"HE WAS NEVER ONLY WHAT HE SEEMED TO BE"[1]

Solomon MARCUS

Introduction

Mihai Nadin's career path is testimony to his multi-faceted activity: it covers electronics and computer science, logic, philosophy, aesthetics, semiotics, computational design, and, to top it all, the study of anticipatory systems. This is yet another knowledge domain which he initiated - in this case, years back, when he was still studying at the Polytechnic Institute in Bucharest. He defines anticipation as a cross-disciplinary perspective of the living (contrasted to the non-living). Previously, the distinction was between the animate and inanimate, but Nadin's distinction - more on this later in the text - is better defined.

Nadin is one of those great "madmen" of our time, according to no one other than Grigore Moisil, who pursued the path of the continuum from philosophy to engineering. Contrary to how science is practiced in our time, the "madmen" - John Conway was one, Claude Shannon another, Turing - defy fixed disciplinary boundaries. For them, there are only great paradigms; no center, rather the jagged periphery where the important questions are asked. Indeed, Nadin's accomplishments cannot be forced into the cubbyholes of specialized knowledge. His activity is by excellence trans-disciplinary - both in academic teaching and in research.

Mihai Nadin is part of a paradigm that I call the Moisil paradigm. Our impressive Grigore Moisil wrote in an article (*From Philosophy to Engineering and Back*) that the "fundamental change which appeared in pure mathematics in the first half of our century was the transition from the mathematics of quantity to the mathematics of structure." During the same time, Lotfi Zadeh was referring to the mathematics of quality, of approximations. Nadin was one of those who made this change happen. Both Moisil and Zadeh were aware of his work. Moisil also stated that that culture proceeds on a continuum that runs through every possible itinerary between philosophy (more broadly, the humanities) and engineering, by which he understood also the sciences. Of course, Moisil himself was the epitome of this paradigm. In our days, it is Mihai Nadin who deserves this recognition.

As we know, he started his career with a degree in Engineering and Computer Science at the Polytechnic; some years later, he earned his doctoral degree in Philosophy (with Ion Ianosi, but also with Boboc and Enescu - given his interest in logic), concentrating on Aesthetics - the logic of the senses, as he practices it in the spirit in which Baumgarten defined the subject. I knew since the time he applied to the Polytechnic that creativity was his focus. He asked me where to pursue his interests, and my advice was to seek a solid foundation in science, but also in technology. Some years later, he earned the highest degree that the German university system can award - the highly respected *Habilitierung* - in Philosophy, Logic and the Theory of Science at the Ludwig Maximilian University in Munich. His *Habilitierungsschrift* was on the foundation of a value theory - bringing together category theory, semiotics, and Gödel's decidability. Ever since, he has proceeded along the same path, branching out, overcoming barriers, overcoming animosity, transcending disciplines—while finding connections among all of them and building a network of exceptional intellectuals who were captivated by what he was doing. It was Umberto Eco who admired his first major book (*The Civilization of Illiteracy*). It was also Zadeh who recognized Nadin's work in fuzzy category theory applied to semiotics (analyzing Brancusi's work, but also Shakespeare's *Hamlet*),

[1] This paperwritten by the late Academician Solomon Marcus was prepared in 2015, when Professor Nadin visited Romania and presented in Bucharest, at the Faculty of Mathematics of the University of Bucharest, the translation into Romanian of his *Civilization of Illiteracy* (1997).

and it was George Klir, so active in possibility theory. Let me add Joseph Goguen, a brilliant mathematician who wanted to re-establish semiotics in information science. He was captivated by Nadin's work on the "semiotic engine." I would add to this virtual network the renowned Max Bense, and many of Bense's students: Frieder Nake, Siegfried Maser (active in information aesthetics), Helmut Franke, Georg Nees, among others.

Along the line of what I call the Moisil's paradigm, Claude Shannon made the jump from philosophy to engineering (at the end of the 1930s), arguing that that philosophy and engineering are very closely connected. Nadin discovered Shannon's love for games - bringing the father of "information theory" into a present that Nadin himself is experiencing at his University, where games are a major program of interest to mathematicians, computer scientists, brain researchers, designers, artists, and social scientists. In a way, Turing is also close to this Moisil paradigm: he came from mathematics and ended up discovering not only the most ubiquitous machine of our time, but also very interesting phenomena pertinent to intelligence and to biology. It is no accident that Nadin celebrates Turing's algorithmic computing while also pointing out its limits. In "Can predictive computation reach the level of anticipatory computation?" Nadin reminds us that Turing himself introduced other forms of computation. His knowledge comes from having studied what experts throughout history have passed on to science, often reading them in their original language (from ancient Greek and Latin to German, Russian, and French). More important: he worked with what they left behind, and accumulated practical experiences driven by a curiosity not matched by anyone else I know. His focus on Leibniz is by no means accidental.

