



POIESIS AND ENCHANTMENT
IN TOPOLOGICAL MATTER

SHA XIN WEI

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Sha Xin Wei

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Preface

If asked what the world is made of, we can say it's made of *objects*, or we can say it's made of *stuff*. This book takes the point of view of stuff, the stuff of which objects are made. Moreover, the world changes—*Eppur si muove*, to repurpose Galileo's legendary observation. So any response to the question of what the world is made of should take history, dynamism, and temporality into account. In more precise terms, my project is to understand distributed, field-based activity and materiality in rehearsed as well as unrehearsed situations in the presence of responsive media. In this philosophical and interdisciplinary investigation, the strategy is to suspend or bracket certain conventions about what constitutes body, subject, or ego while trying to develop a working understanding of embodiment and subjectivation—the formation of subjective experience. Movement, and in particular gesture, is an arguably essential aspect of engendering human experience. But rather than taking “the body” or “cognition” for granted as conceptual starting points, I attend to the substrate matter in which gesture takes place—hence the interest in responsive and in particular computational media created for sustaining experientially rich, improvisational activity. The investigation also puts in play notions such as interaction, responsive media, and performativity, and so aspires to contribute to contemporary exchanges between art and philosophy. The betweenness is most essential. Though it uses evidence and even bits of argument, this book is neither a mathematical proof nor a philosophical argument. Perhaps, as Wittgenstein said of a far more logically credible investigation, “[t]his book will perhaps only be understood by those who have themselves already thought the thoughts which are expressed in it—or similar thoughts. . . . Its object would be attained if it afforded pleasure to one who read it with understanding.”¹ On the other hand, this is also written with an ear for poetry with equal calls upon rigor and affect. In this aspect, I have little intention to convince you of an analytic method, but I will share, as well as I can in this first essay, an *orientation*, a way toward thinking and making things with people.

I argue for an approach to materiality inspired from continuity, field, and philosophy of process, based on ethico-aesthetic as well as technoscientific grounds. This

project investigates what could be implied by continuous, or more precisely *topological*, approaches to media and matter in the concrete setting of installation-events. Another motive is to explore the ethico-aesthetic consequences of topologically creating performative events and computational media, drawing from the critical studies of science and technology. This project is a philosophical investigation that is conducted in a poetic mode of installation or event-based art and technology. This study of gesture and agency is informed by scholarship in multiple literatures: philosophies of process represented by Heraclitus, Henri Bergson, Alfred North Whitehead, Gilles Deleuze, Isabelle Stengers, Gilbert Simondon; certain mathematico-poetic philosophies represented by René Thom, Gilles Châtelet, Michel Serres, Jean Petitot, Alain Badiou; and theories of distributed agency represented by Humberto Maturana, Andrew Pickering, Donna Haraway, Edwin Hutchins, and of course Gilles Deleuze and Félix Guattari. Methodologically, its critical relation to psychology and cognitive science draws from Ludwig Wittgenstein, Edmund Husserl, William James, Eugene Gendlin, and Félix Guattari, with implications for other attempts to quasi-scientifically systematize practices such as design, engineering, or art.

However, to cite these authors does not imply a subscription to a school of thought or a ready-made method, only that elements of these conceptual approaches have proven fruitful in furthering the understanding of some aspects of my chosen phenomena of study: field-based materiality and activity. One of the motivations for my project, in fact, is to contribute coherently to this multipolar conversation by producing a genealogy of topological media. Using the word *genealogy*, I am mindful of Foucault's critical and nonteleological approach to history. In an analogous way, this project offers a detailed and critical reflection on theories of distributed, dynamical, and processual matter that have been of interest to humanists over recent decades.

I try to discover, critically, the antecedent assumptions that have evolved into certain conceptual frameworks that are taking hold in contemporary academic approaches to media and art and literature, especially as they appeal to nearby fields of design and cognitive science. The critical project reflects not only on what concepts of plenum materiality and distributed agency are being constructed and deployed, but also on how they are being constructed and deployed, by whom and with what effect. As such, this project should contribute to philosophy of process and subjectivation, philosophy of art and technology, as well as historical and critical studies of technology and science as practiced by Isabelle Stengers, Ian Hacking, Bruno Latour, Tim Lenoir, Niklas Damiris, Helga Wild, Brian Rotman, Steven Shapin, Donna Haraway, Kavita Philip, Mario Biagioli, Peter Galison, David Bloor, Lucy Suchman, Kriss Ravetto, Mike Fischer, Doug Kahn, Frances Dyson, and many other scholars.

In recent history, there is an equally distinguished and diverse set of thinkers, such as Nietzsche, Freud, Lacan, Levinas, Bataille, Blanchot, Derrida, and Lyotard, who have worked profoundly with concepts such as difference, disconnection, discontinuity,

and atomicity that are complementary to the approach of this book. One can situate this book with respect to those thinkers in several ways. First, while pragmatically respecting their complementary and profoundly humane insights, one can perhaps see a basic difference in “first philosophy.” Anthropocentric thought begins with the human condition and with relations between human subjects, and then proceeds to think about the world. By contrast, a nonanthropocentric philosophy starts with questions about the world, and then considers the social or the human via a cosmological perspective. This project takes the latter approach. Second, as I said at the outset, this book is neither a mathematical proof nor a philosophical argument. Rather than debate, I would prefer to make an alternative art or technology. I do not presume to explain what the world really is made of or how the world really works, or what it really means to be human. Indeed, the work that I have done with speculative artists, philosophers, and technologists does not debate, but gives a sense of how one might regard with a certain “as if.” Inspired by the tactics of a de Certeau or the situationists vis-à-vis their city, or Grotowski’s nonperforming performance laboratory, we’ve found a few conceptual tactics over the years, a set of orienting tropisms, what Stengers and Whitehead have called lures for feeling and thinking. They are particularly elaborate lures, informed by political, artistic, and technological practices. But they are not recipes or methodologies. Comparing and contrasting these orientations against apparently competing domains of thought, while valuable as a scholastic exercise, would eat a great deal of patience and energy that may be better reserved for trying on this book’s alternative orientation for fit.

Although this is a project of reflection whose main tangible product is a book, it draws on a critical familiarity and engagement with recent material practices in the *mise-en-scène* of installation art and performance: computational video, sound, sensors, active textiles, and so forth, as well as specific experimental researches in performance, movement, and visual arts. I draw not only on my own work, but also on a set of ongoing professional conversations with Michael Montanaro, Toni Dove, Joel Ryan, Tirtza Even, Laetitia Sonami, Michel Waisvisz, Sponge, and FoAM, and informed by other contemporary artists such as Ann Hamilton, Kiki Smith, Mona Hatoum, Janet Cardiff, Dan Graham, and Robert Irwin. To understand, and to feel, how these arguments matter at sufficient scope and depth requires an intimate engagement with experimental performance or installation-events, and with specific technoscientific research programs. This investigation accompanies, situates, and reflects on the speculative material practice. I hope to recirculate the conceptual fruit of this investigation in the communities of allied artists and technologists, and am most grateful to the many fellow scholars, artists, activists, and students who have traveled with me in these past two decades of speculative practice.

