The Challenges for Science. Education for the Twenty-First Century
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A PHILOSOPHICAL PLATFORM FOR PROPORTION IN EDUCATION: THE "SCIENTIFIC SUBJECT" AND THE CREATIVE ACT OF THE HUMAN BEING

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Introduction

The Crisis of Science and Culture: The Danger of Overobjectifying and the Dissolution of a Harmonious Worldview

a) When Edmund Husserl in his *Die Krisis der Wissenchaften und des Europäischen Menschentums* called out his alarm signaling the crisis of Occidental science and culture, that work aroused intense intellectual excitement and provoked a discussion that has continued through the decades since. However, the focus of that discussion has changed with time. Husserl's focus was on a sclerosed, rigidly rational approach to scientific inquiry that put science in danger of losing all relation to the world in which it is rooted. True appreciation of the "lifeworld" from which scientific research into the manifestations of reality proceeds was at the heart to his appeal. the essence of his philosophical innovation. An overobjectifying rationalism was confining science to the strictly mathematical description of reality. The effect of this approach was the opening of a gulf between the so-called "hard sciences" and the humanities effecting an alienation of man from himself.

Today our situation has a different aspect. The crisis of Western – and, we can say, of all – culture has deepened, but there has meanwhile occurred a series of transformations in the nature of scientific inquiry such that its relation to the humanities has been revised. The issues involved concern ultimately the human being as an individual and the person in his/her role in life and place in the world.

In an brief discussion here we will show the great relevance of these issues to the matter of education. It is the human being who is meant to be educated, and thus what is fundamentally in question is the human condition in the world of life generally and as specifically human existence. This discussion is fundamental because it is one's worldview that gives one a foothold in existence, gives one's bearings in the world. The directions of one's striving in life are in the balance here.

b) At this stage of our scientific and cultural development, the crisis signaled by Husserl has taken the form of nothing less that the dissolution of the universal worldview that carried humanity over the last few centuries. That worldview, of course, was not static. It had its transitions and stages, which have followed developments in science and human knowledge in general.

But now the inherited, traditional worldview carrying human existence is disintegrating under the impact of an ongoing dissection of man so radical that worldview must be retrieved if the human being is to survive as human. The expansion of scientific knowledge has led to an imbalance view of man. The dazzling discoveries made there have diminished the significance of the reflective side of the human person, that is, his/her stream of emotions, sentiments, desires, expectations, hopes and ideals – a conundrum not entirely thematizable rationally – all of that which constitutes the inward, intimate dimension of the person within which she "dwells" in her very own being and within which she accomplishes her innermost striving for contentment, satisfaction, happiness.

While the hard sciences focus on the discovery of the physical world and its laws, the vast and ramified and ultimately imponderable side of the human being that is his own reflections has been left to the humanities to investigate. While the sciences deal with the objective sphere of reality, the humanities are concerned chiefly with the inner life of the person and with interpersonal relations. Although the sciences touch marginally on our human experience of beauty, solidarity, sympathy, beneficence, etc. (as well as on aggression, etc.), this experience is chiefly the focus of the humanities. Consequently, history, literature, the fine arts, etc. have an essential role to play in the education of the person and the foundation of his worldview, interpersonal life, and ultimate happiness. This side of life that appears at first to be strictly subjective is actually shared by people as sentiments and ideas so that there emerges what Nicolai Hartman called the "objective spirit", the culture of a society at a given time.

c) Plato, who distinguished in the Laws numerous matters indispensable in the education of an accomplished citizen, saw in the interrelations of the various disciplines of learning a harmonious order that he compared to a choral dance. In the Republic he calls for an equilibrium or proportionality to be established between them.

Today it has become urgent to devote some thought to how the effort devoted to education is to be apportioned among the disciplines. Do we focus early on education in a particular field in order to give the student a guarantee of professional success? Or do we make life enjoyment our aim and impart a broad education? For that matter, the question of how much versatility a person may need to be able to respond effectively to changing professional demands is rapidly forcing itself on us. These are the great practical issues underlying contemporary debates over education. The question of balance is of paramount significance for dealing with them adequately.

One postulate comes to the fore: In the formation of the human mind, we have to aim at such a proportionality that in the midst of the stream of unsettling transformations occurring in the world of science and societal life, a harmonious, flexible world view may be acquired so that students may find their bearings, their orientation in existence, their direction in and expectations of life. In order to find optimum equilibrium in all this, we have to spurn any one-sided over concentration on a particular field of study. In avoiding that pitfall the study of philosophy is of great significance for philosophy embraces all fields. In their investigations, therefore, philosophers are positioned to develop an estimation of the specific roles to be played by the various fields in the formation of the mind in their mutual interaction.

But what philosophy can be said to do so free from all presuppositions? Which may be said to be not only sufficiently informed but to have the impartiality to rightly estimate the shape of optimal education? As we have seen, in Husserl's estimation, the traditional accentuated opposition between the hard sciences and the humanities does not allow us to find in them a common denominator. But since his day the situation has changed. On one side, the sciences are transforming themselves from within sua sponte, and on the other side, a philosophy of life has emerged in which the sciences and the humanities may now converse on a common platform.

The proposal of this paper is that this platform is constituted by the coincidence of two developments. First, scientists are tending toward or have arrived at a new conception of the very nature of their pursuits and of

the object of their pursuits as well. Second, in the philosophy of life, there has been a deepening recognition and appreciation that the human creative act is the source of all human pursuits, with scientific discovery and invention providing prime examples of that.

I will now review the general situation that has witnessed these developments that now may provide us a platform for balanced education.

