The Atlas of Social Complexity

Brian Castellani
Lasse Gerrits

Opening argument

- Although the complexity sciences have done much to advance the social sciences, over the last decade the field has run into some hard situations – thirteen to be exact.
- Some are self-imposed, others come from how 21st century science is conducted.
- Examples include
  - ignoring the wider social sciences
  - privileging computational modelling over qualitative research
  - being tone-deaf about the real world.
- These situations presently prevent the study of social complexity from becoming the disruptive, transdisciplinary field it originally sought to be in the 1990s when the *complexity turn* in the social sciences took place.

Opening argument

- Fortunately, a small but growing global network of scholars are charting new territory.
- **They are part of a fresh turn in complexity, the *social science turn***, which fosters a transdisciplinary, social complexity imagination that, in one way or another, addresses the field's thirteen situations to create new areas of disruptive and highly innovative social inquiry.
- The ***Atlas of social complexity*** charts this new territory, seeking to map its present future.
- Organised around SIX THEMES, the Atlas functions as a tour guide, surveying over thirty leading-edge research areas (some still under construction) that readers can variously combine and develop.

Opening argument

- The Atlas is a practical guide for those seeking new ideas and new avenues of study to pursue, all in the hope of fostering the transdisciplinary social complexity imagination needed to address some of the biggest global challenges we, as a world community, presently face.
- **The purpose of this interactive Workshop is to introduce the Atlas to foster a discussion on the future of the field and for participants to explore what a future map might look like for their work.**

Overview

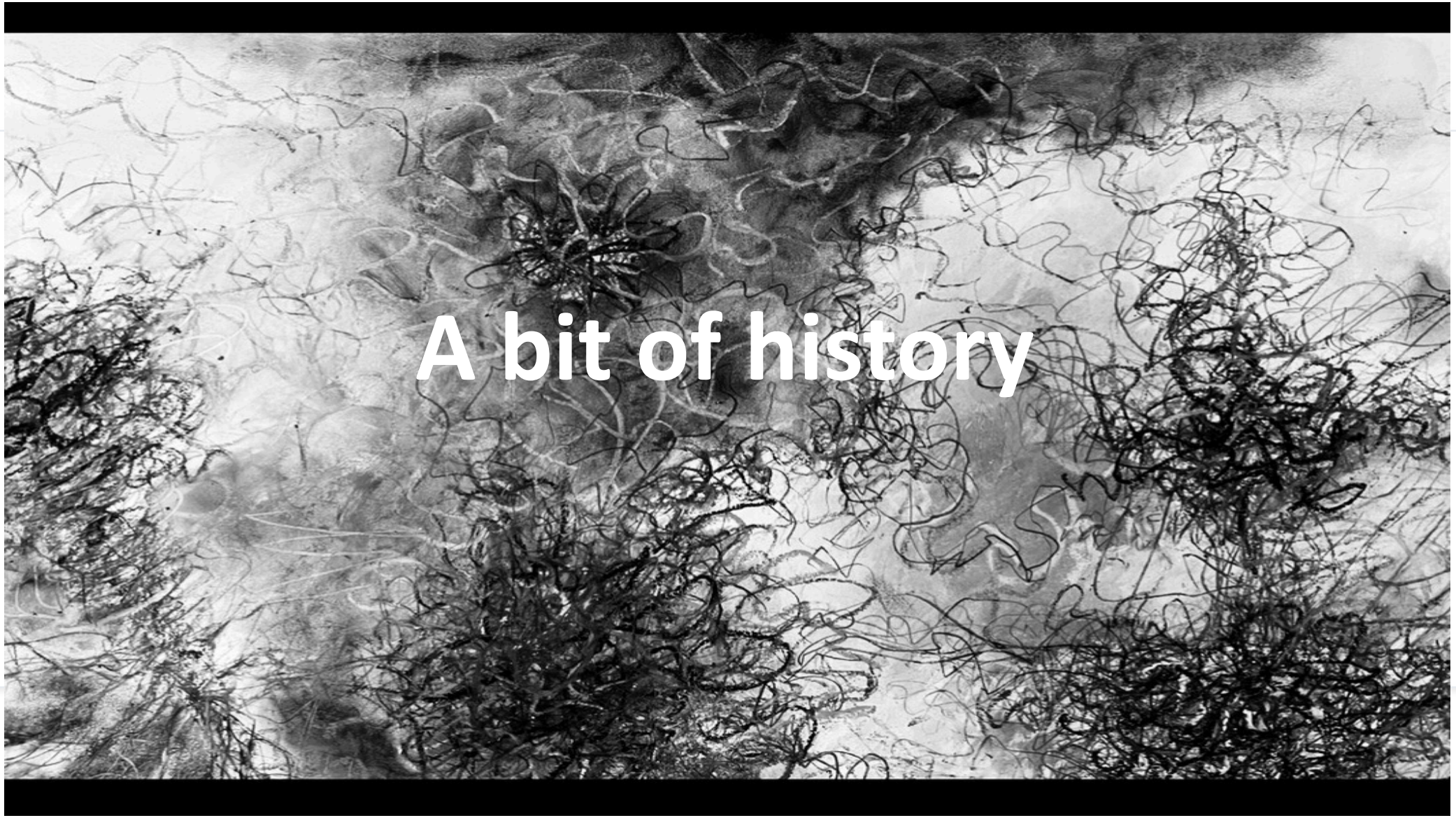
- **Setting the context**
  - A bit of history
  - Social complexity imagination
  - The social science turn
- **Mapping current terrain**
  - Thirteen challenges facing the study of social complexity
- **Charting new territory**
  - The *Atlas of social complexity* charts this new territory, seeking to map its present future.
- **Organised around six major themes:**
  - Setting the context
  - Cognition, emotion and consciousness
  - Dynamics of human psychology
  - Living in social systems
  - Advancing a new methods agenda
  - The unfinished space