Chapter Summary

Chapter 1: Why This Book?

What is at stake: the potential for ethico-aesthetic experiment. The first chapter orients the book for readers concerned with what is at stake given computationally augmented and nondigital responsive media and responsive environments. The book appeals to artists and philosophers of media who are concerned with ethico-aesthetic as well as political implications in contemporary material practices in media and the technologies of performance. Setting aside transcendentalist appeals to universal immortal frameworks structuring our experience, and in the absence of any Archimedean point external to subjective experience upon which we can lever social and ethico-aesthetic judgment, what remains? How can any sense of sociality and pathic subjectivity emerge? This chapter introduces the argument for a deeper approach with the poetic, rather than instrumental or technical, use of continuous topology and related modes of nonatomistic articulation. The argument is substantiated and informed by speculative projects over the past twenty years that challenge existing paradigms in computational media technology and media arts.

Chapter 2: From Technologies of Representation to Technologies of Performance

This chapter rapidly recapitulates what I consider the most salient forces motivating the move from technologies of representation to the technologies of performance. The forces derive from critical history as well as engineering advances in computational media technology. We review some of the core crises of representation that thread the modernist and postmodernist moments, through the lenses of Bruno Latour and Akeel Bilgrami. With the advent of electronic computation, representation in its particular form of the scientific model comes alive in the mode of numerical simulation and graphical visualization. I concretize this in the context of the role of musical notation in twentieth- and twenty-first-century performance, and the impact of computer technology. A key phenomenon here is how the non-real-time computer model as a

tool of scientific analysis has transformed into a real-time instrument for live performance, thanks to the increase in computer hardware power, the enrichment of the operators, and the transformation of attention from modeling in virtual computer space to shaping, manipulating, and articulating the material world live, in real time, i.e., the technologies of performance.

Chapter 3: Performance in Responsive Environments, the Performative Event

If we are to create events that are not allegorical, and that have an authentic and immanent rather than representational relation to their content, these events ought to be constructed not using technologies of representation but rather technologies of performance. Moreover, if we aspire to create events with affective and sociopolitical power, then it matters how we fashion our environments. In other words, unless the techniques and the technical practices are also, to use a shorthand expression, topological, creating representations of topological events using conventional atomizing schemas and object-oriented technologies merely produces simulacra of play, which has the same effective constraints as the most restrictive, disciplinary games.

We return to a fine-scale, process-oriented approach to distributed agency, intentional or nonintentional gesture and movement. And we investigate concretely the experience of rich, corporeal, live events in built environments or installations filled with thick, responsive media. The canonical examples come from a family of related installation-events envisioned and built over the past decade. In such installation-events, we discuss questions of superposed agency, of collective versus individual action, of correlates (rather than certificates) of intentional gesture, and other topics.

Chapter 4: Substrate

Détourning Antonin Artaud's call for attention to the materials of performance, after interpreting performance more broadly via the technologies of real-time, live performance in responsive environments, we argue for a turn to examining the substrates in which events and objects take shape. In place of epistemic and hermeneutic investigations that require explicit analytic objects like Subjects, Egos, or Roles, organized into a priori taxonomic structures, we start with an experientially continuous ontology of plenum or field. This requires unpacking distinctions between the discrete, the algebraic, the atomic versus the continuous, and developing some notions of the field, material plenum, substrate, and tissue. This discussion traces a history of arguments that includes Heraclitus, Spinoza, Leibniz, and Whitehead in the West. Of course, bracketing objects does not deny that objects exist. It shifts the ground to considering how objects come to be, i.e., to ontogenesis. In order to articulate plenum and onto-

genesis, we turn next to a rich set of concepts from point set topology, topological dynamics, and deeper branches of continuous mathematics.

Chapter 5: Ontogenesis

Armed with the concepts of the previous chapter, we can turn properly to ontogenesis without a priori objects, developing our consideration of distributed matter, substrate, plenum, tissue. In this chapter we consider some philosophies of material process—those of Poincaré, Whitehead, Stengers—and propose an approach to process—namely dynamics—consonant with such process philosophies, informed by the more precisely nuanced articulations afforded by concepts from topological dynamics and other *poietic* arts, as well as by the technologies of performance in responsive media.

Chapter 6: Topology, Manifolds, Dynamical Systems, Measure, and Bundles

This is the core chapter, introducing concepts that articulate continua, continuous substance, and continuous process. These concepts find precise and deep forms in point set topology, topological and differentiable dynamical systems (qualitative, topological, and geometrical approaches to systems of ordinary differential equations), and the much more sophisticated perspectives of differential geometry and fiber bundles. We introduce basic poetic concepts such as the open (closed) set, neighborhood, map, space, continuity, connectedness, limit, convergence, compactness, and so forth. Along the way, we consider the work of Brouwer, Thom, and Petitot and prepare the reader for a critical encounter with Petitot's program on ontogenesis. Articulating matter with such anexact concepts seeds the ground for an alternative, nonreductionist approach to ontogenesis.

Certain terms used in earlier chapters for their intuitive senses, such as continuous, limit, dense, etc., will now be presented more rigorously, so that they can be used with more precise connotations and conceptual purchase after this chapter.

Chapter 7: Practices: Apparatus and Atelier

The motto “art all the way down,” which harkens to the amodern working ethos of the preindustrial atelier, the Bauhaus fusion of craft and art, and the plenist ontological commitments driving our object-free approach to ontogenesis, prompts us to examine how such art practice and the critical studies of media arts and sciences can be sustained in the sociocultural and capital economies of the arts and the academy. What sort of working ethos can we derive to sustain the work of atelier-studio-labs like the Topological Media Lab or FoAM and their kin? We derive practices that draw

from the collectivist practices of the engineering laboratory and the theater, as well as the more solitary aestheticoeconomic practices of the art studio.

Chapter 8: Refrain

Answering the challenge to do art “all the way down,” in place of anthropocentric art and science can we build world-oriented art and engineering? This motivates the creation of events and technologies with a nonconventional notion of agency sans agents. We harvest the implications of the previous chapters for articulating and inhabiting the world as quickened matter. In particular, we consider materiality and lifelikeness of objects as effects of process, rather than predicates on objects. Nevertheless, objects are not epiphenomenal, because they and the processes under which they emerge as invariants are immanent in the substrate that constitutes the world. Furthermore, when we articulate and inhabit the world in such a mode, the world becomes as rich as we imagine, but without boundless complexity. This profoundly motivates field-based rather than object-oriented or ego-oriented social technology and technologies of performance sustaining ethico-aesthetic play.

