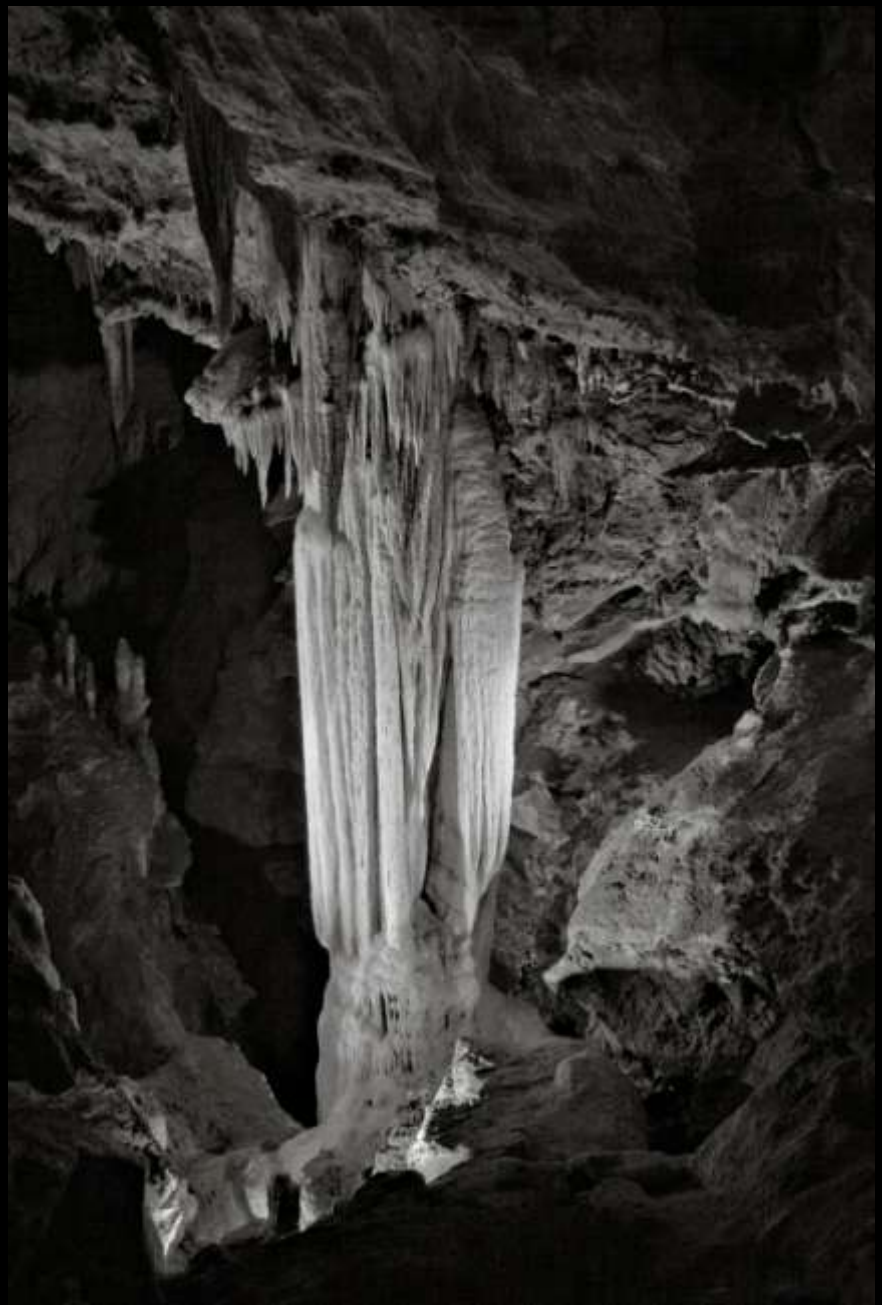
Physics, Complexity, and Photography: One Last Take

Luray Caverns



Despite having visited *Luray Caverns* countless times…

I never took anything other than a small "point and shoot" camera, relegating family picture taking chores to my wife.

