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A Brief History of Mind and Civilization

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Abstract

The rational mind is the highest evolved status of human consciousness. The evolution of mind and civilization has proceeded hand in hand for millennia. The development of new capacities of mind made possible the development of tools, language, agriculture, permanent settlements, towns, cities, religion, trade, transportation, communication, government, law, money, literature and the arts, education, nation states, scientific and technological research. So too, each stage in the development of civilization has shaped the evolution of the human mind and its faculties and the way they are applied in life. The limits to our knowledge and accomplishment reflect limits to our rationality and the utilization of our mental potential. Our knowledge consists of fragmented, piecemeal, compartmentalized theories, when the reality we seek to understand is inclusive, complex and integrated. Our conceptions are based on mechanistic, static, inflexible equilibrium models, whereas the world we live in is alive, dynamic, organic, conscious, responsive, creative and continuously evolving. Our science assumes the poise of an impartial observer of objective reality, whereas all knowledge without exception is colored by the subjective perspective of the observer. Our science strives to be neutral and value-free, whereas the knowledge we need should help us realize universal values. We need to evolve ways of thinking that reunite the objective and subjective dimensions of reality and reflect the integrality, dynamism and vibrancy of evolutionary nature. That is the challenge and adventure before us.

1. The Paradox

The advance of knowledge over the past two centuries has been awe-inspiring. Our understanding of the physical universe and our own evolutionary past now extends millions of light years across the universe and billions of years back in time. Our capacity to measure and process data, transmit and disseminate facts, formulate new concepts and ideas, discover and invent, organize and educate, create and imagine, and harness the forces of Nature for human ends has multiplied exponentially.

Knowledge is power and never before has humanity known so much about the world in which we live. Yet never before have we faced challenges of such unparalleled magnitude and complexity, which defy solution by existing knowledge. Our progress has had unintended consequences. Efforts to develop a truly global civilization on the foundations of science and technology have been accompanied by rising levels of economic insecurity, political turmoil, social unrest, displaced populations and environmental instability. Our economic system leaves billions in poverty and promotes widening inequalities. Our mechanical inventions displace, alienate and dehumanize us. We are dominated and oppressed by the monetary system intended to enhance human security. Our inability to establish effective instruments for democratic global governance leaves us powerless to address the existential threats posed by nuclear weapons and climate change. Our way of life ravages the Earth. In spite of ever increasing knowledge, our sense of uncertainty and insecurity is increasing. In spite of ever greater power of control and mastery over the forces of physical nature, there is an increasing sense of powerlessness to control the forces we have unleashed and the future course of our own evolution.

Concerted efforts are being made at the national and global levels to address each of the political, economic, social and ecological threats confronting humanity in the 21st century. New policies have been applied to enhance control. New institutions have been created to improve coordination. Yet these efforts have been largely ineffectual and often counterproductive. A quarter century after the end of the Cold War, political tensions are on the rise and nuclear weapons continue to proliferate. The recent flood of refugees into Europe threatens to undermine decades of progress toward European unity. In spite of unprecedented inter-governmental coordination, global financial markets remain unpredictable, unstable and uncontrollable, and multinational corporations increasingly operate beyond the reach of national governments. In spite of institutional and policy initiatives at the national and international levels, all of these problems appear to be growing. No effective solutions are in sight to counter the rising number of unemployed youth and displaced migrants, the spread of nuclear weapons, depletion of soil and water, the drug trade, cultural conflicts, terrorism, and climate instability.

The World Academy of Art & Science has traced the roots of these multiple challenges to a common set of underlying factors. They are all global in nature and defy solution at the national level. They are all interrelated and defy solution by fragmented, piecemeal sectoral strategies. They are all the result of rapid globalization in the absence of effective institutions for global governance. They are all impacted by the increasing difference in the pace of technological innovation and cultural evolution. They are all perpetuated by outdated social institutions. As Canadian mathematician William Byers insightfully summarized it, "What looks like a series of disparate crises is really one crisis that manifests itself in various ways—one all-encompassing crisis that arises from inner contradictions that are inherent in modern culture."[1]

Research by the Academy has led to the conclusion that these multiple crises are the result of three deeper root causes. First, they all reflect the limitations of prevailing knowledge in the social sciences. The failures of policy measures and institutional reform reflect the insufficiency of our understanding about how human society grows, develops and evolves. This has led WAAS to conclude that a radically new paradigm in thought is needed to support a new institutional and policy framework founded on the values of human welfare and well-being.[2] For the past five years WAAS has been promoting initiatives to foster new thinking on

human-centered economic theory, on a conceptual framework for a comprehensive paradigm for human development encompassing all dimensions of social existence, on basic principles of a transdisciplinary, integrated, value-based science of society, and on the unique catalytic role of the individual in social development.[3,*]

The second conclusion from this research is that the present crises are a result of the current distribution of social power in the world. Theoretical knowledge of society is incomplete so long as it fails to comprehend the way in which social power is generated and distributed. Social power refers to the cumulative capacity of society to accomplish whatever goals it aspires for. Never before has humanity possessed so much power—power to interact, communicate, exchange, transport, produce, discover, invent, educate, experiment, prolong life, entertain and enjoy. Yet never before has the distribution of social power and its fruits been as uneven and inequitable as it is today. At a time when society possesses more than sufficient capacity to ensure sufficient food, clothing, housing, education and health care to meet the needs of all human beings, billions of people still struggle for bare survival. Existing social institutions and policies have failed to remedy the situation and existing economic and political theories largely ignore this underlying problem. This has led WAAS to initiate an inquiry into the theoretical and historical origins and determinants of social power.[4]

Third, and most importantly, this research has led to the conclusion that all these causes are themselves founded on a more fundamental cause arising from the way modern society has developed the faculties of the human mind. The crises confronting civilization today are rooted in the way we use our minds—in the way we think.[5,6,7]

2. Mind

The basic premise of this paper is that the course of human civilization has been the result of fundamental evolutionary advances in development of the human mind, its faculties and powers for knowledge and conscious action. The central thesis is that the dilemma confronting civilization in the 21st century reflects inherent limitations in the specific way in which modern civilization utilizes the powers of mind; namely, that the present combination of analytic and systems thinking in concert with mathematics and the scientific method is inadequate to comprehend and effectively deal with the root causes and complexity of the challenges we face. Moreover, the institutional and social authority presiding over the present intellectual framework has itself become a major impediment to the formulation of more effective knowledge, particularly in the human sciences. The central conclusion of the paper is that we need to consciously strive to enhance our understanding of the characteristic ways in which we think, to increase our awareness of the inherent limitations and blind spots generated by those characteristics, and to develop the capacity to think creatively in a more comprehensive and integrated manner outside the confines of the existing conceptual framework.

2.1. Mind, the Instrument

Mind is humanity's most developed instrument for knowledge of self and world. Like every other instrument, mind has certain capacities and is subject to certain limitations. Science has expanded our knowledge of the world around us by developing the microscope, telescope, X-rays, chronometer, spectrometer, computer and an endless variety of other tools. In each case it has discovered both the utility and the limitations of these tools, the range of their effectiveness, the distorting factors that influence their accuracy and the inherent limitations to their power. Knowledge about the characteristics of each instrument is essential for using it appropriately. Modern civilization is founded on the primacy of scientific discovery. Minute attention is focused on the procedures and processes for validating scientific hypotheses and developing new instruments to extend the reach of our senses and the computational capabilities of mind, yet very little attention is devoted to learning more about the creative processes of mind itself, which are the source of great scientific discoveries. Having utilized mind as our principal instrument of knowledge for thousands of years, it seems ironic that there is so much about the nature, functioning, and limits of the mind and its faculties that we have yet to understand.

Our preoccupation with using the instrumentation of mind has nearly eclipsed serious inquiry into the nature and operation of mind itself. Neuroscience has recently made significant strides in understanding the structure and functioning of the human brain and its relationship to memory, sensory and motor functions. Computer science and artificial intelligence have discovered how to mimic certain mental capacities, such as memory and computation. But our understanding of fundamental processes of conscious awareness and knowing, self-consciousness, thinking, reasoning, insight, creativity, willing and decision-making remains rudimentary. Indeed, we still lack even a clear definition or conception of what mind is, the myriad faculties it possesses, the various types of thinking that characterize human cognition, and the other processes it consciously utilizes for knowing and willing. Consciousness determines power. We cannot have mastery over that of which we are not conscious. This paper examines the relationship between the way we utilize our mental faculties, most particularly our faculties for thinking, and the course of development of civilization.

This brief history of mind and civilization traces some important stages in the evolution of our capacity for thinking and its impact on the type of knowledge we have acquired and the development of civilization. It covers the broad sweep of human history in an impressionistic, anecdotal manner, highlighting landmarks central to the argument and ignoring others that are not central to the thesis being developed. An effort is made to draw particular attention to aspects that seem most relevant to the present and likely future stages of our mental and civilizational development.

Mind excels in a linear, step-wise, chronological analysis of unidimensional processes in the physical world. However, it is unlikely that the process we are attempting to trace is linear in its development. For it occurs on multiple levels of our existence, involves complex interactions between innumerable factors, alternating between progressive and regressive movements. The actual

* See World Academy of Art & Science project site on New Paradigm http://www.worldacademy.org/new-paradigm?quicktabs_new_paradigm_main=0#quicktabs-new_paradigm_main

evolutionary process is far more complex than any description of it. A major source of this complexity is the fact that our existence contains both objective and subjective dimensions—the world around us and the world of conscious awareness and activity within ourselves. These two complementary dimensions sometimes develop in tandem and sometimes in apparent opposition to one another—subjective belief claiming sovereignty over our knowledge of the material world or apparent material fact dictating the terms of reality for our psychological self-experience. The history of civilization seems to fluctuate between these extremes, reacting periodically to restore the balance. Thus, a narrative of mind and civilization is a dance between our inner and outer worlds.