Part One

Transformations and Innovative Tendencies in Contemporary Science and the Congruent Insights of the Philosophy of Life

a. We are at a stage of transition in both science and our culture at large. Humanity finds itself in a sharply delineated transition period in all spheres: cultural, social, political, and scientific, which spheres usually coincide. Thus, when the Newtonian science of the seventeenth and eighteenth centuries – which had a deterministic, mechanical model of reality and which presented the world as originating from initial conditions in a strictly mechanical fashion so that all further developments were strictly determined, each being a step in a universal mechanical process, so much so that Laplace claimed that on the basis of it we could predict the future – reverberated through the scientific world and was almost universally accepted, that was because it accorded with the social outlook of the era of the Industrial Revolution, in which society too was viewed mechanistically.

Today we are witnessing the end of the Age of the Machine. This is Alvin Toffler's thesis in his foreword to Ilya Prigogine and Isabelle Stengers' work, Order out of Chaos. Man's New Dialogue with Nature.[1] As Toffler sees it, the deterministic model of the world was under attack already in the nineteenth century with the discoveries in thermodynamics, Darwinian biology, and quantum physics. It could then retain partial validity as a reference point for research and the formulation of issues. But in more recent times science has undergone a truly radical transformation such that the assumption of even a basic order and rationality in nature can no longer be persuasively upheld and is losing ground in a profound reassessment as new models of reality suggest themselves.

[1] Ilya Prigogine and Isabelle Stengers, Order out of Chaos, Man's New Dialogue with Nature (Boulder: New Science Library; New York: Random House, 1984).

As Prigogine, a prominent scientific researcher and interpreter, states, "Our physical world is no longer symbolized by the stable and periodic planetary notions that are at the heart of classical mechanics. It is a world of instabilities and fluctuations, which are ultimately responsible for the amazing variety and richness of forms and structures we see in nature around us".[2]

With Ilya Prigogine we may speak of a revolution in the scientific outlook, of the birth of a New Science.[3] The emphasis of classical science on the principles of stability, universality, regularity, symmetry, equilibrium recedes from the foreground and is replaced by the evidence of crucially significant states of disorder, arbitrariness, instability, irregularity, disequilibrium.

In all the sciences, not only the life sciences but those of physics, astronomy, mathematics as well, the essential role of change, transformation, evolution, event in the universe, the earth, human society has come to be appreciated. We have become aware of the birth and dispersion of elementary particles and of galaxies too, of changes in chemistry and geological upheavals that would be considered exceptional events in a mechanistic model. These are now considered to be part of a grand but hazy picture, as are the puzzling origins of living beings and the modalities of their differentiation and evolution, as are the unaccountable origins of and shifts in societal norms. The search for answers must correspondingly undogmatic.

This new outlook has proceeded from the "discovery" of time in physics, once almost ignored and now recognized as having crucial significance. The New Science, as presented by Prigogine in his numerous books, offers a "new dialogue" between the human being and nature. At its crux is precisely a reversal in the significance attributed to the temporal aspects of becoming.

b. With the introduction of the notion of "complexity",[4] encompassing all modes of order and disorder, we witness a bifurcation of hitherto one-sided concepts. For example, there are evident in dynamic systems contrasting processes that conserve energy and dissipate it. Similarly, we see mechanical and thermodynamic equilibria balanced by constraining non-equilibria. Moreover, Prigogine makes a sharp distinction between "closed

[2] Ibid., p. ix.

[3] Gregoire Nicolis and Ilya Prigogine, "Introduction", Exploring Complexity (New York: W.H. Freeman, 1989), p. ix.

[4] Ibid. pp. 71-141.

systems" in which things originate, change, deteriorate according to fixed patterns and "open systems" in which energy maintains itself.[5] It is the open systems of becoming that are primordial; these are open to exterior forces and exchange of energy, with the environment being susceptible to influences and exercising influence in turn.

The concept of open systems has emerged in response to the issues raised by Darwin's evolutionary theory and the dynamic systems observed by Prigogine. The common way of conceiving the temporality of becoming has been completely revised. When Ludwig Boltzmann set for himself the task of identifying evolutionary phenomena in the physical sciences analogous to those observed in the life sciences, he found them on the level of populations of molecules. He attempted to describe not only the equilibrium found in a population of molecules but how that equilibrium evolved. In doing so he discovered the irreversibility of the toward-equilibrium process, a time vector similar to that found in the evolution of species.[6]

Critically, Prigogine pursues the notion of irreversibility and attributes it to all open systems.[7] He shows that open systems, whether physical or biological or social, do not proceed in a reversible fashion, that the processes of constructive constitution do not go backwards. On the contrary, they follow a "vector of time". They are one-way constructions due to this irreversible vector of time.

It is precisely in such open systems having this constructive direction, interacting and exchanging energies with their environments in random, irregular, topsy-turvy fashion that Prigogine sees the initial conditions of becoming. Biological and societal systems present particularly striking open systems. Biology and genetics show us that below the recurrent scheme of life that we conventionally attribute to life's processes – what is merely an objectified, universalized surface – lie life's inner workings.[8] Under the surface innumerable sub-systems pulsate, bubble, criss-cross; instead of stability here is constant disorder and fluctuation.[9]

[5] Ibid., pp. 45-71.

[6] Ludwig Boltzmann, Populäre Schriften (1905), (Braunschweig-Wiesbaden: Vieweg, 1979).

[7] Prigogine and Stengers, op. cit., pp. 257-290.

