

History of Economic Thought

Prof. Roger E. Backhouse

Philip Mirowski's *Machine Dreams*

João Oliveira Correia da Silva

Machine Dreams: Economics becomes a Cyborg Science,
by Philip Mirowski.
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In the 20th century, economics went through a deep process of transformation. The comparison of the panorama of economic science before the Great Depression with that which prevails during the period of the *cold war* shows numerous fundamental and elucidating differences. The verbalising of ideas, and the concept of rigorous reasoning as robustly founded on reality, gave way to abstract modelling and to a concept of rigorous reasoning as logically and irrefutably derived from given assumptions. While in the 1920s, neoclassicism,¹ classicism, institutionalism, and other independent views co-existed, after the 1950s, we observe the dominance of neoclassical orthodoxy. Other important and instrumental changes took place: the European supremacy was overthrown by the rise of American economics; and vast masses of data became available, originating a quantification movement towards the development of econometrics and national accounting. All these evolutions seemingly occurred in an interdependent way. And we should not underestimate the importance of the several landmark theories and of the outstanding figures that revolutionized the economic thought in the 20th century. But how does this all ties up together?

This profound transformation can be seen as a paradigmatic shift, a Kuhnian revolution in economic thought and science. A paradigmatic shift implies that conceptions that make sense in one of the systems of thought may be meaningless in the other. Some even hold that to be able to understand the new ideas, one must unlearn the old conceptual scheme and adopt that of the emerging paradigm. It may be true that an empty mind, the *uncarved block*, favours the sympathetic understanding of reality, as was stressed by the ancient oriental sages, as well as by the modern psychologists.² But one thing is to keep an open and flexible mind, and quite another is the need to reformat one's referential of thought. Valuable knowledge is lost in this latter process, and the mind remains *stuck*, only in a paradigm that is synchronised with the modern society. This need for lost knowledge and *mind formatting* is not forceful, as the capacity to hold and use different conceptual schemes at the same time should not be

¹ This early neoclassicism was itself pluralist, as there were important differences between the theories of Fisher, Shultz, Hotelling and Bates Clark. The co-existing doctrines were themselves *fuzzy*, that is, far from perfectly defined.

² Try answering some simple questions: Do you have a fridge? What colour is it? What do cows drink?

excluded *a priori*. It actually should be identified with intelligence.³ To understand the *new reality*, one doesn't need to forget the old paradigms. The different perspectives may actually overlap, and provide richer insights.⁴ Understanding the inspirations, essence and implications of the different paradigms can be, thus, quite enlightening. In this context, "*Machine Dreams*" can be quite valuable to the understanding of what may be called the *cybernetic paradigm*.

Philip Mirowski's "*Machine Dreams*" combines the history of the economic thought in the 20th century with a war story. In economic thought, a revolution takes place, bluntly described in the book's subtitle: "*Economics becomes a cyborg science*". In parallel, a war story takes place: the *cold war*. What else do you need to get interested? Well, there's John von Neumann starring as a super-genius. And what is at stake is nothing less than the future of economics and even of mankind. Philip Mirowski puts together these ingredients – the revolution, the war, the genius and the emerging society – in a quite creative and cinematographic fashion, with plenty of metaphors and witty remarks. It is unquestionable that writing this book required the gathering of an amazing collection of facts, a thorough understanding of the paths of the main figures, and of the relations between the scientific and military institutions in which research took place. Besides all that, Philip Mirowski also demonstrates how knowledgeable he is about the history of the natural sciences, about general equilibrium and game theory, and even about linguistics and cybernetics.⁵ As well as an important source for the history of economic thought in the 20th century, "*Machine Dreams*" is relevant for the history of the natural sciences (specially in what relates to thermodynamics) and for the history of the computer and cybernetics.

Underlying this merge of the history of the science with the social history is the idea that science and society evolve jointly, with interactive mutual transformations. Philip Mirowski is averse to what he perceives as the social transformation that could arise out of the *cyborg* sciences. The clues to this vision are scattered throughout the book, like the references to Stanley Kubrick's nuclear catastrophe in "*Dr. Strangelove*"⁶ and the futuristic vision of "*2001 – A Space*

³ The word "*intelligent*" joins the latin "*legere*", which means pick up, gather and the prefix "*inter*". Its etymology identifies it with the gathering of insights from many sources.

⁴ A good metaphor lies in seeing phenomena in colour or in one-dimensional black and white. Overlapping red, blue and green lens provides a colourful (richer) picture of reality. The beauty of some black and white photographs and movies is not questioned.