The Role of Mathematical Notation in This Book

One of the exhilarating strengths of the Interaction and Media Group seminar at the Stanford Humanities Center (1995–1997) was the principle of drawing from all the conceptual resources available around the table to gain purchase on our phenomena of study (the nature of interaction, digital media): whether it was contemporary theorists such as Derrida, Kittler, Lakoff, or Foucault; or performance work by William Forsythe and Dumb Type; or mathematical poetics like topology and differential geometry. Two of our implicit working principles were a “principle of charity” and “no dumbing down.” By a “principle of charity” I mean the starting assumption that even if I don’t know what you are talking about, I believe you do and that you are saying something significant; so I will continue the conversation. By “no dumbing down” I mean that if you do not share my area of expertise, I will not feed you superficialities used only for advertising my discipline to “outsiders”; I will present habits of thought that experts would consider significant as well, in notation that adequately articulates the thought, yet is cleared of what (even) a master of the discipline would think of as technicality.

It is in the same spirit of adequating language to thought that Heidegger constructed his neologisms to notate his philosophical concepts, to the benefit of those who would work productively with those concepts. My ambition is much more modest: I do not presume to invent so much as to adopt notation already well polished by use. Leaving some concepts in their idiomatic notation, I give you access to some

of their articulation so you may, if you choose, accommodate and adapt these habits of thought yourself, rather than refer to them from a distant gloss.

However, anglophone critical and humanities studies, even the philosophical literature reflecting on mathematics, have tended to avoid the use of mathematical notation, taking Derrida's comment about the "silent" mathematical sign as a limit to rather than an instrument of critical reflection. To some extent, this has been the unfortunate and complicated reaction against the structuralist interpretations of mid-twentieth-century students of human phenomena such as Jacques Lacan and René Thom.

Roger Penrose cites Stephen Hawking about using mathematical notation in "popular" physics books: every equation cuts the audience in half. I share Penrose's respect for the reader, rather than the presumption made by most popularizers of physics. As Derrida and Roy Harris recognized, mathematicians have invented signs for two millennia to best articulate their ideas in their practices of thought. With Penrose and Heidegger, I trust that if you are inspired by the aspirations of this work as a whole, you will appreciate having some well-crafted notational handholds to avoid "verbal" circumlocutions that obscure as they gloss.¹

Time-Based Media References

Although one feature that paper enjoys compared to time-based media is a material durability, this book would make more sense in tandem with media references to the art and research on which it reflects. In the spirit of what mathematicians call a constructive proof, ten years ago I decided to build and find working indicators of what could be the case, starting with a different sort of laboratory—the Topological Media Lab—modeled after theatrical production, engineering research lab, and the preindustrial atelier.²

1 Why This Book?

In recent years I've taken to asking students and colleagues, "Why do you do what you do?" Although that question is not the same as "Why do we live?," it is not unrelated, because *how* we live would be part of my own response to the question of why we live. It's a phenomenological question about the experience of life, but I would like to answer it in a poetic way in the context of contemporary and emerging technologies of performance, where performance is construed generously beyond the domains of performing and performance arts.

One may aspire to do philosophy in the mode of poetry again, a Laozi multiply transposed. But didn't Plato throw out the poets from the Republic because they operated in the realm of the fictive imitative, thrice removed from the truth, and therefore were not to be trusted with the proper affairs of the *polis*? I'm writing this as an exercise in philosophy in the mode of art, trusting that it can be done, that it matters not only what we say or do, but *how* we say or do it. I'm wagering that both truth effects and ethico-aesthetic¹ passions can be accommodated in the same breath, the way mathematicians construct truths. However, mathematicians are not scientists, because their theorems do not claim anything about the "real world." Therefore they do not write under the sign of empirical truth. Mathematicians prove theorems true or false within propositional systems that they themselves construct. Therefore their constructions are works of imagination. Writing neither under the sign of truth nor of fiction, mathematicians create truths via imaginative processes that can be regarded as poetic processes.

It is in this spirit that I would propose exploring some questions refined over the years from their sources in crude, concrete, and technical craft. Together with fellow artists, engineers, and scholars, I have explored those questions via a hybrid of material and phenomenological experiments which have been built in the Topological Media Lab and by affiliate art groups, notably Sponge and FoAM. Most importantly this book shows how questions of craft, under inspection and reflection, can become refined into philosophical questions. Under rigorous inspection, questions how become questions why as well. Questions of philosophy in turn can provide heuristics,

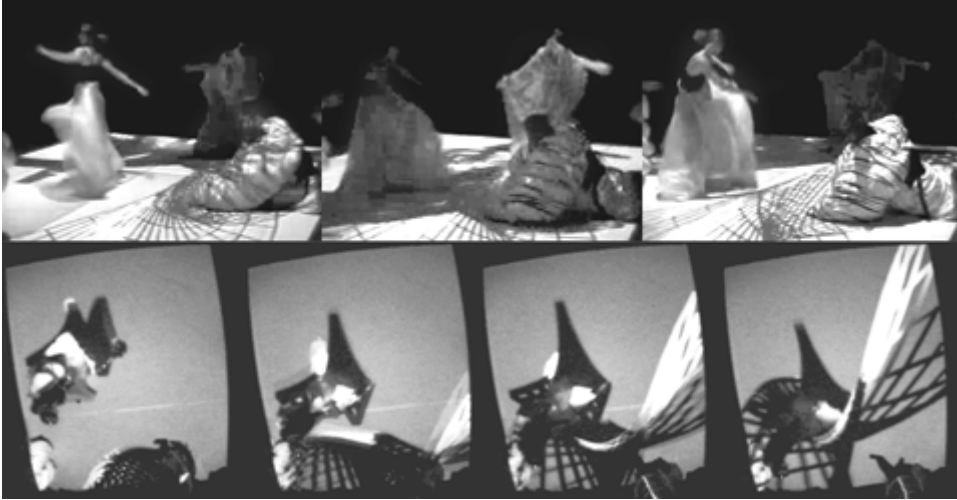


Figure 1.1

Visitors, dressed in projected and sensor-laden costumes, playing in a TGarden responsive media environment. Dutch Electronic Art Festival, Rotterdam, and Ars Electronica, Linz, 2001. Side view and overhead view. Images courtesy of FoAM and Sponge.

though never blueprints or methodologies, for craft. The most compelling reason for refining technical challenges into philosophical questions is to accommodate value. Given that we can engineer A, B, or C, the question we ought to answer first is *why* A, B, or C? Such an ambition places this book in the area of the critical studies of media arts and technology. The book provides a thoughtful place, more ample than the confines of a technical journal article, in which to resituate the work, and to provide some sense of how some approaches to art and technology may be more fertile than others.

However, this project of constructing a genealogy of topological media embodies a more radical ambition, which is to produce matters of value as well as matters of fact. To make sense of how we may approach the production of matters of value occupies the central chapters of the work. Mindful of Foucault's view of history as punctuated by rupture, my account of topology and potential reenchantment pretends no progressivist history of ideas. The discursive field linking, say, Heraclitus, Leibniz, Spinoza, Whitehead, Deleuze, and Stengers is just as present as the discursive field of Democritus, Frege, Newell, and Simon. In any event, we have always been topological. You may adopt various positions with respect to the concerns of this book, and with them you may develop alternative conceptualizations of art and technology, and alternative approaches to the material practices of artist and engineer at micro, meso, or macro scales of process.