[8] Nowhere do the inner workings of life appear more clearly than in the search for rules of articulation, the formation of models. See Rene Thom, Structural Stability and Morphogenesis: An Outline of General Theory of Models, trans. A.D. Fowler (Reading, MA: W.A. Benjamin, 1975).

[9] See Largeault, Systemes, op. cit. and Thom, "La creation de nouveau...", op. cit.

The very recognition by scientists of haziness, fleetingness, arbitrariness in physics and then in biology extends to all sectors of reality. In psychology too there is recognition of the turbulent life of the mind at the pre-conscious level. The pre-conscious turmoil of the psyche is also an open as well as closed system or cluster of systems, out of the interplay of which that which is irregular, crooked, fleeting, singular emerges. This is a game of chance factors, necessary dispositions, and the unforeseeable, the unpredictable.[10]

But what is most striking in all this is the rapprochement being achieved between the physical and the human, social, cultural sciences. The realization of the historicity of the human being and the course of society and culture is, following Dilthey, Unamuno, Ortega y Gasset, at the vibrant leading edge of contemporary thought. With Husserl and Heidegger's concept of the lifeworld and with Gadamer and Ricoeur's hermeneutics, this realization has entered literature, linguistics, sociology, political theory. We may safely say that it is transforming the human sciences. The goal in these disciplines is no longer the rigging of rigid, immutable models. The reality of "progress" has been discovered, the critical phases of turbulence, consolidation, and dissipation. With the recognition of the irreversible phenomena of physics and their constitutive propensities together with the vector of time, we are finding common denominators in physics and the human sciences.

The finishing touch of Prigogine's approach to becoming is his conviction that becoming is self-generative. Like Aristotle, Leibniz, Spinoza, Kant, and others, Prigogine believes that becoming emerges "from within", sua sponte.

Here is the gist of the phenomenology/philosophy of life: a coincidence between science and philosophy. Assuming that the varieties of becoming all proceed sua sponte from the interplay of the regular development of forms and irregular, unpredictable conditions, Prigogine suspends the sharp dilemma of determinism and freedom, necessity and chance. Both are at work in the processes of the universe. There is a vast intermediary realm, then, in which it is interrelations that are to be investigated.

Significant in its own way within the modern intrusion of unpredictability into the abstract, mechanical order reigning in classical science

[10] Creation et desordre, recherches et pensees contemporaine (Paris: L'Originel, 1987), (Interviews with Henri Atlan, Guitta Pessis-Pasternak, Gerard Ponthieu, and Michel Treguer).

is "chaos theory", that is, the study of turbulence. Altogether singular and unrepeatable is the flow of smoke out a chimney. From the same initial conditions, that flow can take innumerably different courses. Consideration of this invites a look into the chaotic disorder behind all ordering, the fleeting behind the fixed.

Furthermore, with recognition of an intrinsic mobility in all physical nature, the radical contrast between spontaneous movement in living beings and inertia in inanimate physical being vanishes. And so the mechanistic model yields to an overall organic model. The organization and finality of physics have thus come to approximate those of the life sciences.

The concept of science has undergone a radical transformation. Indeed, recognition of "chaotic systems"[11] and "catastrophe theory",[12] has removed the backdrop of a manifest objective order of the universe, world, and life by revealing a turbulence of bubbling energies and forces running at random.

There is a new approach to scientific validity as such. The classical postulates of precision, exactitude, certainty lose their hold on the imagination. We move to viewing a hazy, imprecise, fleeting reality. In this way the "hard" sciences seem to be becoming more like the sciences of life and society.

This movement of the sciences toward each other is particularly obvious in the case of a mathematics that now treats sensitive and qualitative features as well as forms different from those of classical Euclidean geometry. This is the fractal geometry of Nature.[13] Although this geometry was discovered as far back as Leibniz, to whom its present inventor, Benoit Mandelbrot, refers,[14] and although it was somewhat developed at the end of the last century, it has just now gained proper acceptance and appreciation. It concerns the forms of nature, things etc. We are accustomed in life as well as in scientific inquiry to rely on forms, structures, on geometry in general as we deduce it in our constitution of reality. We seek in nature the geometrical relations so constructed. So-called "fractal geometry", however, looks past the preconceived forms usually seen in nature and the whole

[11] David Ruelle, Hasard et chaos (Paris: O. Jacob, 1991); Ivar Ekeland, Le calcul, l'imprevu (Paris: Seuil, 1984). For fascinating explanations geared to the layman of chaos theory as well as of the related theories making up the "New Science", James Gleick's Chaos, Making a New Science (New York: Penguin Books, 1988) is much to be recommended.

[12] Ekeland, op. cit., pp. 122-153.

[13] Benoit B. Mandelbrot, The Fractal Geometry of Nature (updated and augmented), (San Francisco: W.H. Freeman, 1977).

[14] Ibid.

of the reality which science encounters, seeing that there is there a completely different composition of things.

Liberation from Euclidean geometry's circles, squares, cones – into which we have been trying to squeeze reality – shows us the structure of nature's "dislocated" irregularity, all sorts of irregular objects torn, and fluid in their relations, constructs. Here is a new mathematical approach to nature, one freeing it from the absolute rigidity of forms and structures into which classical geometry pressed reality. Going against a growing tendency of formalism in mathematics that leaves behind human intuitive representation, Mandelbrot's fractal approach to reality is all intuitive. His device is, "to see is to believe".

From the side of mathematics, then, comes a revolutionary strong affirmation of the universal significance of the concrete, unrepeatable, unique.

The infinite range of the fractal forms proceeding from mathematical algorithms effects a crucial transition in mathematics from an abstract way of conceiving nature to one which passes into the visual. Mathematics is, as it were, given senses adequate to the riches of objective experience. We move away from the classical prejudice that mathematics involves "calculability" only, in a qualitative, aesthetic expansion of the discipline. The abstract science of mathematics "humanizes" itself!

