



PROMOTING LEADERSHIP IN THOUGHT  
THAT LEADS TO ACTION

*THE WEALTH OF NATIONS REVISITED*

# CADMUS

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### *The CADMUS Journal*

*The acronym of the South-East European Division of The World Academy of Art and Science – SEED – prompted us to initiate a journal devoted to seed ideas - to leadership in thought that leads to action. Cadmus (or Kadmos in Greek and Phoenician mythology) was a son of King Agenor and Queen Telephassa of Tyre, and brother of Cilix, Phoenix and Europa. Cadmus is credited with introducing the original alphabet – the Phoenician alphabet, with “the invention” of agriculture, and with founding the city of Thebes. His marriage with Harmonia represents the symbolic coupling of Eastern learning and Western love of beauty. The youngest son of Cadmus and Harmonia is Illyrius. The city of Zagreb, which is the formal seat of SEED, was once a part of Illyria, a region including what is today referred to as the Western Balkans and even more. Cadmus will be a journal for fresh thinking and new perspectives that integrate knowledge from all fields of science, art and humanities to address real-life issues, inform policy and decision-making, and enhance our collective response to the challenges and opportunities facing the world today.*

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## Science and Economics: The Case of Uncertainty & Disequilibrium

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### 1. Neoclassical Economics & the “General Equilibrium” System

#### 1.1 Supply and Demand in a Static “Perfect” Equilibrium

The act of selling or buying goods always takes place at a given moment or instant in time, at which a price is agreed and paid. The general economic system is considered by standard economics to be based on a “General Equilibrium” which represents the various transactions taking place in the overall economic system. Prices agreed for transactions represent the equilibrium point between supply and demand. Price, in this sense, is extremely important because it functions as the yardstick for measuring the real value of goods transacted (the exchange value) and is the measurement criterion for either the notion of supply (added value) in classical economics or the subjective, demand based notion of value in neoclassical economics.

Price thus represents a situation in which equilibrium is self-evident: equilibrium where supply is by definition equal to demand. The reference to time and equilibrium in this context is equivalent to that which dominated Newtonian science in the 18th and 19th centuries in Europe: the equilibrium between supply and demand is clearly analogous to the Newtonian equilibrium of our solar system. The planets, the sun and the moons of the various planets find themselves in a situation of “instant” equilibrium, which can be reproduced by, for example, photography. Reality is then contained, in its entirety, in an instant moment of time from which considerations of real time or time duration are excluded. This is in fact the application of “Cartesianism”, which posits that reality can be discovered by segmenting or isolating each part of any event or phenomenon in discrete (separate) units of time and space. As noted by Clark, this notion of instant time is the complement of the notion of universal time which pertains to the realm of metaphysics or religion.<sup>1</sup> The historical value of equilibrium theory in economics based on a monetarized price system relates to the fact that one of the essential features of the Industrial Revolution has been the monetarization of the economy as a tool for solving the logistic problems of exploiting ever higher levels of technology. However, giving the notion of price equilibrium universal significance and a kind of definitive scientific validity (based on the definition of science before Einstein) is much more a matter of belief or even ideology than a truly scientific approach.

The notion of equilibrium is not really a concept or an explanation, but rather a tautology (“something that is right because it is right”), which has been given the value or status of an axiom (those basic self-evident truths used in mathematics for developing subsequent logical

deductions). Understanding this notion of equilibrium, where supply is equal to demand, is essential because it explains why economic theory has from the beginning always tended to be one-sided. The notion of economic equilibrium, as the key preoccupation of classical economists in reducing scarcity or of their neoclassical successors in defining the behaviour of consumers, has engendered such attitudes as: “if supply and demand are of necessity equal, once we have clearly understood one part of the equation, we have also, by definition, defined the other side”. It is tantamount to a contradiction in terms. This simplification has proved to be a tricky one, for it has caused classical economists, for 150 years, to fail to understand that demand had to be expanded to cope with deflationary economic crises, and that it has, more recently, prevented neoclassical economists, concerned essentially with demand mechanisms, from getting to grips with the problems of rigidities of supply.

The notion of a general equilibrium at each instant in time is also bound up with the 19th century’s quest for certainty. In a positivist oriented scientific culture, certainty was equated with scientific evidence. If we have not yet achieved perfect equilibrium, or if our grasp of a given situation still falls short of total certainty, then, says the ideology, it is merely a matter of time; sooner or later perfect certainty will be ours.