⁵ Cybernetics – "*The science of communications and automatic control systems in both machines and living things.*" (The Concise Oxford Dictionary).

⁶ In this movie, "*Dr. Strangelove, or How I learned to stop worrying and love the bomb*", an American military commander manages to bypass his hierarchic

Odyssey”, to “*Dilbert*”,⁷ and to Aldous Huxley’s absolutely controlled society of the “*Brave New World*”.⁸ The crux of the argument is that, under the guidance of the military, economics underwent a paradigmatic shift, becoming a *cyborg* science. This is illustrated by the substitution of the old chant of “*economic as the study of the optimal allocation of scarce resources to given ends*” by a new paradigm: “*the economic agent as a processor of information*”. In the context of the new paradigm, the economist’s archetypal image of natural order is still a machine, but now a computer, instead of a steam engine. Philip Mirowski sustains his argument with a thorough account of the links between the military and the economic research during the cold war, and by keeping as an underlying idea that the military inspiration and imperative is the foursome of “*command, control, communication and information*”. Having invaded economic science, there is a risk that this military mantra diffuses to social life in general (not necessarily posing a threat to our freedom).⁹

The dangerous world of the *cold war*, under permanent nuclear threat, reinforced the military obsession for “*command, control, communications and information*”.¹⁰ Having a dominant role in American society, the military sought to manage scientific research, an intention that was more than natural. After the decisive impact of Operations Research, the radar and the nuclear bomb on the outcome

superiors and launch a nuclear strike against the Soviet Union. The result is the nuclear destruction of the planet (Kubrick previously shot a more burlesque ending, with the men in the pentagon fighting each other with cream tarts). John von Neumann, who advocated a pre-emptive nuclear strike against the Soviet Union, was one of Kubrick’s inspirations for the character of “*Dr. Strangelove*”.

⁷ In the Scott Adams’ cartoon, “*Dilbert*” is an engineer surrounded by incompetence in a technocratically managed firm in which workers are promoted to places where they can make the least damages.

⁸ Aldous Huxley’s “*Brave New World*” is about a futuristic society of control and conditioning of individuals, in which stability is praised as the highest value.

⁹ On the one hand, Philip Mirowski gives us a taste of what he means by machine dreams:

“[...] whatever would greet the dreamer awakening to a new dawn of communications, control, and information, where the Mark of Gain was inscribed on every forehead?” (p. 310).

On the other hand, causes and effects are far from being linear - remember the “*unintended consequences*” of Smith, Menger and Hayek”, and also the “*intended but unrealised effects*” that Hirschman alluded to. Philip Mirowski is aware of this complexity in his narrative:

“It does not follow, for instance, that economics at Cowles harbored inherently sinister connotations; nor does it follow that the C³I orientation that informs so much of modern economics is unavoidably inimicable to the freedom of citizens of a democratic society.” (p. 562).

¹⁰ At the turn of the millennium, the worldwide problem of terrorism is in a way taking the place of the nuclear threat that dominated the cold war. The recent September 2001 catastrophe thus endows “*Machine Dreams*” with greater contemporaneous interest.

of World War II, scientific development was irrefutably an important dimension of the military strength. Moreover, the underdeveloped scientific institutions were easy preys for the army's vast budgets. "*Machine dreams*" narrates this incursion of the military in scientific research, as well as the close ties of the three institutions that shaped modern economics (Cowles, MIT and Chicago) with the military. Philip Mirowski convincingly leads us to perceive the military as responsible for the reorganization of scientific institutions in America, and in particular for the design of the research program in economics. In short, his thesis is that the focus of scientific research moved to the *cyborg*¹¹ sciences, which *drafted* the economists into them, and remade the economic orthodoxy in their own image.

One of the major scientific developments in the *cold war* era was the emergence of cybernetics,¹² portrayed as the study of control and communications in animals and machines.¹³ This (then) awkward blending of humans and computers in the same field of study is the fundamental characteristic of cybernetics, which blends the Natural and the Social, as well as the Human and the Artificial. Cybernetics may be seen, then, as a kind of theory of the new information paradigm, only falling short of a Theory of Everything because of the difficulty (or impossibility) of conceiving the world as consisting only of information. In turn, the *cyborg* sciences can be seen as the applied branches of cybernetics. Philip Mirowski stresses the role of the computer and the (potentially) intelligent machines as both inspiration and tool of the *cyborg* sciences, and that a defining characteristic of the *cyborg* sciences is the close relation of its inspiration with the military imperative of "*command, control, communications and information*".