At the end of this all too short survey of the revolutionary changes in science that have thrown our hitherto cultivated worldview into disarray, recognition is due Alexandre Kojeve for his having brought out the most significant factor of the "subject", the living concrete individual who as an inquirer envisages everything around him/herself, whose role is now universally accepted in physics and the rest of science. In describing the subject's central role in scientific investigation, Kojeve gave it this basic characterization: we should not identify the subject with a mathematical, abstract point, uniform and unchangeable, nor with its biological corporeity, nor as a psychological agent.[15] It remains to be seen how we must conceive of the subject according to its function in investigations.

At this point scientific investigation encounters the Archimedean point of the philosophy/phenomenology of life.[16]

[15] Alexandre Kojeve, L'Idee du determinisme dans la physique classique et dans la physique moderne (Paris: Librarie generale franeaise, 1990).

[16] For a full-fledged study of creative experience, cf. compare Anna-Teresa Tymieniecka, Logos and Life, Book I: Creative Experience and the Critique of Reason, Analecta Husserliana, Vol. XXIV (Dordrecht: Kluwer Academic Publishers, 1988).

c. To conclude our brief account, let us emphasize the striking innovative tendencies in science. 1) The physical and mathematical sciences seem to have abandoned sharp boundaries with biology as well as with the social sciences and cultural inquiries. The strict calculative nature of mathematics has taken on a qualitative aspect. These sciences seem to have become "humanized". 2) All of the disciplines have become sensitive to time and change. 3) Their theories of becoming and development seem to share some common features. 4) This sharing among the sciences without the breaching of their sharp boundaries does not allow placing them all on equal footing, nor reductively subsuming some under others, but indicates that a dynamic swing of generation, of ordering, of interactivity may well run through the entire gigantic game of existence. 5) With consideration of the transitory dimensions, transitory trajectories of the dynamic complexes of the world, with the shift in focus of thought away from seeking closed reversible systems to apprehending open self-projecting streaks in the cosmos as well as in nature-life and social life as well as appreciating the vast territories of their attunements, interferences, gulfs of mysteries are opened for science to explore.

These are the vast intermediary, unknown areas of interlinkages, generative propensities, and seminal endowments-in-process, ever expanding dynamic spheres of manifestation with their own turmoils advancing and regressing in complexity and quality, with phases of catastrophe and of regulative constructivism that have now become the fascinating areas of secretive reality. They draw our inquisitive mind wider and further. 6) But it is recognition of the central role of the subject in the process of science as such that will offer us a crucial point for the dialogue between philosophy/phenomenology of life and the New Science.

Today's science is, indeed, offering us elements for a new vision of the universe, nature, society. In fact, the chaotic and turbulent stream, the innumerable streamlets which make up cosmos, nature, life, society and culture, in which from arbitrariness, chaos, chance there emerge segments of ordered world, such that we may acknowledge through our own existence in relatively stable societal, natural, cosmic existential conditions, opens fascinating newly to be formulated issues, views, expectations.

This preeminence given to the turbulent, fluid, accidental, irregular, disorderly in the origination and progress of All does not mean, as I have hinted at a few times, a universal "disorder" or a forsaking of order and rationality. On the contrary, it opens vistas in which we have to ask after the kinds, rules, ways of interlinking, of intermingling, molding..... There

are no sharp divides between matter and life, nature and the cosmos, nature and human culture, but vast intermediary spheres which fascinate our imagination.

This calls for the discovery of laws of transitional phases, of coincidence, encounter, and interlinkage, of systems of spontaneous emergence, of spontaneous designs or projects, developments. This also calls for the investigation of the nature of the center point of scientific inquiry, the human subject.

With this we enter into our sphere of the philosophy of life. To a superficial glance it could appear that this new vision of the world, life, cosmos, human social life in superseding classical visions makes philosophy's traditional queries and conceptual frameworks obsolete or that science has simply replaced them. Could philosophy become obsolete, indeed subject to the penetration of scientific inquiry?

Nothing could be more hasty and erroneous. But also nothing could be more preposterous than a philosopher who believes it possible to reach reality through primary experience and the power of speculation while ignoring scientific inquiry.

The striking fact of our present situation is that philosophy needs to consult scientific data, inquiry, methods in order to be able to grapple with reality. The natural and human sciences in turn need a philosophy that is appropriately informed by them for the more profound organization and interpretation of their findings and their own advance.

In short the situation of our culture with all its potentials and hazards calls for an alliance between philosophy and science.

Remarkably enough, the radical new perspectives which science opens fall in line with those being taken by the new philosophy. The phenomenology of life and of the Human Condition emerges like the phoenix from the ashes of traditional thinking.

The project of the philosophy/phenomenology of life and of the Human Condition springs forth from the idea of this alliance. The concept of the ëontopoiesis of life' is the crucial link and vehicle of the project.

In summary, let us emphasize the four pivotal new intuitions shared by the new scientific approach and philosophy/phenomenology of life.

There are indeed, four pivotal intuitions and proceeding from them four critical issues which are the meeting points for the phenomenology/philosophy of life and the sciences of life and the physical sciences in general. These issues also reverberate in our time's preoccupation with order and disorder, necessity, orchestration, etc.

