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**A Strange Reconciliation: A Conversation about Architecture and Science with Peter Galison and Antoine Picon**

By David Theodore

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**PG** Design has a double anxiety surrounding it in the current moment. One part concerns design and art. Is design art? You can see that anxiety, for instance, in the tensions and the explosive interest in design at the Museum of Modern Art. Paola Antonelli and others have reached a whole new generation of younger people who go to MOMA to see design, but who don't go to see, say, the Picasso show.<sup>1</sup> The other concerns design and science. It used to be pejorative to call scientific work "design." Design, **physicists thought**, was something that would go on at engineering school or at Intel, not in the heartland of pure science. But now design has this double aspect, on the one side reaching towards engineering and science, and on the other reaching toward art. That gives it a special liveliness that is perhaps part of the same ethos that motivates this issue of *tarp*. How are we conceiving architecture and science at this moment, and can we get away from the older ways of speaking?

**AP** But how can you design both architecture and molecules? What does design bring to the table, solutions or problems? For architects—and this is a bit different from design in science—design is a way to let problems emerge. Younger designers are so anxious to participate in solving the problems of the world. One has to remind them that problem-solving is precisely an engineering activity. Today with sustainability we risk a return to this very positivist dream of scientific technology. In architecture good design is about revealing tangible issues, but not **necessarily** complete solutions.

**PG** When I was editing the book ***The Architecture of Science***, I was struck by how many people felt the obligation to argue against the idea that architecture was nothing but a

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<sup>1</sup> See e.g. the 2011 exhibition *Talk to Me*:  
<http://www.moma.org/interactives/exhibitions/2011/talktome/>

kind of calculus.<sup>2</sup> That was surprising. It had never occurred to me that someone would think architecture was nothing other than an automatic calculus, like running a program to build a curve between two points. But I presume the notion had enough sway back in the 50s and 60s so that still in the 1990s people felt obliged to naysay it.

**AP** There's also the prestige of science. Architecture as a discipline is always anxious about its prestige. That's one of the few things that has been transmitted with the DNA of western architecture. It's even in Vitruvius. There's a longing for supremacy and at the same time a deep insecurity. Architecture aspires to be as rigorous and noble as science, and that provokes the counter-reaction: "No! architecture, will never be science!"

**PG** Where we might be able to enter this conversation in a useful way is that both Antoine and I are interested in materiality, and the way that questions of design, engineering, and architecture might be thought about both historically and in the contemporary world. We share a theoretical orientation that takes materiality seriously. Material culture and the object are important to both of us.<sup>3</sup>

**DT** Let me ask the correlationist question. Speculative Realist philosophers want to turn from epistemology to ontology. They use SR as a way out of the constructivism of postmodern theory by pointing out (and rejecting) instances where questions about the existence of objects are turned into questions of how we might know those objects. Ray Brassier, one of the organizers of the first SR conference, had this to say about the movement: "the only thing that unites us is antipathy to what Quentin Meillassoux calls 'correlationism'—the doctrine, especially prevalent among 'Continental' philosophers, that humans and world cannot be conceived in isolation from one other—a 'correlationist' is any philosopher who insists that the human-world correlate is philosophy's sole legitimate concern."<sup>4</sup> How would you characterize the human-world correlate in your own work?

**AP** I don't see how in design you can escape the link between human and world. In design there is something in your mind, and by the end there is an **external** object. And you have to explain what kind of relations there are between the two. The idea of imagination, mental process, representation: this is the important problem.

**PG** I think a lot about design in the sciences. The history of the field I work most in, particle physics, is about how to use evidence to show the existence of something. How does a bubble chamber picture, or spark chamber data, or counts in images, how do they aggregate to form evidence that then can be used as a representation of a world that already exists? In that sense, the question really is fundamentally epistemological, about how do we get and secure knowledge.

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<sup>2</sup> Peter Galison and Emily Thompson, eds., *The Architecture of Science* (Cambridge, Mass.: MIT Press, 1999).

<sup>3</sup> See e.g. essays by Galison and Picon in *Things that Talk: Object Lessons from Art and Science*, ed. Lorraine Daston (New York: Zone Books, 2004).