The theory of perfect, instant (fundamentally timeless) equilibrium (which is in reality “certain” only because of a tautology) has thus become the premise for a system of thought and analysis which views the world as a piece of “contingent” imperfection. But imperfections and disequilibria are not “contingent”, they are the permanent hallmarks of development and dynamic reality.

Over the last decades, the imperfections of general equilibrium have been closely scrutinized by a large number of economists. The notions of incomplete and asymmetric information have entered the jargon of economic theory and analysis, in recognition of the many obstacles to achieving a perfect equilibrium.<sup>2</sup> But these notions are still used as if a perfect equilibrium could ever be achieved. The utopia of the scientists and positivists is still there to suggest that we can increase the level of information on market functioning to such a point that perfect equilibrium will one day be achieved. This reasoning simply shows that the notions of time of the pre-Einstein era - the idea of isolating instant moments of time outside reality - are still with us. Once we enter real time, uncertainty and disequilibrium become the reference criteria of reality. Introducing the notion of real time into the economics of supply and demand (in modern terms, service based production and consumption) is a radical alternative to the view of the economic process as being based on timeless (instant) equilibrium. Accepting time duration, i.e. real time, implies that any decision to produce is inevitably taken in a situation of greater or lesser uncertainty as regards the moment in time when the products or services will be available to the market. In this dynamic view of the economic process, it is recognized that any decision to produce is taken extant of the traditional moment of any economic equilibrium, and that any real price (or cost) definition is always ex-post taking into account all of the costs for distribution, utilisation, repair, maintenance, and recycling.

The moment in time when the price is fixed in the market is only a part, a subsystem, of the wider economic system. In the succession of decisions over time, from research to production, and then to distribution, and from the point of sale further on to utilization - based

activities down to the disposal and recycling of waste, the market function of fixing a price is an important event in the process, but only one element in the greater economic system. And in this greater economic system, uncertainty is not an instance of “imperfection”, but a given fact containing incompressible risk components. Any economic activity or endeavour is based on some unknown and uncertain factors or possibilities, simply because its objective and utilisation lie in the future.

Once we have accepted the dimension of real time, we can attempt to make any future event as probable as possible, but we cannot control it with absolute certainty because we cannot control future time, except by eliminating life. In nature as well as in economic systems, many competitive and often redundant production processes are continuously emerging, only some of which will ever reach the point of sale and/or the moment of utilization. Successful modern technologies are only a small part of all technologies, many of which have failed in spite of the money invested in them. One successful product on the market provides a source of compensation in a strategy based on many initiatives, a great number of which will fail. It is at this point that the role of demand, distinct in time from production, acquires a dimension and an importance which makes it an essential part of the economic system, or indeed of any living system.

### *1.2 Demand as a Selection Mechanism*

In economic as in biological reality, an enormous number of uncertain acts of production are constantly occurring before being selected by demand (through the individuals and/or through the environment). There is an enormous difference between a process whose purpose is equilibrium (of supply and demand), and one in which demand has a selection, not an equilibrium function.

A similar attitude is adopted by Karl Popper in his refutation of induction and defence of empiricism.

*There is no induction: we never argue from facts to theories, unless by way of refutation or “falsification”. This view of science can be selective, as, for example, with Darwin’s theory. By contrast, theories of method which assert that we proceed by induction stressing verification (rather than falsification) are typically Lamarckian: they stress instruction by the environment, rather than selection.* <sup>3</sup>

Current neoclassical demand-based economics views demand as giving instructions to the economy on how to do things and in so doing, provides evidence of the extent to which a fundamentally deterministic philosophy still permeates social sciences, economics in particular. By contrast, even if a process of selection can provide some hints and information as to its future operation, such hints will in practice always remain a hypothesis which can only be verified empirically later, by the facts. At the same time, an area of uncertainty will always persist because of the fundamental impossibility of forecasting a fully predictable environment if real time, evolution and dynamics are accepted as the attributes of real life.

It must be stressed and repeated that we are now in a dynamic situation in which a static, equilibrium theory of economics cannot help to solve our major problems or simply provide a reasonable valid view of the economic situation. Our hypothesis is that economic

equilibrium theories are fundamentally inefficient in their theoretical basis. But this evidence also precludes the possibility of simply returning to the older economic thinking that stresses the importance of supply. Time dimension gives a much broader meaning to the production function than it had in classical economics, and it also underlines the essential complementary role of demand. “Disequilibrium” theory requires a proper in-depth understanding of both demand and supply, and at different levels.