The major *cyborg* of "*Machine Dreams*" is the demigod mathematician John von Neumann. Having made a small but fertile detour into economics, he is known in the profession mainly for the "*Theory of Games and Economic Behaviour*", written in collaboration with Oskar Morgenstern, and for the axiomatization of utility theory. Philip Mirowski places him as the greatest genius of the time, praising his many contributions to mathematics, quantum mechanics, linear programming, statistics and cybernetics, as well as his 1932 linear

¹¹ Abbreviation for cybernetic organism: a hybrid of human and machine. The Merriam-Webster dictionary defines *cyborg* simply as "*a bionic human*", where "*bionic*" is defined as: "*having normal biologic capability enhanced by or as if by electronic or electromechanical devices*".

¹² This is the title of Norbert Wiener's (1947) founding work "*Cybernetics – control and communication in the animal and the machine*."

¹³ The words of a Portuguese musician probably undermine this pretension of the information sciences: "*What one expresses with music could not possibly be expressed with colours, and certainly not with words.*" Can we add: "... *certainly not with bits.*"?

expanding economy, a precursor of the general equilibrium model of Arrow and Debreu.¹⁴ Besides portraying von Neumann as a central figure in scientific research, Philip Mirowski stresses also his links to the military and his role in the design and organization of the research, making a case for von Neumann as the most important figure in 20th century economics. He is the prime responsible for the promotion of economics as a *cyborg* science, having envisioned economics as shifting from a past emphasis on “*motion, force, energy and power*” to a future emphasis on “*communication, organization, programming and control*”. Von Neumann dedicated the last years of his life to the creation of the “*Theory of Automata*”¹⁵. But this commitment to the study of the *thinking* of machines was accompanied by a belief in the inscrutability of the human brain, and in the relevance of social norms and values. This is reflected in his *stable set* solution concept for games, as well as in his rejection of the Nash equilibrium concept, which he thought of trivial yet inadequate. Having convincingly built the authority of John von Neumann unambiguously above that of Arrow, Debreu and Nash, Philip Mirowski then exploits it to support his attack on the neoclassical research program.

The formalist research program in mathematics, designed by David Hilbert, was based on the search for an axiomatic system of the theory of numbers that was both complete and consistent.¹⁶ In 1931, Kurt Gödel proved that this was a fruitless quest. There wasn’t any complete, consistent axiomatic system for the theory of numbers. This legendary result had a great impact on von Neumann’s thought, which shifted from a Hilbertian perspective towards a focus on the firm grounding of assumptions on reality. The general confidence in science was not shaken,¹⁷ and now that more than seventy years have passed, it is still an open question whether this result will undermine the formalist program in economics, or just end up as a mathematical curiosity. The struggle between neoclassicals and *cyborgs* in “*Machine Dreams*” is pretty much related to these divergent paradigms. Philip

¹⁴ Roy Weintraub places von Neumann’s 1932 article as the single most important article in 20th century economics.

¹⁵ Automaton (Oxford English Dictionary): “1. *Something which has the power of spontaneous motion or self-movement.* 2. *A living being viewed materially.* 4. *A living being whose actions are purely involuntary or mechanical.*”

Subject of the theory of automata: “[...] *any information-processing mechanism that exhibited self-regulation in interaction with the environment, and therefore resembled the structure and operations of a computer.*”

¹⁶ A complete system is one in which all true propositions can be derived. If it is possible to derive a false proposition, then the system is not consistent.

¹⁷ One of the critical questions in the development of the nuclear bomb was if it would cause an uncontrolled chain reaction. It was von Neumann that suggested the use of Monte Carlo simulations. In this instance, life on Earth was risked on the base of a statistical test. This illustrates the reach of the faith in science at the time.

Mirowski describes the neoclassical preconceptions as based on: classical, reversible and time-invariant mechanics; formal logic and perfect rationality; and on optimality and equilibrium. On the other side are the *cyborgs*, which focus on: friction and dissipation; information, probability and calculation; complexity, diversity and biology; and on heuristic rules conflating human mind and computer. Philip Mirowski sides with von Neumann and the *cyborgs* in this major philosophical struggle, but with reserves. He is avert to the blending of mind and computer, and shares with von Neumann the scepticism about the possibility of knowing the human mind.

