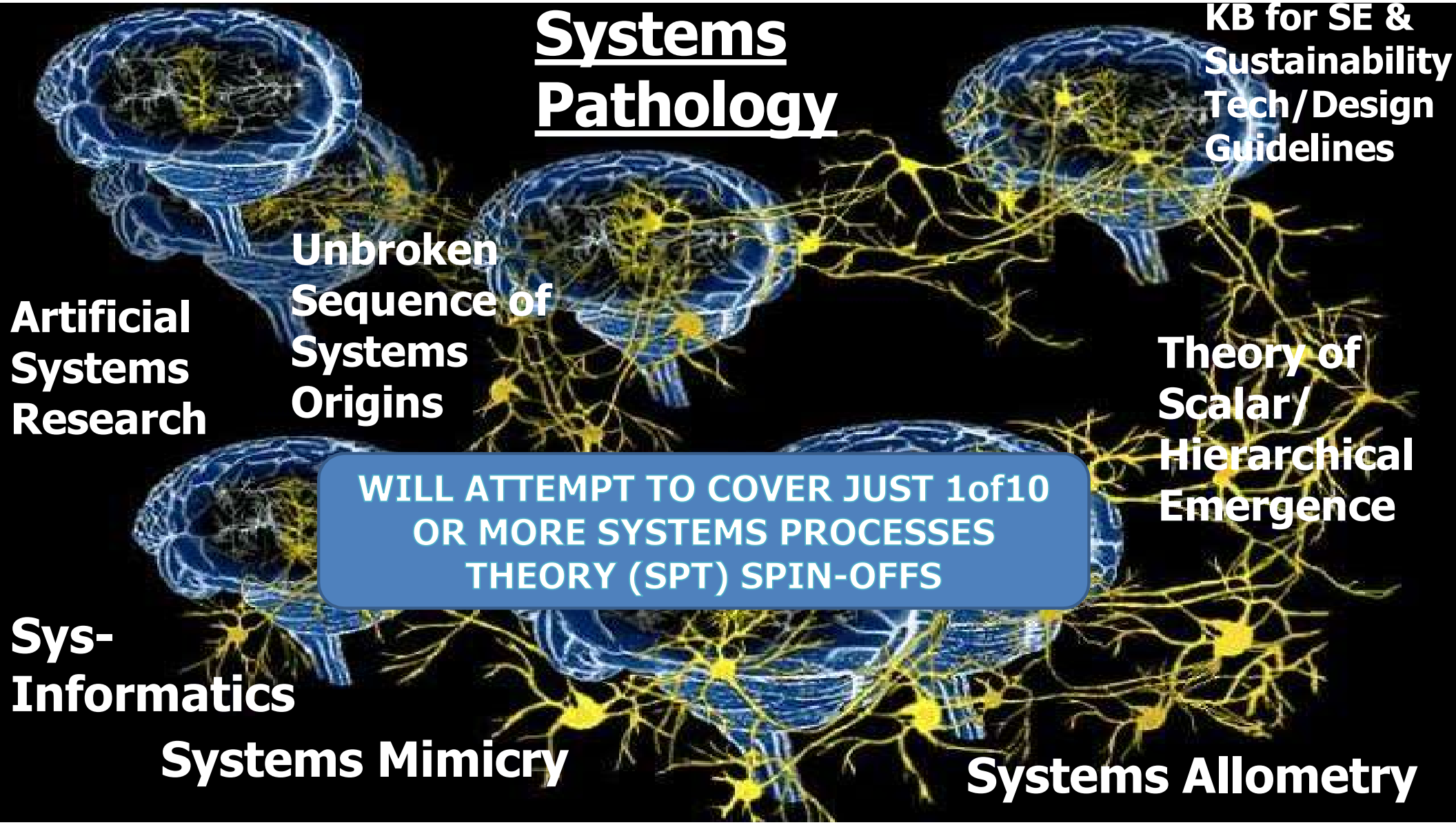
Systems Pathology
KB for SE & Sustainability Tech/Design Guidelines
Unbroken Sequence of Systems Origins
Artificial Systems Research
Theory of Scalar/ Hierarchical Emergence
WILL ATTEMPT TO COVER JUST 1of10 OR MORE SYSTEMS PROCESSES THEORY (SPT) SPIN-OFFS
Sys-Informatics
Systems Mimicry
Systems Allometry

Intro to Systems Pathology: From Fragmented Domains to a Unified, Top-Down, Systems-Science-Based New Field

Len Troncale, Prof. Emeritus & Past Chair, Biology, Director Emeritus, Institute for Advanced Systems Studies, College of Science; Lecturer, M.S. in S.E., College of Engineering, Calif. State Polytechnic U., Pomona; ISSS Past President, 1990; and General Systems Research, Dev't, & Consulting, GSRDC, Claremont, CA; Director, Claremont So. Cal. Office, Wilson Trust, VP & Managing Director, ISSP

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CONTENTS/OUTLINE I.

- **What Is the New td-Systems Pathology: Unify + Model + Org**
  - ✓ Systems community uses 2,500 year experiences of medicine for jumpstart
  - ✓ Identifying, Verifying, Engaging Domains of SYSTEMS-LEVEL Pathology
- **Top-Down versus Bottom-Up Strategies to SysPath**
  - ✓ Existing & Successful Bottom-up systems pathology; Evidence of Success
  - ✓ Using Negative Dysfunctions to Find Way into Complex System Networks
  - ✓ Systems Pathology from a rigorously Science-Based Level or Method
- **New Ontology/Taxonomy of Systems Pathologies**
  - ✓ Briefest Possible Intro to GST/SysSci SPT (Systems Processes Theory)
  - ✓ Intro to Seven Major Taxons/Classes/Categories of Systems Dysfunctions
  - ✓ >350 Reccuring Applied Complex Systems Dysfunctions in Checklists
- **Selected Domain Approaches (~20 Workers) on SysPath**
  - ✓ Miller's (Swanson's) SysPath; Odum's SysPath; & from Systems Engineering: Meadows; Davidz et. al., Katina, Keating; Schindel; Thompson/Gariepy; Hybertson; Kerschmann; Ohno/Meekings; Talbot et. al.; Pennock/Wades; Zwick; Thomas; Gall;

THE BASIC IDEA: of a new top-down td-SYSTEMS PATHOLOGY

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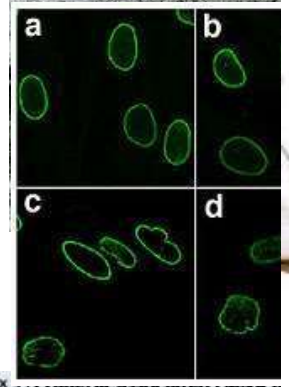
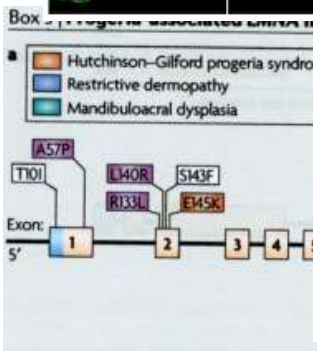
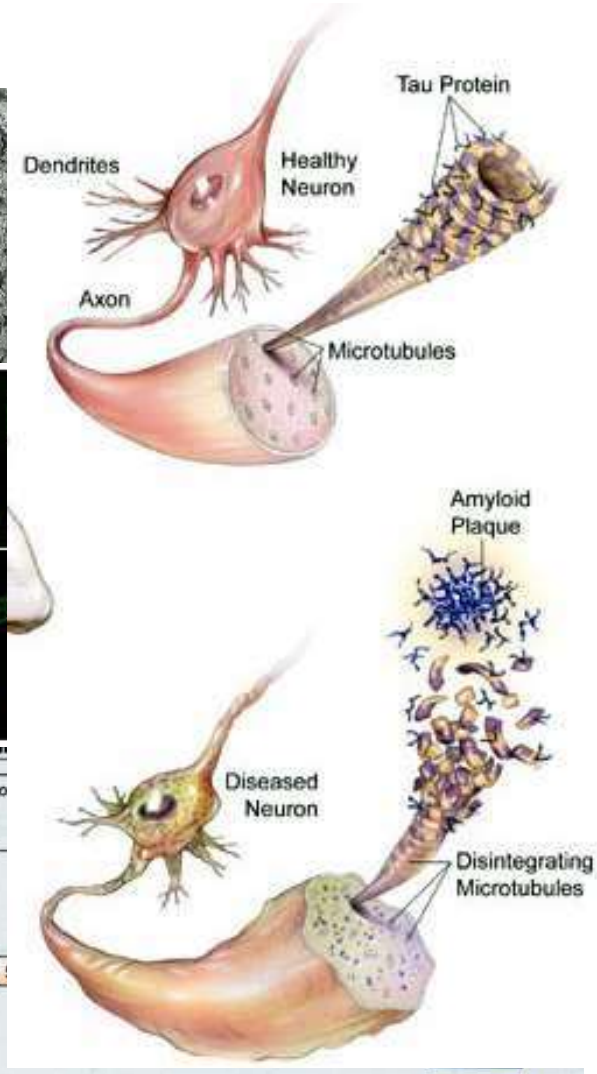
What Is the New td-Systems Pathology? I.

