# 1. Abstract Machines

## Interview with Gary Tomlinson[*]

**About Gary Tomlinson**

*Gary Tomlinson is John Hay Whitney Professor of Music and the Humanities and director of the Whitney Humanities Center at Yale University. Tomlinson has taught and written about the history of opera and early-modern musical thought and practice, but also on the philosophy of history and anthropological theory. In his current research, he combines humanistic theory with evolutionary science and archaeology to search for the role of culture in the evolution of man. Following* A Million Years of Music: The Emergence of Human Modernity *(MIT Press, 2015), his new book* Culture and the Course of Human Evolution *(Chicago, 2018) deepens the theoretical framework on how culture has shaped biology.*

**Johan Fredrikzon:** You participated in a Gilbert Simondon conference, *Modes of Technical Objects*, at Yale in April 2018.

**Gary Tomlinson:** Yes – twelve people sitting around a table for two days talking about Simondon!

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[*] Johan Fredrikzon spent one and a half years as a visiting research assistant at the Film and Media Studies Program at Yale University 2018/2019. Some months before he arrived, a two-day workshop on Simondon was held by the Yale-Düsseldorf Working Group on Philosophy and Media, titled *Modes of Technical Objects*, with scholars from the US and Germany. Fredrikzon decided to engage a few of the workshop participants for this special issue of *Sensorium*, with the purpose to discuss perspectives on Simondon as a theoretical instrument for thinking technology, how the French philosopher matters in their work, and why there seems to be a revival in the interest in the writing of Simondon these days. On behalf of the *Sensorium journal*, the interviewer would like to thank the three interviewees for their generous participation.

**JF:** Your paper was entitled "Perception et Modulation" which refers to a course given by Simondon at the École Normale Supérieure in 1968. What was your talk about?

**GT:** It was about the concept of "abstract machines", which is crucially interesting in Simondon's thinking. It is a Deleuzian and Guattarian notion, developed from, among others, Simondon, even though he never uses the exact term; Simondon talks about abstraction and about the *technical essence*. So, what is an abstract machine? It's a set of processes that arise immanently from an assembly of matter and energy. And that's sufficient to define it.

**JF:** OK.

**GT:** We *can* define it more specifically but I would rather give you an example that has interested me in thinking about evolution: The abstract machines playing a role in the evolution of life on earth are perfect examples of what abstract machines can be. Darwin's natural selection is the most fundamental of them: If there is inheritance, and variation in that inheritance, then, in any circumstance of limited resources, advantages will accrue to certain variations and not to others. In this way, natural selection is an abstract machine at work. In defining the modes of existence in technical objects, Simondon is trying to reach exactly the question of an abstract machine. His famous example of this is the diode and the triode. Diodes and triodes are devices for electrical amplification, invented early in the 20th century. They were instrumental in the development of electronics, and were later replaced by transistors in consumer products. Simondon makes the point that an earlier invention limits the possibilities and complexity of how later innovations will play out. The triode is a wonderful example of that.

**JF:** An abstract machine almost sounds like an algorithm or an equation.

**GT:** Algorithm is a good word for it, I think.

**JF:** Is Simondon looking for something similar to what Cornelia Vismann looks for in her concept of "cultural techniques": a sort of master plan, or the sheet of rules that will then generate certain assemblages of real life phenomena?

**GT:** In my understanding of Simondon I would turn it around. Talk of master plans sounds more like Norbert Wiener and cybernetics to me. I am – or my Simondon is – not entirely happy with cybernetics, because of its top-down quality: Here are the rules, now let's see how they get realized. Simondon is saying something different: Here is a technical device, how did it come about? It came about by a putting together of certain components *such that* rules were generated, or such that the

abstract processes sprang up immanently, automatically from the pieces that were put together.

**JF:** But not independently of its environment?

**GT:** No, right. And that brings us to another abstract machine of evolution: niche construction. Organisms come up against a selective gradient, conditioned by the affordances and constraints of their environments. At the same time, as they live their lives they change these environments. There is a feedback mechanism at work: as the niche is constructed by the organism, so the organism is constructed by the niche through the selective pressure it exerts. This is exactly what Simondon addresses in his book *On the Mode of Existence of Technical Objects*, when he talks about *associated milieu*: "We can therefore affirm that the individualization of technical beings is the condition of technical progress. This individualization is made possible by the recurrence of causality". By "recurrent causality" he means feedback – the technical object creates a milieu around itself, and is at the same time shaped and conditioned by it. This is an abstract machine that is active both in the history and development of technology and in the history of life on earth.