Philip Mirowski holds that the neoclassicals “*didn’t see it coming*”, and actually welcomed the *cyborgs*. Facing the equivalence between the planned and the competitive solution to the economic problem, it was Hayek’s impulse to refute the market socialists that led him to move the focus of economics from the static allocation of resources to the processing of information.¹⁸ The superiority of the market was proclaimed, thus, on the basis of its ability to process the disperse information in a dynamic way, whereas planning required centralising all the required information. This was a perspective of the market that the Walrasian general equilibrium framework could not illuminate. “*Machine Dreams*” shows the entangled Cowles and RAND seeking to incorporate this critique without hurting their cherished Walrasian model, and how this was worked out through the portray of the *homo economicus* as a betting algorithm, and of cognition as intuitive statistics, together with the idea of rational expectations. In the context of political confrontation, Philip Mirowski gives us also an interesting account of the tension between *laissez-faire* and planning. Market socialists at Cowles had in common with the *cyborgs* a like for planning and control, and despite the obsessive hunt of the communists and of any sort of planning ideas in the fifties, the military remained a safe haven for them.¹⁹ One of their landmarks, predictably misrepresented, was Arrow’s impossibility theorem, asserting the inferiority of majority voting relatively to the welfare optima identified by the computer.

Philip Mirowski’s main critic to the neoclassical research program is related to the description of the economic agent. He questions the ethical emptiness of game theory’s basic creed of strategic maximizing behaviour,²⁰ yet overlooks the fundamental problem of the

18 “*The economic problem of society is thus not merely a problem of how to allocate ‘given’ resources [...] it is a problem of the utilization of knowledge which is not given to anyone in its totality.*” (Hayek, 1948, pp. 77-78 - quoted in p. 237).

19 “*The establishment of control was the essential percept in a nuclear world: passive resignation would never suffice; laissez-faire was out of the question.*” (p. 313).

20 “*For once rationality is irrevocably augmented by strategic considerations: what spirit could possibly move us to trust anything which the Strategically Rational Man says?*” (p. 319).

impossibility to provide a complete representation of reality as a game.²¹ Furthermore, he fiercely attacks Nash's equilibrium concept, on the grounds that it is based on assumptions of perfect knowledge, uncooperativeness²² and absence of communication.²³ These insufficiencies, together with the general uncomputability of the Nash solution, turn it incompatible with the vision of the *cyborgs*. Furthermore, Philip Mirowski's one-way critic caricatures the Nash player as a paranoid²⁴ with an innate inability to deceive,²⁵ and gives the final blow to the Nash player by reminding Lewis computability critique papers and the "*no-trade theorems*" that suggest market failure in the case of asymmetric information. Throughout this argument, Philip Mirowski is in no way an impartial narrator, actually posing a ferocious attack on game theory and general equilibrium. Despite being a valuable critic for the knowledgeable reader, this exercise is dangerously close to indoctrination to the reader that is unfamiliar with game theory.²⁶ For instance, Philip Mirowski wonders how can we accept a picture of (hyper-rational) human nature whose creators suffered from problems of mental health. This is a crucial point, as "*Machine Dreams*" is also a story of how the representation of the human in economic theory transcends the boundaries of economic theory to influence the way individuals relate to each other in social life.

The philosophical inquiry reappears towards the end, with an indirect approach to the controversy of *free will versus determinism*. If the future is determined, *free will* seems to lose its meaning. Philip Mirowski blames economic theory for that too, and embarks in a defence of the Self. He criticises all the views of the self that were presented: the *cyborg's* self as a society of ideas, that of the man untied of all dependencies ("*a man in space*"), the neoclassical's theory of revealed preference, the representative agent, and the atomless society (in which a single individual is negligible). Picturing artificial

²¹ This overlook is alleviated when Philip Mirowski refers that an acceptable account of how the market works is yet to be provided by game theorists.

²² No reference is made to the "*core*", a widely used cooperative concept of equilibrium, which has much in common with von Neumann's "*stable set*".

²³ Actually, absence of communication is not so intimately linked with the Nash concept. The recent literature on cheap talk games analyses uncompromising communication using the Nash concept of equilibrium.

²⁴ The Nash player is described as a paranoid because of his demand for complete knowledge and control over other's actions.

²⁵ The much-criticised inability to deceive of the Nash player is a fundamental (and, in other instances, praised) characteristic of this solution concept, having much in common with the idea of rational expectations.