First of all, new awareness of the temporality of events, processes, transformations in the organic as well as in the inorganic sphere has provoked great puzzlement over the nature of "developments", that is, of the irreversible processes that carry life onwards. This is now the central issue of science. Addressing it is the grand idea of formation in which becoming may be grasped – the concept of ontopoietic unfolding, which constitutes the ontologico-metaphysical axis of becoming as such as well as of becoming in its lineaments. This is the fulcrum of the phenomenology-philosophy of life.

The second pivotal point of encounter between the sciences of life and philosophy of life is the whole question of the formation of "complexities" which confronts the sciences of life and of all reality "from physics to politics".[17] Whether the complex reality we are facing be a living being, a society, a political state, a work of art, etc., we intuit that here is an ultimate manifestation of "self-organization". On all levels phenomenology of life apprehends this ontopoietic process unfolding from within and directed by the guidelines intrinsic to the complexity-in-formation, beingness, entity.

Thirdly, philosophy of life and the sciences of life meet in the intuition of the guiding entelechial sequence of life's unfolding, the linkage between individuation and speciation, the individual and the evolution of forms.

Fourthly, and most importantly, science and philosophy of life meet in the intuition of the Archimedean point that is the ground for inquiry into all existence, that is, the creative condition of the investigator, whether experimenting, or observing, or speculating.

This convergence in philosophy/phenomenology and the physical and life sciences of intuitions striking the same chords on the crucial issues of our culture has yielded an universal platform of the sntopoiesis of life upon which the great issues may be envisaged anew.

Therefore we will enter into our analysis of these essential correspondences by discussing the convergence between the "physical subject" of scientific experimentation and the creative human act and the more fundamental ontopoiesis of life.

[17] See Creation et desordre, op. cit., pp. 13-53.

Part Two

1. The Creative Act of the Human Being as the Archimedean Point of the Encounter between Science and Philosophy of Life

a. The "Physical Subject" in Scientific Inquiry and the Creative Mind

It is on the point of the inquirer as "subject", as the concrete center of any investigation, a point now recognized by the New Science, that science and philosophy of life and of the human creative condition arrive at a crucial understanding. Listening to an experimental scientist talk about his experience, we enter into the heart of the matter:

It is an experience like no other experience I can describe, the best thing that can happen to a scientist, realizing that something that's happened in his or her mind exactly corresponds to something that happens in nature. It's startling every time it occurs. One is surprised that a construct of one's own mind can actually be realized in the honest to goodness world out there. A great shock, and a great joy.[18]

The experiences of the scientific discoverer are not like any other. It is an experience of the creative mind. It is precisely the creative human mind immersed in the natural, physiological, psychic, intellectual circuits of an individual human person engaged in creative activity that calls up from its innermost core such powers as allow him or her to meet the powers of nature itself. The phenomenology of life and of the human condition proposes an evolutionary phase in which emerged the human creative condition accounting for this extraordinary synchronization of functions, energies for the constructive application of powers, for this extraordinary condensation of the entire spectrum of the universal conditions that the human creative mind emerged from, a mind that is not only capable of objectifying, differentiating, and charting the immensity of the real in which other beings are passively immersed in and participate in, but is – at the summit of its powers – capable of entering into the inner workings of that reality.

Hence it is from the point of investigation into the human creative genius that it is appropriate to enter into the exploration of reality. Here is our Archimedean fulcral point from which to probe all existence. Along these lines we pay close attention to Alexandre Kojeve as he describes his

[18] Leo Kadanoff, quoted in James Gleick, Chaos, Making a New Science (New York: Penguin Books, 1988), p. 189.

views as a physical scientist on the human subject as the reference point of scientific inquiry, of all inquiry. Kojeve – in his magisterial analysis of the basis upon which was founded the causal determinism of classical physics and of the principles by which it was undermined – elucidated the interpretation given by Niels Bohr to the arguments presented by Heisenberg on the essential and unavoidable imprecision of any attempt to examine the world physically, on the impossibility of speaking in physics of "exact causality in the structure of the world".[19] Bohr's interpretation is, according to Kojeve, a mathematical expression of an absolutely general principle according to which no physical observation is possible without the state of whatever is observed being modified "by the very fact that it is observed"[20]

It is not that physicists were not over time aware of this "gnoseological" state of affairs, but it was Heisenberg who drew all the conclusions together. These conclusions could have been drawn already within classical physics. According to Kojeve, "a necessary consequence of the classical principle of the equality of action and reaction is: if a physical entity is observed that means that it 'acts' upon the instrument of observation; this instrument has then necessarily from the outside 'acted' upon it and modified it in a certain fashion".[21] That is to say, with Heisenberg and Bohr it is the nature of experience and experimenting in physics that was brought into focus. With the theoretical assumption that physics deals with the real world and with the concepts which ultimately may be brought to experimental data, Bohr specified that physics does not deal with one world system as it is in itself but with two systems: the system of the observed and the system of the observer.

There is no way in physics to change the fact that it moves along the borderline between these two systems, which are both opposed and inseparable. Kojeve specifies: "In effect, the observed system is not accessible to experience unless insofar as it is in an interaction with the observing system, modifying it, and is in turn being modified by it".[22]

There are two consequences of this capital recognition. One of them leads Kojeve to affirm that it constitutes a principle rejecting classical causal determinism in physics, effecting the passage to modern physics which holds that physics does not study the world "in itself" as idealized

[19] Kojeve, L'Idee du determinisme, op. cit., p. 152.
[20] Ibid.
[21] Ibid., p. 154.
[22] Ibid., p. 157.

by the spirit but the world which is real and is given in experimentation and observation, in experience, that is, made by scientists with real, physical instruments, scientists who themselves are part of the real physical world that they study. The second conclusion that we may draw with Kojeve from Bohr's analysis is the clarification, elucidation of the situation of scientific experience as such. This clarification leads to the definitive acceptance of the physical subject at the center of physical inquiry, which subject belongs to the real world and simultaneously observes it and acts upon it, reaction to which in the world physics obtains in its data later.