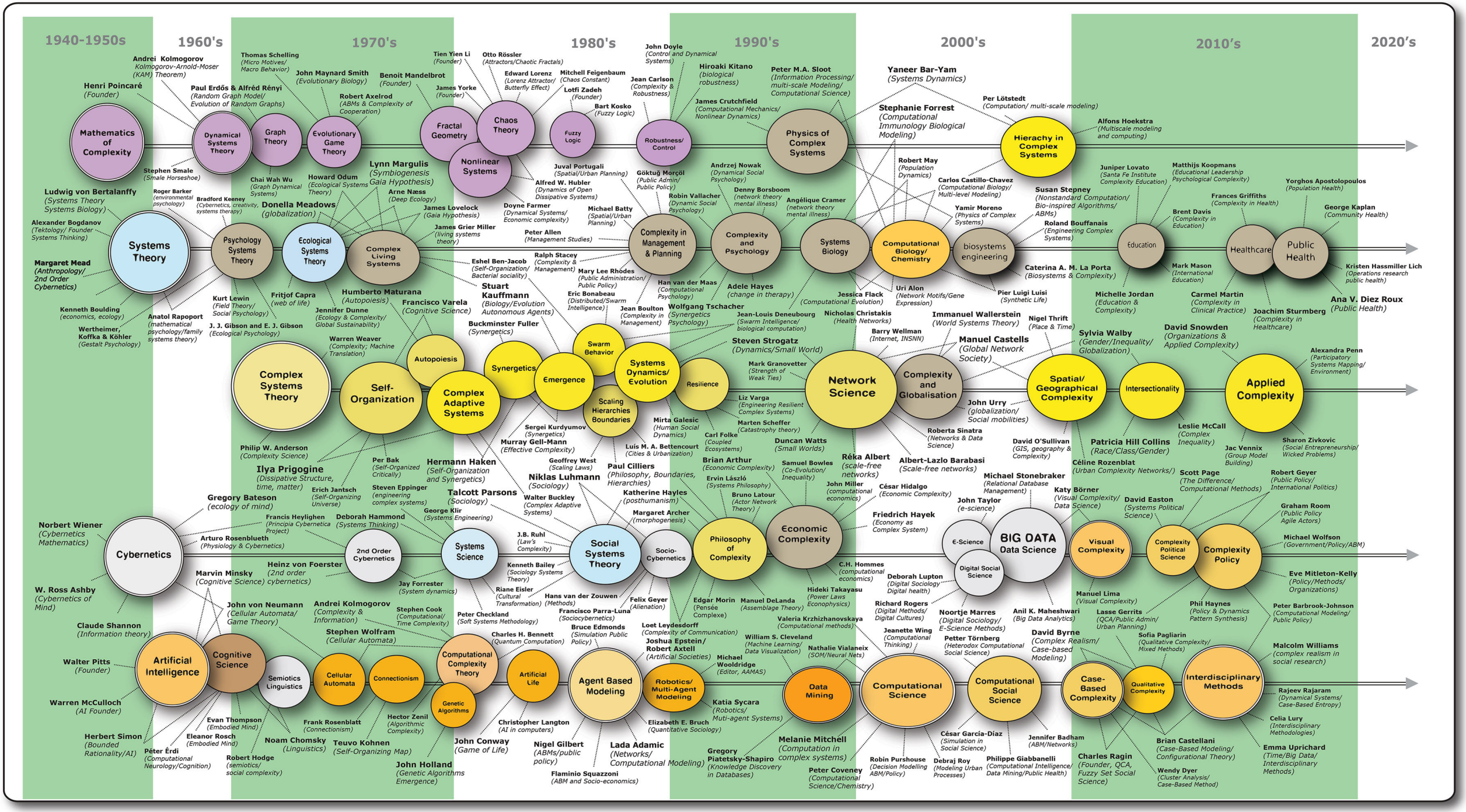
What is the study of complexity in health and social science?

- The study of social complexity concerns the application of theories, concepts and methods of *complexity sciences* to social inquiry.
- Its purpose is to be a disruptive field of study.
- The study of social complexity is not the strict domain of any one discipline, including instead scholars from across the academy as well as from those places where these ideas are applied in practice, including public health and health and social services.

Theme 1: Setting out the challenge.

- The study of social complexity is faced with thirteen significant challenges.
- Unless these situations are addressed, we fear the study of social complexity will struggle to advance or even fall by the wayside, or (worse) being uncritically co-opted and devolve into little more than conventional science.
- Part of reconciling these situations is knowing one's history.
- There are plenty of popular books on what has been done in the complexity sciences.
- The history we outline is more Foucauldian: it is a history of the present to help us establish the 'you are here' place on the map.