Where Does It Spring From? Why Does It Exist?

Twenty-five years ago, in a letter I wrote to R, I metaphorically drew people as distributions and argued that no synchronic sets of characteristics could ever determine whether two people could be compatible together, that the real-time process of living would answer itself. Already then, I was convinced that something smelled wrong about the synchronic notions of modularity, compatibility, and fit, but I lacked the analytic terms to describe the origin of the odor, and only inklings of the alternatives based on history, evolution, flux, and process.

Perhaps the core of this work is a search for a way to live gracefully, but by grace I mean something like and unlike Simone Weil's catholic sense of grace, like and unlike the grace of Kierkegaard's knights of infinity, who hesitate infinitesimally just at the moment of landing on *terra firma*. Living well is a matter of why as well as how. It is also an unfolding in temporal processes, in psychological, biological, historical, cinematic, videographic, ecological, evolutionary, cosmological times. So we need to approach the art of living as process, and imagine what the processes of living offer us. What sort of process am I concerned with?

To answer the children (borrowing a convenient label from Isabelle Stengers) who cite Clausewitz to justify war as a mode of political intercourse, I recall Félix Guattari, who, at the end of his *Chaosmosis*, asks whether art is *the* appropriate mode of radical, ethico-aesthetic experimental subjectivation. Guattari's hyphenation—*ethico-aesthetic*—invites us to articulate together what Plato sundered: the arts of poetry with the arts of truth. It matters not only *that* something works or is said, but *how* something works or is said. What is done or uttered is inextricably the same as the manner in which it is done or uttered. Even more radically, what is done cocreates what could be done, or could have been done; in other words actualization coconstructs the potential. Ever since I came across Guattari's third ontology of an asignifying stratum, a plenum in which subjectivities form and dissolve in a magma of machinic assemblage, I have tried to elaborate how that sort of magma would work, and to explore and make possible in detail the nuanced forms of such free, deschematized, and rematerialized ethico-aesthetic gesture.

But what sort of art would it be? Certainly not art as self-expression or ego therapy, nor even, *pace* Krzysztof Wodiczko's early work, a way to cope therapeutically with the social world, as if the world were an illness. Should we insist that social critique is nothing but collective therapy after capitalism and schizophrenia? That would be a position just one crisis away from nihilism, a position I consider not worth the effort of living a life.

So what would the object of art be? Under capitalism, does contemporary art necessarily function in its residual forms as mimesis, hagiography, illustration, or social memory, and above all as commodity? Can art be about making things with all the

aesthetic and critical contextualization before and after its object? Can it be essentially concerned with unmooring us from our literal and denotative or smug expectations? Although art could help us reimagine the inhabitation of our built spaces, perhaps we ought not begrudge people the need for comfort. Art could be simply about material play. (If even mathematics and words have their materiality, then mathematics and poetry can be performed as art as well, but we'll come back to that.) And fundamentally it *seems to be about objects, rather than process*. It's telling that, aside from practitioners themselves turned teachers, the most durable representatives of process art of the 1970s and 1980s are the documentary images that we have. (Perhaps this is the fate of every process, every performance, that its representatives have the last word. As Derrida noted in his essay on Artaud, the representation of performance is its first word as well, in an endless circle.)

Even as mathematics, engineering, and scientific business management have drawn more and more upon abstraction, we've seen a sequence of critical moves away from the abstract: the linguistic turn, the semiotic turn, the structuralist turn, the materialist turn (again), and the turn to body. In each case, the turn goes through a naive phase and a reductionist formulation. Take the turn to the material in its special case: the body. In the simplest case, the turn to the body is a reduction to naive biologism (as if a curled lip were fully determined by honest glee).

Now what if we give up our conventions of body, ego, agent, object, but still wish to understand and work more deeply with embodiment, with desire, with intentionality and texture? What if we unmoor ourselves from our barnacle dependence on objects and predicates and networks, to swim through our world as a dense, plenist flux? How could we ever navigate, fashion, inhabit, form subjects, attachments, desires in such a fluid world?

Now have I slipped art and philosophy into the same bed, as if by cohabitation I expect them to produce whole offspring the likes of which we have not seen since Zeus split the round atom, and Plato drove the poets from the Republic? In mundane terms, this is the idea for collaboration, a sexual union of disparate species. But if we honestly suspend our reliance on objects, on things in themselves with predicates, on actual occasions or atomic events, then we ought not appeal to a model of work in which artist and philosopher are separate species.

This is a methodological point, and an important one because it gets at the heart of "how we get there from here." Honoring the American pragmatic turn, I feel that even, or *especially*, in a book about *philosophy as art*, we need to say something about how truly fused dispositions and approaches may offer more than juxtaposition or collaboration. In 1976 David Bohm, the physicist and philosopher, published a slim volume titled *Fragmentation and Wholeness* in which he succinctly observed how our modern rational analytic power to divide ourselves from our environment and to divide the world into disconnected domains has fractured our life in the world:

The process of division is a way of thinking about things that is useful mainly in the domain of practical, technical and functional activities. . . . However, when this mode of thought is applied more broadly to man's notion of himself and the whole world . . . then man ceases to regard the divisions as merely useful or convenient, and begins to see and experience himself and his world as actually constituted of separately existent fragments.²

At that time, the postmodern wave of rupture and arbitrary juxtaposition was still cresting. But bricolage has had its day, and now we must gather its shards and make an alloy of the pieces.

But this motivates us to appeal to flux, transform, stuff as a way to come up with fresh—that is, poetic—ways to play in the magma of ethico-aesthetic activity and gesture, collective as well as individual, diffuse as well as sited. In order to do so, we should examine more closely the magma itself and see how we can play in it. It is for that purpose that I construct a genealogy of *topological media*.

What Is Topological Media?

Topological media for me is a set of working concepts, the simplest set of material and embodied articulations or expressions that allows us to engage in speculative engineering, or philosophy as art, and to slip the leg irons and manacles of grammar, syntax, finite symbol systems, information and informatics, database schema, rules and procedures. I argue that topological media is an articulation of *continuous* matter that permits us to relinquish a priori objects, subjects, egos, and *yet constitute value and novelty*.

Topology provides alternative, tough, durable, supple, and—to use Deleuze's term—*anexact* concepts with which to articulate the living world, concepts like continuity, open set, convergence, density, accumulation and limit points, nondimensional, infinite, continuous transformation, topological space. To play on a motto from Latour, we have always been topological. It's only in modern, or I should say modernist, times that we've been so enamored of digital representations, discrete logic, digital computation, and quantization. I believe these concepts of continuity, openness, and transformation also can inform how we evaluate art and technology and enrich the way we make them. There is nothing mathematically fancy about the elementary topology with which I begin, and this accords with my aim to make richness without complication. Nonetheless, impelled by the way we approach ethico-aesthetic creation, we will appeal to significantly more developed mathematical patterns, most of which rigorously and poetically exceed the digital, discrete, computational domain.