Here comes the fascinating question of just how we should understand this subject in scientific experience. Philosophers have long since discussed these things and various of their formulations have thrown up distorting grids between the real world and the perceiving, experimenting subject. The main requirement of the new science is that the subject be seen as belonging to the same ontological region as the world and as interacting with it. In any case, I claim that given all this we cannot continue to consider cognition to be the main factor in scientific experience.

True, Heisenberg in discussing his "idealized" experiences emphasizes that he is discussing the cognition of the real but not the real itself. (This is also the view of Stanley Salthe, who throughout his book Development and Evolution, Complexity and Change in Evolution, to which we will return later, emphasizes that physics is talk about the 'discourse' concerning reality and not about reality itself.[23] But in a 'discourse' approach the subject is of the same significance discussed above, since he is the author of the discourse).

However, I propose that we ask ourselves what we must understand in speaking of the subject in the experience of scientific inquiry; we have to turn our attention to the collection of scientific data, their "verification" through technology. In the perspective of this collection we find a direct interference of the subject in the real, physical nature of the world. It is not discourse about this nature that makes it possible for the inventor to apply physical principles, to put material, physical materials to use. I submit that we must keep this point in mind as we seek a more adequate description of the subject in experimental experience and that we should seek it elsewhere

[23] Stanley Salthe, Development and Evolution, Complexity and Change in Biology (Cambridge, MA: MIT Press, 1993), p. 44: "Once more I remind the reader that what I am talking about is not the world but discourse".

than solely in the cognitive faculties of the human being. These faculties have to be acknowledged to belong essentially to processes deeper than our experimenting and law formulating. We reach the workings of nature under a yet deeper jurisdiction.

To state our problem in its fullness let us call it after Bohr the problem of the relationship between the system of the observer and the system being observed.[24]

A. If we attempt to analyze these systems, we find that the subject in the experience has to be a real physical, physiological being in order to belong to the real world. But physics, and science generally, is not interested in the variables that account for the singular features of a phenomenon. On the contrary, science is concerned with the constants. Consequently, we cannot conceive of the subject as being a singular individual with varying tastes, capacities, tendencies, etc. Inasmuch as the subject has to be concrete living being, we have to make an abstraction of its singularities and focus on its universal/concrete individuality. According to Kojeve, the "physical subject" is a physical entity insofar as it is represented by a system of physical entities".[25]

B. To its system must belong the entire schema of a specifically human personality embodied within a physical, biological framework. Here is a specific type of personality which is inclined toward and endowed with the capacities for scientific inquiry and it assumes various constant forms in accord with the special scientific interests of scholars.

C. How could we conceive of the scientific subject otherwise than as one endowed not only with all the elementary sensory, emotional, and valuating faculties making it an integral participant in nature/world, but with a mature human mind with its focusing, deliberating, calculating, and speculative powers? How could any observer not endowed with these three modes of operating even approach reality?

And yet, this is not enough. In order to complete the picture we have to acknowledge the great lights that throw it in relief. This entire system would not fulfill the expectations we commonly have of it if it did not rotate in all its aspects around the Archimedean point that is its specific but constant axis: the creative virtualities subtending the mind – the creative imagination inspiring it and the creative act bringing that imagination to its unique fruition.

[24] Niels Bohr, Die Naturwissenschaften (quoted by Kojeve, op. cit.).
[25] Kojeve, op, cit., p. 167.

If we unfold the "creative system" of the human being as the scientific subject, we will understand it in the light of what is accomplished in this extraordinary interaction between the technical application of science and the workings of nature. We will also unroll and circumscribe the creative compass of all the spheres of reality/life in which the living creative subject has to participate in order to assume the role of the observer or experimenter, or discoverer, inventor, creator.

In short, I submit that only the creative mind of the human being can fulfill all the conditions set by Kojeve, first, and most significantly, by legitimating its extraordinary vantage point and second by introducing us into the hidden spheres of reality itself.

b. The Circuits of Reality Revealed through the Creative Act of the Human Being

The thesis of the argument we will present may be summarized as follows. Within the mental, cultural, and vital expanse of the living human being there are present peculiar vestiges of all the molds in which living beingness has progressively unfolded from the womb of the biosphere, of all the degrees of life's inward/outward directed system of unfolding. As the study of phylogeny and ontogeny shows us, none of these constructive steps can be omitted in the progression to the next level. This means that the human individual stretches vitally throughout space within the Human Condition.

But let us now begin our argument within our own context, showing that it is in the creative act that the human being retrieves the fruits of its unfolding.[26] Where physics begins with the most fundamental elements of the real, in following the creative act of the human being, we have to distinguish first the sphere of the spirit and intellect of the human being – what is most directly engaged in the intuitive, exploratory, inventive, and creatively imaginative processes. But following this thread we are led to the vast turmoil of the individual psychic life of the human person. Here, first of all, a person gathers a conundrum of habits, predilections, scales and categories of evaluation which permeate his or her functional system. All this, however, is to some or other degree conducted or inclined by the per-

[26] For this context, see Anna-Teresa Tymieniecka, Logos and Life, Book 1: Creative Experience and the Critique of Reason, Analecta Husserliana, Vol. XXIV (Dordrecht: Kluwer Academic Publishers, 1988).

sons's will, aspirations, curiosities. We must recognize that personal factors in our psychic functional system command our feelings, emotions, wishes, aspirations, and the like and have an overall combinatorial tendency to bring the turmoil of disparate acts into some cohesive constructive composition whether merely to serve the demands of survival or at higher levels personal satisfaction, a sense of accomplishment.