Another complicating factor is that we live and act on three planes of existence. Apart from sensations, actions and events that occur in the physical plane, human beings are aware and act simultaneously in life or vital plane in which we perceive, relate, interact and react nervously and emotionally with our environment and with other people. We also exist in a mental plane of facts, thoughts, opinions and ideas in which we observe, conceive, understand, create and decide. The evolution of mind occurs simultaneously in all these three planes. As civilization transits through different stages or phases of development, it also undergoes shifts in the relative emphasis it places on each of them. Ancient Indian culture organized its thought and life around spiritual truths. Hellenic culture centered on the mind and its conceptual ideas. Modern society is preoccupied with the application of mind to the physical world and society by means of technology. Humanity's understanding of its place in the universe, of our relations with one another, of our own psychological processes and capacities for knowledge are continuously evolving. This historical narrative will examine significant developments in relation to all three planes and the interactions between them.

The application of mind for the development of civilization has occurred in four major spheres of social activity that are expressions of four interrelated components of the human mentality—the capacity for conceptual thinking and logical reasoning; the capacity for ethical thinking and moral discrimination; the capacity for aesthetic creativity and appreciation; and the capacity for physical design, practical organization and efficient application for execution of activities in space and time. Philosophy, religion, the arts, science and technology are civilizational products of these capacities.

3. The Conscious Thinking Animal

Mind is a faculty of consciousness. Human beings are distinguished from other animals by the development and progressive emergence of conscious mentality. Lower order species possess to a limited extent many of the characteristics that we associate with conscious mentality, including language, purposeful actions, specialization of function, organization, and development of tools. But the mental capacities and 'knowledge' other species possess are mostly in the form of subconscious instinctive behaviors driven by biological urges, rather than conscious learning processes and conscious volition. The language of animals appears rudimentary in comparison to the extraordinary diversity, complexity, versatility and richness of human speech. Other animals seem to lack the mental capacity for self-awareness and reflection on their own existence which is characteristic of human beings. Do apes ever wonder why they were born or what it would be like to be human? Animals learn but seem to lack the capacity to consciously pass on learning from one generation to another. Animal behavior and social existence remain relatively unchanged from one generation and one millennium to the next, whereas human beings have continued to evolve higher forms of knowledge and new forms of civilization.

The principal faculties of mind include conscious awareness, self-awareness, perception, observation, memory, symbol formation, thinking, judgment, imagination and decision-making. Each of these faculties can be further subdivided in innumerable ways. This paper focuses primarily on the faculty of thinking, and the characteristics of the various types of thinking human beings have developed for the pursuit of knowledge, and the relationship between the ways we think and development of human civilization.

Thinking in earliest times seems to have been narrowly focused on specific actions designed to meet specific physical needs and interactions with the physical environment. The capacity of human beings to conceive of and fashion tools and instruments represents a rudimentary form of thinking. The earliest known stone axes were made 2.7 million years ago. Evidence of campfires are about 790,000 years old. Constructed dwelling places date back to 350,000 BC. Blades, needles, grindstones, paints, fish hooks, spear points, harpoons and mining instruments appeared in succession before 50,000 BC. The needle is of particular significance because it made possible fashioning of tightly fitting warm fur garments that in combination with fire enabled early Homo sapiens to survive in very cold northern climates such as Siberia, which eventually became the land bridge for the peopling of the Americas about 25,000 years ago.[8] These inventions demonstrate that early man had the capacity to translate conscious thoughts into action by a process referred to as decision or will. The development and spread of tools are indicative of what Merlin Donald calls mimetic thinking. Early man learned to cooperate and coordinate their activities as members of social groups. They learned from one another by example before the advent of spoken language facilitated oral communication and transmission of knowledge.[9]

Apart from these physical preoccupations, no evidence is available to determine at what stage early human beings began to reflect on the factors that differentiated them from other animals, the reason for the changes of season, the morality of their actions, their own mental and psychological reactions, or the purpose of their lives on earth. These higher forms of reflection required the prior development of language with a sophisticated vocabulary, concepts and ideas.

3.1. Symbolic Thinking

Mind has the capacity for pure self-awareness. We know that we exist without the intermediacy of senses or even of thought. But the faculty we call thinking is a form of indirect knowledge. Our mind receives sensory data about the world around it, interprets that data and derives knowledge from it. It hears a loud cry, identifies it as an animal, and analyzes it to determine whether it is that

of a prey or a predator. The data of the senses is distinct from the objects of sensation and the knowledge derived is distinct from the data. It is indirect knowledge. "Mind can only have the direct consciousness of self in the moment of its present being; it can only have some half-direct perception of things as they are offered to it in the present moment of time and the immediate field of space and seized by the senses. It makes up for its deficiency by memory, imagination, thought, idea-symbols of various kinds."[10] We try to identify and judge the subjective intentions, mood, and capabilities of another human being by their behavior, expressions and gestures. We have no direct capacity to perceive their subjective state.

Thinking is also a separative form of knowledge. The thinking mind does not directly perceive reality. It perceives thought-forms and formulates thought-symbols representing reality but separate from it. Physical sensation and experience impact on mind in the form of mental energy. The loud cry of an animal generates a mental sensation that activates the mind to full alertness. But until the mind interprets the sensation and identifies it as friend or foe, it does not possess knowledge. As soon as it recognizes the sound as the roar of a lion, it converts the energy into a mental form, a thought expressing the danger of an approaching lion. Then and only then does it also possess the capacity to transmit that knowledge to other minds in the form of symbols, signs or words. All symbolic, theoretical, conceptual, scientific knowledge is separative knowledge. It is knowledge of symbols that represent reality, not reality itself. Relativity and Quantum Theory, medical diagnoses of disease and econometric model of markets are conceptual representations of reality, not reality itself.

Thinking is a symbolic form of indirect, separative knowledge. It may begin with the primitive symbolic representation of the forces of nature as images or sounds or gestures. Cave art dating back 30,000 years confirms the development of symbolic thinking long before the emergence of complex languages. Evidence from this period of the widespread worship of the mother goddess most probably signified belief in the unique power of women for procreation. This suggests that man had not yet realized the relationship between sexual intercourse and the act of child birth nine months later. The symbol of the mother goddess reflected the sense of wonder and power associated with the act of procreation.

Primitive man shook with fear at the occurrence of a solar eclipse or an inauspicious configuration of the planets because he took these events as powerful symbols relevant to his own life. Symbols became the means for the creation and perpetuation of powerful superstitions. Superstition is the subconscious formation of a relationship between two or more things based on the perception or imagination that they are related with one another.

Symbolic thinking ushered in a transition from utilitarian thought focused on gratifying immediate needs to cosmological speculation regarding the nature of reality. Merlin Donald terms this as the transition to the stage of mythic culture in which language was first used to create conceptual models of the universe, grand unifying syntheses.[11] The German historian Karl Gotthard Lamprecht and the Indian philosopher Sri Aurobindo both describe a symbolic stage of psychological development in which man felt a great Reality behind all life which he sought through symbols and symbolic thinking which pervaded primitive society's thought, customs and institutions.[12]

These symbols were often laden with immense power. Historian Peter Watson identifies the idea of God as one of the three most significant acts of cognition in the long evolution of civilization.[13] Thus, numbers acquired mystical significance in many ancient societies as symbols of fundamental truths of existence, long before the rational mind had developed either the understanding or the linguistic capacity to render these truths into words. In Vedic India, intuitive knowledge of human consciousness and the universe was rendered into myths and symbols of profound insight, remarkable beauty and power, unintelligible to the modern intellect trained in analytic discourse. It seems likely that they were the result of intuitive faculties of mind that are no longer well developed or may one day yet become far more prevalent, as the capacity to read, write and calculate was at one time a rare endowment and considered a sign of genius. The brilliant Indian early 20th century mathematician Srinivasa Ramanujan regarded zero as the symbol of God, the apparent nothingness and unmanifest potential from which all emerges, and infinity as the deployment of that potential in creation. In the period of the Upanishads, symbolic images developed into symbolic words born of intuition, rather than rational thought. They sought to depict truths of existence rather than to describe and explain them in rational terms.

In fact, all words are symbols. All thoughts, concepts, theories and models are symbols. They are mental forms or images utilized by mind to represent reality, never reality itself. Today we utilize the same symbolic capacity of mind to infuse power into a currency note, a wedding ring, a policeman's badge, a scientific hypothesis and a doctoral degree. As early man came to accept the symbol as the reality, today we often mistake modern scientific theories for truth rather than abstract representations of truth and constructed mathematical or conceptual models of reality for reality itself. The sophisticated scientific theories, philosophical systems and theological doctrines that have influenced the development of knowledge and the evolution of society are all attempts to represent truths of existence in symbolic form accessible to human thought and communication.

3.2. Causality & Invention

Thoughts are a means of relating things with one another. The capacity to relate two or more things is a basic characteristic of thinking. But correlation is distinct from causation. Symbolic thinking attributes significance and power to things, but does not necessarily represent causal relationships. The capacity to relate cause with effect is a more advanced power of thinking, and one essential for the development of civilization.