Against this illustrious background we can ask: What is so interesting about Nadin? He starts out with one thing - control systems, at the Polytechnic - giving the impression that he is dealing with a problem considered purely speculative: Can control of a process can be driven by a future state? Then he makes reference to something apparently unrelated: What does Aristotle mean when he writes: *If every instrument could accomplish its own work, obeying or anticipating the will of others, and further, if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide it?* What is the invisible hand that replaces the hands of those playing the instrument? Of course, I am simplifying, but the machine he built for his dissertation was only a pretext for asking questions well beyond those of engineering electronic circuits or controlling a complicated industrial process.

Nadin maintains that he is above all a thinker. Once he has thought out a problem - the hard part - he hopes that others find applications - what he calls "the easy part." This is what he did when generating images on a computer (Bucharest, in the 1960s); when conceiving interfaces (semiotics applied to designing languages of interaction between users and machines, for Apple Computer); when inventing *Arketek*, that turned playing with wooden blocks (theorized by Friedrich Froebel, the great mathematician) and Legos into an interactive learning environment; when writing an AI program for computational design (his Design Machine). He elaborated the AnticipationScope, with which he can evaluate the anticipation performance of human subjects of all ages - trying to transcend Heisenberg's uncertainty principle. This led to creating a behavior-driven game (Amazing Grace) for helping those aging maintain their anticipatory capabilities (Project Seneldudens). His work gained international attention at the Games for Health conference (Baltimore, Maryland, 2006) when the French news agency reported on it - over 100,000 clicks to the Agence France Presse reporting on his work presented at the conference.

Nadin has published about these aspects of his work in transdisciplinary journals (just look at his list of publications on Google Scholar). For example, the *International Journals of General Systems*, which covers a broad spectrum of the sciences, but also in *Artificial Intelligence and Society,* in *Poetics,* in *Semiosis,* in the *International Journal of Applied Research on Information*

Technology and Computing, as well as many other peer-reviewed journals covering aesthetics, computer science, human-computer interaction, design, semiotics society and many others.

At the very beginning of Nadin's scientific and cultural activity, he produced works that seemed to strictly pertain to engineering or to science (he got a prize for a paper on Schrödinger's work in quantum mechanics from the University in Bucharest). His early attempt to use a computer to create art (image and sound) - an activity that qualifies him as a pioneer in computer graphics and computer art - was made possible by Moisil (after I explained to him what I thought Nadin wanted to do). Moisil liked the computer graphics output and showed it to many who were asking why we need such powerful machines in Romania. (It was the IBM machine that Moisil acquired for the University's Computer Center.) Strongly dedicated to questions related to creativity, Nadin wanted to know if a machine can create art. This led him to the philosophy of art, that is, aesthetics (although, as I said, his definition is different: the logic of senses, close to Baumgarten's definition in his book *Aesthetica*, 1750). In particular, Nadin contributed over the years to informational aesthetics - an attempt to quantify aesthetic characteristics - and to the semiotic aspects of creativity. Like Moisil and Shannon, and like Conway, and also like Max Bense (with whom he worked, challenging the outspoken professor from Stuttgart as no one else dared), he believed that science and art are connected, although each viewed this connection in his own way.

Nadin is concerned about the rebellion against classical logic because he argues in favor of foundations. He himself is dedicated to fuzzy logic and possibility theory, trying to add to the foundational work of the mid 1960s. It is quite confusing, he claims, to see how one form of logic expression - Boolean logic embodied in computers - rejects all the others without really offering a satisfactory alternative to phenomena where, between black and white, there is a lot of grey, i.e. incertitude. Much new work in computation is created continuously. But we don't take time to see beyond each new machine and each new hypothesis. Human beings are challenged by how to transcend our natural limitations. This is how non-Euclidean geometry, relativity theory, modern art, among others, came about, until they all came together. And all this fascinates Mihai Nadin. He is also worried by the fragmented knowledge - experts from various domains who cannot understand each other. This is what his book *The Civilization of Illiteracy* discusses in detail.

When I met Nadin - the humanities brought us together - I think he was trying to hide his engineering side. I suggested that he study at the Polytechnic, where I was beginning my own activity as an assistant professor. At that time, he was publishing books on the arts - *To Live Art*, among others - and that's what led us to become acquainted because I was jealous of his knowledge of the arts. Nobody I had known at the time visited more art galleries and museums, concert halls, and theatre performances than he did. Nobody reads more than he - and I am quite well known for my reading appetite.

To keep my account of Nadin's work as close as possible to his contributions, I shall now focus on the various domains in which he worked and continues to work. (Since his book on *Anticipation and Medicine* just came out, I will not refer to his new inquiries into medicine - but I was quite fascinated to learn how passionate he is about the subject, maintaining that if anticipation should succeed, it will have to be tested and accepted in medicine.)