<sup>4</sup> Ray Brassier interviewed by Bram Ieven in 2009 for *nY 2*; see <http://ny-web.be/transitzone/against-aesthetics-noise.html>

But these days, colleagues in physics departments are now also concerned with making things. If you want to figure out how to make the smallest conceivable transistor out of a couple of atoms, how do you do that? For them the question isn't so much documentation, but production. It's a design problem. At first this I think rather dramatic change met with a lot of resistance in physics departments. People would say, "That's engineering, that's not physics." But you don't hear that anymore. Physicists are trying to *make* objects, to make DNA strands part of computation, or to make on-off circuits that can be added up to make the smallest conceivable memory structures, or to make nanoscale things in molar quantities not one-off the way physicists have always thought.

These changes have had interesting consequences, one of which is a much less anxious relationship to aesthetics, so that you'll see physicists interested in design. In the nineteenth century, physicists were proud of the non-aesthetic quality of their work. Aesthetics was seen as pulling in an artistic direction away from verisimilitude. Now the journal *Physics of Fluids* has a prize each year for the image that is both aesthetically interesting and scientifically forceful.<sup>5</sup> [Peter—is this the journal you meant? Yes, plg ]

AP Perhaps science and design have evolved in opposite directions, which has enabled them to meet up. One could say that science has moved from a vision of itself as an argument to a vision of itself as a maker. Design—and engineering, too—was always totally immersed in making. But in design, aesthetic sensitivity has become less important, because *argument* is the main question. Making is for designers the natural condition, but design now asks: what's the point? what is the argument? what is the *why*? There is a growing obsession with argumentation in design, and a growing obsession with making in science. This criss-crossing historical evolution enables hybridization.

DT What about realism? Science still believes in an independently existing world, doesn't it?

PG Independently, but maybe not pre-existing. When John and Washington Roebling built the Brooklyn Bridge, they weren't worried about existence. The designer-builders worried about whether the bridge was robust, or whether it would survive under different circumstances. Those are engineering questions. What's changed is a move away from representation to presentation. I agree with Antoine that argument is always part of it. Scientists are not abandoning argument. But they're not worried about whether something *always* existed. Some still do of course. Scientists at CERN are asking whether the Higgs particle exists. Its existence has consequences for the beginning of the universe as well as its current and future functioning. But existence is not the question when you're designing a nanostructure. You're not worried whether this circuit always existed. That would be a ludicrous question. That's not what they're interested in.

AP I think you hit upon something really important, which is the crisis of representation. Reality is not given through a representation today, it's given through manipulation. Let's

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<sup>5</sup> *Physics of Fluids* maintains an image gallery at [http://pof.aip.org/gallery\\_of\\_fluid\\_motion](http://pof.aip.org/gallery_of_fluid_motion)

take for example the representation of a building. The traditional idea was that even if the building did not exist, the image represented something that could exist, and it was of the same nature as the representation of an existing building. Today we see an image as something that has effectiveness in the material world—it can trigger processes of construction, processes of recognizance etc. There still remains for me a question of the relation between the image, the building and what we have in the head, what we call knowledge in the end. I don't see how you could go back to any kind of solipsist or idealist position negating the fact that external reality exists. The issue is not ultimate reality, the issue is ultimately how do we relate to reality.

**PG** These questions about ontology are just not what scientists engaged in nano-construction and bio-engineering are focused on. Once you're in the mode of generating philosophical problems that no longer address the concerns of the scientists, then it seems to me you're in precarious philosophical territory. That's what Wittgenstein was constantly warning about, that is, about making intra-philosophical questions that no longer answered to our concerns: questions of the type "is my sweater *really* blue?" Live, philosophically-informed questions ought to at least be dealing with matters of concern, and those concerns should include those of scientists and engineers.

This connects to the argument of the last sections of the book *Objectivity* I wrote with Lorraine Daston.<sup>6</sup> You could say that the problem of representation is one in which you have a bi-layer world. You have a world and then you have a representation of that world. Realists are people who think the two layers can be attached, that there are arrows that go from model to reality. There are many ways of challenging this bi-layer reality. And images play a role in that. You can ask, for instance, does this electron microscopic image accurately portray what goes on in a neuron? You could say no, there's a problem of artefacts, or interpretation, or that its stains don't work properly. But if you're doing nano-manipulation, the image isn't used as pure documentation to say whether something existed or it didn't exist. The image is part of the tools. If you look at the floor plan of a nano-lab like the one that's just behind this building, you'll see lots of visualization modules surrounding a laboratory. And the reason is not because they're trying to document something, to show the accuracy or the correspondence between model and reality, it's because they're *doing* something with images.