The discrete drops out as a special case, by the way, so we are not losing anything of the graph theories (from syntax parsing trees to actor network theory), but just seeing them in their place would be enormously useful. The space of discrete graphs is so sparse as to be measure-theoretically null, entirely negligible at the human, meso scale.

It could be that one of the lures of the discrete has been the notion of choice, discrete choice, which in turn has been associated with freedom. But choice \neq freedom. And indeed superfluity of choice may simply obscure freedom.

The lure is the possibility that these concepts could provide material and embodied ways to shape, unshape, rework, knead the world. Contemporary engineering is not based on the noncomputable, infinite, and continuous; therein lies the conceptual and technical challenge and interest.

For Whom Is This Written?

I'm thinking with (*penser avec*, to use Stengers's beautiful notion) philosophers who practice in the mode of art. Perhaps the most consistent way for me to do this would have been to make an event out of this book, something more like the 24H Foucault, organized by Thomas Hirschhorn as part of the Nuit Blanche in Paris in 2003 on the proposition that Foucault was a philosopher who practiced in the mode of art. And in a sense, I have, in directing the atelier-studio-laboratory for creation/research called the Topological Media Lab, and in a decade of work as a member of the Sponge art group. So this book can be viewed as an utterance, a long thought in motion rippling out beyond the reach of the drops of material speculative installations and instruments that my collaborators, students, and I have created over the past decade.

I am writing this as an attempt to think with the process philosophers: Heraclitus, Laozi and Zhuangzi, Marx, Foucault, Whitehead, and with Deleuze and Guattari, to make philosophical concepts as art. I am writing this as a letter to MK and other fellow artists who ask, Why should we even try to create anything beautiful or joyful in this world? I'm writing this to articulate to my students and my friends a way of being in the world—of creation of art, *poiesis* . . . not so much a definition of representation or imagination but as permission and as ways to imagine other than the actual. (I say “to” not “for” to be mindful of Stengers's observation that we can speak in front of but not in place of those without voice.)³ And I'm writing this for my son who has asked me, ever since he was seven, why do we live, and what is the purpose of our lives?

What Are the Stakes?

Give me a place to stand and I shall move the Earth.

—Archimedes

Since 1848, utopian narratives of emancipation and liberation have been balanced by criticisms of transcendental frameworks built around notions such as God, Nature, ego (man), and now bit, gene, and network, from which there is no appeal.

What are the transcendentalisms against which I'm guarding, underwriting historical categories such as class, race, gender, nation? These include database (with concomitant schema drag); naturalization; proceduralism and structuralism (with concomitant brittleness); problem solving; shrink-wrapped designer speech and behavior.

These transcendental frameworks, far from being abstract, have had enormous material effect, especially as interpreted by their priests and revolutionaries.

Before we go further, why do we guard against transcendentalism or reductionism? An important part of the twentieth-century motivation for this has been to resist the inquisitional dogmatism, fascism, totalitarianism, and now fundamentalism in whose names so much blood has been shed. As Simone Weil wrote in *Oppression and Liberty*, "only priests can claim to measure the value of an idea by the amount of blood it has caused to be shed," and went on to question the "revolutionaries" of her day who shed their own blood as copiously in the service of a "shade of Helen."⁴

Democratic politics, as Ernesto Laclau and Chantal Mouffe pointed out in *Hegemony and Socialist Strategy*,⁵ is at heart based on the infinite continuability of debate. But as we know, beyond the formal Habermasian requirements for effective communication, what we need are the principles of charity and of balancing destructive with constructive criticism, which in turn arise from a prior sense of care. But how does care appear in the world?

Can we recover or construct solidarity, mercy, or interest, without a priori subjects? If we let go our clinging grip on transcendental verities, how can we still create ethico-aesthetic value?

Biopower today no longer acts only at the scale of docile human bodies (as Rabinow and Dreyfus characterized Foucault's study of power), but has dispersed into the background texture of social and political life. So if our critical technologies, whether they be technologies of entertainment (iconically the personal computer and the iPod) or the psychiatric and public technologies of patient or citizen, articulate egos only in the form of Adam or Eve, then they lie very far from where the contest really takes place.

To anticipate the arguments of this book around topological media, can there be continuous, distributed agency, and what ethico-aesthetic invention would that enable? How free can gestures be in reflexively responsive media? How can and how do people improvise collectively meaningful gesture? Such questions crucially motivate the study of media from a continuous topological perspective.

As Akeel Bilgrami succinctly put it in an essay on the modern roots of what he termed thick rationality:

The metaphysical picture that was promoted by Newton (the official Newton of the Royal Society, not the neo-Platonist of his private study) and Boyle, among others, viewed matter and nature

as brute and inert. On this view, since the material universe was brute, God was externally conceived as the familiar metaphoric clock winder, giving the universe a push from the outside to get it in motion. In the dissenting tradition—which was a scientific tradition, for there was in fact no disagreement between it and Newton and Boyle on any serious detail of the scientific laws, and all the fundamental notions such as gravity, for instance, were perfectly in place, though given a somewhat different metaphysical interpretation—matter was not brute and inert but rather was shot through with an inner source of dynamism that was itself divine.⁶

Eighty years ago Max Weber famously argued that modern rationality, by separating the religious from the rational, removed magic and myth from our world, which he called the disenchantment of modern society.⁷ Perhaps modernity is not so monolithically successful as Weber claimed: what is thrown out by day returns with the night. However, instead of accepting a split into rational and irrational life, instead of resorting to magic tricks or to transcendentalist and fundamentalist retreats, we ask: Can we make cracks in material, ordinary, physical situations in which extraordinary, nonteleological poetic activity can emerge? We emphasize that we are not designing experiences, or images or replicas of experiences, but the material background conditions of the built environment; hence our resort to computational media and active materials as *substrates* of performance rather than technologies of representation.

Reductionism is not merely judicious applications of Occam's razor. Nor ought its opposition be simply a hearty wallow in arbitrary pools of superfluity. (Burning Man is merely the antipode to industrialized property economy that reinscribes technological excess.) In the terms invoked by Bilgrami's observation, what's at stake is the reenchantment of matter.

The Main Argument of the Book

Papa, did you know when I sit down on the ground, I'm already touching the whole world?

[How is that, Gabriele?]

When I'm sitting on the floor, the floor is touching the earth, the earth is touching everyone, so I'm already touching everyone . . . and the whole world!