- ✓ **We present/advocate → need for Doctors to the SYSTEMNESS of the Universe;**
- ✓ **From our working assumption: virtually everything is a system (see USSO)**
- ✓ **Advocate conscious emulation of & learning from successful 2,500 yr history of medicine; avoid its mistakes; leapfrog way ahead from its experiences**
  - **Would involve rigorous use of its concepts and methods**
    - *"recognition and naming of diseases" EACH'S "etiology" "symptomology" "diagnosis" "prognosis"*
    - *Experimental verification of treatments by modeling & follow-up*
    - *Incredibly long term & detailed documentation of outcomes & comparison with initial states*
    - *All of these are currently absent in SE, sustainability, solving hybrid complex-system crisis problems*
  - **Key step is conscious effort at recognizing, naming, prediction & investigation of common, repeated cases of systems-level dysfunctions (what "td" & this talk is about)**
  - **And education in a fundamental sys framework → ontology, or taxonomy of errors resulting in dysfunctions deriving DIRECTLY FROM the nature of complex systems**
- ✓ **Must be based on a well-established, vetted, consensus SS or GST**
  - New top-down SysPath derives from three advances: (1) Raising all studies of dysfunction & failure to level of SYSTEMNESS; (2) search for first causes; (3) emulation of medicine ……

"Bottom-Up" SYSTEMS PATHOLOGY already well established

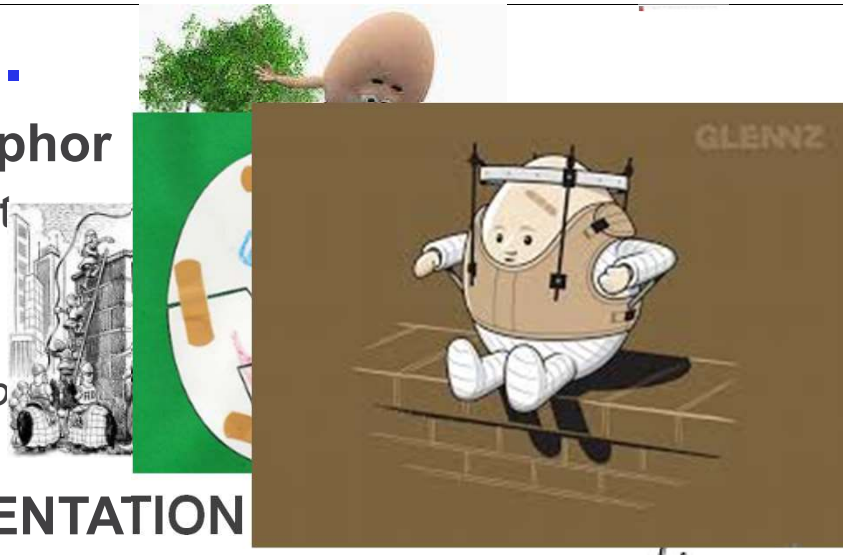






- **<u>Study Disease on cell/molecular levels</u>**
- Searching for "systemic" disease etiology on reduct'n level
- E.g. Progeria's (systems level diseases causing way premature aging of entire body, e.g. HGPS; Werner's; Rothman-Thompson; Bloom)
- Devised name ***laminopathies*** to name this cluster of diseases due to errors in organelle nuclear lamina
- Known down to molecular level as errors in laminA (LMNA) protein; helps explain HGPS
- Also for systems-level diseases like Alzheimer's; reveals reduction cause of sys effects
- Example, ***tauopathies*** within >> CILIOPATHIES; found errors in T.A.P. esp. *tau* proteins (may be one of the causes of Alzheimers) (huge n → 5.6M)
- **Why do I call them a SYSTEMS-Level DISEASE or a Systems Pathology? Because error tho' nominally at reduction level causes dysfunctions to ENTIRE complex system; the error in a component causes all the derivatives to dysfunction; I also call this PLEIOETIOLOGY = one cause; many consequences**

What Is td-Systems Pathology? II.



- ✓ **Umbrella/Tent metaphor: Humpty Dumpty metaphor**
  - **An effort to get separated things under the same tent**
  - **An exercise in PUTTING THINGS BACK TOGETHER**
    - *Sometimes folk wisdom is = to systems wisdom …….*
    - *Easy to find fragmenting; Hard to find healing or integratio*
    - *Somewhat like our current state of politics*
- ✓ **MAIN PURPOSE IS UNIFICATION, NOT FRAGMENTATION**
  - **We have been accused of causing fragmentation by attempting to start new specialty**
  - **But in this talk we will show how the study of dysfunctions of systems is disorganized and fragmenting even worse over time when has great potential for synthesis, integration, unific'n; in SS & SE alone I have lists of ~350 recurring complex systems dysfunctions.**
- ✓ **STUDYING DYSFUNCTIONS A KEY TO PROBING COMPLEXITY (not -; rather a +)**
  - **Biomedicine has demonstrated in the past that study of dysfunction can be the key to unraveling phenomena so complex that pathologies can become key to finding needle in hay**
    - *Enzymopathies in humans; Mutations in bacteria clue to physiology; Gene mutations to understanding function of gene;*
    - *All cases of specific diseases helping science researchers unravel hidden causes; can be used in extremely positive way beyond healing the sick; SO SYSPATH IS POSITIVE, NOT NEGATIVE*

Basic Idea: What is top-down Systems Pathology? III.

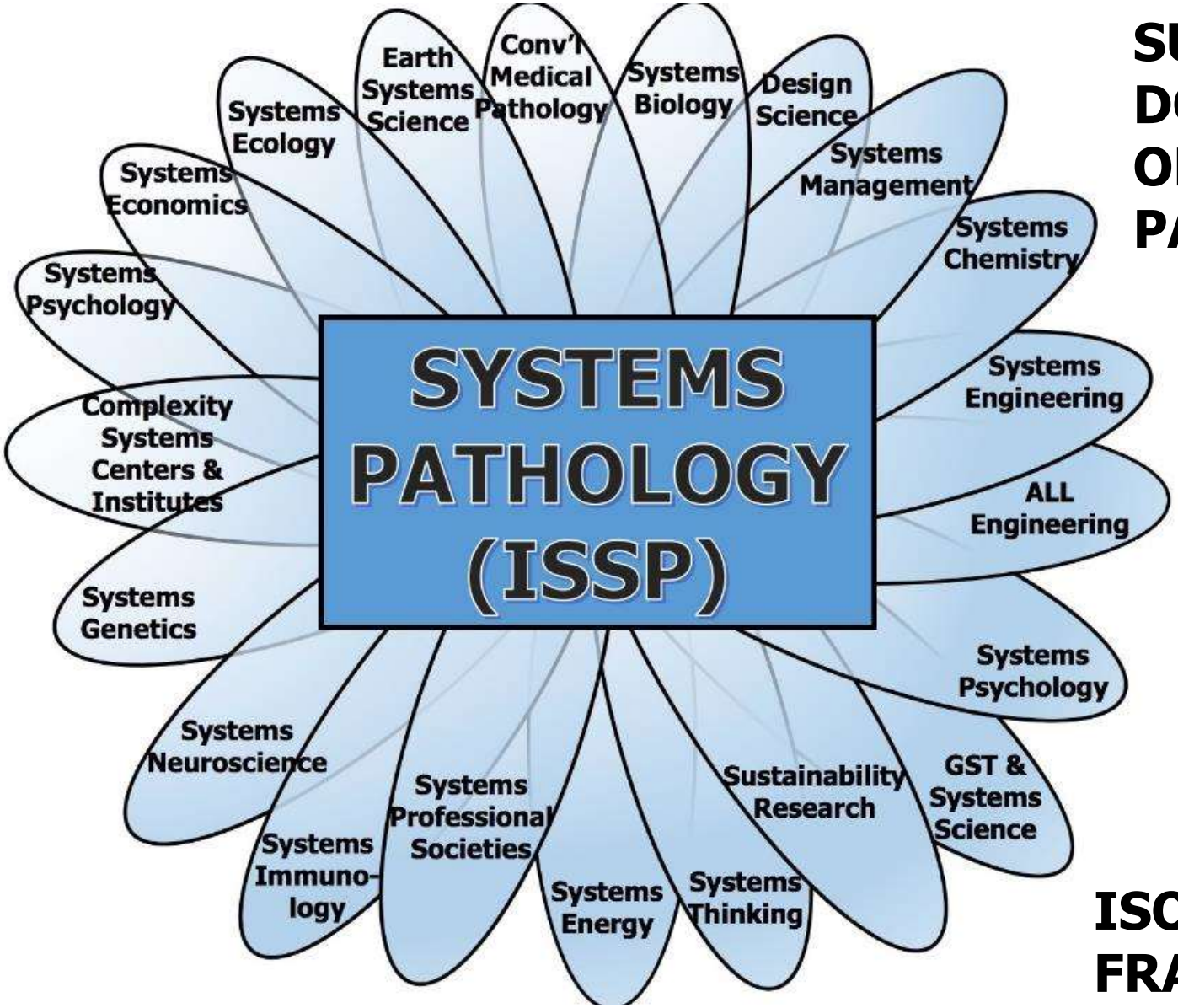
- ✓ **VALUE: Medicine alone in U.S. is a >>$8 trillion/yr industry; ~18% of U.S. GDP**
  - A fifth/sixth of entire U.S. economy; >$10K per person; most pressing sociopolitical problem
- ✓ **Need to extend it to a "systems-level" "top-down" ALL SYSTEMS awareness**
- ✓ **But also recognize that many pre-Systems Pathology movements exist**
  - **But these are fragmented; We intend to try to help several become aware of each other**
    - *Give the same venue for conferences; same journals; same yearbook; integrated bibliography*
    - *Familiarize each other with their basic tenets, findings and terminology*
    - *Again imitating modern medicine; "translational" efforts (new $B industry); translate terms & findings*
    - *The proposed Int'l Society for Systems Pathology would sponsor and mediate intercommunication*
  - **Key step is conscious effort at finding the most fundamental, first, "systems-level" causes of the pathologies or dysfunctions of human systems (a new systems-level etiology)**
  - **This will require several levels of abstraction similar to that necessary to formulate general systems theory and systems science in the first place; to accomplish this we must overcome innate, widespread resistance of human focus on particulars only**
- ✓ **Would also use full spin-off's of SPT (systems informatics; sys mimicry; sys allometry)**
  - **Based on a strong systems mimicry of natural systems enabled by a strong systems theory; systems mimicry would extend eng&designers beyond biomimicry to SysPath**

Basic Idea: What is top-down Systems Pathology? IV.