Until earlier this year, when I finally got the nerve to ask (and be granted!) a *full day in the caverns!*

↓

"As Above, So Below" portfolio

Lenswork, Issue #95
(July-August , 2011)

Sneak Peek: *Work in Progress* …

Synesthetic Landscapes

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Physics, Complexity, and Photography: One Last Take

Physics, Complexity, and Photography: *One Last Take*

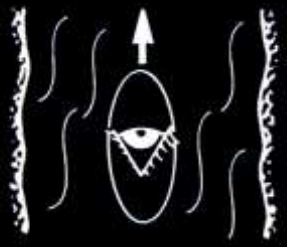
"…I see mountains once again as mountains, and waters once again as waters."

The observer *is* the stream
(Complexity theory / Tao)

Complexity / Tao: no fundamental distinction between "inside" / "outside"

- Forget about *things*…
- Forget about *categories*…
- Forget about *boundaries*…
- *Use camera to find the "I" behind lens!*

"…I came to the point where I saw that mountains are not mountains, and waters are not waters…"

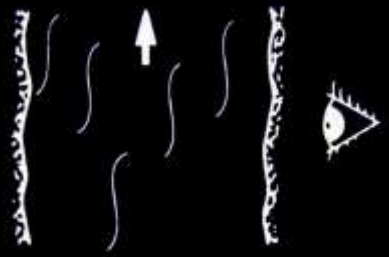


The observer attempts to
steer a canoe in the stream
(Quantum physics / Photography)

Photography: find meaningful patterns

- Use *light*, *color*, *form, texture,* and *pattern* as primitive building blocks out of which to create "mini-worlds" interesting to you
- *You actively roam around the landscape!*

"Before I had studied Zen for thirty years, I saw mountains as mountains, and waters as waters…"



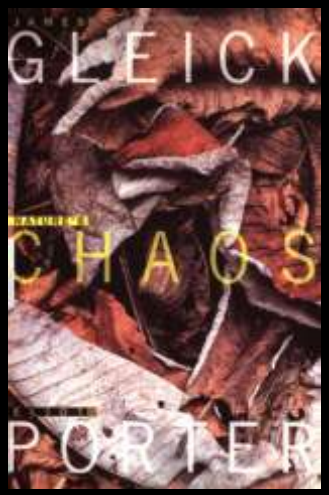
The observer is *outside* the stream
(Newtonian physics)

Physics: let it guide your eye & *camera*

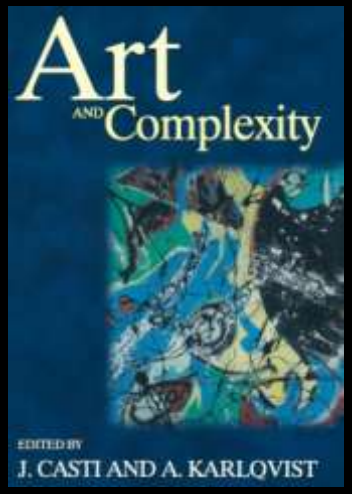
- Search for nature's forms: *fractals, dynamics, symmetry, order, pattern*, … *out there!*

References

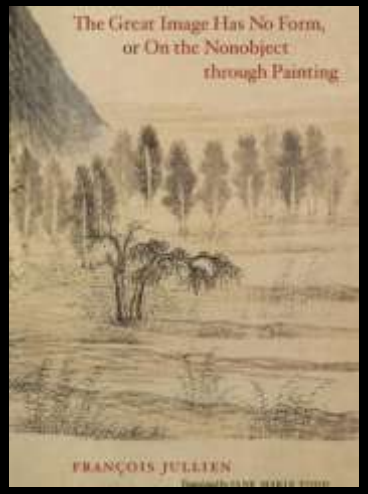
Some books on *physics* / *complexity* / *tao* / *photography* / *art*



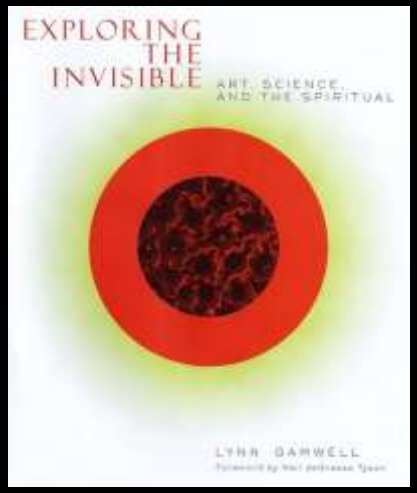
Nature's Chaos
J. Gleick, Eliot Porter



Art & Complexity
J. Casti, A. Karlqvist
(editors)