—Gabriele Weimin Carotti-Sha

Despite the range of art, technology, and thought through which my account will travel transversally, but nontrivially, this book is a single thought. Therefore let me condense the thought of the entire book into one paragraph. This underscores that, despite the apparent diversity of disciplines and practices due to their accidentally, historically evolved boundaries, the thought has a coherence and compactness. On the other hand, one should hardly expect to grasp the book's thought expressed this way since it comes here ahead of all the development of intermediate observations,

reflections, and most importantly the evolution of a notation adequate to the thought. (I say “notation” instead of “vocabulary,” for reasons that may become clearer in chapter 2.)

If we set aside transcendentalist appeals to universal immortal frameworks structuring our experience, and in the absence of any Archimedean point external to subjective experience upon which we can lever social and ethico-aesthetic judgment, what remains? How can any sense of sociality, solidarity, pathic subjectivity emerge? Not from an atomic world, because we run into complexity and the problem of intersubjectivity—the problem of how monads or groups of monads sum to one society. However, if we start with a plenum—already one substance—then we have, not a starting place—an Archimedean leverage point—but a magma of coconstruction that can be the substrate of subjectivation. This magma is already continuous and laden with value, saturated with time and all other quality-creating processes. This magma is not reductionist because it admits infinity and the imaginary—with boundlessly many modes of potential being. All monads, being formed in/out of this magma, are already touching, therefore making ethical action possible. The dynamical behavior of the world’s distributed media is coconstructed with our noematic experience of the world. Hence the apparently simultaneous emergence of shared patterns of behavior or recognition. The contemporaneity is an artifact of the contemporaneous time slice (or Poincaré section) of the evolving world. It’s the very acausality of that contemporaneous region coimplicated with the nonforced, nondeterminist realm of action that is ethical.⁸

This book provides the motivation, background, *mode of articulation*, elaboration, and implications of the preceding paragraph. (I prefer to say *articulation* rather than “context” or “language” to avoid falling back onto the very same crutches of representationalism, linguisticism, anthropocentrism that have hobbled thought.) This investigation is a philosophical, not a scientific one, because it makes no claim to verisimilitude with respect to some naive empirical notion of nature external to and divided from subjective experience. Nor is this a methodology: it prescribes no recipe, no rule-based procedures to govern social, political, economic, or design practices. Yet I do pose approaches to practicing art and engineering in a mode of rigorous speculation most closely aligned with creative, speculative mathematics. To call these approaches “principles” would be presumptuous; what I suggest are an open set of attitudes toward the material and practice of art and engineering that are critical, poetic, and informed by an inside knowledge of artists’ and engineers’ experience.

Ten years ago, I decided to publish written arguments and perspectives in tandem with making exemplary instances of this approach to articulating the world—media, performance events, installations, software algorithms and instruments, workshops, institutional organisms. This decision aligned with the pragmatic spirit infusing the late twentieth-century United States. It also constitutes a material analog to what mathematicians call a proof by construction, a constructive proof.

What Experiences Inform This Book?

At heart, what I describe is not a set of technologies that would homogenize practice, but an attitude toward the design of technology, a disposition with respect to living in the world and shaping it as more than a set of ready-made recipes or synchronic schemas. This approach is substantiated by nearly thirty years of work in various domains of art and engineering, two fields in which practitioners make a virtue of material work and substantiation of concept in alinguistic creative processes. Although the works⁹ have a continuous history intricately intertwined with the conceptual development over the same period of time, I'll introduce the earlier works (1984–1993) in this first chapter and present the later works in chapters 6 and 7, after we have some concepts that will make sense of their approaches. The earlier works include a series of physics simulations and social and historical simulation games, and the applications of the MediaWeaver distributed object-oriented multimedia management system. The later works (2000 on) include speech recognition in public urban spaces, responsive media environments, live (real-time) gestural media, media choreography, and soft architecture. Essentially the dividing point is the great die-off in the diversity of the applications of computational and network technologies that took place when HTML and httpd spread like kudzu around the world.

Blas Cabrera and Andrei Linde's Physics Simulations and Visualizations

Blas Cabrera and Andrei Linde's physics simulations and visualizations made palpable via the computer physical realities inaccessible to our ordinary vision and touch. Rather than merely present animation of canned physics, Cabrera's goal was to create computational microworlds that numerically simulate aspects of the physical universe normally inaccessible to the human, and allow the human to conduct virtual experiments in the simulated world. Students were required to build analytic, mathematical models and at the same time create and observe experiments in the simulated environments that we built.

In 1984, Apple and IBM seeded several universities, including Stanford and MIT, with a revolutionary new personal computer, the Lisa, to discover what could be done with these graphical user interfaces on small computers that could not be done with computers or any other antecedent technology in the world of teaching and research. They also provided funds to hire the first generation of programmers for this new operating system and programming environment.

For a heroic decade, we extended our practice of microworld simulation to interactive simulacra of historical and social microcosmoi, a move profiled by Jean Baudrillard.¹⁰ We extended our computational visualization software technologies to present images of differential geometric and topological structures that one could never encounter in the flesh (or so I thought at that time). For generic system X, however,

a simulation of X is not the same as X, and, practically by definition, one's experience of X is not the same as one's experience of a simulation of X.¹¹

MediaWeaver Distributed Multimedia, 1993–1995

Ten years later, the developers of social simulations were spending up to one year creating media-rich applications, with complex interlocking rules on what media had to be presented under what conditions to the user. Everything, from the creation of the media to the logic, was custom-crafted for the particular form of the simulation, whether it was a videodisc-based conversation between the student and a fictive story space, or a graph-based visual programming interface to create general physics simulations, or a 3D lighting instrument plot program to help a lighting designer visualize and plan a light plot for a theater. The interactive narrative projects seemed ripe for some optimization, because that class of applications seemed to share a common work flow, from the basic research into a set of social relations, media asset collection and creation, coding of simulation logic, and presentation in a multimedia screen-stage, etc. Major logistical challenges included coordinating teams of creators and programmers on networks of computers, rewriting logic which meant recoding, repurposing media, and handling new media formats. Ten years later, such problems transposed themselves to the industry of game design, which has begun to approach the complexity of film production.

For the MediaWeaver, I imagined the earthwide network of stored data as a single ocean of bits on which multiple structures and lenses (optics) could be overlaid. (In fact, in 1995 this was much more than a metaphor. MIT's Andrew File System or AFS joined a set of hundreds of UNIX computers around the world to present a single, unified file system. Sitting at my desktop, I could drag not just a document but any visible file from a computer in, say, Japan onto my own desktop. This file-level unification was much deeper than httpd's sharp restriction only to passive documents that had to be structured as HTML text files, and could only be viewed in a special application, a "browser," that rendered HTML.) A set of bits could be interpreted *simultaneously* as an image, or a sound file, or as strings of characters, or even as an operation to be performed on other data. The multiple structures could be provided by distributed relational databases and object-oriented media archives plus metadata markup. Alternatively the structures could be custom patterns imposed by commercial or personally written "editor" applications. At a finer grain, tools provided "lenses" through which one could view the media. The emphasis lay on multiplicity of interpretation, and on an unboundedly rich space of operators on data.