Features I.: New Field of Systems Pathology

- Note Deep Similarities Between Development of the Medical Sciences & the Sys Sci's
  - Both study whole systems problems; both study very complex systems; both seek to improve the human condition; both had & have trouble applying knowledge to cause better results → medical "translational" res
  - Goal would be to recognize utility of discovering the Etiology; Symptoms; Diagnosis; Treatments; and Prognosis for often encountered complex sys design "diseases" (remember have lists of ~350 recognized)
- Study How Medical Science Overcame Those Obstacles
  - Relate Obstacles Faced by Medical Science Across Its History to Obstacles Now Facing the Systems Sciences; Represent rigorous lessons from a distinguished history
- Must begin with Vital Signs of A Normal System (see beginnings in Miller SysPath at end)
- Begins with Assumption that detailed SPT Models of "mature" natural systems represents systems "normality" (or "sustainability"); as modeled in the Systems Processes Theory (SPT)
- The detailed network of isomorphic systems processes (ISPs) connected by "linkage propositions" (LPs) give immense systems mechanism details like MOLECBIO → MEDICINE
- Plus OTHER sources possible and likely; here we will examine SPT AND 21 other source domains

SUGGESTED DOMAINS OF SYSTEMS PATHOLOGY



ISOLATED & FRAGMENTED

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Basic Idea: What is top-down Systems Pathology? V.

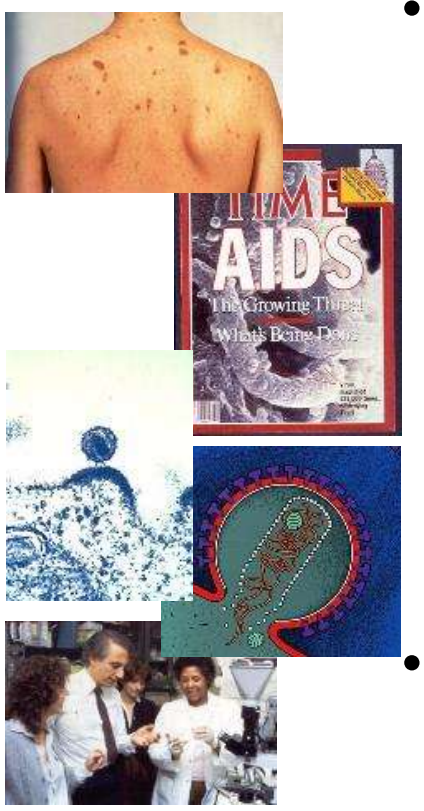
Features II.: New Field of Systems Pathology

- Diagnose man-made influences on natural or social systems relative to GST/SS "isomorphs"
- Can we Identify repeatable Systems-level Diseases? (begin w the 350 item checklist)
- Might enable classification/taxonomy of "systemic" diseases as key to understanding causes
- Derive sets of Symptoms of certain Systems Malfunctions
- Given A Meaningful Taxonomy of Systems Pathologies, Can We Design Diagnostic Tests?
  - This is critically important; whole new sets of systems measures could arise from this effort as in med
- Knowing what went wrong can we Design Treatment Modalities for Systems Pathologies
- Can We Link Systems Diagnosis to Prognosis?
- May even be able to recognize repeated Fundamental Human Causes of Systems Malfunction
- FINALLY all of the above would make it possible for designers to become aware of possible dysfunctions in the beginning, not the end of the process

Basic Idea: What is top-down Systems Pathology? VI.

WHY IS IT IMPORTANT TO RECOGNIZE & NAME SYSTEMS DISEASES?

Again Learn from 2,500 Years of Medical History…….



- Consider the importance to humans of recognizing a vast number of conventional human diseases; 2 brief examples:
  - AIDs at first was merely a set of unusual symptoms that appeared in an unlikely population, e.g. Karposi's sarcoma & opportunistic infections in young rather than old men. After careful collection & grouping of symptoms, AIDs was declared a disease, and a causative mechanism was identified followed by ever better drugs & vaccines. → **1st decade 100% death sentence; now same lifespan**
  - e.g. newly appearing infectious agents; recent SARs & bird flu threat; 2 weeks to find cause, 4 weeks, to get the entire genome!!!
- Lesson: It is important to cluster symptoms to recognize a new dysfunction & use these to become aware of & name a new disease in order to trace its causes (etiology).

Basic Idea: What is top-down Systems Pathology? VII.

Emulate how medicine names diseases & why……

…to discuss something, it is necessary to name it

- **Name after discoverer** (e.g. Ewing's sarcoma; Parkinson's disease; instant reputation; inherent motivation; publication in respected journal)
  - Suggest same for Systems Pathology
- **Name after dysfunctional particular or sub-system** (e.g. laminopathies; pneumonia; small cell lung cancer)
  - Less utility for SysPath since sys architecture, not particulars; but present in Millers LST pathos
- **Name after agent causing dysfunction** (e.g. HIV for AIDS,)
- **Name after place discovered** (e.g. Philadelphia chromosome; Ebola)
- **Name after primary symptoms** (e.g. chronic fatigue syndrome; auto-immune)
- **Name after key patient** (e.g. Lou Gehrig's)
- **Result is a huge data base that is organizable from the first recognition**
  - ~ 22,000 disease categories from GenBank; ~ 12,400 widely recognized, described clinical; ~ 6,000 rare diseases
  - So 40,400 minus overlap; if physicians can master this database to doctor, so can engineers, sustainability experts, etc.
- **BUT above do not give an ontology /or/ taxonomy; will in a few slides, first basics…**

SAMPLE FROM JUST ONE DOMAIN:

GST & SYSTEMS SCIENCE DOMAIN TO SYSPATH

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SPECIFICALLY FOCUS ON ONE GST/SS:

Systems Processes Theory (Troncale):

AS PROGENITOR OF SYSTEMS PATHOLOGY

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FIRST NEED TO DESCRIBE SYSTEMS PROCESSES THEORY (SPT) very briefly

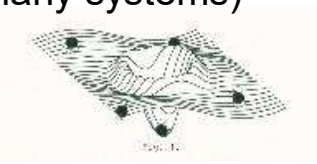
Intro td-SysPath VIA Systems Processes Theory (SPT)

- ✓ **SPT has two major components: ISPs and LPs**
  - **ISP = Isomorphic Systems Processes; LP = Linkage Proposition; hereafter ISPs & LPs**
- ✓ **Isomorphic Systems Processes (after Bertalanffy's use of isomorphies in GST)**
  - **40 to 110 ISP's; how systems work; their mechanics; duplicated again and again by natural systems at diff't scales, origins, times, components, as studied by 7 sciences using their tools and techniques, so should be acceptable by conventional sciences → sci of systems**
  - **FOCUS on researching/documenting each ISP and its functional parameters, as defined by**
    - *35 Categories of Features (often Steps in the process); ID Functions; Measurables; Linkages; History*
    - *When "operating within normal parameters for its scale" defines a "HEALTHY SYSTEM"*
  - **Add to this literally hundreds of LPs derived from scientific experiments across 7 sciences**
- ✓ **UNHealthy Systems; Dysfunctional States; "Pathologies" systems diseases**
  - **When above defined ISP normal functions are not within normal operating parameters**
  - **So dysfunctions in the "architecture" or performance of natural systems processes**
  - **So SPT = a rich source of detailed alternative pathologies & Taxonomy of pathologies**
- ✓ **But as we will see, there are other approaches to td SysPath to COMPARE**
  - *SE Failure Analysis; Fault Analysis already in GST & SE; Miller; Swanson; Odum; Schindel;*
  - *SO my task is also to make initial introductions and comparisons; from SPT to the other domains*

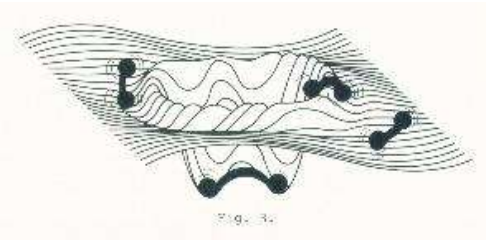
What are Isomorphic Systems Processes (ISPs)? & Linkage Propositions (LPs)?