A bit of history


1940-1950s
1960's
1970's
1980's
1990's
2000's
2010's
2020's
Mathematics of Complexity
Dynamical Systems Theory
Graph Theory
Evolutionary Game Theory
Fractal Geometry
Chaos Theory
Nonlinear Systems
Fuzzy Logic
Robustness/ Control
Physics of Complex Systems
Hierachy in Complex Systems
Systems Theory
Psychology Systems Theory
Ecological Systems Theory
Complex Living Systems
Complexity in Management & Planning
Complexity and Psychology
Systems Biology
Computational Biology/ Chemistry
biosystems engineering
Education
Healthcare
Public Health
Complex Systems Theory
Self-Organization
Autopoiesis
Complex Adaptive Systems
Synergetics
Emergence
Swarm Behavior
Systems Dynamics/ Evolution
Resilience
Network Science
Complexity and Globalisation
Spatial/ Geographical Complexity
Intersectionality
Applied Complexity
Cybernetics
2nd Order Cybernetics
Systems Science
Social Systems Theory
Socio-Cybernetics
Philosophy of Complexity
Economic Complexity
E-Science
Digital Social Science
BIG DATA Data Science
Visual Complexity
Complexity Political Science
Complexity Policy
Artificial Intelligence
Cognitive Science
Semiotics Linguistics
Cellular Automata
Connectionism
Computational Complexity Theory
Genetic Algorithms
Artificial Life
Agent Based Modeling
Robotics/ Multi-Agent Modeling
Data Mining
Computational Science
Computational Social Science
Case-Based Complexity
Qualitative Complexity
Interdisciplinary Methods
Ludwig von Bertalanffy (Systems Theory Systems Biology)
Alexander Bogdanov (Tektology/ Founder Systems Thinking)
Margaret Mead (Anthropology/ 2nd Order Cybernetics)
Kenneth Boulding (economics, ecology)
Wertheimer, Koffka & Köhler (Gestalt Psychology)
Anatol Rapoport (mathematical psychology/family systems theory)
Kurt Lewin (Field Theory/ Social Psychology)
J. J. Gibson and E. J. Gibson (Ecological Psychology)
Fritjof Capra (web of life)
Jennifer Dunne (Ecology & Complexity/ Global Sustainability)
Humberto Maturana (Autopoiesis)
Francisco Varela (Cognitive Science)
Warren Weaver (Complexity; Machine Translation)
Buckminster Fuller (Synergetics)
Stuart Kauffmann (Biology/Evolution Autonomous Agents)
Eshel Ben-Jacob (Self-Organization/ Bacterial sociality)
Ralph Stacey (Complexity & Management)
Mary Lee Rhodes (Public Administration/ Public Policy)
Eric Bonabeau (Distributed/Swarm Intelligence)
Jean Boulton (Complexity in Management)
Wolfgang Tschacher (Synergetics Psychology)
Jean-Louis Deneubourg (Swarm Intelligence/ biological computation)
Han van der Maas (Computational Psychology)
Adele Hayes (change in therapy)
Jessica Flack (Computational Evolution)
Uri Alon (Network Motifs/Gene Expression)
Pier Luigi Luisi (Synthetic Life)
Caterina A. M. La Porta (Biosystems & Complexity)
Michelle Jordan (Education & Complexity)
Mark Mason (International Education)
Carmel Martin (Complexity in Clinical Practice)
Joachim Sturmberg (Complexity in Healthcare)
Kristen Hassmiller Lich (Operations research public health)
Ana V. Diez Roux (Public Health)
Yorghos Apostolopoulos (Population Health)
George Kaplan (Community Health)
Frances Griffiths (Complexity in Health)
Brent Davis (Complexity in Education)
Matthijs Koopmans (Educational Leadership Psychological Complexity)
Juniper Lovato (Santa Fe Institute Complexity Education)
Susan Stepney (Nonstandard Computation/ Bio-inspired Algorithms/ ABMs)
Roland Bouffanais (Engineering Complex Systems)
Yamir Moreno (Physics of Complex Systems)
Carlos Castillo-Chavez (Computational Biology/ Multi-level Modeling)
Robert May (Population Dynamics)
Stephanie Forrest (Computational Immunology Biological Modeling)
Per Lötstedt (Computation/ multi-scale modeling)
Alfons Hoekstra (Multiscale modeling and computing)
Yaneer Bar-Yam (Systems Dynamics)
Peter M.A. Sloot (Information Processing/ multi-scale Modeling/ Computational Science)
Hiroaki Kitano (biological robustness)
James Crutchfield (Computational Mechanics/ Nonlinear Dynamics)
John Doyle (Control and Dynamical Systems)
Jean Carlson (Complexity & Robustness)
Bart Kosko (Fuzzy Logic)
Lotfi Zadeh (Founder)
Edward Lorenz (Lorenz Attractor/ Butterfly Effect)
Mitchell Feigenbaum (Chaos Constant)
Otto Rössler (Attractors/Chaotic Fractals)
Tien Yien Li (Founder)
James Yorke (Founder)
Benoit Mandelbrot (Founder)
Robert Axelrod (ABMs & Complexity of Cooperation)
John Maynard Smith (Evolutionary Biology)
Thomas Schelling (Micro Motives/ Macro Behavior)
Andrei Kolmogorov (Kolmogorov-Arnold-Moser (KAM) Theorem)
Henri Poincaré (Founder)
Paul Erdős & Alfréd Rényi (Random Graph Model/ Evolution of Random Graphs)
Stephen Smale (Smale Horseshoe)
Chai Wah Wu (Graph Dynamical Systems)
Howard Odum (Ecological Systems Theory)
Lynn Margulis (Symbiogenesis Gaia Hypothesis)
Arne Næss (Deep Ecology)
James Lovelock (Gaia Hypothesis)
James Grier Miller (living systems theory)
Roger Barker (environmental psychology)
Bradford Keeney (Cybernetics, creativity, systems therapy)
Donella Meadows (globalization)
Juval Portugali (Spatial/Urban Planning)
Alfred W. Hubler (Dynamics of Open Dissipative Systems)
Doyne Farmer (Dynamical Systems/ Economic complexity)
Peter Allen (Management Studies)
Göktuğ Morçöl (Public Admin/ Public Policy)
Robin Vallacher (Dynamic Social Psychology)
Michael Batty (Spatial/Urban Planning)
Andrzej Nowak (Dynamical Social Psychology)
Denny Borsboom (network theory mental illness)
Angélique Cramer (network theory mental illness)
Nicholas Christakis (Health Networks)
Barry Wellman (Internet, INSNN)
Immanuel Wallerstein (World Systems Theory)
Nigel Thrift (Place & Time)
Sylvia Walby (Gender/Inequality/ Globalization)