Semiotics

To a great extent, Nadin is a semiotician par excellence and claims that semiotics is fundamental science. He was strongly influenced by the writings of Charles Sanders Peirce - whom he cites more often than he does Plato (but probably less than Aristotle or Leibniz). He wrote about Peirce's "logic of vagueness" in a study that is a reference for everyone interested in Peirce - the greatest intellectual of America (as Bertrand Russell famously stated). Nadin's article, "The logic of vagueness and the category of synechism" reveals not only the influence that Peirce exercised on him but also his own original thinking. In this article, he combines his education in engineering, aesthetics, semiotics, logic, and computer science as he delves into early manifestations of artificial intelligence - a discipline to which he contributed over the years. Logic is yet another aspect of

Nadin's transdisciplinarity. His strong ties to Lotfi Zadeh date back to 1973, when he wrote "Sign and fuzzy automata," which dealt with a new type of logic that Moisil insisted upon in his later years.

"Interface Design: A Semiotic Paradigm" (1988), is listed as one of his most significant works, together with "Interface Design and Evaluation." Nadin again reappears as engineer, computer scientist, and aesthetician in "Visual semiosis applied to computer graphics." "Emergent aesthetics: Aesthetic issues in computer art" appeared *Leonardo,* an international journal that cultivates the relation between the arts and science, taking Leonardo da Vinci as its inspiration. The journal recently celebrated Nadin as a pioneer of computer art - and I am glad he brought a copy of the article "Foresight and Hindsight" with him to Bucharest.

He made an interesting detour into exploring marketing, an important pragmatic semiotic activity that relates to economics and engineering. With this in mind, he and Richard Zakia, his colleague form the Rochester Institute of Technology, wrote the article "Visual A(E)ducation," followed by the book *Creating Effective Advertising Using Semiotics* (which was translated into several languages).

When the international journal *Semiotica* wanted to devote a special issue to the semiotics of the visual, Nadin was asked to be editor. His article, "On the meaning of the visual," established him as the pioneer and leader in the semiotics of the visual. At a time when semiotics tended more towards semiology, Nadin referred to Peirce's foundations for semiotics and the triadic nature of signs. "Consistency, Completeness, and the Meaning of Sign Theories" has a Gödelian ring to it, since it applies Gödel's theorem to sign systems, and sign processes. Again, Nadin connected paradigms that seem to go in different directions. When I edited three special issues of *Poetics* about the relationship between theatre and mathematics, I found Nadin to be an essential contributor (see Bibliography).

Computational Design

It seems natural: computation was and remained Nadin's continuous preoccupation. He started with it as a student and programmed at a time when access to computers was not possible. Machine language programming is tedious, because it pertains to the lowest level where you deal with the physical phenomena and with the logical gates. That is where he learned, on his own, how to transform numbers into images. Design became an area of interest since the output of engineering is design. That is what engineers do. Of course, he went into more areas of design: industrial design or product design as it was called. But this was the consequence of his interest in aesthetics. In March 1970 - many years ago! - I read in a paper about his work in this domain. He taught Industrial Aesthetics (what today is called "Product Design") to 300 students eager to work with him. Today Mihai Nadin is recognized as the founder of a new domain of extraordinary importance: Computational Design. I see how Industrial Aesthetics, which is design, led to its computational expression. His chair in Computational Design at the University of Wuppertal, in Germany, was established officially in 1994. I visited in 1996 - and my impressions are still vivid. At the entry to his office was one quarter of the Thinking Machine that Hillis conceived - the most powerful parallel computing machine at that time. High performance computers allowed him and his students to dream up things that 20 years later became the cellular phone and the iPad. It was quite telling that the cover to his book *The Civilization of Illiteracy* features what the Internet was to become: a global network, where the digital library was at your fingertips. The image represents the iPad before Apple even had the thought of it. Graduates from Nadin's program became well known for contributions in the area of ubiquitous computation and mobile computing. His article, "The Computer as Semiotic Machine," remains a title of reference. During that time he also organized,

together with Frieder Nake and Peter Bogh-Anderson the Dagstuhl Conference on Information Science and Semiotics, where I was delighted to make a contribution.

Civilization of Illiteracy

The oxymoron that makes the title of the book is symptomatic of our time. We are living the triumph of the oxymoron, in which opposing ideas destroy each other. Illiteracy, associated with a lack of civilization, against the background of spectacular progress in technology becomes symptomatic of the new civilization. This is the world today - probably more in America, but no place on earth is spared the change. The expectation of efficiency and the associated expectation of everything at the lowest price (including the cognitive effort) make us all the authors of this civilization - reflected in the ways we communicate, what and how we eat, how we dress, family and sexuality, design and create art. Education is of extreme importance to Nadin - and to us all. That is why he suggests ways for education to develop the talents of each individual.