Only time for the briefest glimpse of the two major components:

- An I. Systems Process (**ISP**) describes an obligate sequence of transformation steps that fulfills a necessary systems function (isomorphic because found similar across many systems)
  - Natural sciences = phenomena = natural processes; ISP abstraction of all processes
  - Like "algorithms" in computer science, except never finished; ongoing; probabilities
  - Precise, well-defined, limited set of step-by-step rules or operations to change a defined input to a defined result or finish
  - Natural Systems Processes Theory (SPT) – integrates – **based on 40 ISP's; many phenomena into ONE**



- **LP's** are language-based or formal statements of a documented & described influence between two or > **ISP's**
  - Can show graphically by node & link diagrams
  - Different types can be shown by diff't lines



A Graphic portrayal of what it means to be iso-morphic

…when you go beyond their particulars to their general dynamic structure & function...
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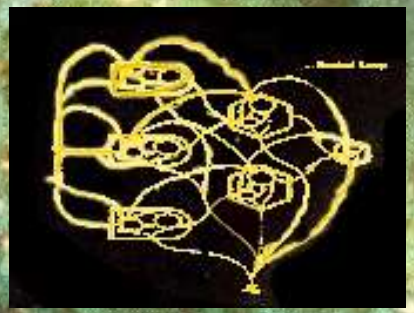
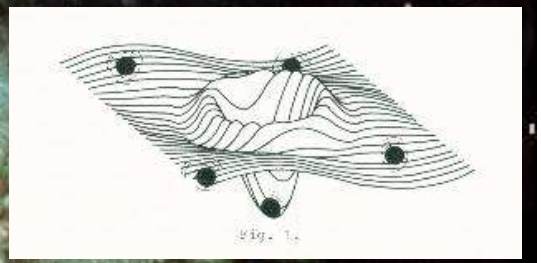
…fundamentally, they exhibit identical key processes & dynamics





…Why? Especially if their origin times and mechanics of origins are so completely separate and different from each other…

…This unified Systems Processes Theory (SPT) posits because the SP's are the multi-parameter MINIMAL CASE…

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Systems Processes Theory (SPT) Recognizes & Defines >110 Isomorphic Systems Processes (ISPs)

Many more than other candidate systems theories…

- Adaptation Processes
- Allometry, Systems-Level
- Allopoiesis
- Anergy Mechanisms
- Ashby's Conjecture (Requisite)
- Attractors
- Autopoiesis & Autocatalysis
- Bifurcations
- Binding Processes
- Boundary Conditions as a Proc
- Boundary Limits & Constants
- Catastrophe Processes
- Causality Processes (linear vs net)
- Chaotic Processes
- Circuits & Network Motifs
- Closed Systems
- Competitive Processes
- Complexity Processes
- Constraint Fields & Analysis
- Cooperative Processes
- Counterparity Diagrams & Proc's
- Criticality, Self-, Tipping Pts
- Cycles and Cycling, General
- Cycles, Rechargeable Loops Limit
- Decay, Autolytic & Senescent Proc
- Deterministic/Directive Process
- Deutsch's & Dollo's Conjecture
- Development Patterns & Laws
- Dissipative Processes
- Diversity & Variation Processes
- Duality-Complementarity Mech's
- Embodiment & Subsumption Proc
- Emergence Processes
- Energy Processes
- Entropy, General
- Equifinality as a Process
- Equilibrium & Steady State Proc's
- Ergodic Processes
- Evolutionary Processes
- Exclusion Principle
- Feedback, Coupled
- Feedback, General
- Feedback, Negative
- Feedback, Positive
- Feedforward & Anticipatory Proc
- Field Processess & Potentials
- Flow Processes
- Fractal Structure & Processes
- Functions, System (Goals)
- Growth Patterns & Laws
- Hierarchies & Clustering as a Process
- Hypercycles
- Information-Based Processes
- Input Processes
- Instability Mechanisms
- Integration Processes
- Interactions, Linkages, Connections
- Least Action/Energy Principles
- Limits, Informational
- Limits, Physical
- Limits, Wilson-Troncale
- Maximality Principles
- Minimization Principles
- Morphodynamic Processes
- Network Structure & Processes
- Non-Equilibrium Therm as SPs
- Open Systems Processes
- Origins Processes
- Oscillations
- Output Processes
- Pathology Processses
- Periodic Processes
- Phases, Stages, Transitions
- Pleioetiology as Process
- Pleiotrophy as Process
- Plenitude, Principle of
- Potential Spaces or Fields
- Power Laws, Cross-Scale
- Recursive Processes
- Redundancy Processes
- Replication Processes
- Restructuring Rules
- Scaling & Scaled Processes
- Self-Organization
- Self-Reference Processes
- Singularities
- Soliton Theory (Long Waves)
- Spin Processes
- Stability Processes
- States, Systems
- Steady State Mechanisms
- Storage Processes
- Strings, Generic Systems
- Sub-Specialization Processes
- Symmetry, Systems-Level
- Symmetry-Breaking as a Process
- Synergetic-Synchrony Processes
- System Identification, Sub-, Super-
- Systems of Systems Processes
- Thermodynamic Processes
- Transducer Processes
- Transgressive Equilibrium
- Variation Production as a Process
- Zipf's/Pareto's Patterns (as Proc's)

But Beyond ISP Dysfunctions SPT Candidate LPs Yield Additional Causes of Systems Malfunction (Disease)

- Unsynchronized cycle component timing
- Multiple positive feedback loops in a series
- Exceeding optimal “cluster” sizes
- Large deviations from sufficing allometric proportions
- Unbalanced or uncoupled pairs of positive and negative feedback loops
- Dysfunctional or non-adaptive delays in feedback
- Synergy of malfunctioning components (total systems’ collapse
- Unbalanced numbers of feedback types
- This list would be even more extensive than that for SPs

SYSTEMS PROCESS THEORY

(LP Charts from the NATURAL SCIENCES)

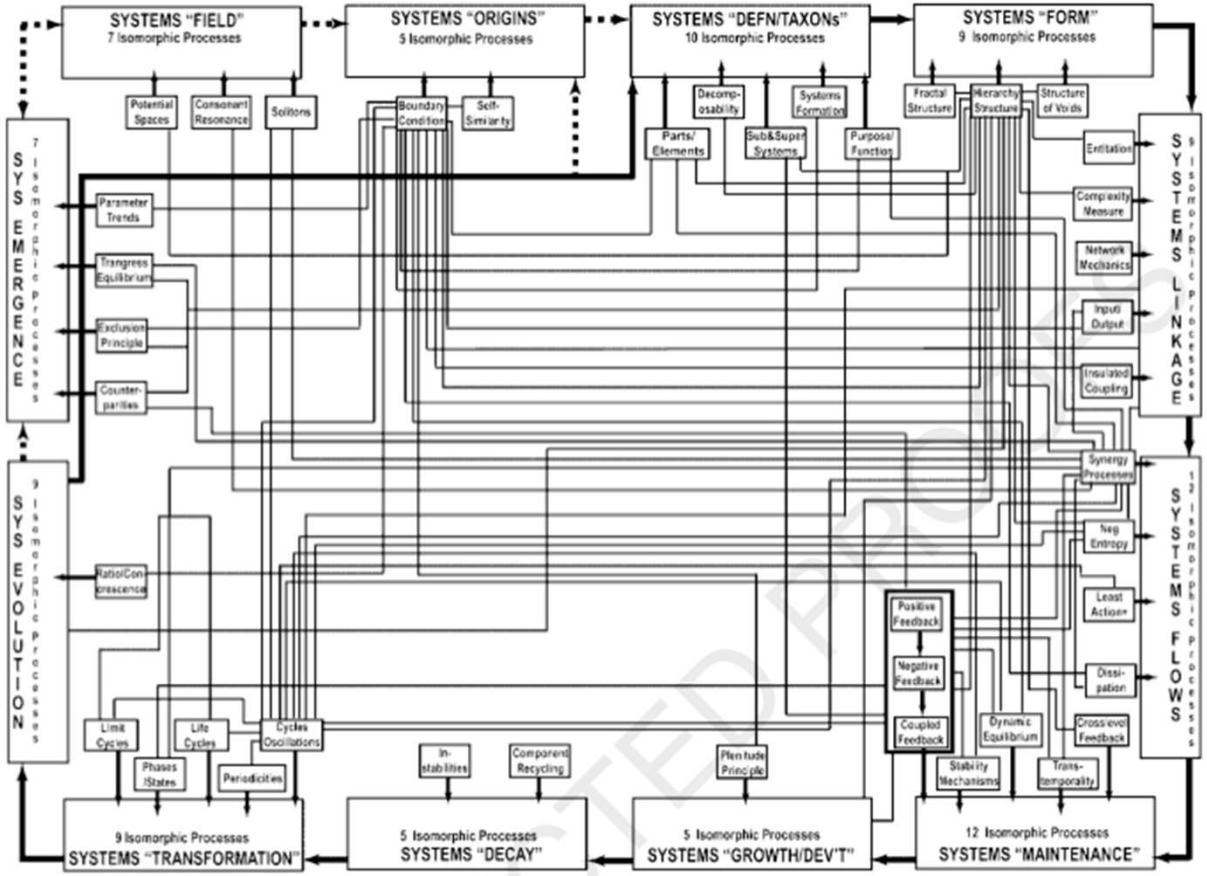
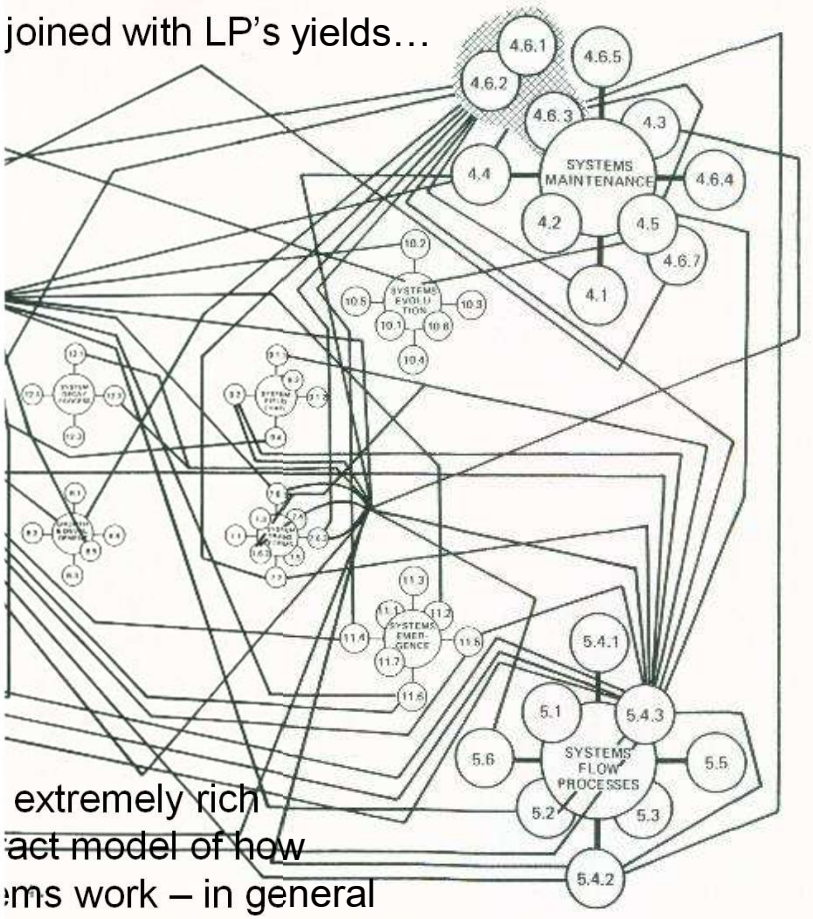