David Snowden (Organizations & Applied Complexity)
Alexandra Penn (Participatory Systems Mapping/ Environment)
Steven Strogatz (Dynamics/Small World)
Mark Granovetter (Strength of Weak Ties)
Manuel Castells (Global Network Society)
Liz Varga (Engineering Resilient Complex Systems)
Marten Scheffer (Catastrophy theory)
Roberta Sinatra (Networks & Data Science)
Duncan Watts (Small Worlds)
Réka Albert (scale-free networks)
Albert-Lazlo Barabasi (Scale-free networks)
John Urry (globalization/ Social mobilities)
David O'Sullivan (GIS, geography & Complexity)
Patricia Hill Collins (Race/Class/Gender)
Céline Rozenblat (Urban Complexity Networks/)
Leslie McCall (Complex Inequality)
Jac Vennix (Group Model Building)
Sharon Zivkovic (Social Entrepreneurship/ Wicked Problems)
Scott Page (The Difference/ Computational Methods)
Robert Geyer (Public Policy/ International Politics)
Graham Room (Public Policy Agile Actors)
Michael Wolfson (Government/Policy/ABM)
Eve Mitleton-Kelly (Policy/Methods/ Organizations)
Peter Barbrook-Johnson (Computational Modeling/ Public Policy)
Malcolm Williams (complex realism in social research)
Rajeev Rajaram (Dynamical Systems/ Case-Based Entropy)
Celia Lury (Interdisciplinary Methodologies)
Emma Uprichard (Time/Big Data/ Interdisciplinary Methods)
Brian Castellani (Case-Based Modeling/ Configurational Theory)
Wendy Dyer (Cluster Analysis/ Case-Based Method)
Michael Stonebraker (Relational Database Management)
John Taylor (e-science)
Katy Börner (Visual Complexity/ Data Science)
David Easton (Systems Political Science)
Manuel Lima (Visual Complexity)
Lasse Gerrits (QCA/Public Admin/ Urban Planning)
Phil Haynes (Policy & Dynamics Pattern Synthesis)
Sofia Pagliarin (Qualitative Complexity/ Mixed Methods)
Deborah Lupton (Digital Sociology Digital health)
Richard Rogers (Digital Methods/ Digital Cultures)
Noortje Marres (Digital Sociology/ E-Science Methods)
Petter Törnberg (Heterodox Computational Social Science)
Anil K. Maheshwari (Big Data Analytics)
David Byrne (Complex Realism/ Case-based Modeling)
Charles Ragin (Founder, QCA, Fuzzy Set Social Science)
Jennifer Badham (ABM/Networks)
Philippe Giabbanelli (Computational Intelligence/ Data Mining/Public Health)
César García-Díaz (Simulation in Social Science)
Debraj Roy (Modeling Urban Processes)
Robin Purshouse (Decision Modelling ABM/Policy)
Peter Coveney (Computational Science/Chemistry)
Melanie Mitchell (Computation in complex systems)
Gregory Piatetsky-Shapiro (Knowledge Discovery in Databases)
Katia Sycara (Robotics/ Muti-agent Systems)
Elizabeth E. Bruch (Quantitative Sociology)
Lada Adamic (Networks/ Computational Modeling)
Flaminio Squazzoni (ABM and Socio-economics)
Nigel Gilbert (ABMs/public policy)
Christopher Langton (AI in computers)
John Conway (Game of Life)
John Holland (Genetic Algorithms Emergence)
Hector Zenil (Algorithmic Complexity)
Frank Rosenblatt (Connectionism)
Noam Chomsky (Linguistics)
Teuvo Kohonen (Self-Organizing Map)
Robert Hodge (semiotics/ social complexity)
Péter Érdi (Computational Neurology/Cognition)
Eleanor Rosch (Embodied Mind)
Evan Thompson (Embodied Mind)
Herbert Simon (Bounded Rationality/AI)
Warren McCulloch (AI Founder)
Walter Pitts (Founder)
Claude Shannon (Information theory)
W. Ross Ashby (Cybernetics of Mind)
John von Neumann (Cellular Automata/ Game Theory)
Marvin Minsky (Cognitive Science)
Heinz von Foerster (2nd order cybernetics)
Jay Forrester (System dynamics)
Arturo Rosenblueth (Physiology & Cybernetics)
Norbert Wiener (Cybernetics Mathematics)
Francis Heylighen (Principia Cybernetica Project)
Deborah Hammond (Systems Thinking)
Gregory Bateson (ecology of mind)
Philip W. Anderson (Complexity Science)
Ilya Prigogine (Dissipative Structure, time, matter)
Per Bak (Self-Organized Criticality)
Erich Jantsch (Self-Organizing Universe)
Steven Eppinger (engineering complex systems)
Hermann Haken (Self-Organization and Synergetics)
Talcott Parsons (Sociology)
George Klir (Systems Engineering)
Sergei Kurdyumov (Synergetics)
Murray Gell-Mann (Effective Complexity)
Niklas Luhmann (Sociology)
Walter Buckley (Complex Adaptive Systems)
J.B. Ruhl (Law's Complexity)
Kenneth Bailey (Sociology Systems Theory)
Riane Eisler (Cultural Transformation)
Hans van der Zouwen (Methods)
Peter Checkland (Soft Systems Methodology)
Andrei Kolmogorov (Complexity & Information)
Stephen Cook (Computational/ Time Complexity)
Stephen Wolfram (Cellular Automata)
Charles H. Bennett (Quantum Computation)
Bruce Edmonds (Simulation Public Policy)
Francisco Parra-Luna (Sociocybernetics)
Felix Geyer (Alienation)
Edgar Morin (Pensée Complexe)
Manuel DeLanda (Assemblage Theory)
Valeria Krzhizhanovskaya (Computational methods)
Loet Leydesdorff (Complexity of Communication)
Joshua Epstein/ Robert Axtell (Artificial Societies)
Michael Wooldridge (Editor, AAMAS)
William S. Cleveland (Machine Learning/ Data Visualization)
Nathalie Vialaneix (SOM/Neural Nets)
Jeanette Wing (Computational Thinking)
Hideki Takayasu (Power Laws Econophysics)
C.H. Hommes (computational economics)
Brian Arthur (Economic Complexity)
Ervin László (Systems Philosophy)
John Miller (computational economics)
César Hidalgo (Economic Complexity)
Bruno Latour (Actor Network Theory)
Friedrich Hayek (Economy as Complex System)
Samuel Bowles (Co-Evolution/ Inequality)
Paul Cilliers (Philosophy, Boundaries, Hierarchies)
Katherine Hayles (posthumanism)
Margaret Archer (morphogenesis)
Geoffrey West (Scaling Laws)
Luís M. A. Bettencourt (Cities & Urbanization)
Scaling Hierarchies Boundaries
Mirta Galesic (Human Social Dynamics)
Carl Folke (Coupled Ecosystems)