One may wonder why it took so long for primitive human beings to learn how to imitate natural processes occurring right before their eyes. The invention of agriculture took place around 10,000 years ago and met an essential precondition for the evolution

of human civilizations. We can only speculate now regarding the mental processes that led to the invention of agriculture. The discovery of which plants, fruits, leaves, roots and flowers were edible and nutritious must have been a labor of many tens of millennia. The observation of where they grew and when they flowered and ripened must have taken even longer. But understanding these relationships was not sufficient to give rise to agriculture. Without language, these observations could not be communicated. Without written language, they could only be preserved by oral transmission from generation to generation.

It was also necessary for early man to closely observe the relationship between crops, soil types, rain, sunlight, temperature and the changing of the seasons. A long slow process of subconscious observation eventually must have led to the first conscious realization that human beings could replicate and even improve on the natural process. Instead of roaming the earth to find food, human communities learned how to imitate Nature. It fostered the development of sophisticated cognitive skills for planning, organization, specialization of function, and timely execution of complex sequences of activities. It led to the concepts of land as property and principles governing ownership. Agricultural surpluses spurred the development of trade and the advent of money, as a symbolic form of social power. The field of human productivity shifted from the land to the marketplace, from toiling on the soil to mutually beneficial interactions with other people. It spurred the rise of commercial centers, towns, cities, kingdoms, and overseas empires.

3.3. Early Civilizations

Archeologists associate the emergence of early civilizations with four important social developments: the invention of written language, the creation of cities with monumental architecture, specialization of work, and organized religion.[14] Organization is a characteristic power and action of mind. Mind organizes objects, ideas, beliefs, people, activities, events and countless other things. Civilization represents the outward organization of the life of the collective. It is made possible by the further development of a range of mental faculties and cognitive abilities.

The development of written language around 5000 years ago required a sophisticated capacity for precise definition, organization of thought and expression, and formulation of grammatical rules. The development of cities involved the orderly physical arrangement of structures, a division and categorization of activities, a hierarchical arrangement of authority and decision-making. Specialization of function required the capacity to break down complex activities into their parts, to arrange the sequence of steps and coordinate the relationship between multiple activities.

The development of religious symbolism and ritual long preceded the emergence of organized religion, which combines a mental construction of beliefs and ethical rules of conduct, a hierarchical organization of authority, social organization of the community and physical organization of events. The close and structured association between larger groups of people in cities was a catalyst for rapid advances in law, formal systems of weights and measures, trade, development of money, public administration, participative governance and education. These capacities in combination necessitated the systematic application of mental faculties at three levels—mental, social and physical.

3.4. Dividing Mind

Definition, categorization, organization, specialization, coordination and hierarchy are complex human endowments founded on the mind's capacity to differentiate aspects of reality, compare and contrast them, and express their relationships with one another in terms of space, time, characteristics, function, authority, action, and causality. These capacities derive from the power of mind for division and aggregation.

Mind is primarily and quintessentially an instrument of division. In its pursuit of knowledge, the characteristic action of mind is to divide reality into parts and deal with each of the parts as an independent whole. It distinguishes and categorizes these parts by comparison and contrast.[15] The earth is an undivided whole, but mind perceives it piecemeal, dividing it into geographic, geological and climatic regions, each with its own characteristics. All human beings share common characteristics, but they can be distinguished and sorted by size, sex, age, familial relationship, place of origin, skills, etc. The identification of differences is the basis for the mental faculty of definition, the delineation of characteristics, properties, qualities, categories, territories, social position, occupation, powers, privileges, varieties of behavior, personality traits, species of plants and animals, types of minerals, etc. There are innumerable ways in which the elements of any whole can be distinguished from one another. Therefore, there are an unlimited number of ways in which reality can be divided and subdivided. Thus, Wikipedia lists 27 types of snow and the Eskimos of Scandinavia have more than 200 words to describe different varieties of snow and ice.

Division is the origin of the mind's capacity for analytic thinking. The more it divides, the more it distinguishes, separates, compares and contrasts things with one another. It comes to consider each thing as a separate object of reality distinct from all others. Division also leads to abstraction of objects from their context. Thus we observe a ripe mango fruit as something separate and distinct from an unripened fruit, the inedible leaves, branches and trunk of the tree on which it grows, the soil in which the tree is planted, the sunlight and rain by which it is nourished, and the season in which it ripens. Similarly, mind divides us from one another and from the world around us. It separates the pursuit and dissemination of knowledge through science and education from the life of the community. It even divides our own inner psychological existence into thoughts, opinions, beliefs, sentiments, emotions, feelings, urges, desires, impulses and sensations. The mind's capacity for division is the origin of foundational concepts of modern science—the Cartesian divide between mind and body, the independence of the observer and object, and the distinction between objective and subjective forms of experience.

Mind also has a complementary capacity to aggregate the elements of reality it has divided in order to construct some conception of the greater whole of which they are the parts. Mind synthesizes the parts generated by analysis to create greater wholes. As the division of reality into parts is always based on a specific set of characteristics and differences, the aggregation of the elements to form a whole also depends on the characteristics used to reassemble them. Modern science has identified a diverse range of micronutrients known as vitamins, which are derived from a wide variety of very different sources and support the entire gamut of physiological functions, yet are grouped together to constitute a whole. In this case, the very small quantity required is the common factor between them that serves as the basis for combining otherwise very dissimilar substances. The whole can never be fully represented by an assembly of its parts, any more than the living human body can be represented by the sum of all the minerals, molecules, types of cells, anatomical organs, physiological functions and systems of which it is constituted. Thus, the whole is more than the sum of its parts, as Aristotle said. Analysis and synthesis, the capacity of the mind to divide and aggregate reality, lie at the root of all mental knowledge, the languages mind has evolved to formulate and express that knowledge, and the civilizations that have resulted from these developments.

3.5. Birth of Reason

What is described above is a simplistic rendering of the primordial stages of mental evolution in prehistoric times leading up to the creation of written language and the founding of civilizations. The capacity of the mind for acute physical observation, symbol and language formation, definition, categorization, correlation, organization and causation evolved gradually over very long periods of time in different places and grew through contact, exchange and imitation between early civilizations.

Thinking is primordial. The formulation of principles for valid reasoning was a later invention. The symbolic and intuitive knowledge of ancient India became in ancient Greece conceptual knowledge based on rational thinking and gave rise to the development of formal logic. They pondered the nature of definition and sought to identify the principles of effective reasoning. The Greeks sought to render reality into terms intelligible to the rational thinking mind. The Egyptians were concerned with the practical application of geometry. The Greeks transformed the practical tools of geometry developed in ancient Egypt into principles validated by formal proof based on logical reasoning. Greece lived in a world of ideas that were considered valuable in themselves, not merely for their practical utility.

Greece marked the transition from practically effective knowledge to ideative truth affirmed by rational mental processes. The combination and correlation of thoughts led to the development of complex abstract ideas and theories of knowledge. The birth of logic vastly augmented the mind's capacity for analysis by clarifying definitions and refining thought processes. The development of logic coincided with the conception that the universe is essentially a rational place that can be explained in rational terms.[16] The Greeks established science as the pursuit of knowledge of a rational universe knowable by observation and reason. Their science was wide and borderless, not confined to narrow conceptual boundaries or cut off from other forms of knowledge. It encompassed both natural science and philosophy. They developed democracy, mathematics, education, formalized the role of hypothesis and evidence in law, and based medicine on observation of symptoms and rational diagnosis.

The Hellenic period was remarkable for its development of rules for discernment by reason and logic and rules for communication through rhetoric and dialectic in quest of metaphysical and scientific truth. But it also applied analytic thinking to questions of justice, right and wrong, ethics and morality, which are at the core of organized religion and social thought. Nor did its rationalism prevent Plato, Aristotle and others from extolling the virtue of intuition in their mystical quest to realize transcendent spiritual truths.[17] The ancient Greeks also excelled in the application of the mind's aesthetic powers for the creation, appreciation and enjoyment in literature, architecture and sculpture. They invented a wide variety of expressive literary forms—historic, epic, philosophic, tragedy and comedy, pastoral and lyric, oratory and didactic. Reason, discrimination, judgment, imagination and intuition all contributed to the efflorescence of Hellenic civilization.

Hellenic civilization was extraordinary in one other way. It affirmed the value of individuality and individual uniqueness. Ancient Greeks never allowed strict rules of logic or mechanical laws of nature to infringe on the place of independent thinking, free will and creative imagination. They revered mathematics but would have scorned the indiscriminate application of statistical probability when applied to conscious human beings.

What is most impressive about Hellenic culture is its inclusiveness, sense of proportion, balance and harmony. Perhaps unique in history, the Greeks simultaneously pursued knowledge in all fields and by all means—in philosophy, metaphysics, polity, religion, the arts and applied science. They affirmed intuition and logic, aesthetic sensibility, mathematical precision and ethical conscience. They embraced the objective and subjective dimensions of reality. They applied the analytic powers of mind with great depth and precision, yet never lost sight of the larger reality which is eclipsed by the focus on minute particulars. They accomplished this by a remarkable tolerance and respect for diversity of perspective. While individual thinkers may have proclaimed with insistence the sole reality of the physical, their assertion was not permitted to overshadow or obscure contrary points of view. This sense of inclusiveness and proportion might well be the finest contribution of Hellenism to humanity. It appears all the more precious in the current age of exclusive concentration on the objective and the physical. Ancient Greece was able to aggregate an impressive range of perspectives, but it could not truly synthesize and integrate them to form a comprehensive conception of reality.