Figure 2. Network map showing ~85 linkage propositions between 12 systems "functions" & the 42 systems processes with which they experience mutual influences

joined with LP's yields…



extremely rich

act model of how

ms work – in general

SO ARGUMENT FOR USING SPT-BASED td-Systems Pathology:

- Using tdSPTSysPath already have >20x55 or >1,100 specific pathologies to become aware of, learn, watch out for in designs
- They come ready-made: RICH, DETAILED, ORGANIZED, ONTOLOGICAL
- Establish NOP Range of Values for Systemic Vital Signs
  - "normal operating parameters" requires much scientific, expt'l knowledge
  - Problem of measurables; easier in natural science phenomena; not so in human
- Develop a comprehensive symptomology
  - Symptoms must be clustered
  - Symptoms must be associated; exhibit proven "correspondence principles"
  - Symptoms must be linked to normal systems processes
- But STOP DELAYING. What are the Taxonomic Categories of Complex Systems Dysfunctions (Diseases) that the SPT RECOMMENDS ……..

A Top-Down Organization of SysPath from SPT

ONTOLOGY or TAXONOMY for Systems Pathology from Systems Processes Theory (SPT-Troncale):

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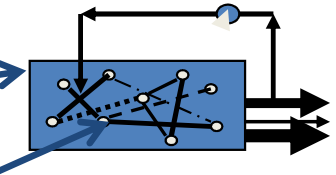
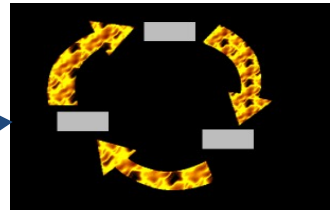
SPT-Based SysPath NAMES MAJOR TAX CATEGORIES of Systems Diseases

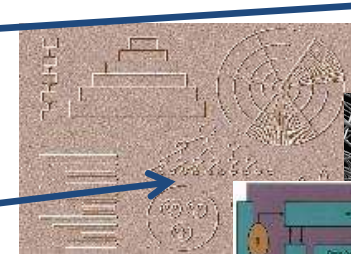
…Top-down strategy means dysfunctions derived from a KB at the systems-level

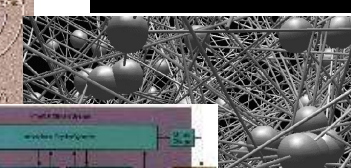
- **CAN USE SPT to Identify MAJOR CLASSES OF Systems-Level Diseases from the outset…**
  - **Cyberpathologies: errors in feedback**
  - **Rheopathologies: errors in flows**
  - **Cyclopathologies: errors in cycling, oscillation**
  - **Heteropathologies: errors in hierarchical/modular structure**
  - **Nexopathologies: errors in network str & dynamics**
  - **Teratopathologies: errors in development**
  - **Allometric Pathologies, etc.**

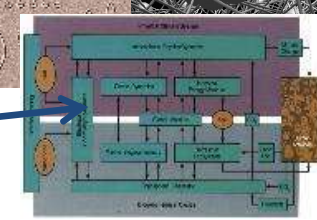
…Traces dysfunction TO steps in the process of a particular ISP or SPT