We will see this psychic openness to constitutive modes much more clearly still if we will consider that it is immersed in a quite different preconscious turmoil, a turmoil involving the arbitrary and deformed.

And the intuition of Heraclitus comes to mind who, as interpreted by William Capelle, says: "Die Natur der Welte enthuelle sich ihm als er in die Tiefen seiner eigenen Natur hinabsteig".[27]

The idea of the human being as a cosmos in filigree is as old as Western Philosophy. Already with the Pre-Socratics Anaximander speaks of the cosmos as mirroring the human social order insofar as it indicates that its composite elements are to be kept within the confines of "justice" and "retribution".[28] Pythagoras draws a parallel between the "harmony" he conceives to be central to the order of the cosmic spheres and the human being in whom body and soul have to work together in harmony on a miniature scale.

This idea of the human being as presenting in miniature the whole of cosmos is reflected in Plato – in the Timaeus 35 A – when he draws a figure of the human soul and its combining opposite strivings toward the "pure" world of ideas and the "lower" world of the body as a charioteer driving two horses with great difficulty, for reason and irrational desires do not easily carry on together. The soul by partaking in both worlds plays a median role between them.

But it is in Leibniz's concept of the monad that we find the most striking picture of all living beings – each is animated, alive, and reflects the entire universe. It does so according to its own expansion and in its own perspective. Each living being is an embodiment of the universe, its living

[27] William Capelle, Die Vorsokratiker, die Fragmente und Quellenberichte übersetzt und eingeleitet (Leipzig: A. Kroner, 1935), p. 148. In my monograph "The Great Plan of Life" in Anna-Teresa Tymieniecka (ed.), Phenomenology of Life and the Human Creative Condition. Book 1: Laying Down the Cornerstones of the Field, Analecta Husserliana, Vol. LII (Dordrecht: Kluwer Academic Publishers, 1997), I quote and discuss this fragment.

[28] Rudolf Allers, "Microcosmos from Anaximander to Paracelsus", Traditio 2 (1944), pp. 319-409.

transposition in filigree, pulsating with the universe's life on its very own. Leibniz saw infinite gradations in the complexity and modes of nature, each of them reflecting the universe in its making.[29]

In his conceiving of the individual living being as a monad, Leibniz emphasized the reasons why "each created monad represents the whole universe".[30] He brings out first his general metaphysical concept that all there is interconnected. We read earlier,

For everything is a plenum, so that all matter is bound together, and every motion in this plenum has some effect upon distant bodies in proportion to their distance, in such a way that every body not only is affected by those which touch it and somehow feels whatever happens to them but is also, by means of them, sensitive to others which adjoin those by which it is immediately touched. It follows that this communication extends to any distance whatever. As a result, every body responds to everything which happens in the universe, so that he who sees all could read in each everything that happens anywhere, and, indeed, even what has happened and will happen, observing in the present all that is removed from it, whether in space or in time "All things are conspirant", as Hippocrates said.[31]

And then, to come back to the passage previously quoted explaining how the monad may mirror the entire universe, he writes:

Thus, although each created monad represents the whole universe, it represents more distinctly the body which is particularly affected by it and of which it is an entelechy. And, as this body represents the whole universe by the connection between all matter in the plenum, the soul also represents the whole universe in representing the body which belongs to it in a particular way.[32]

The great question is what is the "position" of the human mind such that we may attribute to it the power to descend into the inner workings of becoming and to then lift them up from their particular irregular/regular, chaotic/leading mix to an ordering, seemingly separated from that mix and in fact involving intermediary territories. What "sight" sees into this

[29] Gottfried Wilhelm Leibniz, Monadology, ed. and trans. Leroy E. Loemker, in Gottfried Wilhelm Leibniz, Philosophical Papers and Letters (Chicago: University of Chicago Press, 1956), 2 vols.

[30] Ibid., p. 1055.

[31] Ibid., pp. 1054-1055.

[32] Ibid., p. 1055.

immeasurable turmoil in which no order, no reason is visible and then distills sense from its fragments, truncated pieces, segments of ordering-in-process and by innumerable nudges provokes recognition of the wealth of rationalities which are projected by the conjunction of hazard and necessity in their constructive game?

We submit that it is precisely in the transitory phase of the Human Condition that we have within the topsy-turvy flux of constructive/destructive, advancing/receding progress within the distorted and yet constant "unity-of-everything-there-is-alive" an effervescence of the vast intermediary phase stretching from the life process getting ready for its constructive swing to the radical transition in which self-enclosed inner direction shifts toward an ever widening opening for interaction with the environment, interaction in which the soul in its "highest" swing enters into the entire spread of the "lower" bodily, organic and inorganic functioning of nature-life as well as the cosmic dynamism.

The imaginary intuitions of the Greeks, the metaphysical speculations of the moderns find an echo in the contemporary approach with its reformulations and adumbrations – its opening horizons. First, the human microcosmic realm at every moment gathers into its composition the functioning of the various preceding phases of the evolutionary process; nothing is lost; all is revaluated with respect to the new virtualities currently being activized.