Whereas priority in economic theories could in the past swing from supply to demand, considered individually and separately as workable instruments, we now not only need to reassess the importance of the supply-side, but also the fact that the selection function of demand is an absolute necessity, a complement to the production function. By analogy with the quotation from Karl Popper, we could say that an economic system is obliged to produce on the basis of hypothesis (and may be even of dreams or of any other process stimulating action and initiative). This is the first essential step. But the demand process must also be as efficient as possible in its selective function (and must include criteria on how best to use material and human resources, and how best to reflect societal values).

All this of course does not mean that demand is totally unpredictable when production decisions are taken, but even the best market research on the modern economy always involve an incompressible level of approximation. We must accept that no certainty exists, but at the same time any approximation is better than no approximation at all. We have to live with an inevitable degree of uncertainty, which in itself provides the margin for improvement, modification, new ideas and progress.

In spite of appearing difficult at times, the selection function of demand is nonetheless essential. Production without control by selection can proliferate to the point of destroying the entire system. Cancer is a biological form of uncontrolled self-production with inefficient selection. Demand is efficient because of its ability to select. Deterministic philosophy which aspires to perfectly defined demand in advance, to pre-regulated production, is unnatural, can only be inefficient, and becomes a source of destruction of material and human resources. Ambitions can only survive through a path of “imperfections”; in a way, imperfections are the great road to learning and improvement.

Over time, demand must determine whether in reality available productions are useful. Sometimes, after initial feverish success (as with computer games for example), it may fade out very quickly. In other cases, the fact that this selection mechanism exists at all guarantees the striving for a better quality of production. Mozart produced his operas among hundreds of other contemporary composers. He became the essential reference and demand has selected him and every time we listen to his music on the radio or in concert, the selection mechanism is still active.

In the new Service Economy, where utilization value implies taking into account real time, demand fulfils an essential role complementary to production. It is no longer a matter of concentrating on either the supply or the demand side, as within the framework of general equilibrium theory, but on the economy as a whole. Accepting uncertainty means that we are coming closer to reality.

## 2. Equilibrium vs. Non-equilibrium

### *2.1 Economics between Certainty and Uncertainty, between Static and Real Time: a dialogue between economics & science?*

Economic thinking is still very largely related to traditional Cartesian (and Newtonian) concepts of science, to the extent that a Nobel Prize winner like Prigogine has seen the possibility of a “new alliance” between human and natural sciences. They would be no longer different in kind: they are simply more or less indeterminate. Weisskopf for his part, defines the Heisenbergian Paradigm in the following way: “Heisenberg’s principle of uncertainty (or indeterminacy) implies that in microphysics the influence of the observer on the position and velocity of particles makes it impossible to ascertain both, their position and velocity, together. Thus, the bases of precise predictions are destroyed”.<sup>4</sup> This leads to a different view of reality: “There is no complete causal determination of the future on the basis of available knowledge of the present. This means that every measurement creates a unique, not fully predictable, situation”. The conclusion can then be drawn that “we cannot observe the course of nature without disturbing it”. Niels Bohr has stated that “man is at once an actor and a spectator in the drama of existence”, and Max Born compared this situation to a “football game where the act of watching... applauding or hissing has an influence... on the players and thus on what is watched.”

According to Weisskopf, “Man is a finite and conditioned being. He is conditioned by his anatomy, physiology, life history, social environment, and innumerable other factors. The position of the scientist is no different; he is also a person subject to such conditions. He cannot step outside himself. His cognitive horizon is limited by his conditioning. Within the limits of these conditions man is free, and he can transcend them within the limits of his consciousness. However, this knowledge, scientific or otherwise, contains these conditions as (often silent) assumptions. The reality he recognizes is true reality under the conditions of his existence. He thinks and knows, but the “he” is a conditioned being.”

This ontological analysis contains ideas similar to the indeterminacy principle in physics and could be called the philosophical Heisenbergian paradigm. It is more than a coincidence that in two such disparate fields similar ideas were developed. They are rooted in the spirit of the times. The new ambience in metaphysics, physics, and politics is one of uncertainty. If pushed to its ultimate conclusion, the Newtonian model elevates man as the objective, detached, “scientific” observer to the level of an omniscient deity who can foresee the future. In contrast, the Heisenbergian model demotes man to a participant who cannot extricate himself from the reality he analyzes. This new world view exposes the helplessness and uncertainty which is inherent in the human situation and which was repressed and denied in Newtonian thought.