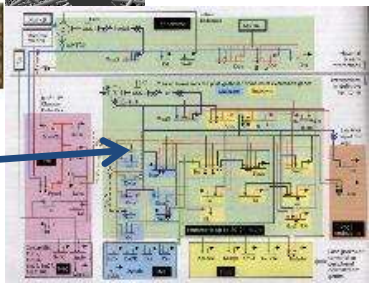


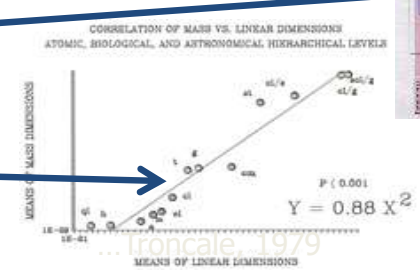








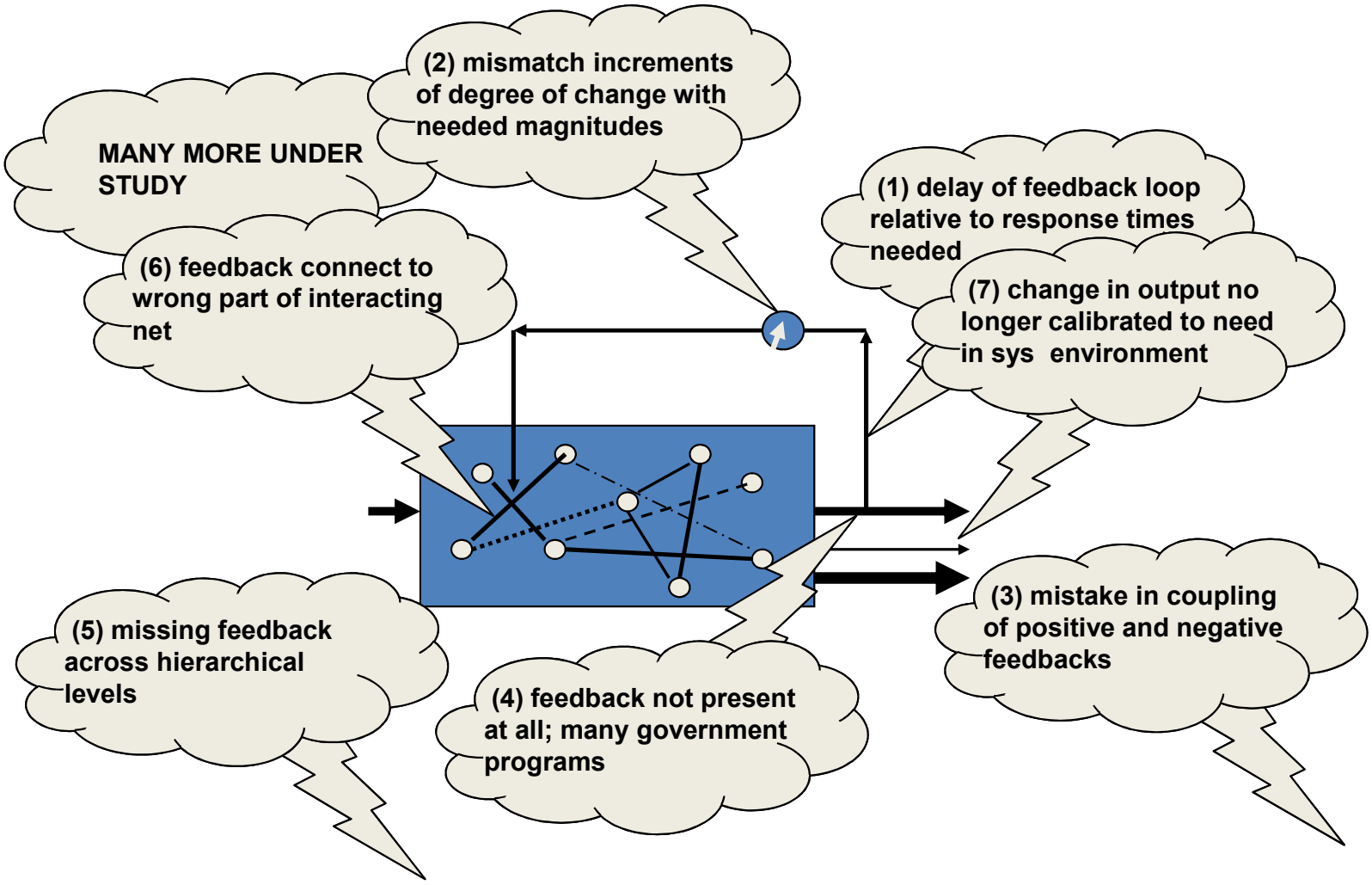




…Ironcale, 1979

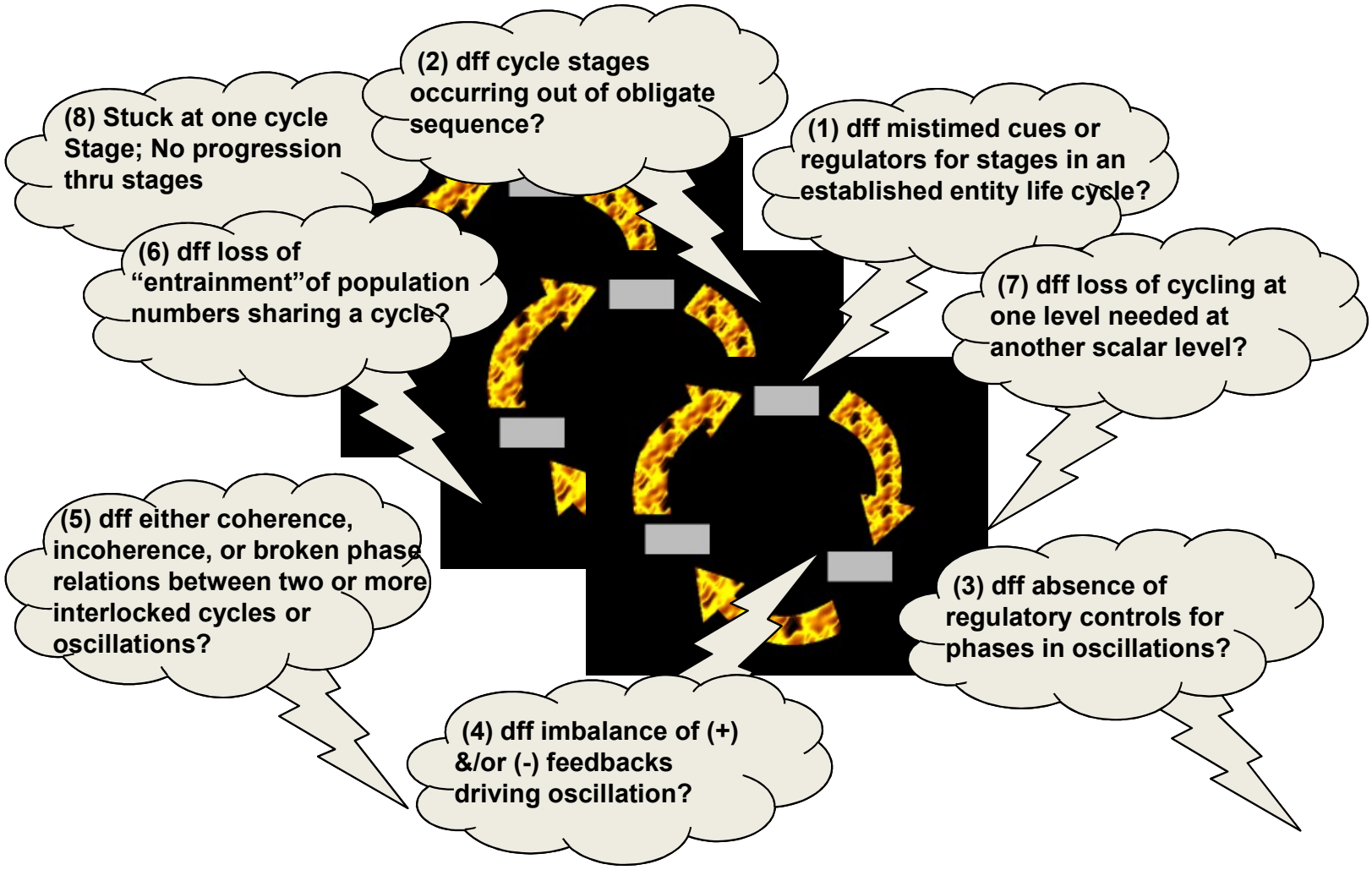
CYBERPATHOLOGY DISEASES

Examples X_1 to X_7 = dysfunction from (hereafter dff)



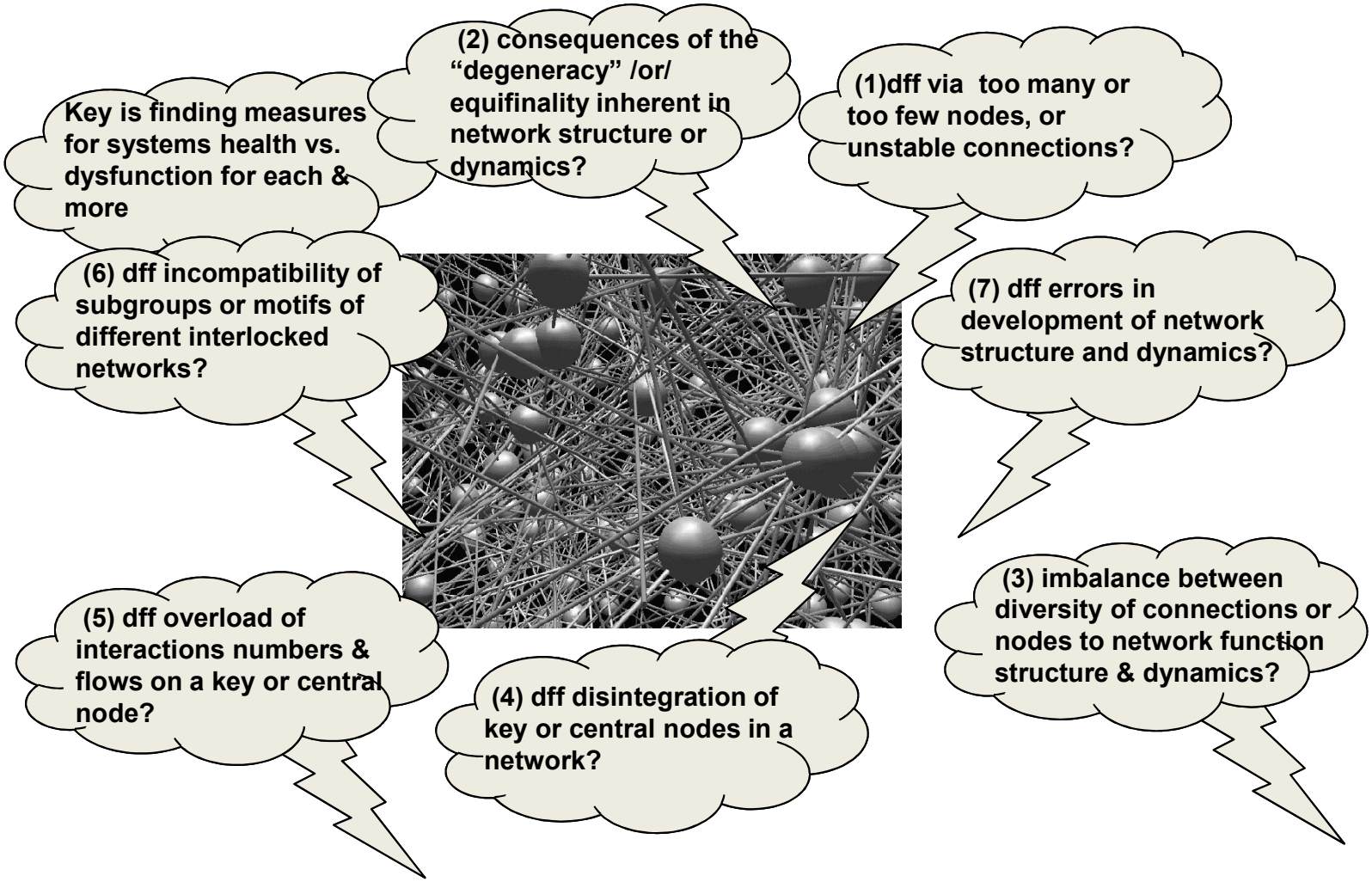
CYCLOPATHOLOGY DISEASES

Examples $X_{1\ to}\ X_8$ = dysfunction from (hereafter dff)