**JF:** Right.

**GT:** The reason I singled out *Perception et Modulation* in the paper at the conference – this little treatise that Simondon never published – is because in it he likens *modulation* to *perception* – modulation being what happens in a triode, for example, and perception what happens in certain organisms. Thus he identifies an abstract machine that works analogously in the technological world and the biological world. Already in the sixties he saw something that Deleuze and Guattari in *A Thousand Plateaus* twenty years later would dwell on at great length. His approach is radical even today – when you talk to evolutionists, they struggle with this idea. The immanent processes that arise in the course of evolution – what I call abstract machines – are difficult for them to get to.

**JF:** Why is that?

**GT:** Well, partly because the abstract machines are staring them in the face. They're right at the heart of everything that they think about all the time. Many evolutionists today are opening up to, I won't say a speculative, but rather a conceptual space in order to understand the processes that ultimately arise from living organisms in an environment. This includes phenomena such as niche construction, the Darwinian algorithm of natural selection, as well as autopoiesis. Autopoiesis is fundamental to our notion of how life arose in the first place. And autopoiesis exists in the technical

world as well, according to Simondon: Machines are essentially enabling themselves to function as machines. What interests me about Simondon is the foresightfulness of his concept of "technical essences" as a locus for this enabling. It took thirty years after him before robotics experts suddenly realized that the only way to make a robot was from the bottom up. You cannot make a robot that will do anything very interesting using a top-down guidance system.

**JF:** Provide it with a "world", and then it will learn structures…

**GT:** Exactly, and Simondon was on to that already in the 1950s. I think this is decisively different from the approach of Norbert Wiener, which, in a sense, is much more "American". It resembles American corporate views, whereas Simondon was doing something very different.

**JF:** I struggle with his use of the word "essences". As an undergraduate, one learns to be cautious with such words, because they often harbor ideas of technical determination. As media scholars, should we worry about Simondon talking so much about essences or does the concept mean something else to him?

**GT:** We're suspicious of essences because they have the patina of transcendentalism, and we don't want to go there. But there is no transcendental ingredient of technical essences in Simondon, as I understand them. Essences must be thought of in a reversed way: As immanent things within arrays of materials with flows of energy running through them. Certainly, in Deleuze and Guattari's vocabulary, there's nothing transcendental about essences. They are precisely things that arise from within assemblages. Assemblages can be machines or parts of machines, and they can be the components of an ecosystem and organisms within it.

**JF:** "Conway's Game of Life" is an example of a work that expresses ideas gaining traction in the 1970s, namely an attempt of scientists to imitate natural life. It is a game developed by the mathematician John Horton Conway, with no players, based on the idea of a cellular automaton by John von Neumann and Stanislaw Ulam; a basis of life with the capacity to reproduce itself and simulate a Turing machine. Using four simple rules for what automatons can do, amazingly complex patterns can arise with no external intervention. "If we can just find the algorithm here, life is going to basically start popping up in our machines…." Do you recognize this search for a grand theory in the people you work with, today?

**GT:** Have you heard of the *Boids* project in the 1980s? Craig Reynolds was trying to model the flocking of birds and schooling of fish. He put a lot of little triangles on his computer screen and programmed them to behave according to a few simple rules

and set them in motion. The triangles started flocking just like birds. What he had discovered was *seemingly* immensely complex, rule-governed behaviors that in fact are generated absolutely from the bottom up, with a very few simple rules.

**JF:** So now we have proven that these birds and fish are really robots?

**GT:** No. This is what my newest book is about. In late hominin evolution the abstract machines of evolution we talked about are at work: niche construction, natural selection, and autopoiesis. There is a fourth one, for me: Peircean semiotic behavior, which I see extending out to a huge array of animals today, not just humans. I am not talking about *symbolic* behavior, which is arguably just a human thing, but about *semiotic* behavior more generally. This sign-making forms the basis of animal cultures, which build up when animals are capable of learning something in their lives that they can pass on to a future generation.

**JF:** Not on the gene level.

**GT:** Not on the gene level, no. Even though it can have an impact at the gene level across long stretches of time. But a songbird learns songs that are taught it by other birds. It tweaks the songs in specific ways, it does certain things with them and passes them on to the next generation. This is, to me, a clear instance of a rudimentary, but still complicated, animal culture. So for songbirds, not only their non-cultural behaviors in the environment, but their *cultures* are changing their niches. Culture enters into the niche constructive feedback.

Now, as more and more complex cultural patterns develop – and late hominins are the great example of this – you get what I call *cultural epicycles*. These are formalized patterns *within* culture that begin to stand outside the feedback cycle and influence it almost from the outside. The patterns are generated by the feedback between cultural behavior and niche, but they take on some degree of autonomy that can influence the feedback pattern *as an autonomous force*. So, what you have is no longer feedback at all: it is feedforward, because feedforward refers to a control mechanism. A cultural epicycle can come to look like a control mechanism that affects the feedback cycle of niche construction.