We have confirmation of this in science. Paleolontologists in reconstructing the intermediary stages of the brain's development from anthropoid to full human being have found an incremental enlargement of the brain. At the same time neuropsychologists have demonstrated that the human brain is composed of three spheres of functioning that are all the time actively adjusting to each other. That is to say, homo sapiens has three brain centers, the reptilian brain, the mammalian brain, and the human brain. The reptilian brain evolved first and is still maintained in the human brain. Reptiles are characterized by lack of care for their offspring. When the mammalian brain evolved millions of years later as an extension of the reptilian brain, the reptilian brain did not vanish. It remained to provide the instinctive responses needed for individual survival, while the mammalian brain extended the individual's concern to the care and survival of its offspring and its group as well, but not beyond that. We see this at work in present-day animals. Some of them, like birds, display a solidarity with their whole flock. The brain specific to humans sustains what I call "creative" activity. It allows the expansion of the

social, cultural world, while relying on the instinctive and caring responses of the reptilian and mammalian brains.[33]

This "third phase" in the human brain's development was marked by the growth of the neocortex. Its development made the median position of the human being possible. Self-individualizing beingness unfolded its latent powers, virtualities, valuating capacity at this stage allowing an outburst of personal freedom by which the individual may take in hand, at least partly, its own course, forging its own identity and destiny. This is the grand transitory phase in which all that was tending precisely toward such a liberation of the latent faculties of living beings saw the dawn of the Human Condition. A measure of freedom was realized within individualizing existence. All the preceding threads of the self-individualization of life have been gathered up and reworked in the accomplishment of this transition. The individual may now employ for itself all of life's streaks of energy, forces, segmented integrations, disintegrations, powers to mold its own functioning in novel significant fashions. This is what the creative virtualities of the Human Condition offer.

Thus the human condition becomes a relatively stable station in the process of life's game, a station processing all the material coming from the "lower" circuits of existence for the establishment of a "higher" region, that of the creative mind. The novum which the human condition as a phase in the progress of life presents is precisely creative virtualities attuned to the unique conglomerate of functions gathered up in this constructive passage.

The creative act of the human being in its meanders yields insight into the "creative forge", the sphere in which our specific, singular objective oriented creative process encounters its source. The source is the human being who carries out the creative quest. In this quest the human being descends not only into the originary moment of the singular creative process but most significantly into the networks of its existential/vital functions, which carry the creative quest as such. He discovers that the specific creative search after a shape, a form, or a substance for an object in view is carried on by a shifting schema of functions in which all of the individual's powers – the intellectual, imaginative, sentient, volitional, physiological – are involved in specific ways, employed from a center, this center being the fulcrum of force, the agency in which all the powers are gathered and from which they flow with roles being assigned them. In short, there is an "agency" in the performance of the creative act who plays all the strings that radiate in all direc-

[33] Stephen Jay Gould, Ontogeny and Phylogeny (Cambridge, MA: Belknap Press, 1977).

tions, a "power" that gathers and distributes, directs and controls every move, a central distributor of forces and roles, a full-fledged conscious being who is obviously self-governing and self-initiating in its acts. This so ramified, versatile, imaginative, and powerful constitutive act fulgurates from its innermost. It is a simultaneous orchestration of all the faculties under the aegis of a creative imagination that projects possibilities, of an intelligence that scrutinizes, compares, differentiates, etc., and of an effective will which prompts the search and the progress. All of these faculties represent the dynamic complex of the living individual carrying the process and determining its self-promoted constructive/interpretive route. Here we gain access to the inner virtualities, freely projected from within in consistent albeit fluctuating and changeable directions as trial and error dictate – directions whose sequence itself knows interchangeability and mutability, is uncertain in its steps, and yet, as fragile as it may be and as unpredictable as its outcome may be, being subject to disruption and periods of stagnation, still advances with a discrete continuity/discontinuity of purpose. In all its potentialities, virtualities, advantageous situations for their actualization as well as hindrances, through progressive steps, this is a self-projecting, self-organizing system of meaning by which an entity, an object, a creation is produced by human acumen and power as it were crystallized.[34] These poietic threads reveal the lines human functional powers follow and the poietic selfhood of the human being as a projecting and effectuating agent.

Drawing a conclusion from the above, we may recapitulate by stating that it is due to the creative virtualities of the human condition – as a station in the evolving progress of types with all their ties to the cosmos and its laws and to the biosphere – that the human creative act may progressively penetrate into all the spheres of existence, of life, the reality in which this station is not always openly rooted but out of which it has developed in stages maintaining permanent ties.[35] Since these developmental stages represent the becoming of the universe of life, we find here a new version of the Leibnizean monad that "reflects" the entire universe. But as we will see in our further analysis, this is a different type of monad.

[34] For a fuller treatment of cultural creation, see Anna-Teresa Tymieniecka, Logos and Life, Book 3: The Passions of the Soul and the Elements in the Ontopoiesis of Culture. The Life Significance of Literature (Dordrecht: Kluwer Academic Publishers, 1990).

[35] See my elaboration of the Human Condition in Anna-Teresa Tymieniecka, "The First Principles of Phenomenology of Life", Analecta Husserliana, Vol. XVII (Dordrecht: D. Reidel, 1978).

The significance lies in the elucidation of in virtue of what the creative act of the human being may penetrate into the innermost workings of nature, existentially partaking of the interaction which the living being maintains with them. For this is what makes the creative human individual unique and what must be taken into account in appreciating him or her as the "subject" in scientific experimentation and experience.

c. Having reached with the human creative act not only the point of the encounter with the discovery endeavor of the scientist but also with that of the writer, artist, choreographer, poet and of every undertaking of the human being aiming at the grasp, ciphering and formulation of reflective experience, we may indeed, establish a platform for the investigation of all human endeavor in respect to the functions of the mind and of their life significance. A vast field upon which education may seek to project the ordering of its "choral dance".