Rome inherited the Greek reverence for the powers of mind. But while in Greece, the principal field of application was mental knowledge and the creative arts, the mind of Rome was concentrated on social organization. Rome harnessed the powers of mind to organize the life of the polity, law, the military, economy, education, civil administration and civic life. It developed a written

body of law and a theory of jurisprudence. It organized education, establishing a widespread system of schools with a standardized curriculum. Greece gave birth to the modern mind. Rome gave birth to modern social institutions. Greece developed the intellectual and aesthetic faculties of mind to rare heights. Rome gave birth to the modern state founded on a culture of duty and discipline and based on development of the ethical faculty. The Greeks worshipped beauty. The Romans worshipped character.

4. Rise of Empirical Science

The evolution of mind in Europe was submerged for centuries during the Middle Ages by the collapse of the Roman Empire, the reversion to a feudal social structure, and the weight of church doctrine. Important developments during this period prepared the way for the explosive outburst of mentality that characterized the Renaissance, Reformation and Enlightenment.

4.1. Quantification of Reality

Quantification is an inherent power of the analytic faculty of mind that divides reality into smaller and smaller parts. The full development of the analytic mentality required the development of symbols, concepts and logical principles governing the use of numbers. The ancient Greeks gave emphasis to the geometric application of numbers for measurement, as in the fields of architectural engineering and astronomy. Indians made important advances with the development of the Hindu numerals and applications of trigonometry to astronomy at the end of the 5th century AD. With the perfection of the decimal system and solution to indeterminate equations and the addition of the zero symbol in the late 9th century, a decimal based system of positional notation was fully in place. The introduction of the Hindu numerals and algebra into Europe from Arabia gradually supplanted the Roman numerals. Precise quantification was extended to many fields of life. The use of letters in place of numbers in mathematics was introduced in the 13th century. The operational symbols in arithmetic were devised in the 14th. This was accompanied by a significant change in written notations. The order of subject, verb and object, the separation of individual letters into words, sentences, and paragraphs, the adoption of punctuation, chapter headings, headlines, cross references and alphabetization as an organizing principle were major advances. In combination, they facilitated the spread of literacy and the use of numbers. The spread of mechanical clocks from the late 13th century enhanced the consciousness of time. The development of musical notation combined symbols and mathematical concepts to denote both octave and tempo. The introduction of double entry resulting in the separation of assets and liabilities, debits and credits greatly facilitated the development of commerce and banking.

4.2. Return to Nature

While Greece focused on the application of mind to ideas and Rome focused on the organizing power of mind in society, the modern period began with intensive concentration of the powers of mind on the physical world. The power of the analytic mind turned its attention to the physical world of Nature. It gave rise to methods of inquiry that replaced the authority of Church doctrine with validation by physical observations.

A brief survey cannot do justice to the many stages through which modern science has developed or the complex array of civilizational advances that influenced that development. The founding of universities, spread of learning, and rediscovery of the Greek classical legacy gradually restored the preeminent authority of logical reasoning and empirical experience. It led to the development of inductive and systematic testing in the 12th century and the reemergence of mathematics, philosophy and metaphysics in the 13th century. A commercial revolution led to important innovations in agricultural production, manufacturing, entrepreneurship, trade, shipping, banking and insurance. This in turn gave rise to a bourgeoisie of unprecedented wealth and sense of independence, which spurred a radical reorganization of society with increasing freedom and independence from feudal and church authority. The revival of Platonic philosophy legitimized the pursuit of metaphysical truth through number, geometry and intuition, laying the intellectual groundwork for the emergence of rational, secular humanism and individualism in the 15th century.[18] The invention of the printing press facilitated that rapid reproduction and inexpensive dissemination of ideas. An efflorescence of originality in the arts coupled with the rise of individualism gave birth to the concept of genius, an idea unknown in the medieval world-view.[19] The Reformation brought with it a more tolerant and more secularly intellectual atmosphere for considering alternative viewpoints in the 16th century. The founding of learned societies and scientific journals in the 17th century established an 'invisible college' of independent thinkers to challenge orthodoxy, exchange new ideas and explore new discoveries and inventions. During the same period a new type of combinatorial mathematics developed based on analysis of gambling situations which ultimately gave rise to the inductive method of statistical probability. The spread of democratic ideas during the 18th century promoted freedom of thought and expression. The spread of education increased the population that could engage in and benefit from new ideas and scientific discoveries. All these factors gained far greater significance when the Industrial Revolution demonstrated the enormous power of science for generating wealth and military power during the 19th century. Although most of the early inventions of this period were developed by skilled mechanics rather than trained scientists, it soon became evident that a systematic study of scientific principles could vastly enhance the process of innovation. The marriage of science, technology and economy spurred the development of technical education in engineering, agriculture and medicine.

The remarkable achievements of science over the past four centuries are too vast and self-evident to be given adequate treatment in this paper. The focus here is on the profound impact the rise of empirical science and the scientific revolution has had on our conception of knowledge and the way we utilize the powers of mind to discover it. If inordinate attention seems to be placed on the limitations and unintended consequences of science as a pursuit of knowledge, it is with the hope that a greater understanding of these limitations and consequences will provide insight into the need and potential for evolving more effective instruments of knowledge and more successful forms of civilization in the 21st century.

4.3. Mind and the Scientific Method

Our primary concern is the relationship between these developments and our approach to understanding the world. Physical observation, measurement, analytic thinking and experimentation formed the foundations of modern science. Minutely detailed and careful observation of physical phenomena that could be independently verified by other observers was the starting point. Scientific instruments were developed to extend the reach of the senses and improve their accuracy. But the real power of modern science issued from a marriage of observation and measurement with analytic thinking.

The Copernican Revolution dramatized the limitations of sensory data as the basis for knowledge. From ancient times it had been known that sense impressions could distort reality. Copernicus applied logic and precise mathematics to refute the notion that all heavenly bodies move around the earth. Galileo confirmed this heretical view by using a telescope to observe four moons orbiting around Jupiter. Copernicus' discovery led to the formulation of a radically different world view that contradicted both the evidence of the senses and the prevalent conception. It ushered in what Kuhn calls a scientific revolution, based on a new conceptual system and a new method of knowing reality.[20]

Newton combined acute observation, precise measurement, reflective analytic thinking and mathematics to change the way science viewed the world for three centuries. His discovery of universal laws of nature and the invisible force of gravitation had profound impact on our conception of reality and knowledge. Newton applied new concepts and a new mathematics to arrive at a more precise understanding of the physical world. The concept of immutable laws of governing an orderly, machine-like universe became a conception in science. His work spurred advances in mathematics as a field of knowledge in its own right and as an instrument of knowledge applicable to all fields of existence. As a consequence, modern science has come to identify valid knowledge with mathematical proof and to search for knowledge in places where the light of mathematics can shine brightly.

4.4. Intellectual Impact & Cultural Consequences

The rise of modern science altered the course of global civilization, the evolution of the human mind and the development of our conception of knowledge in fundamental ways.

1. *Physicalism:* It led to the materialization of knowledge. The exclusive focus on knowledge of physical nature eventually led to the implicit premise or explicit belief that the physical is the sole plane of reality, a conclusion which Newton and other early scientists would have vigorously rejected. This premise is now pervasive even in the social sciences, where genetics and neuroscience seek to unveil the mechanisms governing psychology and even conscious mentality.

2. *Deterministic Mechanism:* The scientific revolution led to the conception of knowledge as a set of immutable, universal laws determining the functioning of a static, mechanical universe. Knowledge of reality became synonymous with certainty and predictability until challenged by the discoveries of quantum mechanics nearly three centuries later. Outside Physics this premise remains largely unchallenged. The Newtonian quest for immutable, universal laws of Nature was later extended to identify universal laws governing polity, economy and society. For the past two centuries economists have attempted to reduce human behavior and interaction to external factors and mechanistic processes governed by universal principles. The study of general principles has obscured the unique role of the individual in social development, innovation, discovery and creativity. The mechanical view of reality has led to the rejection of human free will as an appearance and neglect of individual uniqueness.

3. *Specialization:* Mind's capacity for division and analytic thinking inevitably led to a proliferation of separate disciplines, to specialization, and compartmentalization of knowledge with immense consequences. Over the last five centuries, the number of intellectual disciplines has multiplied from five to around 1000 disciplines and sub-disciplines. As the study of reality is divided up into smaller and smaller pieces, specialization has led to increasing fragmentation of knowledge. Viewing each field independently has generated precise knowledge of the parts, but obscured the complex interactions and relationships between elements that are essential for knowledge of the whole.

4. *Quantification of Knowledge:* It led also to the quantification of reality—the confusion of data and information with real knowledge and the misconception that mathematical models and statistical probability are true and accurate representations of the real world. Mathematics is an extremely powerful tool for the discovery and validation of knowledge. But increasingly it has come to be regarded as knowledge itself. In String Theory, mathematical consistency has become a substitute for measurable, verifiable evidence. The awarding of two Nobel Prizes in economics for development of computer algorithms that model the functioning of financial markets is only an extreme example of a widely prevalent phenomenon. Its consequences during the financial crises of 1998 and 2008 underline the extreme danger of mistaking models for reality and mathematical formulas for knowledge.

5. *Measurement of Randomness and Uncertainty:* An unintended consequence of the Scientific Revolution has been to redefine the notion of chance. The conception of the universe as a giant mechanism subject to universal laws of causation made it possible to also postulate its very opposite, a complete absence of causality, pure randomness.[21] The development of probability theory originally aimed at obtaining knowledge about complex causal processes, but later was applied to situations assumed to be characterized by a total absence of causality. The merger of probability and statistics in the early 20th century resulted in the new hybrid field of mathematical statistics. Under the influence of positivism the philosophical dimension of causality was dropped and probability came to be viewed purely in mathematical terms as an expression of randomness.[22] The application of *a posteriori* induction to ascertain the likelihood of future events dramatically broadened the application of mathematics to the

human sciences, with profound consequences.[23] The concepts of uncertainty and randomness were inadvertently elevated from philosophical questions to the status of objective scientific fact.