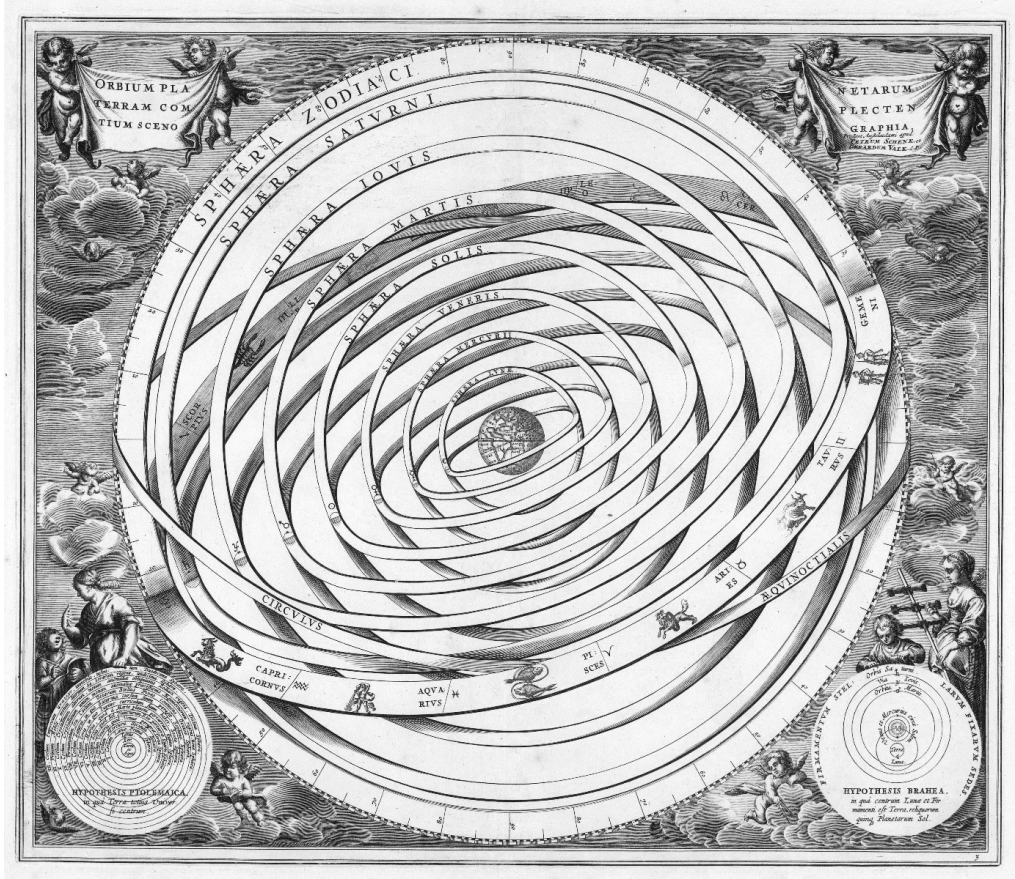
The social complexity imagination

- **BACK TO THE FUTURE**
- In the spirit of C. Wright Mills, the best way for the study of social complexity to overcome its current limitations and to become truly transdisciplinary is to reembrace a social complexity imagination.
  - Imagination 1: Moving beyond the traps
  - Imagination 2. Observing the larger universe
  - Imagination 3. Accepting complexity psychologically
  - Imagination 4. Adopting a critical complexity
- This time, however, the inspiration comes from a different direction: it comes from a direct engagement with the social sciences, practice, policy and the arts, in particular those areas that don't associate themselves with the complexity sciences.
- This is part of what we call the social science turn in complexity.