The conundrum was how to make available to the authors of these socially and culturally rich multimedia simulations the tools that could register the predicates and relational database schema structuring their media ontology, while at the same time retaining all the expressive power of the media editing tools with which they were

familiar. Further, the forms of representation and protocols never remained static but would evolve over time. The MediaWeaver was designed to provide the infrastructure that would allow the composition and population of rich media environments that could sustain events ranging from physics simulations to reenactments of French theater from the Renaissance through the twentieth century in hybrid physical-computational built space. It used a multipronged strategy to accomplish this. (1) Designers could use not just one structured schema but a *multiple and dynamically variable number of databases* to describe the relations among its set of media. (2) Each object could be represented by an equivalence class of concrete media proxies of any type—text, image, sound, stream, executable code, and so forth, even types yet to be invented. (3) The system provided a set of services (dynamically supplied from a global network) that could convert media objects from type to type, for example deriving a paragraph of text from the audio channel associated with a video clip as a summary for a client application that needed text. This followed the principle that the *space of transformations* of a base set of objects is at least as important as the base set itself. As I will summarize it at the end of this chapter, the tactic is to move from working with nouns to working with verbs. (4) No interface was imposed, but rather the MediaWeaver managed and supplied these media objects, links, and metadata using standard *commercial* applications as well as a set of interface kits, under UNIX, Macintosh Hypercard (the precursor of Director / Flash), and NeXTStep (precursor to Mac OS X), and to the World Wide Web via httpd and CGI.

The MediaWeaver database presented a limit case of relational databases and an object-oriented approach to handling the mutability and interconvertibility of humanly parsable media.¹²

A Remark from Sociology of Technology

In that early epoch of finding ways to use “personal computing” in humanistic, literary, if not aesthetic applications, it was enlightening to witness how scholars who were clients external to the new technological arts and sciences progressed through an arc of attitudes toward computational technology. The successive attitudes could be described as remediation, awe, disillusionment, false expertise, and, very rarely, virtuosity. Over my decades of working with individuals and professional communities, it seemed that mathematicians, artists, poets, historians all went through at least a few of these attitudes, especially infatuation and disillusionment. The wish for remediation was expressed by a demand such as: “I just want to write a book, and have the computer turn the pages.” The graphical user interface fed and accentuated this conceit. Some encounter with the unique and eye-opening features of desktop computing, and later of networked computing, led some to an attitude of awe: “The computer can do ALL.” But the experience of the rigidities of technology, and the brittleness in particular of software riddled to a Heideggerian depth by bugs, plus the

long development times required to make something sufficiently robust and rich for ordinary use, led to an attitude of disillusionment. Depending on the person, their encounter with computational technology could also lead to a false sense of expertise. Individualists might insist on their idiosyncratic inefficiencies and circumlocutions and view their continued cottage industry as vindication of their DIY (do-it-yourself) method. DIY practices have run the gamut from writing personal applications to do what can be done with off-the-shelf commercial software, to creating custom languages within which one can express a certain computation that extends an application. Brilliance, a quality abundant among mathematicians and literary scholars, can accentuate the tendency to DIY. On the other hand, collectivists rush to standardization, the more global the better. What I call the tendency to “reach for your ISO” (International Standards Organization) percolates into almost every large symbol-processing industry, including electronic documents (SGML–XML), 3D graphics (VRML–X3D), and video (MPEG-1–MPEG-21). Beyond skill and knowledge lies virtuosity: consummate skill with its particularity, plus consummate knowledge which brings professionalism and perspective, plus an expressive leap that finds fresh but idiomatic ways to use techniques not as black-boxed technology, but as developable ground for prepared improvisation.

Geometers Workbench and the Holy Grail of the Magic Blackboard, 1998–2000

After about a decade¹³ of working with different computational tools for doing research in differential geometry and topology, I wondered why it was, after fifty years of work in logic programming, automatic theorem proving, 3D graphics, and numerical simulations, that computers were so unuseful for the actual day-to-day work of creative mathematical work. This may seem surprising, but the bulk of the free creative mathematician’s activity has little to do with calculation and graphics, as conceived by computer scientists and programmers. Taking a step back from both logicians’ and programmers’ externalist cartoons of mathematicians’ practice, I studied in particular what really existing differential geometers do in their native habitat, in front of blackboards, talking over coffee, and typing in TeX. In fact I looked at their gestural activity as much as their verbal activity, trying to bracket linguistic assumptions about how signs are used, yet paying attention to the differential geometer’s phenomenological experience of differential geometric entities: the constantly evolving tissue of definitions, theorems, proofs, estimates, conjectures about objects, functions, classes of entities, etc. This led me to realize that the most basic activity was traced in a mode of nontelemental writing, writing that I argued *constituted mathematics* rather than “represented” preexisting, transcendental forms. My key interest here was to shift the perspective from tools for representing idealized, crystalline mathematical objects to tools for creating or fashioning them, tools of *mathematical performance*. Thanks to Terry Winograd and colleagues in Stanford’s Information Mural research group, in

particular François Guimbretière, I was able to realize a “blackboard” that mapped freehand gestures to algebraic and differential geometric operations. I’ll say more about this in chapter 3.

The key insight here is that writing can be more usefully understood as a collective processual constitution of fresh entities and relations rather than a static representation of transcendental objects. One could transpose this approach to all sorts of sign-making activity, in fact to the entire domain of semiotics, and beyond. In fact, I transposed many of these questions about writing and poiesis to the domain of visual arts, media art, responsive environments, when in 2001 I founded an atelier called the Topological Media Lab to study such questions experimentally.¹⁴

Hubbub Speech-Sensitive Urban Surfaces, 2000–2002

Continuing in this vein of evaluating and conceiving the technologies of writing as performative technologies, I imagined an installation based on speech recognition.



Figure 1.2

Hubbub installation, speech-animated dynamic glyphs. Projection onto steel cloth, Chrissy Field, San Francisco, 2002. Photo by the author.

What if, I speculated, surfaces in public spaces were to register fragments of text from casual spoken conversation, so that ephemeral speech would acquire some of the fixity of writing? Moreover, what if these glyphs were to dance and reshape themselves according to the timbre and dynamics of the voices that speak the words, so that the glyphs acquire some of the prosody of speech? How might social spaces thicken in the presence of such partial condensation of speech in shared spaces? Over three years, first as artist in residence at Jason Lewis's Arts Alliance Lab in San Francisco, I created a series of speech-sensitive installations in public spaces, in San Francisco, Brussels, and Atlanta. These installations sidestepped the problem of "surveillance" by the idiomatic capitalization of the very errors and ambiguity of the technology. The design took advantage of the errorful speech-to-text transcription to detach the sign from the lips of the speaker. Moreover, the glyphs circulated through a given public space according to dynamics that were predesigned for the site, and so this further materialized the autonomy of the glyphs. The early Hubbub experiments allowed a carefully prepared but playful relation and projection between the intention of the speakers and the latent, responsive dynamics of a speech-sensitized site.