6. *Dominance of the Objective:* Modern science commenced with an exclusive focus on the study of observable external phenomena in the material world which lent themselves to measurement, verification and experimentation. This led to the rise of the philosophy of positivism, founded on the premise that information derived from sensory experience, interpreted through reason and logic, forms the exclusive basis for all authoritative knowledge. Only knowledge that can be independently verified can be considered authentic. Thus, knowledge of the objective world and knowledge acquired by objective methods alone is valid. The study of subjective phenomena and subjective forms of evidence became inadmissible and invalid. Introspective and intuitive knowledge were rejected. In the 20th century logical positivism rejected metaphysics as pure speculation and attempted to reduce statements and propositions to pure logic.

The contributions of modern science to the march of civilization are immeasurable. Even its tendency toward exclusive concentration on physicality, the objective world, the measurable, quantitative, and universal has had salutary effects of great value. Materialism has wiped away much that was merely superstitious or speculative. Its irreverent questioning of acknowledged truths has unleashed an insatiable curiosity and spirit of adventure. Its ruthless rejection of unfounded opinion and prejudice has helped discipline the thinking mind to challenge opinions, shed preferences and prejudices, question conventional beliefs and challenge established authority. Even its atheism has helped cleanse religion of pious posturing and vacuous moralizing. It has served as a basis for the democratization of our lives as well as our minds, at least within the boundaries of the world as science perceives and understands them.

Each of these characteristics has contributed positively to the advance of scientific knowledge and is partly responsible for its collective achievements over the past five centuries. At the same time, each of them has imposed arbitrary limits on the development of knowledge. After reigning victorious for four centuries, today we see the weaknesses and insufficiencies of modern science rising to the surface, staring at us with its unvarnished flaws and glaring inadequacies. Byers used the term 'blind spots' for intrinsic limitations to what can be known through science.[24] It behooves us to generously recognize its enormous contribution, and yet equally to acknowledge and inquire into its errors, omissions, blind spots, prejudices, pompous presumptions, superstitions and intolerances—the very characteristics against which it first arose in rebellion and has since fought for centuries to eliminate. An impartial consideration of their role will help us understand both the strengths and weaknesses of science today and reveal opportunities for the further advance of both knowledge and civilization.

4.5. Objectivity & Subjectivity

The initial concentration of modern science on physical nature was justified as a logical choice and practical necessity. The rise of positivism converted practical necessity into philosophical dogma with profound implications for the development of science and the further evolution of mind. The transition was abetted by confusion regarding the ambiguity of the terms objectivity and subjectivity, each of which has a double meaning. The study of physical nature is the study of inanimate objects and subconscious life forms which can only be observed objectively ("observe as object") in the external environment, since we have no access to their subjective intentions or self-experience. Descartes' body-mind dualism encouraged the idea of the scientist as an objective ("impartial") witness standing outside of nature, rather than as an involved participant in the world he observes. Gradually, the notion of objectivity as the study of external objects without impartiality merged with the very different notion of objectivity as the absence of 'distorting personal preferences' of the subject and came to be regarded as one and the same thing. This led eventually to the philosophical premise that reality consists solely of objects that can be studied objectively and by extension that all subjective phenomena are secondary results of objective causes.

The word subjectivity also has two meanings which have gradually become conjoined and confused with one another. Subjectivity ("experience as subject") is the psychological field of conscious human experience that is not directly accessible to external observation. Only its behavioral expressions can be observed by others. But it is also used to connate subjective ("personally biased and preferential") factors contributed by the observer, such as preconceived notions and prejudices, the legacy of traditional beliefs and superstitions prevalent at the time.[25] In its quest for impartial knowledge of physical objects in the world around, emphasis was naturally placed on eliminating this distorting influence. So the idea of subjectivity as the psychological experience of a conscious individual came to be regarded as an unscientific and invalid form of evidence and to some extent an invalid form of experience. As in the anecdote of the man who lost his keys on a dark street and searched for them down the block under a street light where there was better light, science sought to discover ultimate knowledge by the exclusive study of physical factors that could be observed by the physical senses and measured by material instruments. In the process the entire subjective dimension of reality, the dimension which distinguishes human beings from all other species, was subordinated to the objective dimension observable by the senses. Eventually it resulted in philosophical and scientific efforts to reduce all non-physical phenomena solely to physical causes.

The course of science exerted a subtle influence on the development of mental faculties and concepts of truth, knowledge and logic. It displaced the Greek conception of truth as that which could be known in the form of pure ideas accessible to logical reasoning, but not necessarily to physical observation or measurement. Rationality itself came to be narrowly associated only with that which can be perceived and verified physically. The old adage that I will believe it when I see it acquired the status of scientific dogma, even when applied to aspects of reality beyond the reach of the senses. This phenomenon might be termed the materialization of knowledge.

4.6. Fragmentation of Reality

Divide and subdivide reality ever so much and we still arrive at some smaller portion of reality that eludes our grasp. The infinitesimal is infinite. The dominant role of the analytic intellect in modern science resulted in the dissection of knowledge into smaller and smaller fragments resulting in the proliferation of specialized fields of study. Analysis is an extremely powerful instrument. It harnesses the dividing power of mind to separate reality into smaller and smaller parts. By so doing, we acquire more precise, detailed knowledge of the part and are enticed to drill down to ever deeper levels of minuteness. As its focus narrows to laser-like precision, the surrounding fields and interconnected aspects of reality grow proportionately out of focus and obscure. The more we know the part, the less we know about the integrality of the whole.

Physical science has compensated for this divisive tendency by aggregating knowledge from different specialized fields to form a remarkably cohesive and coherent conception of the physical universe. It has successfully incorporated the fundamental principles of physics into chemistry and the principles of both into astronomy, geology, the material sciences, climatology, oceanography, soil science and innumerable other disciplines. While the same fundamental principles are consistently applied, the interactions between subsidiary fields founded on these principles have been less effectively related and integrated. Partly, this is due to the complexity arising from these multiple interactions, but also partly because research and theorization have largely proceeded in a compartmentalized manner. Raging controversies regarding climate change are partly attributable to the fact that for so long the complex array of phenomena that influence climate have been studied piecemeal, independently from one another.

The consequences of compartmentalization and fragmentation become more evident when we look at the life sciences. Here the effort to overcome compartmental barriers is far less advanced. Interdisciplinary and cross disciplinary research have become more common, but the fundamental principles applied in different fields remain largely autonomous. For decades, evolutionary biology remained preoccupied with the exclusive role of random mutation in the evolution of species, ignoring important biological and environmental factors that impact on the chemistry and biology of genetic materials.

In medicine, specialization has led to remarkable progress in our understanding of specific pathologies, but it has taught us relatively little about the overall concept of health. Moreover, the piecemeal treatment of specific illnesses often has consequences quite detrimental to the overall health of the patient. In allopathic medicine health is conceived primarily in negative terms as the absence of disease; whereas in traditional systems of medicine such as Ayurveda, developed by reliance on more synthetic and integrative mental processes, health is conceived in positive terms as the property of a balanced and harmonious living organism. This becomes even more evident when we take into account psycho-somatic phenomena. Research on the 'placebo effect' dramatically demonstrates the impact of the patient's attitude and expectations on treatment outcomes and general health. Indeed, recent findings indicate that the placebo effect is increasing over time. This and other phenomena directly connecting physiological and psychological processes testify to the need for a much more synthetic conception and approach.

5. Naturalization of the Social Sciences

The six characteristics of empirical science discussed above have each had profound impact on the development of mind, knowledge and modern civilization. Re-examining the implicit and explicit premises underlying modern science is vitally needed to further the advance of knowledge in all fields. But the limitations of the prevailing approach are most apparent in precisely the fields of knowledge closely associated with the challenges humanity confronts in coping with rapid and radical global social, economic, political, intellectual, technological and cultural evolution. Therefore, it is especially necessary to consider whether the application of the analytic methods of the natural sciences to the social sciences is itself one of the root causes of the current problems confronting humanity today.

A comparison of the natural and social sciences needs to take into account the significant differences between these two bodies of knowledge. The most obvious is the fact that systematic study of physical and biological phenomena began several centuries before the systematic application of the scientific method to the study of society. By comparison the social sciences are still in a very early stage of development. Furthermore, there is an enormous difference in the intricacy and complexity of the phenomena being studied in the two realms. Living organisms are far more complex than inanimate material objects. In addition to possessing all the attributes of material things, they also superimpose on their physical base structural and functional characteristics and environmental interactions not found in inorganic forms. This adds enormously to the complexity of living things.

The same is even more true of the phenomena studied by the human sciences. To the complexity of physics, chemistry, biology, genetics and earth sciences, is added the complexity of conscious, self-aware purposeful human beings living in complex social and cultural environments, interacting with myriad social institutions and organized activities, utilizing a vast array of tools and instruments, and influenced by the cumulative knowledge and experience of countless generations of humanity. Moreover, the level of individuation, complexity and uniqueness observed in human beings is far greater than that found in other life forms. The behavior of every electron, every atom of hydrogen and every red blood cell may be identical, but the behavior of every individual human being is characterized by a very large degree of variation and uniqueness. The range of factors influencing behavior and outcomes defies numeration. Physical and biological factors apply, but social, cultural and psychological factors play a determinative role. Individuality may safely be ignored in the study of physical and biological phenomena, but it is central to the knowledge of conscious human beings.