**AP** I am really struck these days by how the organicist metaphor has come back in the design world. There's a new organic discourse in the digital around emergence which makes me really perplexed.<sup>7</sup>

**DT** Do you have a specific example?

**AP** Take Karl Chu, who tells us that nature is a computation.<sup>8</sup> From now on what computation does is to emulate nature. I think it goes back to the idea that design is an

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<sup>6</sup> Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007).

<sup>7</sup> Antoine Picon, *Digital Culture in Architecture: An Introduction for the Design Professions* (Basel: Birkhäuser, 2010).

extension of nature, an idea you find already in nineteenth-century German architecture, with architects such as Karl Friedrich Schinkel, who believed that design was pursuing and extending the work of nature.

**PG** Antoine's observation is very interesting. In physics there was a moment after WWII when simulation became very important. A really interesting contrast developed between those who thought that nature was best got at through platonic models and those who thought it was best replicated through stochastic simulations. Physicists realized they could simulate the processes of what went on in a nuclear reactor or a nuclear bomb, and solve problems that were otherwise intractable to them through older analytic techniques. This became known as the Monte Carlo method.<sup>9</sup> The computer was programmed to use real or pseudo-random numbers to allow a process to unfold. The Monte Carlo became very popular among physicists to solve all sorts of problems, not just in nuclear matters, but also in weather, in fluid dynamics, in all sorts of things. For some scientists this random simulation was actually *truer* to the processes of nature than the analytic techniques that had been used for hundreds of years, because, they said, nature was at its root random. A stochastic model of a stochastic reality (so this group thought) was actually a replication of reality rather than a model of it. If you might call those people the "stochasticists," they were opposed to the Platonists, like Einstein, Dirac, or Maxwell, who said that the furniture of the world was written in the language of differential equations, of exact curves. This mathematics was what was really true behind things that looked random.

**AP** Today we see a kind of strange reconciliation, a new organicism or vitalism unheard of in the past. Vitalism used to be adverse to computation. From the eighteenth century on, you had a stable opposition between people interested in mechanics and those interested in medicine and vitalism. Today we see the merging of these two traditions. Digital designers interested in computation have the idea you can imitate life. For those interested in the application of cellular automata to modeling, for instance, this is a looming idea. The discourse of emergence, which is so strong among so many designers, precisely suspends the question of deterministic versus random or stochastic. They are interested in how order unfolds from apparent randomness.

**DT** Their situation sounds very close to the stochasticists Peter just described.

**AP** It is both different and related through the reality of computation. For many digital designers, the difference between the model and real life gets abolished in important ways.

**PG** To go back to the beginnings, speculation on cellular automata came through the work of Stanislaw Ulam and his colleagues, who were also the people creating these Monte Carlo methods and simulations. So they are closely related. It also occurs to me

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<sup>8</sup> See for instance Karl Chu, "Metaphysics of Genetic Architecture and Computation," *Perspecta* 35 (2004): 74-97.

<sup>9</sup> On the Monte Carlo method and artificial reality, see Galison, *Image and Logic*, 689-780.

that surrounding the art world there's this fascination with neuro-acts and neuro-aesthetics. That point of view often takes a computational picture as the root of that which is neuronal, and so by extension, a computational picture of aesthetics. Not that this notion hasn't encountered huge resistance; it's a battle that continues. But there is a kind of "pan-computationalism" that we see across many different domains, from art and architecture to aesthetics and psychology.

**DT** Cities seem to be mixed in the ways we've been talking about, that is, they are hybrid objects that combine the abstract and the physical. Is a city a real thing?

**AP** A city is not really a thing. Or it's a very imprecise thing. There is still a problem of representation. To call something a city is inseparable from a certain set of preconceptions we have. I am interested in thinking about these categories, strangely abstract and at the same time concrete, that we mobilize to read technological reality. For instance, "infrastructure," which came not long after "structure" in the mid-eighteenth century, was a way to divide the world into a platform structure and then a superstructure. It was a very general divide. But "structure" does not exist naturally. How do we construct categories like structure or image or map to read the world?