Nadin maintains that what he affirms in *The Civilization of Illiteracy* has a grounding in mathematics. First argument: this is a systems view, i.e., it goes back to system theory. Second argument: it is based on mathematical descriptions of the dynamics of our time. For example: Nadin claims in the book that we produce in one minute more information that was ever produced in all of human history. What is so frightening about this informational inflation, which will only become greater and greater, is that we believe we can master the increasing amount of information. The obsession with big data - more and more data - is met by Nadin with a call to look at *meaning*. If we don't, he warns, we will become slaves to digital technology. That we are manipulated by information is in the meanwhile evident. Nadin attempts to find a path through the labyrinth of digital technology, a path that the majority of those involved with it cannot make out. He is very optimistic about new opportunities, but also vigilant concerning dangers. I read Nadin's almost 1000 pages, trying to discover factual errors. I found less than ten, which is nothing in comparison with all the original ideas he sets forth in an almost a cascade. His book is yet another proof of why the world needs "madmen" to shake us up and go against the flow. "Only dead fish go with the flow" is one of Nadin's favorite sayings, quite often repeated even by those who do go with the flow.

Anticipation

Anticipation is a paradigm rooted in the past, Aristotle is the source Nadin mentions. It was given new attention in the 20th century when Nadin (in *Mind - Anticipation and Chaos*) and Rosen (*Anticipatory Systems*) brought them up. Nadin has given this paradigm much attention for the past 25 years. He often cites the work of Robert Rosen, who developed his theory of anticipatory systems in the 1980s within the framework of mathematical biology. Nadin, who started with it when he was finishing his studies at the Polytechnic, has developed the notion even further and is recognized as a leading authority. Therefore he was invited to write the "Prolegomena" to the second edition of Rosen's *Anticipatory Systems*. Several articles appear in the *International Journal of General Systems*; he also edited a special issue on anticipation, *Anticipation and Dynamics: Rosen's anticipation in the perspective of time*. Anticipation is the capability found in all the living, not just human beings, of projecting themselves, through innate functions, into possible future situations. His 1991 book, *Mind - Anticipation and Chaos*, shows Nadin's tendency towards the nonlinear, and the acknowledgment of the non-deterministic. If you scrutinize his most important works, you will find a certain circularity. His book *Anticipation - The End Is Where We Start From* (2003) exemplifies this tendency. By no accident, he went on to develop the notion of anticipatory computing - following Feynman's suggestion that it will have to be performed in the medium in which it is embodied (in this case, in the living itself).

Nadin took note that anticipation is expressed in action and that aging (humans, animals, plants) leads to a progressive loss in anticipation. His research of aging from the perspective of

anticipation (*Project Seneludens*, 2004) was yet another pioneering effort. Today, many follow the path he forged (sometimes ignoring the results he shared with scientific community). Dedicated to the scientific foundation of anticipation, he organized the Study Group *Anticipation Across Disciplines* at the prestigious Hanse Institute for Advanced Study. Three international conferences set the foundation for interaction among major scientists from all over the world: *Early Soviet/Russian contributions to a science of anticipation* (2014); *Anticipation Across Disciplines* (2014); *Anticipation and Medicine* (2015), As you notice, medicine was the culminating conference - with contributions that will affect the future of medicine.

What next? He does not seem to tire in his passion for research and his creative output stays testimony to it.

Conclusion

My experience with "madmen" is very intense. Here is one reason why: I am one of the members of the Romanian section of the Club of Rome. I attempted to engage the members in a discussion on anticipation because it seemed to me that there is a very natural connection between anticipation and prediction. The first reaction was negative: my colleagues still think that anticipation is the same thing as prediction. They did not care for anticipation because it implies several possible directions and outcomes. But that is what "madmen" are after - not fitting in a paradigm, rather disrupting it.

I could go on about Mihai Nadin. He maintains that we are living in a time of increasing complexity (what he calls "G-complexity"), in social life, science, culture, never before experienced. One the one hand, the internet and globality have greatly increased our capacity to master information; on the other hand, our ability to recognize ever-increasing complexity is not sufficient. We are either masters or slaves of information. Complexity is a key word describing Nadin's own activity. His work is a call to be aware all aspects of our time and of the future.

Here is a Bibliography of works mentioned in my report (in chronological order). For a complete list of his works and activity, consult the websites www.nadin.ws, and www.anteinstitue.org

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Grigore C. Moisil pioneered the application of mathematical logic to computer science.
Some of his books had a great impact on the beginning of computer science development:
1953 New and Old Approaches in Neoclassic Logic
1959 Algebraic Theory of Automata
1961 Transistorized Circuits

Kurt Friedrich Gödel: mathematician, philosopher, logician (considered one of the most significant logicians in history.
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