**JF:** Hmm...

**GT:** This is, admittedly, a tough concept – a complicated mechanism and probably one that only hominins have had cultures complex enough to show in its full impact. But I think it goes a long way toward explaining the tremendous difference between niche construction among hominins over the last three hundred thousand years, and all other species who have constructed their niches in the history of the earth as far

as we can make out. Why did human cultural development take off so very, very quickly? How did that happen? I think you need first of all the *biocultural mechanism* – culture involved in the feedback of niche construction. But you also need something more. And this something more has to do with cultural systems forming and coalescing and taking on the kind of autonomous power I signal in the notion of a cultural epicycle. Not wholly autonomous, not transcendent, because they're generated from within, but nonetheless something that operates as a cultural system.

**JF:** You seem to be saying that culture has had a more important part in biological evolution than is normally granted?

**GT:** Absolutely.

**JF:** And that semiotics plays a key role. In your article "Semiotic Epicycles and Emergent Thresholds in Human Evolution" (Glass-bead.org, 2017), you say that once you have started to use beads and bead making in a cultural meaning, you cannot go back to what they were before: "once the transformation had occurred, there was no undoing it – no revoking of the semiotic potential, no matter how many times it was not exploited." What does that mean?

**GT:** What happened in hominin evolution – and the system of bead making is an example that sprang up at a number of different times and places – is that signs, semiotic materials, were brought into an array that then formed a coherent whole, a cultural system, an epicycle that had the potential to act as a control mechanism in niche construction. It doesn't matter if there is a society that doesn't make beads. That society has still attained the semiotic capacity not only to use signs but to array them in cultural systems so that they *could* make beads. The materials of the world came to have new dimensions for late hominins, they sprouted new possibilities: semiotic, social, technological, and cultural possibilities all at once.

**JF:** But if they are not materialized, how are they retained and cultivated?

**GT:** Two ways. Number one: By a certain point in hominin evolution the burgeoning of cultural epicycles made cultural niche construction so powerful a force that it could eventually alter the genome, through feedback. And second: because of that capacity, humans were making cultural systems everywhere they went. Sixty to seventy thousand years ago, whether humans were making beads or not, they were making complex systems. And these systems were at once semiotic, technological and social. The capacity doesn't disappear, because the successful negotiation of every new niche humans came in contact with demanded the capacity.

**JF:** So, how does this relate to the romantic idea of finding a tribe that has not seen any culture, as it were, where we'll find the pure human?

**GT:** Of course you couldn't find such a tribe, even though attempts are still being made today. The reason I start from a million years ago in *A Million Years of Music* [Tomlinson, 2015], 750,000 years before *Homo sapiens* existed, is because I think I can see *technological* patterns already in place – flint knapping and stone tool making – that in their *social* existence would have required certain kinds of entrainment. And this social entrainment could have provided the foundation for the later capacity to entrain to musical meters. I think you can see signs of such beginnings a million years ago, in the social relations that are suggested by the nature of stone tool making.

**JF:** We were "toolmakers before we were human", as you say in your paper "Semiotic Epicycles and Emergent Thresholds in Human Evolution".

**GT:** Exactly.

**JF:** This is not my own field, so I have a hard time judging whether this would be a shocking idea to bring forward to the researchers in this area.

**GT:** By no means shocking to *all*, but shocking to *some* of them. My work fits into what is known as the *Extended Evolutionary Synthesis*, and it's an extension of that, focusing on late hominin evolution. But I'm also collaborating with a wonderful evolutionary biologist here at Yale, Günter Wagner,[*] who works at the intracellular level of evolution. He is interested in how certain biological features are promulgated across hundreds of millions of years with very little change: How could this happen in a free, adaptive Darwinian model? What he finds on the intracellular level are certain kinds of feedback-generated systems that come to operate as control mechanisms and that are epigenetic, not fully directed by the genome. They take on something analogous, at the biological level, to the autonomy I am talking about with the concept of "cultural epicycles". We are finding hugely interesting analogies from his micro level all the way up to the evolution of human culture.

**JF:** So you are bringing the niche concept into a cultural studies or humanities domain?

**GT:** In 2003 F. John Odling-Smee, Marcus Feldman and Kevin Laland wrote a book that is sort of the bible on niche construction. In their book, they build culture into

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their model of niche construction, but, in my view, they don't have enough of a "culturalist view" of what culture is. They try to build it into their quantitative models as coefficients in their equations. But this can only work to a certain extent – Peter J. Richerson and Robert Boyd have done very interesting work along these lines, but it can only get you so far. As a culturalist I point out the limitations of the quantitative models.