**PG** We have some classical relations we go around with almost unquestioned about the relation of abstraction and the physical. One way is to think that we come up with ideas in the most abstract of mathematical physics, and then we form models of it that become applied physics, and then it filters down, maybe through the other disciplines, through chemistry and biology, or it goes down to more and more applied mechanical or electro-mechanical things and eventually it will end as something on the factory floor that can be made and manufactured and become physical. It's a descent from the most abstract through many intermediate processes to the most concrete. The second way follows the opposite direction. It's the idea that we consider abstraction in a sort of Platonic ascension, that we look at machines, and then we abstract simple machines, and then we abstract principles, and eventually we get up to some object in Plato's heaven.

But what happens when the concrete and the abstract really enter together? When Einstein or Poincaré look at trains or clocks or telegraphs, but also at philosophy, and the abstract principles of what becomes relativity theory?<sup>10</sup> I've recently been doing work on Freud. He was thinking about censorship practices in WWI Vienna through what he had learned about censorship in the mind. All of his work involved postal networks and gathering information through newspapers, that's how he thought. He was really worried about actual censorship: can he send a letter to his son at the front, can he get a paper through to his collaborators? He used the practices of the censor in Vienna to articulate and modify his notion of psychic censorship—a mix of the most abstract and the most concrete.

It interests me a lot when objects function both in their material form and in abstraction simultaneously, not through this long process of ascension from the factory floor to

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<sup>10</sup> Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W.W. Norton, 2003).

Plato's heaven or vice versa, but in their co-mingling all along. I'm less interested in metaphors of ascent or descent, but instead in the sudden presence together of very abstract and very material things.

**DT** Is a building, a work of architecture, always, as Peter just described it, suddenly and simultaneously making present the abstract and the physical?

**AP** Oh yes, I think architecture is always about that. But more and more I'm interested in a physical, almost physically empathic dimension. You remember Panofsky and his very strange analogy between scholasticism and Gothic construction?<sup>11</sup> I think we have all kinds of constructive metaphors like that in the head. Construction is related to the way we understand our own thought, and to the way we relate to the world through our body.

**DT** In what way is it not a metaphor?

**AP** Of course it's always a metaphor.<sup>12</sup> If you go behind the metaphor, though, you get to the fact that through objects we construct categories to read the world. When we produce objects, we also produce division—not metaphors, but ways to divide, analyze, and sort the world. An object for me is always a kind of proto-argument. The difference is that if it was an argument, you would not need an object. In architecture today form always needs to be related to an argument; but if it's an argument, it's not architecture.

**DT** Is every object a hybrid object?

**AP** For me there are two ways of understanding objects. One way is to place them in networks as Bruno Latour does, seeing the object as an actor. I'm more interested in other properties of the object. First, the object has a material epistemology. An epistemology, before being ethereal, is material, linked to the way we produce and understand objects. Second, an object is physical experience, a relation to the body. If you visit a cantilevered building, you feel some kind of anxiety, or pain, or exhilaration; you feel something almost in your bones. Yet nothing a priori will tell you how to divide it into parts. Nothing will tell you how to distinguish a ceiling from a wall. When we are in this room, we understand that there is a floor and a ceiling and so on, but there is nothing in the room itself that forces us as to distinguish them. The very fact that we conceive an object and recognize it as an object is linked to categories and experience. And it's this that allows them to participate in a complex Galisonian argument where you can find clocks, maps, and special relativity. There is already something in the object that links to these epistemological questions.

**PG** Different histories carve up the world and objects in different ways. Do you count a city as an object or not? Is an individual person an object? Or are collectivities objects? These are the foundational debates that have wracked every academic discipline for the

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<sup>11</sup> Erwin Panofsky, *Gothic Architecture and Scholasticism* (Latrobe: The Archabbey Press, 1951).

<sup>12</sup> Antoine Picon and Alessandra Ponte, eds., *Architecture and Science: Exchanging Metaphors* (Princeton: Princeton Architectural Press, 2003).



last several hundred years. The existence of sociology, for instance, depends on the status of the collective. So it appears to me two different questions could be asked. One is, “can you have non-material objects that are worth calling objects?” And the other is, “are there multiple ways of parsing a given object, whether it is material or non-material?” which is what Antoine is pointing to today.