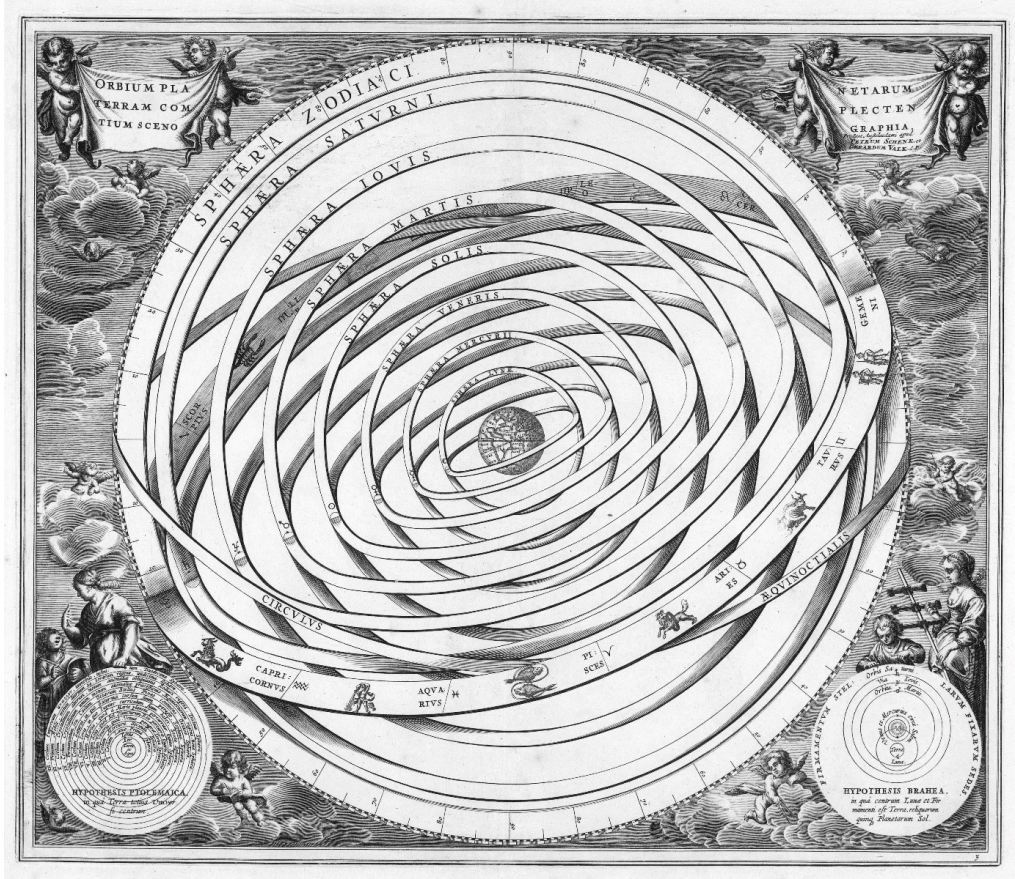
The thirteen challenges

Situation	Characteristics
1. No philosophy of complexity	Few attempts to define an epistemology and ontology for social complexity
2. A failure to engage the wider social sciences	Assumption that the social sciences can be ignored because the complexity sciences would offer superior insights
3. Reinventing the wheel	Reinventing existing insights from the social sciences that are then presented as new insights
4. Old words, new words	Rebranding existing insights using terms from the complexity sciences
5. Obscurantism and mystification	Scientific overreach and complicated jargon combine to suggest that life's biggest questions are uncovered
6. The need for multilevel thinking and modelling	Despite the transdisciplinary approach of social complexity, almost all research focuses on a single level of analysis.
7. Technique in the absence of theory	Focus on computational methods and big data pushes social theory out of sight
8. Learning tools vs. predictive machines	The ability to learn from simulations is replaced by a desire to predict and control social complexity
9. Minor role of qualitative research	Dominance of quantitative research and quantification of data established a blind spot for qualitative data and methods
10. Methodological closing of social scientific mind	Shying away from advances in computational methods sees many social scientists becoming illiterate with such methods
11. The dire sound of technicalities	Going into a spiral of ever-smaller technical refinement while losing the bigger picture out of sight.
12. Being tone-deaf about the real world	Advanced analyses are coupled to crude recommendations that fail to appreciate the complexity in the target domain
13. Practice does not make perfect	Pragmatic and rushed adoption of the complexity sciences by practitioners constitutes verbal detritus

Charting new territory



- Traveling with the Atlas does not require a linear front-to-back reading.
- Nor do we suggest reading only to one's topic.
- We encourage the reader (and today, participants) to wander around and to foster a transdisciplinary curiosity.
- We designed the Atlas to be modular, each chapter representing an avenue of research in social complexity.
- As guides, our goal is to entice readers to read broadly, and to consider these various areas of study and to go so far as to reorganise them into various combinations to explore as yet unknown or unrealised programmes.
- *It is all up to your social complexity imagination!*



- We also encourage readers, both theoretically and methodologically, to do something other than what they always already do, to learn and use the tools of social complexity in new and different ways.
- **Indeed, we even go so far as to encourage a 'team reading' of the Atlas**, with the multiple and diverse members of a group (be it an institute, centre, community organisation, governmental branch, or business) creating different and unique systems map into the issue that their network is advancing or addressing.
- Still, an Atlas without some roadmaps or signposts is a bit useless.
- We organised the Atlas into six major themes:

Theme 2 through 5

- For Themes 2 through 5, we travel along traditionally unfamiliar but increasingly more defined routes.
- **Theme 2: (Cognition, emotion and consciousness)** resolutely grounds the study of social complexity in the body, ecology and our material world.
- **Theme 3 (Dynamics of human psychology)** makes certain that any social complexity going forward involves the advance of a complex psychology.

Theme 2 through 5

- **Theme 4 (Living in social systems)** requires that a critical configurational social complexity be embraced and that the study of social complexity consider such wide-ranging issues as inequality, relations of power, the machine-body linkage, socio-technical systems, governance and evaluation.
- **Theme 5 (Charting a new methods territory)** addresses the issue of methodology.
  - There are an almost limitless number of books and articles on the methods of computational modelling. There are a lot less on its linkages to ontology, epistemology, and modelling complex causality.
  - We stake out our position, strongly arguing for the approach we see as the most promising, which involves some combination of complex realism, configurational methods, case-based modelling, and an interdisciplinary toolbox of methodological techniques that emphasises the importance of qualitative inquiry.