It is the recognition that “action is the setting in motion of a new beginning with an uncertain outcome”, which makes “action” both real and possible.

It is rather surprising that in recent decades, while “social” scientists of all kinds, economists in particular, have been chasing after an “objective” image of their “science”, and have often implied that social sciences would in this way one day come to bear comparison with the “more scientific” natural sciences, the latter have in the meantime moved away from the traditional Cartesian-Newtonian paradigm.

W. Weisskopf states very clearly that “The Newtonian paradigm, used in classical and neoclassical economics, interpreted the economy according to the pattern developed in classical physics and mechanics, and by analogy with the planetary system and clockwork: a closed, autonomous system, ruled by endogenous, mutually interdependent factors of highly selective nature, self-regulating and moving toward a determinate, predictable point of equilibrium. The Newtonian paradigm, in line with eighteenth century thinking, represents economic events as a reality independent of the observer. The observing subject is supposed to be detached from the observed object, but he can grasp this object with his reason. An objective reality, subject to natural laws, is comprehensible to and knowable by human reason. The idea of natural law was the intermediate link between subject and object which, despite their mutual independence, united them through ‘scientific’ understanding.”

“Thus separate subjects, objects, natural law, and reason formed a quaternary, unitary configuration. The natural laws were laws of causation, interpreted as *causae efficientes*, not *causae finales*; as moving forces, not aspirations and motivations; not only in non-human nature but also in the realm of human existence. The goal of this pattern of thought was to predict future events and to arrive at determinate solutions in all dimensions of reality. If all variables, all cause and effect relations were known, we could understand and predict the events in the universe, in society, and all human action. The basic conviction of most scientists was and to a large extent still is that despite the temporary ignorance, ineluctable laws determine all events and actions. No place was left for freedom, choice, uncertainty, and mystery. This pattern of thought was used in classical and neoclassical economics as the foundation of equilibrium models: it was supplemented by fictitious assumptions, such as perfect knowledge and perfect forecasting, and through elimination of time and change by the *ceteris paribus* clause. This paradigm, as applied in economics, was connected with a belief in the benefits, justice and fairness of the free market and industrial system.”

“The Cartesian mechanism of thinking, although effective and influential in situations where industrialization is the top priority and the best tool for organizing wealth and welfare, has raised a series of methodological and practical problems. Isolating monetized economic factors is a method that is today proving to be increasingly deficient. In order to clarify this point, consideration will first be given to the way the notion of science is often perceived in economics.”

It was customary in the nineteenth century to believe that the Cartesian or Newtonian method of scientific research consisted first in defining a situation or a problem clearly, identifying and measuring all its constituents, as if the said situation or problem could be fully determined (or at least assuming that anything left out had no appreciable influence on the system under observation). In this way, a water molecule can be isolated and studied. In the same way, Newton gave a clear view of celestial mechanics and the economist hoped to provide scientifically framed and determined “models” of reality. In practice, frequent use is still being made of this simple, even trivial, method which reflects the underlying assumption that the reality examined is for the most part “objective”. This view presupposes simple systems and as an essential corollary, the divisibility of time and space.

It has been clear in the natural sciences for many decades that even if a multitude of realities exist which we can profitably research in the “Cartesian” way, when we get down to



basic issues (such as What is matter?), and to issues related to “objectivity” (if such a thing exists), we find ourselves faced with extremely complex and even indeterminate systems. (Indeterminate is used here in a Heisenbergian sense. The whole controversy, started by Einstein with his “probabilistic” reality, is highly relevant to this issue).

If what has been said here is only partially acceptable, it nevertheless follows that it may benefit economics to question some basic assumptions, especially the notion of value, on which economics itself is founded, as well as its historical and cultural determinants with reference to the notions of time and space.

In the Cartesian-Newtonian universe, time is either infinite or specific: one can isolate a moment in time. One can examine “reality” statically as if it were a picture, freezing all movement. The equilibrium of Newton’s universe is like the equilibrium of the economists’ supply/demand curves: at a given moment in time (instant time) the situation is such and such. Simple, definable forces determine equilibrium situations, and each state or situation can be isolated.

Under such conditions, the relative behaviour of phenomena in time and space tends to disappear, or to be represented in a static framework, eliminating duration or real time.