Each of these projects (MediaWeaver, Geometer's Workbench, and Hubbub) constituted an extensive response to and against prevailing technical conceptual frameworks, and as such each constituted a fairly elaborate probe into the sociotechnical and associated cultural, ethico-aesthetic milieu. Each probe was a diagnostic embodying internalist but critical response to simulation and what would become the trope of virtual reality; to multimedia and what was to become the trope of the World Wide Web; to a limit case of the augmentation of knowledge via computer representation; and to pattern recognition as a technology for public discipline. Building on the critique, these responses constituted computational technology invented according to scientific, humanist, and artistic desiderata rather than market or industrial norms, and they constituted material interventions based on expert internal knowledge.

Conceptual Lily Pads, Landing Spots

Out of this spiral of work from physical and social simulations, through geometrical and cosmological visualizations and distributed media archives, to media art and technologies of performance based on real-time media resynthesis from gesture and movement, emerged vignettes and meditations, concepts, arguments, rants, and judgments that inform this book. Together they constitute an adventure in experimental phenomenology.

I'm trying to discover and mix together mathematics as materials that are adequate to life, because mathematics has a peculiar power to intertwine the imaginary and the actual. It could be sharply different sorts of poetic, symbolic matter: continuous topological dynamics, geometric measure theory, or even fancy stuff like noncommutative

algebra and étale cohomology. But I choose to start with the simplest symbolic substances that respect the lifeworld's continuous dynamism, change, temporality, infinite transformation, ontogenesis, superposability, continuity, density, and value, and are free of, or at least agnostic with respect to, measure, metric, counting, finitude, formal logic, linguistics (syntax, grammar), digitality, and computability, in short the formal structures that would put a cage over all of the lifeworld. Simplicity here is not a requirement of the theory (no Occam's razor here) but merely an acknowledgment that I do not understand enough about the lifeworld to bring out fancier stuff yet, of which there is so much more up the wizard sleeves.

The fundamental difference in this approach is to *use mathematics as substance* in a workmanlike way, patching here and there to see what values ensue, as a *trellis* for play, rather than a *carapace*, but always considering whether the poetic material accommodates *transfinite*, *incommensurable*, immanent passion. Totalizing carapaces like Wolfram's computational equivalence principle, which at bottom is a transcendental atomic metaphysics founded on making counting sacred, would hammer us into a very sparse ontology. And to a hammer everything is a nail.

Why mathematics? Mathematics is conventionally cast as the quintessence of certainty, which is equated with dry rigidity. It has, however, the advantage of being a mode of articulation that escapes (and exceeds) the linguistic, a mode of argumentation and disquisition that escapes the legal and the political, and a mode of measurement that escapes the naive notions of the senses and sense data. Then what value lies in looking to mathematics? Isabelle Stengers wrote, in her essay "A Constructivist Reading of Whitehead's Process and Reality":

Abstractions, for Whitehead, are not "abstract forms" that determine what we feel, perceive and think, nor are they "abstracted from" something more concrete, and, finally, they are not generalizations. . . . [A]bstractions act as "lures", luring attention toward "something that matters", vectorizing concrete experience. Just think of the difference between the mute perplexity and disarray of anybody who faces a mathematical proposition or equation as a meaningless sequence of signs, as opposed to someone who looks at this same sequence and immediately knows how to deal with it, or is passionately aware that a new possibility for doing mathematics may be present.

In order to think abstractions in Whitehead's sense, we need to forget about nouns like "a table" or "a human being", and to think rather about a mathematical circle. Such a circle is not abstracted from concrete circular forms; its mode of abstraction is related to its functioning as a lure for mathematical thought—it lures mathematicians into adventures which produce new aspects of what it means to be a circle into a mathematical mode of existence.¹⁵

And farther on:

Such is the power of what Whitehead called propositions, luring abstractions which are not to be confused with sentences (which eventually serve as their vehicles), that their acceptance into

experience may disrupt social order. “When a non-conformal proposition is admitted into feeling . . . a novelty has emerged into creation. The novelty may promote or destroy order; it may be good or bad. But it is new, a new type of individual, and not merely a new intensity of individual feeling.”¹⁶

In these passages, Stengers has described an essential feature of the pleasure and consolation of doing mathematics, which is the constant reaching via a rigorous imaginary beyond the actual, and beyond matters of fact. Mathematics hitched to utility can be as rigid and asphyxiating as any schema. But mathematics, as Stengers recognized in the practice of mathematicians in their own terms, is indeed a performative art, and it is in this poetic and poietic mode that I will articulate some of my arguments and expressions by adapting the concepts and theorems of topology, differential geometry, Lie theory, and dynamical systems.

One final qualification may bear repetition throughout this book. I do not use mathematics for instrumental purposes, e.g., to measure objects or to model some phenomenon. Nor do I aim to construct a philosophy *of* mathematics or physics, making judgments about, say, the metaphysical status of mathematical objects, or a theory of agency explaining mathematicians’ discursive agency. Nor do I intend to mine mathematics for metaphors, e.g., using fractal geometry to stand in for nature or art. My interest lies in seeing how certain mathematical concepts can inform philosophical insights. Antecedents adopting a similar approach to mathematics include A. N. Whitehead, René Thom, Gilles Deleuze, and Alain Badiou, with a fountain of diverse results. However, standing more with Stengers than with Badiou, being well aware of mathematics’s coherent power, I would urge us to go slowly, thinking that we may not have concepts adequate to the phenomena and to our concern. As Stengers wrote in her essay “Beyond Conversation: The Risks of Peace”:

As Deleuze said, to think (or create) is to think “in front of” or “for” alphabets, dying away rats or alcoholics. Which does not mean addressing them, or helping them, or sharing hope or faith with them, but not insulting them with our power to justify everything. Thinking with them in front of us means thinking with the feeling and constraint that we are not free to speak in their name or side with them. . . . What would be a conversation “in front” of all the unknown people our words so easily disqualify as a matter of fact, even when those words speak of mutual appreciation, respect and love? Deleuzian tradition, with its built-in decision to side with the damned, may help process people to “stammer,” or “quake” when trying to produce the words for a sorely needed “relational worldview.”¹⁷

Stengers’s caution for those who would “produce words” holds equally for those of us who would tap mathematics for philosophical or artistic inquiry.

Some people say that ideas are cheap, that making is hard. But we know very well that humans create and rework concepts with just as much effort and rigor and material discipline as the making of a physical installation. It’s just that the young domain

of media arts and sciences has not enjoyed the luxury of alloying and working out concepts as thoroughly as, say, biotechnology or Renaissance literary history. Domains of practice that benefit from billions of dollars or centuries of investment develop practices that exploit the making and composition of concepts based on antecedent literatures, intricate dependencies and interrelationships of publication and citation, the social networks that give meaning to concepts, and procedures of evidence and argument and generative logics indigenous to the epistemic culture.¹⁸