Theme 6

- **Theme 6 (The unfinished space)** intentionally ends in an undefined space.
- We leave the last word to the N=38 colleagues we interviewed for the Atlas.
- They had important things to say, not the least of which is that they mostly do not seek themselves as complexity scholars. Instead, they see themselves as explorers, restlessly and intuitively on the go as they seek out new intellectual territories.
- At the same time, they ensure that what they leave behind is more porous and open to the ideas they seek to bring back on their return.
- Some are entirely uninterested in returning at all, sending instead letters and gifts back to others, hoping to entice them to join them on the new journey.

THEME 2: COGNITION, EMOTION AND CONSCIOUSNESS

CH05: Theme 2 Introduction
CH06: Autopoiesis and Cellular Cognition
CH07: Social Behaviours of Bacteria
CH08: Brain-Gut Microbiota Communication
CH09: Immune System Cognition
CH10: Brain-Based Cognition
CH11: Social Self
CH12: Human-Machine

THEME 3: DYNAMICS OF HUMAN PSYCHOLOGY

CH13: Theme 3 Introduction
CH14: Human Psychology and Dynamical System
CH15: Psychopathology of Mental Disorders
CH16: Healing and the Therapeutic Process
CH17: Mindfulness, Imagination and Creativity

THEME 4: LIVING IN SOCIAL SYSTEMS

CH18: Theme 4 Introduction
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CH20: Sociology of Collective Behaviour
CH21: Critical Configurational Complexity
CH22: Global Mobilities and Complexities of Place
CH23: Socio-Technical Life
CH24: Management of Socio-technological Systems
CH25: Resilience and all that Jazz
CH26: Complex Economics
CH27: Complex Governance

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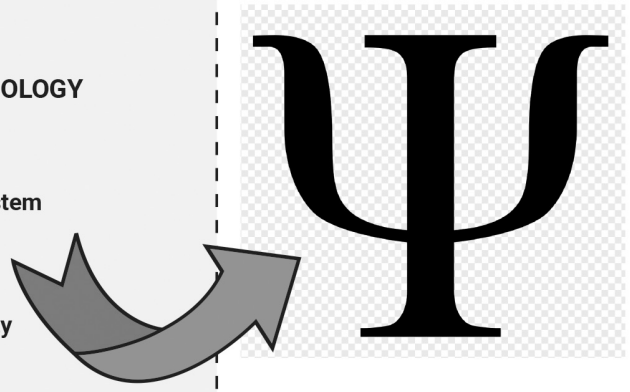

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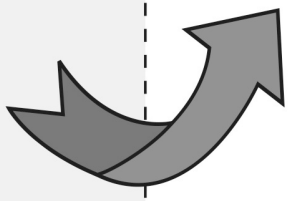