Today, the notion of uncertainty has become a “fact of life”, linked to specific perceptions or to a particular business cycle. Furthermore, ever since Einstein had to admit implicitly, against his will and deep moral conviction, that God “plays with dice”, there has been a constantly growing volume of literature dealing with fundamentals concerning the nature of science and the structure of knowledge. Basic notions such as relative time/space, the indetermination of systems, the historical relativity of axioms, and uncertainty are proliferating across the entire research spectra of natural and social sciences.<sup>5, 6, 7</sup>

Contrary to what happened in the nineteenth century when science was considered to be equivalent to a more efficient way of attaining “universal” truth and, as such, the rival of religion, it is now generally accepted that science is a method of “falsifying” (in Karl Popper’s terminology) all theories, hypotheses and facts. In other words, there is no such thing as “universal” scientific truth, but only a limited operational validity in time and space of any scientific law or theory (which means that “it works” for a certain period).

Our culture, by and large, is not yet accustomed to looking at science in this way. It is very revealing to find the survival of the “universal objectivity” notion of science even in recent literature. A brilliant example is “The Sleepwalkers” by Arthur Koestler, in which science and religion are treated as complementary ways of reaching universal truth. In our opinion, underlying these attitudes toward truth and science is again the notion of time/space. If time/space is considered to be something that can be isolated in a given moment or place, this “abstract” moment (like Newton’s notion of the universal equilibrium) can logically be considered to be of “universal value”.<sup>8</sup> But this pretension to “universal” logic breaks down when mathematics tells us that “universal”, unchangeable (God-sent) axioms are no more such.

Economics itself has developed for over two centuries on the basis of this cultural background of a “static” Newtonian notion of time/space, which goes hand in hand with the assumption of certainty (as an acceptable, achievable goal) that still dominates today’s thinking.

Yet the notion of uncertainty has also started to make some important inroads in economic thinking. A major breakthrough will come with the adaptation of economics to the notions of real space/time dimensions, which implies taking into account real and relative duration. This process has already virtually begun. It calls in the first place for the definition and acceptance of a new notion of value.\*

In general terms, it should be remembered that life itself, real life, is based on uncertainty. Risk and uncertainty characterize life not as chance, but as a condition, if only because life is real time, and risk and uncertainty are its attributes. The corollary is that:

*future events for the Heisenbergian paradigm are the result of unpredictable human actions and reactions, ...if the Newtonian paradigm on the one hand enthrones man as a potentially omniscient, detached observer of an independent objective reality, ...at the same time nature, society and man are subject to inexorable "natural" laws which determine unequivocally man's future and fate.<sup>4</sup>*

We are bound to admit that, during the classical Industrial Revolution, such principles proved to be rather efficient. But from the end of last century we have witnessed the degradation of their significance (see the present confused and contradictory debate on the meaning, origin and solutions with regard to the "economic crises". The perception that the "fundamentals" – which fundamentals? – are somewhat lost is easy to detect).

Over thirty years ago, Rene Passet, a French economist, wrote that economics has until now been concerned with "dead things".<sup>†</sup> He starts his analysis by drawing attention to the correspondence between economic thinking during the past two centuries and changes in the notion of science.<sup>‡</sup> Dead and living things are opposites, analogous to another pair of opposites, static and real time. The transition from one to the other is a transition from utopian certainty to the challenge of real uncertainty, from essentially deterministic thinking to the possibility of building real responsibility and freedom, taking advantage of a largely indeterminate world.

Of course, too much uncertainty leads to impotence, which is precisely the reason why its origin must, whenever possible, be understood (as must our understanding that rigidities of economic supply are conditioned by the diminishing returns of technology). But in the end, the problem is how to live better, i.e. to learn how to face risks better.

A new synthesis (which we hope will soon take place) between advances in economics and the various social sciences, and the basic thinking underlying progress in natural sciences, is of vital importance.

## 2.2 From Newton to Prigogine: Equilibrium as a Goal or "Attractor" in a Far From Equilibrium System

*"Today, wherever we look, we find evolution, diversification and instabilities. A fundamental reconceptualization of science is going on.... The artificial may be deterministic and reversible. The natural contains essential elements of randomness*

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\* This is precisely the type of debate that Giarini's *Dialogue on Wealth and Welfare* has tried to initiate.