5.1. Fragmentation in the Social Sciences

The problem of compartmentalization of knowledge in the social sciences becomes evident when we consider that each discipline has developed its own set of fundamental principles and applies them relatively independently from the rest. Different concepts and hypotheses regarding human behavior are routinely adopted by political scientists, economists, sociologists, anthropologists, lawyers, and management scientists, yet all with application to the same subject—individuals and groups of individual human beings. No universally accepted principles are uniformly applied across fields.

The consequences of this fragmentation are apparent in the problems we confront related to environmental degradation, unemployment, political instability, social alienation, crime, drugs, and psychological disorders. For two centuries Economic theory developed without giving serious consideration to the impact of human economic behavior on the physical environment. Similarly, the development and application of technologies for economic purposes have been done without regard for their impact on employment, social stability, human welfare and well-being. Many economic theorists ignore the central role of political regulation in the successful operation of free and competitive markets. Legal theory has become increasingly divorced from political principles, social aspirations and human rights. The humanitarian rights of humanity are rejected on the basis of legal principles that recognize only the rights of sovereign nations, not of their citizens.

The same fragmentation of knowledge occurs within disciplines supporting an increasing divorce between different aspects of our social existence. Backed by fragmented theoretical conceptions, financial markets have become divorced from the real economy and the economic welfare of people which they were originally intended to support. A similar fragmentation has led to the treatment of a wide range of psychological problems as if they are simply physical in origin.

The Cartesian divide also isolates and insulates social science from society and the social consequences of its theories. Theorists assume no responsibility for the failures arising from application of their flawed conceptions, as exemplified by the global crisis of 2008. Scientists in leading universities refuse to acknowledge or apply the findings of educational researchers in the same institution about the most effective pedagogy to promote learning. Medical doctors are licensed without receiving any training in managing patient and family relations. The list of gaps and short-circuits is endless.

5.2. Legitimacy of the Subjective

The phenomenal success of the natural sciences spurred efforts by early social scientists to imitate and replicate the same approach. The discovery of immutable universal laws governing the physical universe led to a search for similar principles applicable to society. The extension of the concept of law to conscious human behavior, individual and social, has been the source of endless confusion and error. The governance of political systems and the functioning of our economies are not determined by natural law. They are the result of conscious choices made by individuals and groups in the past, which have undergone a continuous process of evolution over the centuries and are always subject to modification by conscious choice. The resistance posed to social and psychological change by established habits, beliefs, self-interests and inertia may indeed be formidable, but no social arrangement is unchanging or inevitable.

In the field of Economics, the enunciation of principles and the construction of mathematical models similar to those in Physics have fostered a basic misconception regarding the factors that govern economic systems and the scope for altering their outcomes. For nearly two centuries the Newtonian concept of equilibrium in a static universe that dissipates energy and tends toward the lowest possible energy state prevailed almost unchallenged in Economics. The theory of perfect, instantaneous equilibrium is inapplicable to social systems that function far from equilibrium, adjust gradually, organize energy and continuously evolve higher levels of orderliness.[26] The extension of the principle of scientific laws has fostered passivity and resignation before social injustices, political oppression, economic inequality, and other social ills. The vastly disproportionate distribution of the world's wealth, the displacement of human beings by machines, the subordination of women, the political influence of the rich, and the social exclusion of minorities are the results of human choice, not natural law.

Similarly, the Darwinian concept of the evolution of subconscious biological forms narrowly viewed as competition and survival of the fittest was inaptly applied and later rejected with respect to conscious social systems. Society evolves by processes that are conscious and subjective. Aspiration, curiosity, observation, thinking, creativity and imagination are more fundamental than external forces in human social evolution. Competition takes place within a wider and more fundamental framework of cooperation. As this narrative affirms, human evolution is a complex conscious process involving continuous interaction among the objective and subjective dimensions, physical facts and mental conceptions, natural forces and human aspirations, creative individuals and social groups. Analogies between the natural and human world may provide useful insights into similarities and parallels between the two domains. But the automatic extension of physical principles to conscious living beings conceals more than it reveals, obscures rich complexity by overly simplistic assumptions, and reduces the profound creative complexity of human existence to rudimentary mechanical models and quantitative equations.

The consequences of the conflation of objectivity with reality and subjectivity with unreality as discussed earlier are most evident in the study of humanity's conscious social and psychological existence. It is here that the confusion regarding impartiality and reality has imposed the most serious obstacles to the progress of knowledge. The identification of knowledge with objective fact has erected a serious barrier to the progress of knowledge. The sciences of society and psychology are concerned with the actions of conscious human beings. Those actions include not only the physical movements of our bodies, but also our mental actions of observation, thought, will, imagination and creativity. They also encompass our vital actions of perceiving, feeling, emoting,

aspiring, fearing, desiring, loving, enjoying, playing, and so forth. The effort to discount, dismiss, or delegitimize our subjective experience is to reject all that is most truly human about us, simply because it does not lend itself to observation and measurement in physical terms. The effort to compress, reduce or reinterpret all subjective experience solely in terms of neurophysiology is akin to looking for lost keys under the street light, because that is the only place our eyes can see.

It seems reasonable that the physical scientist studying matter assumes the position of an observer mind witnessing an independent physical reality. Yet the same premise does not equally apply to a psychologist examining a subject's conscious and unconscious mind. Self-experience is the most vividly real and tangible experience of which human beings are capable. Indeed, we can never experience anything else so directly and intensely. When we impartially examine the supporting evidence, we realize that the reduction of all subjective experience arises from the initial premise of physical science rather than from either rational or evidential justification. The fact that there are neurophysiological correlates to our conscious experience no more proves that our thoughts and feelings are the result of neurophysiological phenomena than the fact that adjusting the dials on a television proves that the program being broadcast originates from the TV.

Nevertheless, the pursuit of extreme hypotheses such as this one and the presumption that human intelligence and machine intelligence are the same may serve an evolutionary purpose. Indeed, it can help us understand the mental and social processes by which both mind and civilization have advanced up to the present stage. Undoubtedly there are correlations between our mental and physiological processes. An impartial observation of both the similarities and differences between them may generate valuable insights. But this requires that we remain conscious of the hypothesis we are testing.

The problem of objectivity goes still deeper. In regarding reason as an impartial judge and witness of reality, we overlook the implicit biases that colors all rational thought. Reason has a pronounced tendency to concentrate on facts and ideas consistent with its premises and to ignore or differently interpret those that contradict it. Science is itself a subjective discipline for generating knowledge governed and framed by philosophical conceptions that are themselves inherently 'unscientific' because they cannot be validated by the scientific method. The effort to exclude philosophy from science suppresses open discussion, but can never eliminate its subjectivity. In denying the validity of subjective forms of knowledge, science invalidates itself.

5.3. Quantifying Humanness

The application of statistics to social problems has brought to the front inherent problems with the quantification of human experience. Nassim Taleb argues in *The Black Swan* that for over a century social scientists "have been operating under the false belief that their tools could measure uncertainty."[27] The enormous power of quantitative methods has progressively obscured the important contribution of qualitative components of reality and individual differences in the social sciences. Taleb seeks to challenge a blind or misguided sense of confidence in the reliability of political and economic decisions based on statistics. He concludes that the problem lies in the structure of our minds.[28] On the other hand, Weisberg argues that precious qualitative information relating to individual differences is being consciously suppressed or neglected in clinical fields such as medicine and psychology by what he terms 'willful ignorance'.[29] Both these viewpoints reinforce the need to reexamine fundamental philosophical issues with respect to the application of quantitative methods to the social sciences.

The point here is not to criticize either science or social science. It is rather to emphasize the inherent limitations and untoward consequences that arise from a partial, one-sided and unbalanced development and application of our mental faculties. The knowledge we need is very unlikely to be discovered by objective analytic methods, quantitative measurements or experimental neuroscience. It lies in our conscious experience and can be most directly accessed by reflecting on our own mode of functioning as scientists, rather than hunting for answers through mountains of clinical experiments. Mind has been the instrument of all humanity's achievements and it lies at the root of the problems confronting civilization today. No other field of scientific inquiry has so much to offer.

6. Synthesis

Long before the development of logic, the ancients discovered the profound truth that reality is one and indivisible. What mind infinitely divides for the purpose of analysis remains at all times a unified, integrated whole. Mind's capacity for analysis and its capacity for synthesis are in constant tension. The more we divide reality for the purpose of understanding its component parts, the more we lose sight of the interconnections, relationships and interdependencies that reflect its underlying unity. Division and aggregation present complementary perspectives of reality. The microscope and the telescope are instruments fashioned by these compensatory needs to zero in on a specific target and zoom out to see the big picture.

The inherent limitations and inadequacy of the knowledge generated by extreme specialization, compartmentalization and fragmentation became increasingly apparent in the 20th century and inevitably gave rise to efforts to reunite that which had been torn asunder into tiny fragments. Compartmentalized universities introduced interdisciplinary, cross-disciplinary and multi-disciplinary studies and research, which sought to bring a variety of different perspectives to bear on problematic issues. But the inherent limitations of these efforts soon became evident. Each brought to the problem a different set of concepts, theories and evidential data to talk about the same problem, without any shared conceptual framework indicating the relationship between these disparate perspectives, their interdependencies or the unifying factors underlying their different expressions.