²⁶ Nash equilibrium is not defined throughout the book. The simple idea of equilibrium as mutual optimal reactions - a situation in which every player is reacting optimally to the others is not even mentioned (an idea shared at least with Cournot and Hotelling).

intelligence as threatening the primacy of man, Philip Mirowski is merciless to the sleepwalking machine dreamers.²⁷ This search for a meaning of life in the economic agent as a processor of information is hopeless, as it is a known fact of life that science can give you answers, but cannot provide any meaning. But in “*Machine Dreams*”, convenient fictions are summarily rejected, especially regarding to the *nature* of the economic agent, perhaps for their gist to diffuse to reality and become self-fulfilling prophecies. This is an (unexplained) assumption of “*Machine Dreams*”.²⁸

With the computer inexorably transcending the machine-like nature of hardware towards artificially intelligent software,²⁹ Philip Mirowski turns to stress the future ubiquity of the computer in economics and to suggest possible impacts on how we think about economics, dwelling on future developments of computational economics. The present and future economics in “*Machine Dreams*” is a *cyborg* science, having moved from a paradigm of “*motion, force, energy and power*” to one of “*communication, organization, programming and control*”, as predicted by von Neumann. And the turnaround here is that Philip Mirowski (surprisingly) puts his *cyborg* vests³⁰ (perhaps to influence from within), rehabilitating von Neumann’s theory of automata, but directing its principles and potential to the study of an ecosystem of markets, instead of the modelling and prediction of human behaviour. “*Machine Dreams*” envisages an inescapable influence of the computer on the structure of *economic value* – which, like the economic agent, also transcends the boundaries of science and diffuses to society. At this point, Philip Mirowski suggests a judo movement. Instead of becoming a computer, the economic agent should simply live with them. Economic value should not be determined by what happens in the “*idealized computer situated between the ears of the representative agent*”, but could be seen as an

²⁷ “Desperate to endow economics with scientific status, they seem unconcerned with the changes going on all about them in science. Desperate for rigor, they skirt the most pressing logical paradoxes. Desperate for science to give their lives meaning and significance, they are revulsed by what modern science has done to meaning and the self. Desperate for philosophical succor, they redouble their efforts to concoct mathematical models. Desperate to paint the market as *Natural*, they conjure up sciences of the artificial. Desperate to assert the primacy of individual will over social determination, they end up effacing their own individuality.” (p. 503-4).

²⁸ The same assumption would hold that the *homo economicus* has, to a certain extent, transubstantiated into the 20th century human. But Philip Mirowski, besides quoting Foucault, doesn’t approach this thesis.

²⁹ In the same fashion, the mind transcends biology, as thoughts run on brain and nerve cells that have biological substance.

³⁰ And here we discover Philip Mirowski as a deceiver, hiding behind metaphors and his witty and poetic style. This ambiguous tone is not what one would expect in an historical account, leaving us wondering about his actual opinions. A lot of room is left for misunderstandings in “*Machine Dreams*”, and Philip Mirowski is the one to blame.

“intermediate output of a population of automata called ‘markets’”. All the unrealistic conceptions of the economic agent in game theory and artificial intelligence would still be appropriate to the design of electronic market agents (roboshoppers and the like). Meanwhile, the human soul would be preserved, with machines being kept simply as something good to think with.

Technology is used by mankind, but also transforms it. In this moment in history, which Philip Mirowski likes to call the *fin de siècle frenzy*, we run the risk of economics and technology pursuing their own purposes,³¹ above those of mankind. The purpose of economics, Philip Mirowski persuasively argues, was purposefully determined by the military, for the good and the bad. From *“the allocation of scarce resources to given ends”* to *“the economic agent as a processor of information”*, we moved even further away from Marshall’s definition of economics as *“the study of mankind in the ordinary business of life”*. The purpose of science and technology in general became inspired by the mantra of *“command, control, communications and information”*. From the dark *control dreams* of Huxley and Orwell, we now awake to a reality in which the required technologies (like communication technologies and the genetic engineering) became available. Besides useful tools, to what extent and in what direction will they influence society and mankind? This is left open, as *“prediction is very difficult, specially of the future.”*³² The interdependence between the evolution in science and society is a constant in this book, and, certainly with the best of intentions,³³ Philip Mirowski warns the economics profession about the ethical dimension of scientific activity, particularly in economics. Hopefully all of us economists, and scientists in general, can hold our heads up when reading Rabelais:

*“Science without conscience is the soul’s perdition.”*³⁴

³¹ In Kubrick’s *“2001 – A Space Odyssey”*, HAL turned against its creators, but Dave managed to disconnect him. Philip Mirowski’s view is not so desperate.

³² This is a famous quote from the brilliant physicist Niels Bohr.

³³ Like when he dedicates this book *“to those of the younger generation who resist the confident blandishments of their teachers: in them resides the hope for the future of economics.”*

³⁴ *“Science sans conscience n’est que le ruine de l’âme.”* (Rabelais, Pantagruel).

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