† Rene Passet is one of the pioneers in building bridges for economists between modern developments in scientific thinking and economics; see for instance: Passet, Rene (1979) *L'économie et le vivant*, Payot, Paris.

‡ His testing of economic paradigms against the work of Ilya Prigogine is very promising.

*and irreversibility. This leads to a new vision of matter that is no longer passive, as described in the mechanical world view, but associated with spontaneous activity. This change is so deep that I believe we can really speak about a new dialogue of man with nature....”*

We are more and more numerous to think that fundamental laws of nature are irreversible and stochastic and that the deterministic and reversible roles are applicable only in limiting situations.

Today, our interest is shifting to known equilibrium systems, interacting with a surrounding environment through the entropy flow. The thermodynamic point of view is one of interaction; we could say a holistic one. Dynamical systems have no way to forget perturbations. In thermodynamics, perturbations may be forgotten. In the thermodynamic description including dissipation we have attractors.

Without attractors, our world would be chaotic. No general rules would ever have been formulated. Every system would pose a problem apart. We can now also understand in quite general terms what happens when we drive a system far from equilibrium. The attractor which dominated the behaviour of the system near equilibrium may become unstable, as a result of the flow of matter and energy which we direct at the system. Non-equilibrium becomes a source of order; new types of attractors, more complicated ones, may appear and give the system remarkable and new space-time properties.

*“I like to say that at equilibrium, matter is blind; far from equilibrium it may begin to see... “.* \*

These quotations come from Ilya Prigogine. He has been at the forefront of the research and debate now resounding in many sectors of natural and social sciences. The world over, books from many different horizons have contributed to convey the same message: acceptance of the notion of uncertainty, of disequilibrium, of real time taken in its duration, not as imperfections of our scientific knowledge, whatever the field, but as the hallmarks of the dynamics of life and evolution.<sup>†</sup>

A fundamental philosophical aspect of all these trends is the constantly growing interest in indeterminism, as can be seen from major publications such as the updating of the famous book by Karl Popper on “The Logic of Scientific Discovery”. His last three volumes (“Realism and the Game of Science”, “The Open Universe: an Argument for Indeterminism” and “Quantum Theory and the Schism in Physics”), published and republished from 1983, constitute a recent exhaustive “post script” to this fundamental work.<sup>9</sup>

Given this background, economics will hardly be capable of maintaining for long the notion of general equilibrium as the basic reference for a general theory applied to our contemporary world. At best, the notion of equilibrium might, in practice, be identified with the notion of “attractor”.

Attractors then are points of reference, indicators of directions (possible, probable or even improbable), in a real time dimension. By carefully reading the writings of many

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\* Excerpts taken from the Honda Lecture 1983 by Professor Ilya Prigogine, Nobel Prize in Chemistry in 1977, Professor at the Universities of Brussels and Austin, TX.

† See among others: Capra, Frank (in preparation) Keppel: Uncertainty, the ground for life.

contemporary economists, one soon discovers that, under the formal definition of the general equilibrium theory, goals, objectives and possible directions are described. But the real issue in accepting the idea that systems are essentially in a far from equilibrium state is a better identification of the dynamics of economic progress and evolution: the dynamics of real time. If we accept the fact of disequilibria and that every judgment is at best the expression of a probability, then accepting and managing uncertainty becomes the key issue.

Our ignorance and our imperfect information are an instance of disequilibrium, a condition of life and evolution. Our growing ignorance, determined by the growth of our knowledge which increases the number of unanswered questions, is the best evidence that we are part of the flow of life.

Experience tells us that whenever we have the feeling of having completely mastered and understood a problem, it is often because the object or the situation of reference no longer exists: we are just about to discover that our confidence in our capacity to “totally” understand is normally misplaced. Normal life is not so different from the process of scientific thinking. Hypotheses are emitted and tested; they may work for a while until at some point something ceases to fit into our picture. We then have to readapt, rethink and reformulate our ideas, understanding and theories in a broader or different framework.

In the words of Ilya Prigogine:

*“The views of evolutionary changes as a dialogue between “randomness” and “deterministic selection” is at least as old as Darwin; but in the views developed here, the randomness results partly from the ignorance of the actors concerning the system as a whole, a lack of knowledge which allows the exploration of new ideas that give rise to creative reorganization.”*

Ignorance is there to be continuously challenged and reduced, but its very existence enables us to discover and create; in short, to develop ourselves.