**AP** And these are old problems. For the Romans, you had a question: when you fix something on the wall, is it part of the wall or is it independent? That was linked to the concept of ornament. For the Romans ornament was something fixed to the wall that you could still intellectually consider as distinct. A brick is not an ornament, but fixed marble on the wall is an ornament. So you see, where is the object? Today we have difficulty understanding what the Romans understood as ornament.

**DT** So it’s an historical problem.

**AP** It was a cultural problem, but also a legal problem. In Roman law, there is the strange case of an aristocratic family that was forbidden to sell wall ornaments, because the ornaments were considered part the family’s heritage. Romans saw ornament as something that “piled up.” Ornament was like wealth or money. Hence you had to constantly increase the *quantity* of ornament, of the family, of the empire, of the city. We have a qualitative vision of ornament and a relatively quantitative vision of the fabric. The Romans saw it in reverse. When we see Roman **bathhouses** we think that what is quantitative is the masonry and what is qualitative is the marble, but ornament is much more complicated.

**DT** Part of the discussion in Speculative Realism has to do emergence. At what point do you have something that you call an object yet can still take away parts of it, so it’s not understood as an aggregate but as an entity?

**AP** I think we live in a post-Deleuzean world. We see objects more as processes that unfold **than as static entities**. Emergence is linked to a certain philosophical dimension going from Deleuze up to today. So you have that line. Then you have a certain understanding of the physical world as described by science linked to a certain understanding by designers. And then there is something at stake in the discipline: what do designers really do? Do they shape forms like potters? Or are they people who manage dynamisms? Today’s designers wish to go beyond the potter, who finishes a building like you finish a piece of pottery. So “emergence” is also the name given to a professional claim for the social relevance of architecture.

**DT** Is that true in science today?

**PG** The example of ornament is a beautiful one. The way that entities enter into our world is very consequential. I agree with Antoine these are not categories determined once and for all. Take DNA. What is DNA? Well, we can say that what it *really* is, is the mechanism of genetic transmission of information. But then it turns out it’s also part of computation. So then what is it? Is it part of a computer? Which is more fundamental?

Once you build new scientific structures (to come back to the term Antoine was discussing before), it changes the status of individuation and categorical classification.

Physicists worry about emergence, too. The question might be seen to be purely metaphysical, or it might be seen to be a question of directing our attention to certain phenomena, or it could be a political economic one in the sense of whether you support disciplines. For instance, there is the famous debate carried out between Philip Anderson and Steven Weinberg concerning whether condensed matter physics is as fundamental as particle physics. Is condensed matter physics just particle physics carried out on more complicated systems? Anderson would say that when you talk about heat or superconductivity or any other collective phenomenon, it's not a property of an individual particle. Lasing is a collective phenomenon. It's meaningless to say that a single electron is "lasing."

You could say the question is purely metaphysical, concerning where you think first things should be located. The particle physics question concerns foundation, the fundament of our universe. So for scientists it was an argument about metaphysics, but it was also an argument about a \$15 billion superconducting supercollider which they wanted to build in Texas.

**DT** With buildings are we again discussing objects at a different register from the ontological level of realism and anti-realism? What about physicality?

**AP** The urgent question is, how do we rearticulate what we still do in the physical world? The virtual world creates as many material problems as it's supposed to solve. Its space consuming, there are format obsolescence issues. A lot of things will probably not be digitized. Lots of old papers and so on. This electronic world needs a lot of physical spaces, energy, etc. Which might be its real limit. We may reach a point where information is just too expensive to store.

**PG** Yes. We've talked about the abstractions inherent in the immediate physicality, but the opposite is true too. That is to say, the virtual is not bloodless, without physicality. All you have to do is look around at cyber bullying, and cyber security and cyber warfare. These are responses to having a presence in a virtual world. It is extremely consequential in the physical world how we're playing things out in the virtual one.

**AP** We're not yet in a totally dematerialized world. To access this immaterial world, you need a big screen, and cables, and server farms that create heat: all of these have physical dimensions.

**PG** And surveillance, privacy, identity. These are questions that are very pressing.

**AP** The truth is the world is becoming more hybrid, but it's not dematerializing. That's a pure fiction.

**PG** I agree with that completely.