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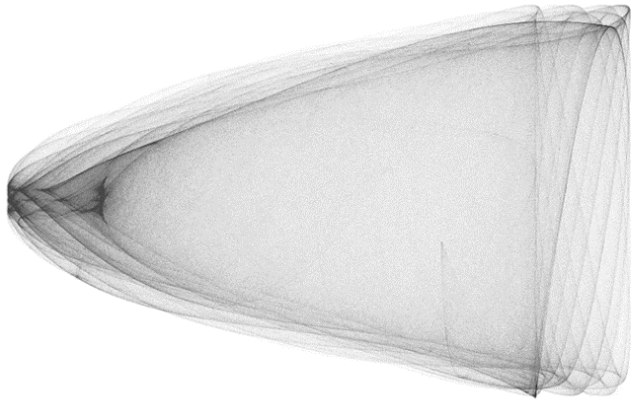
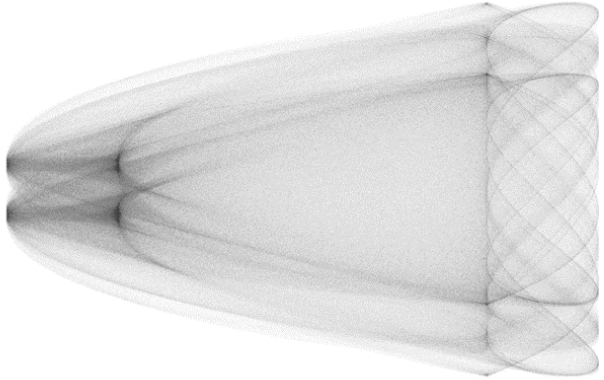
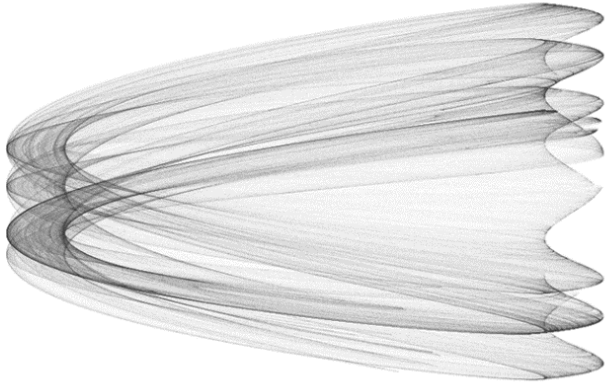
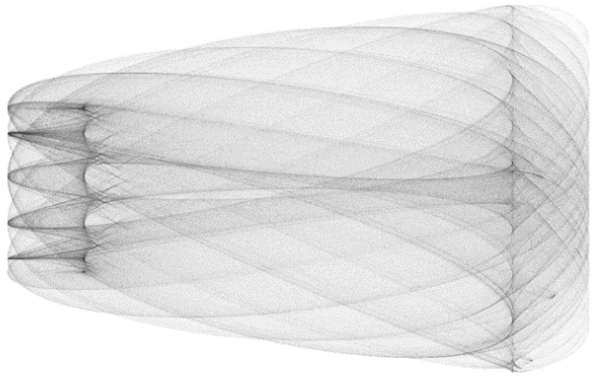
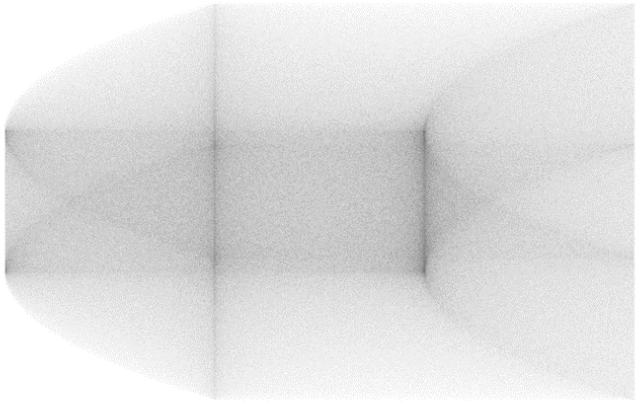
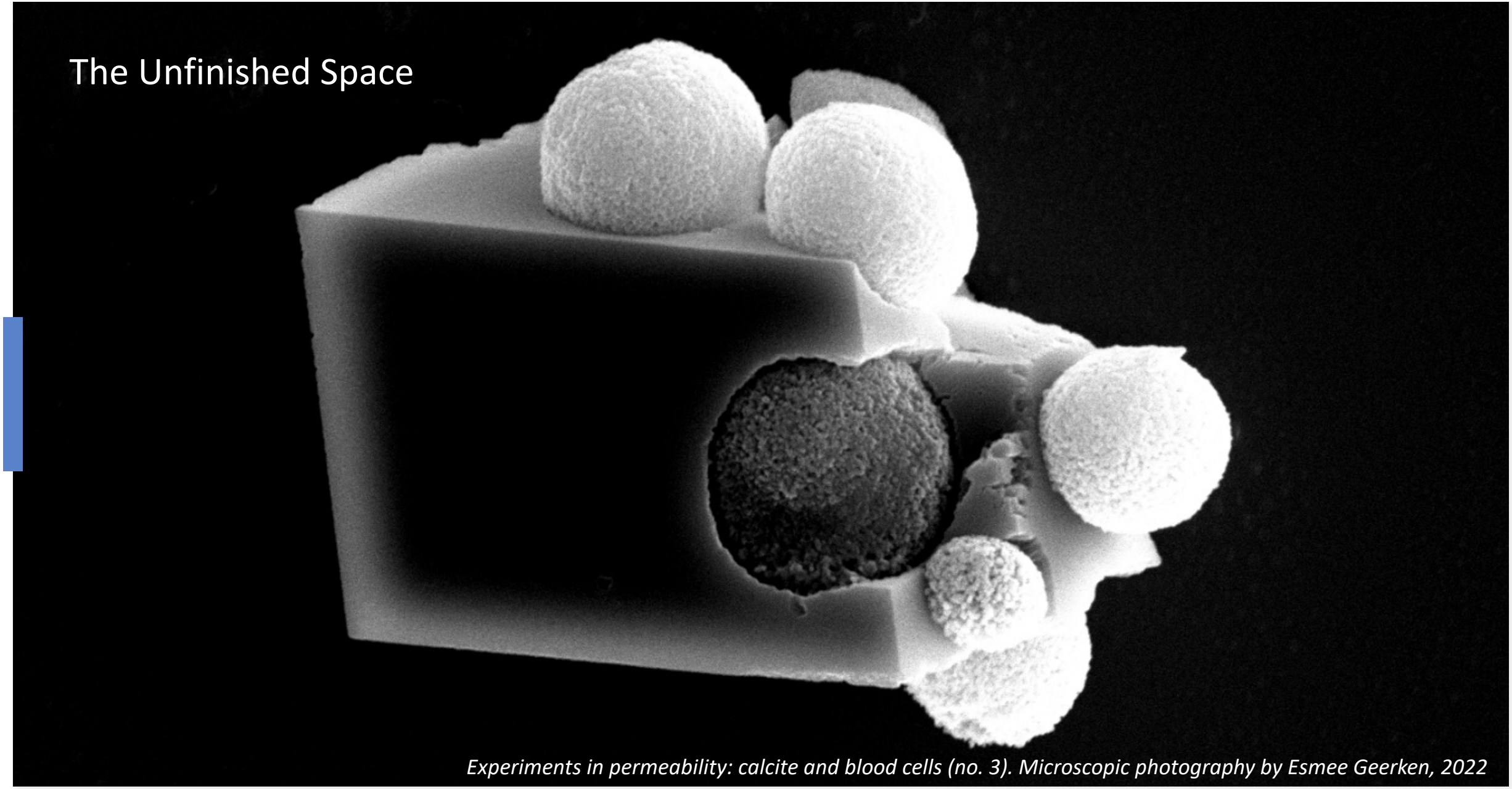


THEME 5: CHARTING A NEW METHODS TERRITORY

- **Where is the qualitative in complexity?**
- **Embracing complex realism**
- **The importance of mixed-methods**
- **Case-based complexity**
  - **Cases, clusters and trajectories**

The Unfinished Space



Experiments in permeability: calcite and blood cells (no. 3). Microscopic photography by Esmee Geerken, 2022

The unfinished space

- The art of incompleteness
  - Unease and comfort
    - A thousand plateaus
      - Permeability and Pores
        - The terrain not yet grasped
          - Organizing emergence
            - Becoming transdisciplinary
              - Becoming educated