## Notes

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3. Karl Popper, *Unended Quest* (Glasgow: Fontana Collins, 1977), 86.
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5. Morris Kline, *Mathematics: the Loss of Certainty* (Oxford: Oxford University Press, 1980).
6. John Little, “The uncertain craft of Mathematics,” *New Scientist* 88, no. 1230 (1980): 626-628.
7. David Bohm, *Wholeness and the Implicate Order* (London: Routledge & Keenan, 1980).
8. Ronald Clark, *Einstein, the Life and Times* (London: Hodder & Stoughton, 1973).
9. Karl Popper, *The Logic of Scientific Discovery* (London: Hutchinson, 1969).

Those who are engaged in building democracy in their countries and who are animated with a fresh spirit like in Egypt will have to ask themselves: What purpose does building a democratic nation have if it is embedded into an undemocratic and non-transparent international system? In a globalized world the confinement of democratic participation of citizens to the institutions of the nation-state is almost equivalent to disenfranchisement. True democratic emancipation cannot stop at national borders.

*Andreas Bummel*, Chair, Committee for a Democratic UN

Politics is the whole of which economics is a part and employment is a small part of the wider domain of economic life. Ushering in a global government generates the power of solving these minor problems. Government is the context that activates the politician. Politicians can cure the ills created by economists. A wider vision of economics solves the problems created by narrow inspiration.

*T. Natarajan*, President, The Mother's Service Society

The role of labour is crucial for the social cohesion and stability it provides. Threats to financial stability do not exclusively emanate out of capital markets. As the unrest in several Arab countries demonstrate yet again, without social stability there can be no financial stability.

*Patrick Leidtke*, Director, Geneva Association

Economic thinking is still very largely related to traditional Cartesian (and Newtonian) concepts of science. The notion of equilibrium is not really a concept or an explanation, but rather a tautology, which has been given the value or status of an axiom. Understanding this notion of equilibrium, where supply is equal to demand, is essential because it explains why economic theory has from the beginning always tended to be one-sided...Once we enter real time, uncertainty and disequilibrium become the reference criteria of reality. Introducing the notion of real time into the economics of supply and demand (in modern terms, service based production and consumption) is a radical alternative to the view of the economic process as being based on timeless (instant) equilibrium.

*Orio Giarini*, Director, The Risk Institute

According to Roosevelt, "necessitous men are not free." The narrow conception of individual freedom founded on private property rights advocated by neoliberalism neglects a much wider, more humane conception of social democracy, freedom from want and human security affirmed by the New Deal, the Atlantic Charter and the UN Charter.

*Winston Nagan*, Director, Inst. for Human Rights, Peace & Development

A human-centered theory of economy and employment needs to be founded on the realization that human beings – not impersonal principles, market mechanisms, money or technology – are the driving force and central determinants of economic development.

*Garry Jacobs & Ivo Šlaus*, World Academy of Art & Science Global Employment Project

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# CADMUS

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## *Inside This Issue*

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Our world is headed into a Perfect Storm of an interconnected financial, ecological and social crisis. Almost all forward-looking assessments demonstrate that business as usual and incremental improvements will not be sufficient to take us to a future world blessed by equitable prosperity, safety, security and contentment.

*Ian Johnson,*  
Secretary General of the Club of Rome

The three organizations – WAAS, Club of Rome and the Pugwash Movement – should sincerely join forces and act together, so that we can fully utilize use our collective experience, intellectual capacity and foresight. Together, we will have a much stronger voice to get our good messages out to the world and be listened to by policy makers, parliaments, governments, academics and all societies in general, in both the industrialized and developing economies.

*Heitor Gurgulino de Souza,*  
Former Rector of United Nations University

Decisions on our common future should no longer rest solely on world leaders, who can evade or even obstruct meaningful change. A simultaneous electronic ballot on saving bios is a brilliant opportunity to demonstrate that, as citizens of the world, we can all agree on safeguarding the Earth for the generations to come. By giving priority to individual voices to be heard, the World Referendum can elicit the personal involvement of every citizen in the race to save the environment and help to bridge the gap between the rich and poor.

*Agni Vlavianos Arvanitis,*  
President, Biopolitics International

The greatest global challenge that faces the international community today is that of the current trans-national revolution in human affairs, which in turn is triggered by the combination of three revolutions: a revolution of rising expectations, the information and communications revolution, and a broader industrial-technological revolution.

*Jasjit Singh,*  
Director, Centre for Air Power Strategy

*Continued . . .*