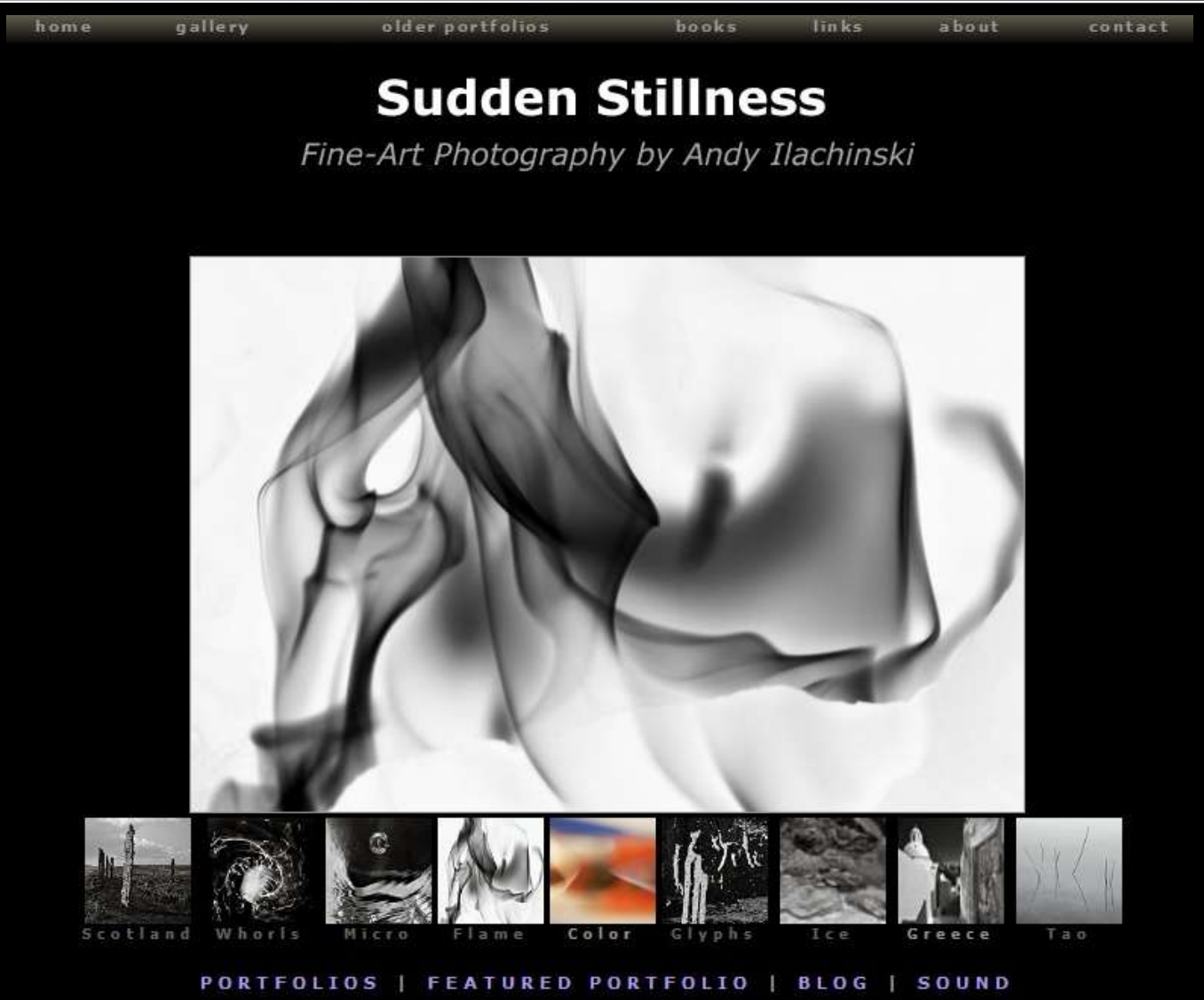
The Great Image Has No Form
Francois Jullien



Exploring the Invisible
Lynn Gamwell

Nature of Order
Christopher
Alexander

Please visit my website…
http://www.sudden-stillness.com



“When words become unclear,
I shall focus with photographs.
When images become inadequate,
I shall be content with silence.”

— ANSEL ADAMS