6.1. Systems Thinking

The limitations of aggregating multiple sets of data based on different theoretical frameworks gave rise to efforts to conceptualize

the relationships between all the parts by viewing the whole as a complex interconnected system. Cybernetics evolved as the study of control systems in the early 20th century in the fields of electric network theory, mechanical engineering, logic modeling, evolutionary biology and neuroscience. Its insights contributed to the theory of complex systems. It stimulated transdisciplinary research in information theory, artificial intelligence, robotics, medical science, economic systems, biology, cognitive science, management, sociology, and the earth sciences. The systematic application of mind's capacity for synthesis led to practical applications of immense importance in computer science and communications. A similar approach has been adopted to build systemic theories and models of global financial markets and the global economy, as well as to comprehend the complex array of forces that govern the climate of the earth and on the impact of human behavior on the planet.

Systems theory has helped compensate for the extreme fragmentation of knowledge resulting from specialization. It has restored a vision of the totality of existence within specific fields and with relation to specific problems. The significance of this change in thinking is most dramatically reflected in the development of the Internet and World Wide Web over the past few decades, giving rise to the world's first truly global social system. Conversely, the practical development of cyberspace has provided a tangible example, symbol and metaphor for systemic thinking and has been a catalyst for the development of more comprehensive, inclusive thinking in all walks of life.

But the development of core complex systems theory extends beyond the mind's capacity for aggregation and synthesis. At a more fundamental level it seeks to identify universal principles that underlie and govern the behavior of complex adaptive systems in a very wide range of applications, such as network effects, emergence, self-organization, and self-reproduction (autopoiesis). It represents a serious effort to move from the aggregation of specialized knowledge through multi-disciplinarity to the search for unifying trans-disciplinary principles.

6.2. Barriers to Systems Thinking

In spite of these momentous developments, the advance of knowledge remains encumbered by several other characteristics of the Scientific Revolution which have yet to be seriously challenged. The first and most obvious of these is the mechanization of reality. The perception and conception of reality in mechanical terms still dominate scientific thinking, even with regard to living beings and conscious individuals. The idea of a simple clockwork universe has given place to more complex network models, but the models remain very largely mechanical and mechanistic. Science still tends to perceive all phenomena, even life, consciousness and society, in physical terms, and to reduce them to theirs lowest identifiable physical denominators. Our physical conceptions have become more complex and sophisticated, but the underlying materialistic mechanistic thinking remains. Computerized modeling of financial markets and economic systems remains the primary instrument for both theorizing and policy-making. Neurological models of human behavior that have proven effective for the tracing of sensory pathways and muscular responses seek to reduce all conscious human experience to chemical and electrical events, resulting in a dramatic increase in use of drugs for the treatment of conditions with obvious psychological and social origins, such as attention deficit disorder.

The second limitation of the current approach is the persistent emphasis on the universal aspects of behavior. Science is the quest for knowledge. It began with the study of fields in which the type predominates and individual variation is of little or no significance. The physical elements readily lend themselves into categorization on the Periodic Table. The known subatomic particles come in a few discrete varieties. The laws of motion and thermodynamics apply uniformly within broad boundaries as do the principles of relativity and quantum mechanics. Plants and animals lend themselves to classification in terms of phylum, class, order, family, genus, and species. The tendency to view reality in terms of categories and types has been extraordinarily effective in advancing knowledge in the natural sciences. It is inevitable that the same approach would be extended to the study of individual and collective human behavior. The classification of similarities and differences has led to important advances in the social sciences, but it has also imposed serious barriers to knowledge of human beings. Comparison of types inevitably results in suppression of individual differences. Uniformity of type is characteristic of the inanimate and subconscious ranges of reality, but the most significant attributes of human consciousness are individuality, innovation, creativity and uniqueness. The human sciences remain grounded in the bias of natural science for viewing reality in terms of similarities and differences and ignoring the single most momentous development in the history of the universe—the evolution of conscious individuality. This bias is programmed into the way we use our minds and imprinted in our very conception of reason and logical thinking. Our very notions of rationality and logic, the rules by which our minds seek knowledge, are based on implicit biases and limitations that retard the development of knowledge.

The third major limitation of modern systems thinking inherited from natural science is the suppression of the subjective dimension of reality. Indeed, most complex systems are an attempt to define and represent all subjective experience in physical terms and to reduce conscious experience to automatic subconscious processes. The collapse of the subjective into the objective dimension is dramatically illustrated by prevailing economic models of society. The assumption that human beings make rational decisions is only another way of saying that individual decision-making can be modelled in mechanistic terms without recourse to consciousness, just the way we say that plants lean toward the sun and their roots reach out for water. The obvious fallacy in this assumption has compelled economists to introduce terms such as irrational exuberance to explain the extreme fluctuations in the behavior of markets under extraordinary circumstances, while leaving intact the underlying premise for normal applications. Economic behavior is characterized by myriad subjective factors—aspirations, attitudes, preferences, the search for status, fear, insecurity, ambition, interest, curiosity, attraction, ideas, misconceptions, superstitions, prejudices, opinions, beliefs, ideals, values,—that vary markedly from person to person, moment to moment. The consequences of the near exclusive emphasis of economics and other social sciences on the objective dimension of human behavior are apparent in the inability to comprehend and manage the increasingly complex

social world in which we live. The effort to reduce complexity so we can manage it can only be successful in the measure our conception embraces the full scope of that reality.

Fourth and as a consequence of the other three, the efficacy of systems thinking is impacted by inherent limitations in the concept of randomness and the measurement of uncertainty as applied to human systems. As Byers has argued, randomness and uncertainty are ambiguous concepts. The appearance of randomness may result from the real absence of causation or from a lack of information, effective measurement and valid knowledge. Black swans may surprise and overwhelm us because a phenomenon is truly random or simply because our concepts, models and measures are grossly inadequate to represent what is really going on. They are likely to become increasingly prevalent, so long as our study of human behavior neglects subjective factors, individual uniqueness and conscious human choice.

7. Integration and Unification

All knowledge seeks unity. The greatest discoveries in natural science have been those that led to the unification of phenomena that had hitherto appeared to be unrelated to one another. Thus, Newton unified inertia and motion. Maxwell unified electricity and magnetism. Einstein unified space and time, gravity and acceleration. WAAS Fellow Abdus Salam unified the electromagnetic and weak nuclear forces.[30]

The capacity to identify relationships between apparently unconnected or contradictory phenomena is one of the defining characteristics of genius. The quest for unification in Physics has spurred efforts to formulate a Grand Unifying Theory reconciling the physical macrocosm and microcosm. Should it ever succeed based on the present premises, it could only apply to the plane of inanimate matter and energy. A Grand Unifying Theory of Life or of Mind or an integrated theory encompassing all three would remain elusive.

A mere aggregation of variables to encompass the totality of phenomena is not sufficient to achieve true integration and unification. Synthesis can combine and relate the parts, but it cannot arrive at true integration. Although the word is widely used in a more limited sense as synonym for totality, comprehensiveness, holism and interdependence, true integration that is the basis for unification is something more fundamental. It may be best described in the words of the Upanishads as *all is in each, each is in all, all is in all.* Integration is a state in which each element in a totality is not only related to the totality but also to every other individual element in the totality.

The struggle of climate scientists to construct accurate and effective theories and models of climate change is compounded by the fact that the entire earth with its myriad zones, geographic and geological characteristics is in constant interaction with the life forms that inhabit it and the conscious and subconscious activities they carry out. Climate is impacted not only by physical factors, but also by the biological functioning of living things and the conscious and subconscious actions of human beings. Our capacity for analysis and synthesis is poorly suited to manage complexity of this sort.

The remarkable integrality of the human body is an excellent example and analogy. Medical science has created an abstract conceptual framework to represent the functioning of the body. It is divided into anatomical structures and physiological functions. The structures include cells, tissues, organs and systems. The functions include respiration, digestion, circulation, reproduction, and so forth. But both of these classifications are themselves abstractions. There really is no such system as the circulatory system distinct and independent of the skeletal, muscular, nervous, lymphatic and other cells, tissues, organs and systems. Each cell, tissue and organ forms an integral component of the overall body. But the functioning of each type is also integrated with the functioning of other types. Thus, a prick of the surface tissue of the finger may evoke a response from the skin, capillaries, blood cells, heart, brain, glands, circulatory, nervous and lymphatic systems. Moreover, as the Placebo Effect and other well-documented neurological, psychological and sociological phenomena amply testify, the body's physiological functioning is also seamlessly integrated with a host of other factors—nutritional intake, physical environment, type and amount of physical activity, the endless flow of sensations, impulses and emotion occurring consciously and subconsciously, mental conceptions, opinions, attitudes, beliefs and aspirations of each individual, as well as the ever-changing physical, emotional and mental interaction between the individual and the physical, social, and psychological context in which it is situated. The limitations in prevailing conceptual models of reality severely hamper efforts to pass beyond an aggregation of physical parts and functions to a truly comprehensive integral conception of human health.