**JF:** You try to approach it from another angle?

**GT:** Yes. I'm a musicologist and a humanist, but that doesn't mean I want to dispense with quantification altogether. Still, I want evolutionary biology to recognize its limitations and to understand humanists' cultural approaches. Peirce's semiotic theory is one of these.

**JF:** When I read Simondon, it seems as though machines have an evolution of their own. Is there an evolution of machines that is separate from cultural or biological evolution?

**GT:** Here we are at the matrix, right? The adaptability of the machine is one of the less defined aspects in his book on technical objects. I can see why Simondon neglected to publish his little treatise, *Perception et Modulation*. It's an attempt, an experiment, and it falters because it pushes too hard at the analogies between modulation in a machine or technical object and perception in an organism. You can push that analogy only so far. Are there cultures of machines? Are there lineages of machines in the same way there are lineages of organisms?

**JF:** He seems to say that machines can "liberate" themselves from humans to find their balance.

**GT:** There are very interesting possibilities there.

**JF:** Almost like an AI philosophy.

**GT:** I think in this day and age it's hard *not* to read Simondon that way. But my sense is that his work in the 1950s and 1960s was more a critique of the culture around him than a visionary AI notion.

**JF:** His book *On the Mode of Existence of Technical Objects* came out in 1958, four years after Heidegger's and Ellul's work on technology.

**GT:** I don't know whether Simondon was responding explicitly to Heidegger, but certainly his view is opposed to Heidegger's. We've all studied Heidegger's important, but romantically poetic essay "The Question Concerning Technology". In 1958, Simondon is maybe not so much looking at Heidegger as at Sputnik. Looking around at a world that is overwhelmed by technology. I think he is just

trying to make sense of what it means that technology is such a central aspect of human life. How do we bring it into philosophy? How independent are these processes from living processes?

But then, of course, you cannot escape the fact that technology is the invention of animals – and, as Simondon saw it, the invention of humans in particular. His thoughts on technology fold back into a critique of human culture and what culture is making of these things. There *is* something visionary about Simondon, which is why so many of us are thinking about him today. There's something speaking to us much more directly in his philosophy of technology than in Heidegger's.

**JF:** There is still a bit influence of Heidegger in Simondon.

**GT:** The two big German influences on the critique of technology – Heidegger and Benjamin before him – are compelling and famous, but Simondon is doing something decisively different. Reading Deleuze and Guattari's *A Thousand Plateaus* you see that Simondon's notion of abstract machines can be generalized – not always responsibly: *A Thousand Plateaus* is a wild book in many ways – to extend to every array of materials with energy coursing through it. There is something hugely interesting about the power of that generalization. Interesting also because it's not a transcendental move, it is immanent. For the real forebears of that kind of thinking you don't look back to the Frankfurt school and Benjamin. You look back to someone like Whitehead and his *processual ontologies*. That notion of ontology as process is, after all, hugely influential.

**JF:** Parts of Simondon's writing seem to express an aesthetics of the machine. It goes beyond fascination – as if he wants to defend the beauty of machines. Is there a notion of beauty in these abstract machines?

**GT:** One of my colleagues, the evolutionary biologist Richard Prum,[*] devotes himself to the understanding of the evolution of beauty. For me, beauty is a problematic, deeply culturally circumscribed word. That doesn't mean I don't find beauty in the world. I am overwhelmed when I sit down and play a certain Beethoven movement at the piano. When I read with my undergraduates *On the Origin of Species* (1859), the conceptual beauty of Darwin's algorithm is likewise overwhelming to me – the brilliant turns of mind and speculation that enabled him to see natural selection. All of us savor beauty where we find it. For Alexander Baumgarten in the 1720s and 1730s, aesthetics was an *embodied* kind of knowledge, not a transcendent,

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romantic thing. It was precisely opposed to spiritual and "ensouled" knowledge. Exactly what is so wonderful about Simondon and about evolutionary models going all the way back to Darwin is that they are about complex systems generating something – whatever we want to call it – call it a soul if you want to – that is always embodied, always in an *associated milieu*, to use the term that Simondon uses about his technical objects. And it's that array of things that generates, from the bottom up, all these capacities, all these powers, all these systems, all these cultures.

**JF:** All this complexity?

**GT:** That's the best word: all this complexity. So, what's beautiful is the notion that from simple beginnings and relationships of components, and a few simple algorithms, all the complexity in the world is generated, whether technological, physical or biological. It's staggeringly beautiful to stand back and be able to contemplate that! The last paragraph of *On the Origin of Species* – the famous "entangled bank" – encapsulates that kind of contemplation. There is something deeply beautiful in that.