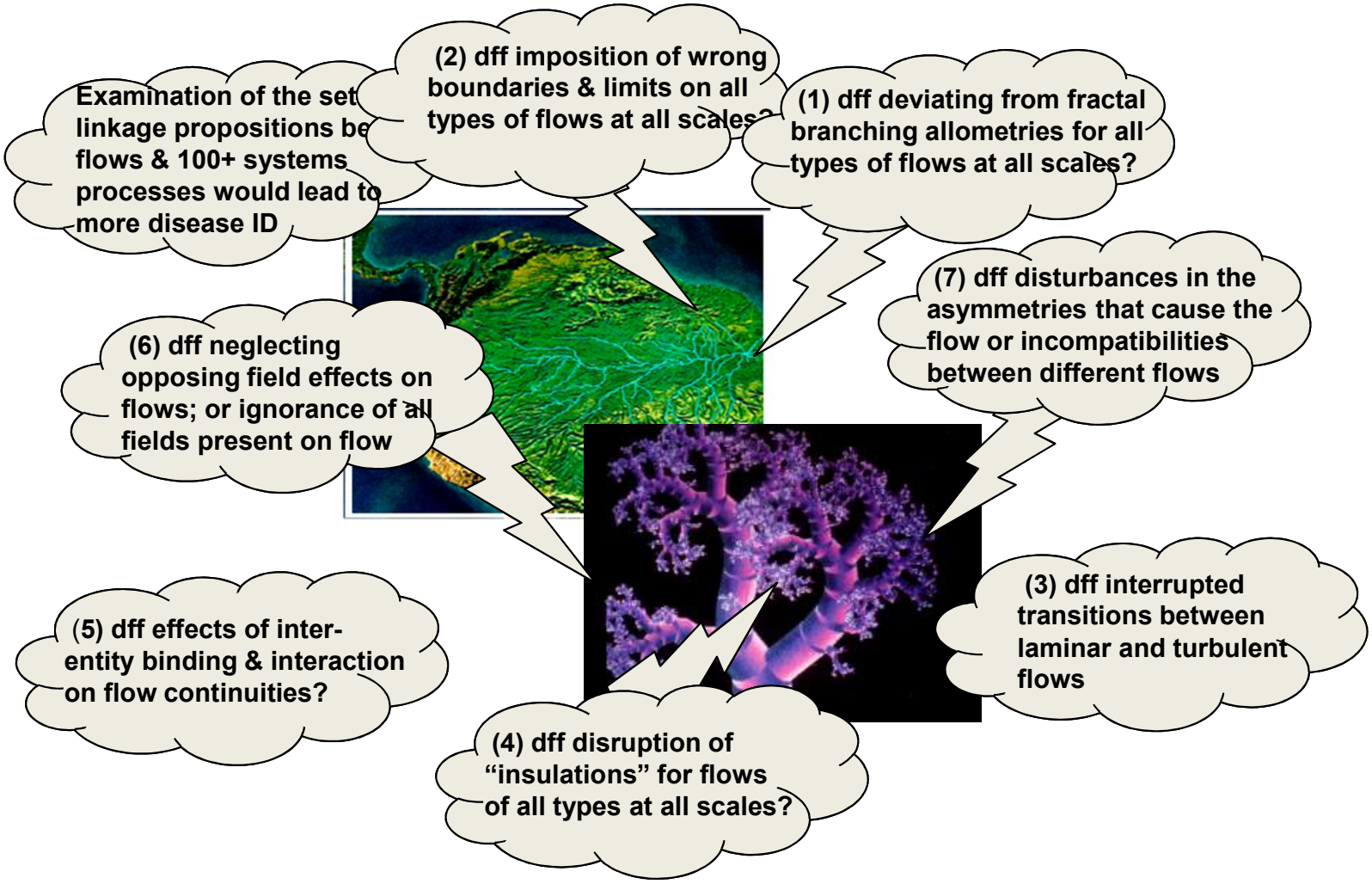
NEXOPATHOLOGY DISEASES

Examples $X_{1\ to}\ X_7$ = dysfunction from (hereafter dff)



RHEOPATHOLOGY DISEASES

$X_{1\ to}\ X_7$ = dysfunction from (hereafter dff)



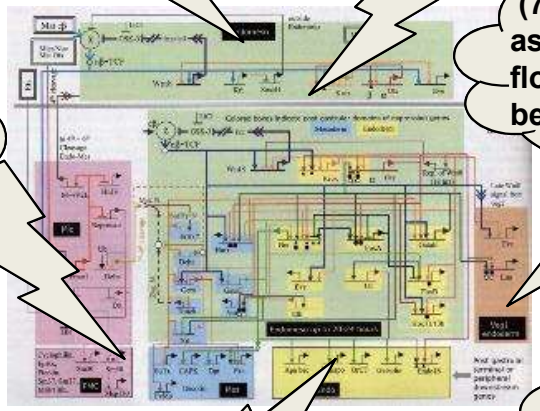
TERATOPATHOLOGY DISEASES

$X_{1\ to}\ X_7$ = dysfunction from (hereafter dff)

Examination of the set linkage propositions be flows & 100+ systems processes would lead to more disease ID

(2) dff imposition of wrong boundaries & limits on all types of flows at all scales?

(1) dff deviating from fractal branching allometries for all types of flows at all scales?



(7) dff disturbances in the asymmetries that cause the flow or incompatibilities between different flows

(6) dff neglecting opposing field effects on flows; or ignorance of all fields present on flow

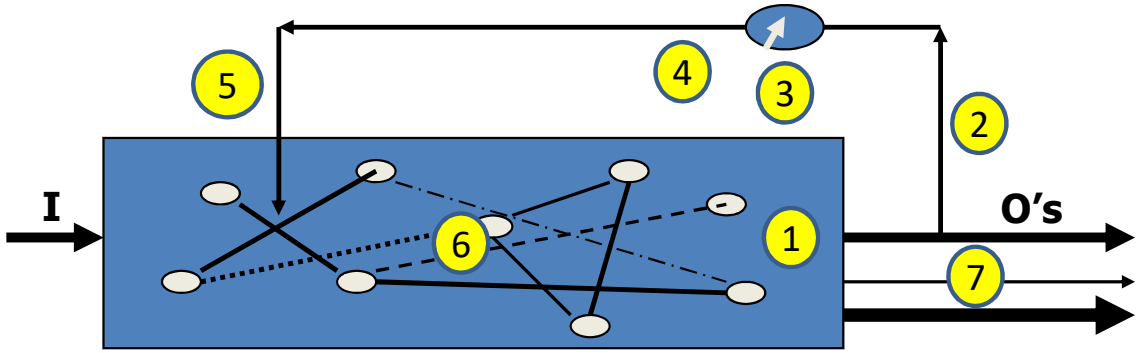
(5) dff effects of inter-entity binding & interaction on flow continuities?

(3) dff interrupted transitions between laminar and turbulent flows

(4) dff disruption of "insulations" for flows of all types at all scales?

From Category to Specific Predicted Dysfunctions

Notice all this is all dependent on verified, proven, consensus Model of the Isomorphic Systems Process before hand



- ✓ **How do you go from knowing a ISP to Predicted Problems in Complex Systems?**
  - **Foreknowledge of Specifically Identifiable Design/Operation Failures (I have lists of 350 recurring)**
- ✓ **Focus on <u>Steps in Process</u>; one example FEEDBACKS**
  - *Above illustrated steps: (1) black box of net of specific interactions responsible for producing outputs ; (2) measurement of output; (3) set point; (4) comparator; (5) message to responsible parts of producer; (6) change in production; (7) change in output. THEN IMAGINEER OPPOSITE OF ISP ACTION*
- ✓ **<u>Very Important</u> to note A MAJOR difference between human & natural sys's**
  - **In regard to the "set point"**
    - *Humans often set the points, or parameters, in all levels of Human Systems;*
    - *But in natural systems there is no conscious entity setting the point;*
    - *The context /or/ environment /or/ interaction with other natural entities set the point; so it is self-selecting and self-organizing*

SYSTEMS PATHOLOGY DOMAIN SURVEY

OTHER GST/SS DOMAIN Additions to SYSPATH: Living Systems Theory (Miller) Ecological Systems Theory (Odum)

© Troncale, July 9, 2017

Prototype SysPath Work of Miller I. ((1916-2002))

- ✓ ***Living Systems*, 1978, first extensive GST attempt (Miller, Pres ISGSR 1973, Pres UoL)**
  - *Miller was an M.D.; always encouraged more science in GST; helped rename ISGSR → ISSS*
- ✓ **Repeatedly stressed importance of "measurable systems parameters" in sys health**
  - *DISTINGUISHED healthy from unhealthy systems with definition I still use ……*

  - *"Any state of a system is pathological in which one or more variables remain for a significant period beyond their ranges of stability, or in which the costs of adjustment processes required to keep them within their ranges of stability are significantly increased." (Miller, 1978, p. 81) very consistent w traditions of medicine*
  - *Defined steady state as open systems maintaining dynamic balance of key variables by a continual flux fed by lower entropy input & hi entropy outputs within a range where continual adjustments within range are healthy*
  - *After medicine (e.g. healthy ranges of wbc 4-11, platelets 130-400 per 1000/mcL; 4.7-6.1 rbc per mill/mcL or ranges for postassium, sodium, creatinine, hemoglobin A1C cholesterol etc. in blood)*
  - *Can you even imagine a time when we will have equal numbers of measures of systemness "health"; he did*
- ✓ **But 1978 text of 1,102 pp had only limited material indexed as "pathology"**
  - *For LST, Pathologies were considered any deviation from the 7 hierarchical levels or 20 common subsystems*
  - *Only 1% of its 173 "cross-level" and 1% of its 600 general "hypotheses" are cited as pathologies*
  - *Only 9 of the 130 lines of the Chapter Outlines are devoted to pathology*
- ✓ **But Miller did specify some specific unhealthy systems markers**
  - *These included 8 "causes" of pathology via "lack of" or "excesses" of matter/energy/information inputs but also cited these as "adjustment processes" that were used to get variables back within range*

See also Miller, J. G. and Miller, J. L. (1991). A living systems analysis of organizational pathology. *Behavioral Science,* Vol. 36, No. 4 (Oct. 1991), pp. 239-252.

Prototype SysPath Work of Miller II. (th Pres of ISSS)

- ✓ **Here are some of the Systems Pathologies of Miller in his own words …**
  - One
  - Two
  - three
- ✓ **Compare these to expressions of dysfunctions in the SE and Systems Thinking world, Miller's descriptions of pathologies are non-anthropomorphic and expressed in >abstract, general, causative terms of SS & general systems theory**
- ✓ **This, a main theme of SPT, & will become more evident as we go thru various domains of SysPath**

See also Miller, J. G. and Miller, J. L. (1991). A living systems analysis of organizational pathology. *Behavioral Science,* Vol. 36, No. 4 (Oct. 1991), pp. 239-252.

Prototype SysPath Work of Swanson I.

- ✓ **Protégé of Miller; Accountant; past ISSS M.D. & President, 1997**
  - **Outlined main System Pathology etiologies (or causes) in Miller's LST Lifework**
    - *These included: Eight causes of pathology = 6 dysfunctions of Inputs & Outputs and 2 abnormalities of Internal Proc's, and by implication changes to 8 "structural" relationships & 11 "process" relationships*
    - *Swanson added "lack of" or "excesses" of outputs to Miller's categories of causes*
  - **Analyzed Living Systems SysPath content for ISSS, SysPath SIG, Special Interest Group**
    - *Swanson concluded: (i) The study of Pathology is informed throughout LST. That happens because the definition of Pathology is connected with central ideas of the theory, that is the concepts of Steady State, 7 Adjustment Processes, Critical Subsystems, Stress, Strain, and Purpose (as relationships). (iii) The conceptual intertwining of its definition with those basic concepts provides a large array of details informing Pathology.*
  - **Noted: "General causes of pathology should not be confused with comparable classes of pathology. The etiology is not the pathology. The cause of a condition is not the condition."**
  - **Noted: The power of LST to inform…**(systems pathology)**…rests not in the volume of its coverage but, rather, in the conceptual location of the definition of Pathology *vis-á-vis* the definitions of (LST) fundamental ideas.** (that is it is embedded) (parentheses mine)
  - **But also noted: "If implications for the study of pathology permeate LST, that penetration is not obvious."** (more like must 'read in' implications in the vast amount of data in LST book)

See also Swanson, G.A. (1991). Living Systems Theory and the Study of Pathology. *ISSS Proceedings.* Vol. 36, No. 4 (Oct. 1991), pp. 239-252.

Prototype SysPath Work of Odum I.

- ✓ **Howard T. Odum ((1924-2002))**
  - **Professor emeritus, University of Florida**
  - **Director, Center for Environmental Policy; Founder, Center for Wetlands**
  - **Past President of the ISSS for 1991; regular conference participant**
  - **Crafoord Prize Winner, 1987**
    - *Considered the Nobel Prize for Ecology (astronomy, mathematics, geosciences)*
    - *Preceded other winners such as E.O. Wilson, James Van Allen, Seymour Benzer, Richard Lewontin, Carl Woese, James Peebles, Ernst Mayr, John Maynard Smith, Fred Hoyle, Robert May*
  - **Originated new concepts & formulae for "emergy" "empower" "transformity"**
  - **Wrote several books on Ecological Modeling; very powerful use of tools; claimed beat out Forrester (Systems Dynamics) models in point-by-point predictions of past data sets**
    - *Ecological and General Systems: An Introduction to Systems Ecology (1994) Revised Edition*
    - *Modeling for All Scales: An Introduction to System Simulation (2000)*
    - *Environment and Society in Florida (1998)*
    - *Book Indices do NOT contain words like pathology/disease/dysfunction; but some on "errors"*
  - ***Environment, Power, & Society for the 21st Century: The Hierarchy of Energy* (2007)**
    - *Chapter 11: Energetic Basis for Religion contained 13 pages on "Religious Pathology"*

Prototype SysPath Work of Odum II.

- ✓ **Odd and unusual that a scientist would pick this arena as exemplifying pathology**
- ✓ **Odum cites many of the excesses of our current civilization as patholog**
  - *To him, the highest good is increased transformity (meaning nrg of one form to another)*
  - *Developed intriguing "sequences" of transformity of increasing embodied energy*
  - *But did it using rigorous calculations of a standard of energy; allows simulations*
- ✓ **Odum's Systems Pathology in Religion (on "systems"-level with these Features)**
  - **Pathological when Too Little or Too Much; Needs Balance**
    - *Balanced cases channel energy to maximize empower; defines good as embodying energy*
    - *<: Emergy disperses; society loses cohesion; because rituals tie humans into net → empower*
    - *>: Many historical Egs. Spanish Inquision; witch hunts; lynch mobs; models of learning only dogma*
  - **Cites as "pathological" religious explosions modeled as chain reactions; holy wars; energy dissipation; concentration of empower that is non-functional; hi energy idols; celebrity worship; dogmatic ignorance;**
  - **Ends Chapter on Religious Pathology with suggestion of a NEW religion for the FUTURE based on emergy features**
    - *"Because energy laws explain the self-organization of society (and the resources of nature for society), these principles define what is moral. Emergy waste is immoral." () mine*
    - *Earlier tenets of religion based on smaller scales; need new one for much larger scales = systems*

Prototype SysPath Work of Odum III.

✓ **Odum's Energy System Ethics for All SCALES based on Emergy w**

- **These not expressed in terms of causative GST terms like Miller/Troncale**
- **Essentially anti-pathology behaviors; shows one of the uses of a SysPath**

- Seek satisfaction in useful contribution
- Help maximize real wealth (increase empower)
- Reinforce enbironmental sources
- Treasure genetic & cultural diversity
- Adapt to natural hierarchy
- Minimize luxury
- Minimize waste
- Adapt to systems rhythm
- Share Information
- Optimize Efficiency
- Circulate Materials
- Circulate Money
- Fit the Earth
- Reproduce only as needed
- Have Faith in Self-Organization
- I would add Minimize Inappropriate Celebrity

Notice though how these are different from Troncale's SPT-Based Anduranormism; even tho' both expressed as positive values to have for future generations

INITIAL COMPARISONS ACROSS 5 DOMAINS

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COMPARISON of Historical SysPath Domains:

	Conventional MedPath	AnatomicalSysPath	SysBioSysPath	td-GST/SS SysPath
1.	*Human body hierarch ONLY*	*Human body as a system*	*Bottom-up Biological Systems but All Scales*	*Depends on domain; goal is ALL systems rigorously including physical, living, human, social*
2.	*Reductionist*	*Bit More holistic*	*VERY Reductionist Dominant*	*GST or Systems science-based*
3.	*Often Disease/Organ ONLY*	*Disease as entire system*	*Disease as physiological system*	*Dysfunction of general system mechanics*
4.	> 3000 Specifically Identified & Named Diseases with Symptoms	> 3000 Specifically Identified & Named Diseases with Symptoms	Newer field, so more limited set of Bottom-Up	*Lists of >350 Complex Systems Failures, not yet curated, but documented*
5.	*Human only*	*Human only*	*Biosystem only*	*SPT brings in ALL Natural Systems*
6.	*Only Medical Literature & History*	*Only Medical Literature & History*	*Broader use of Bio even Network Literature*	*SPT brings in ALL Science Literature*
7.	*NO Isomorphies*	*NO Isomorphies*	*Some few Isomorphies*	*SPT brings in Interactions Between Isomorphies; Linkage Propositions*

DOZEN COMPARISONS: td-SysPath Prototypes:

➢Miller/Swanson/DeLamare	Troncale	Odum	Schindel
1. *Some explicit SysPath*	*Clearly Explicit SysPath*	*Implicit SysPath*	*Some SysPath mostly within SE Domain*
2. *SysPath Taxonomy Implied*	*SysPath Taxonomy Explicit*	*No SysPath Taxonomy*	*SysPath Extension to Design Innovation*
3. *Few Specific Dysfunctions*	*Many Specific Dysfunctions*	*Some Dysfunctions*	*Some Dysfunctions*
4. *Dysfunctions Living only*	*Dysfunctions very general*	*Dysfunctions Ecol/Econ*	*Dysfunctions to SE Process*
5. *Few Fixes Included*	*Fixes Explicit*	*Fixes Suggested*	*Fixes Not Yet Addressed*
6. *LST Framework only*	*Generic GST/SS Framework*	*No Framework*	*Describes "features" as Framework*
7. *Can be used to Model*	*Model of Models*	*High Level Simulation*	*Model-Based*
8. *<5 ISPs, not as ISPs*	*110 ISPs AS ISOMORPHS*	*<5 ISPs, not as ISPs*	*Several ISPs, not as ISPs*
9. *Indirect limited proof of ISP's*	*Extensive Proof of ISP's*	*Some proof of few ISP's*	*No natural science proof of ISP's*
10. *Hierarchy as framework*	*Hierarchy included as I SP*	*Hierarchy included, not ISP*	*Hierarch&Network included, not as ISP*
11. *Living systems only*	*All systems natural+human*	*Ecological, Energy, Human*	*Human engineering predominates*
12. *20 Critical Gen'l Subsystems*	*Subsystems Implicit*	*Many Specific Subsystems*	*Subsystems not the framework*
13. *8 causes but not Classes*	*55 Classes of Pathology*	*No Path Classification*	*Path Classification by Features*

SOME INITIAL CONCLUSIONS and THE FUTURE:

- ✓ **There are many domains of pre-existing Systems Pathology (at least 21)**
  - Rich in findings but not shared; VERY RICH in potential of applications for good
  - Known by entirely different names and using different terminology
  - Are also at many different levels of scale and focused on what are considered different types of systems
- ✓ **These domains do not know about each other; isolated communities & KB's**
- ✓ **Opportunities exist for synthesis, integration, & unification (SIU)**
- ✓ **Some at "symptom" level (SE, ST); others at causation levels (SS or GST)**
  - **Most work at the human level of system dysfunction; systems pathology would label these as "symptom" level (contributions of systems thinking domains)**
  - This is one of the advantages of using the medical analogy
  - It usefully clarifies the functional distinctions between symptomology and etiology
- ✓ **FUTURE: <u>Join the International Society for Systems Pathology (ISSP)</u>**
  - Visit Website intsocsyspath.org
  - Founding Faculty Member $100; Founding Student Member $50; PayPal
- ✓ **A general model of systems is needed to help formulate the pathologies in a manner that can transcend disciplines and existing SysPath domains**

END END END PSU SEMINAR

ADDITIONAL SLIDES IF TIME