The conclusion that present knowledge is inadequate to guide the further evolution of human civilization is not an indictment of the vast body of specialized knowledge of society generated by science up to now. It is rather a realization that more of the same will not suffice. Relativity Theory did not invalidate the principles of Newtonian Physics. Rather it placed them in a wider context, in which their limits became evident. Today, there is a need to venture beyond the limits of the present conceptual system in search of one that is more inclusive and effective in reconciling our knowledge of the world with the persistent failures and recurring problems that stand in contradiction. The first step in the evolution of a new conceptual system is to acknowledge and embrace these contradictions and willingly reexamine the premises which constitute the foundations of the present conceptual system.[31]

7.1. Integration in the Social Sciences

The need for transcending the limits of both analytic and synthetic thinking is most apparent in the social sciences where compartmentalized, fragmented knowledge persists as the dominant pursuit and each field is founded on a discipline-specific set of principles with little relevance beyond the narrow borders of specialized applications. This approach has generated a condition resembling the psychological syndrome of multiple disconnected personalities known as dissociative identity disorder. In both

instances it is symptomatic of deeper disorder. In an effort to arrive at rational, scientifically valid knowledge, we have fallen prey to the natural tendency of the thinking mind to separate itself from the objects of study in a static universe and regard them from a detached perspective objectively and impersonally. In doing so, our sciences of living human beings have become mechanical, materialistic, value-free and lifeless. They lack the vibrancy characteristic of living things. They lack the depth and insight needed to plumb the rich complexity of the individual psyche and collective soul. "Classical, deterministic science is a science of stasis. It misses the essence of life".[32]

This realization has been the driving force behind the efforts of the World Academy of Art & Science and World University Consortium in partnership with other organizations to advocate the need for a new paradigm in human development, a human-centered economic theory, and a transdisciplinary science of society. Our work has identified critical respects in which the new conceptual framework needs to transcend the limits of the present one. The new paradigm should be value-based rather than value-free. It should be transdisciplinary rather than discipline specific or merely multi-disciplinary, which means it should seek to discover the underlying principles governing human behavior in all fields of social existence. It should embrace and reunite the objective and subjective dimensions of reality, recognizing the central role of human consciousness and human aspiration in human affairs. It should be founded on the creative process governing the interaction between the individual and the collective. It should rise beyond the mechanistic, materialistic models of natural science to establish knowledge based on the dynamic living process by which human beings release their energies, consciously and purposefully direct them, channel those energies through formal organizational and informal institutional structures and systems, and express them through skilled action to accomplish results. And as a foundation and central pillar of this work, it should strive to advance our understanding of the human mind and thought processes, the sources and obstacles to creativity and their relationship to the evolution of civilization.[33]

Preliminary work has been done by members of the Academy on many elements of a new approach, but the real purpose of the project is to influence the general direction and course of our collective intellectual progress. Decades ago Former WAAS President Harold Lasswell made a profound contribution to the study of law by liberating it from the narrow confines of legislatures and judiciaries and viewing it in the context of evolving social and political processes and the affirmation of values by individuals and institutions in society.[34] In a remarkable contribution to rethinking economics, Orio Giarini strove to break down the arbitrary conceptual barriers imprisoning contemporary economic theory. He expanded economics to encompass the non-monetarized sector, introduced the concept of negative value to account for economically detrimental activities, emphasized that in a modern service economy value must take into account the entire utilization time from conception through final disposal, replaced the classical notion of equilibrium with one of continuous evolution, and affirmed the principle of uncertainty as central to all economic activity.[35] Building on his seminal contributions, WAAS is engaged with other institutions and scholars in a collaborative effort to frame new economic theory.[36,*] A fuller exploration of these findings lies beyond the scope of this paper, but it may be helpful to briefly examine a few of its central tenets.

7.2. Value-based Science

Popper warned against the tendency of the social sciences toward 'misguided naturalism'.[37] The effort to free the study of the natural world from religious doctrine rejected the imposition of human values on the natural world. The role of the natural scientist is to observe dispassionately and reflect rationally. Freedom from prejudice is essential for discovering knowledge. With respect to physical nature, this implies not imposing human values on the behavior of lower life forms. We cannot accuse the lion of evil because it instinctively hunts other species for food. But the social sciences involve the study of conscious human beings living together. The discovery of universal values governing conscious human evolution is the social equivalent of the universal laws governing physical evolution. The purpose of social science is not merely to impartially understand but also to consciously intervene to enhance the effectiveness of social systems to realize the aspirations and values of humanity. It must necessarily be value-explicit rather than value-free.

Values are not merely prejudicial judgments. They are a form of knowledge and a powerful determinant of human evolution. To strip our study of society of all values is akin to viewing the material world as random, chaotic, directionless meanderings of chance stripped of all insight into the forces influencing it. Values are the governing principles of human evolution, just as natural laws are the governing principles in physical nature. Universal values such as freedom, equality, peace, security, tolerance, trust, integrity, goodwill, organization, cooperation, collaboration, fraternity, self-giving, harmony and truthfulness represent the quintessence of knowledge and wisdom humanity has derived from millennia of experience. Values are knowledge of the process of human accomplishment and evolution. They are central to the practice of science as they are to every other field of civilized human activity.

7.3. Principles of Society

As already mentioned, the development of economic science has been strongly influenced by the success of the quantitative physical sciences, most especially Physics. It has taken the form of a quest for universal laws or principles of economy and mechanistic, quantitative models to represent the workings of economic systems. The economy we have today is the result of choices made in the past, of a long evolutionary process founded on ideas, values, beliefs, and social institutions established for the benefit of specific sections of the population and preserved by force of social influence. If it is not able to equitably meet the needs of all human beings, we have the power to change it.

* For information on the partners and working papers, see www.neweconomictheory.org

The rejection of immutable laws of economy does not mean that there are no principles governing the development of economy and society. But it does suggest that these principles are more fundamental than what commonly passes for economic principle, as the principles governing chemical interactions are founded on a more fundamental set of physical principles. Economy is a subset of society. An understanding of the principles governing the development and operation of economy needs to be founded on principles applicable to the development and evolution of the wider society of which economy is a part.

The success of organizational theory and systems theory in identifying principles applicable to a wider range of human and non-human activities marks a first step toward development of truly transdisciplinary social science. Organization is a unifying principle found at all levels of existence—the structure of physical matter, the dynamic systems of life, and the conscious organization of ideas, activities and things characteristic of mind. Energy is another unifying principle—the physical energy of material systems, the vitality and social energy characteristic of living systems, and the conscious mental energy expressing as curiosity, imagination and creativity in mind. Conscious awareness, aspiration, values, evolution, self-multiplication, authority, hierarchy, networks and conceptual frameworks are fundamental principles common to all human activity. Transdisciplinary science founded on principles such as these would mark a significant advance toward a new conceptual system for the social sciences. It should shift the perspective of society from inanimate, mechanistic organization to conscious living organism, from a perspective that focuses exclusively on objective, superficial processes to one that encompasses both the subjective and objective dimensions of reality, from an emphasis on general patterns confirmed by statistics to one founded on the complex creative interaction between creative individuals and the conforming social collective.

8. Deep Thinking

8.1. Changing Conceptual Frameworks

If mind starts from division and possesses only constructed understanding of unity, the question naturally arises as to what mental faculty is needed to achieve true integration and unification. As Sri Aurobindo observes, mind "thinks, sees, wills, feels, senses with division as a starting point and has only constructed understanding of unity."[38] If the analytic and synthetic faculties of the thinking mind are not sufficient, what alternative is left?

Mathematician William Byers uses the term deep thinking to describe creative intellectual processes that transcend the conceptual limits of existing thought and the rules of logic. He observes that all thinking occurs within a conceptual system. The system may be explicit and implicit, conscious or subconscious. The definition of every word is a conceptual system determined by prevailing cultural norms, social context and individual psychological experience. Every theoretical concept is defined, populated and delineated by defining and limiting perspectives. The boundaries and tenets of any conceptual system are supported and reinforced by forces that resist any assault. Among these forces is the sense of security derived from existing knowledge, the inertial resistance to a major reconsideration of beliefs on which so much has been invested, the egoistic identification with a particular viewpoint, and unconscious bias for elements that conform to its existing premises and rejection of those that undermine or contradict it. Logic and mathematics are conceptual systems. Science itself is a conceptual system. This paper identifies some of the pillars on which science is based that are implicitly accepted as valid, but rarely subject to examination.

Byers argues that all major intellectual breakthroughs involve a breaking out of the existing conceptual system. Since the boundaries of the system are often implicit and unconscious, they are not easily accessible to identification or scrutiny. Therefore, the creative process of transcending the existing system usually begins with the contemplation of questions that are not easily addressed within the existing context. These questions often take the form of conflicting viewpoints, contradictory facts or unresolved ambiguities, which the current framework is unable to assimilate and reconcile within existing premises. The willingness to recognize and embrace the tension of ambiguity, contradictions and paradox releases energy and generates the force needed to breach the boundaries or challenge the fundamental premises of the existing system. The Copernican Revolution and the other major intellectual advances referred to by Thomas Kuhn as paradigm shifts are classical instances of this process.

The process of deep thinking and the obstacles to it are illustrated in Arthur Conan Doyle's stories of Sherlock Holmes. In many cases the police arrive at a conclusion regarding the facts of a crime and the guilty party by carefully constructing a plausible hypothesis that either consciously or inadvertently overlooks apparently insignificant contradictory evidence. In "Silver Blaze" the police develop an airtight theory of how a race horse was stolen and its trainer murdered by the thief and they make an arrest of a suspect with both motive and opportunity to have been responsible. Holmes alone is bothered by apparently insignificant questions. Why didn't the watch dog bark during the theft? By what coincidence was the stable boy served a dinner that was sufficiently spicy to mask the flavor of an opiate? Embracing the implied contradiction which the police chose to ignore, he constructed an alternative hypothesis that led to an entirely different conclusion. The trainer was actually killed by the horse while attempting to maim its ankle muscles so it would lose the race. The deep and lasting appeal of Doyle's fictional character derives from the fact that he points the way to a higher evolutionary pathway.

Viewed in this manner, the possibility of consciously fostering the process of creative thinking is stripped of its mystical shroud. The process requires a willingness to question implicit assumptions and established tenets and the strength to embrace rather than reject or ignore conflicting points of view. There is no guarantee that stepping outside the secure boundaries of an existing conceptual system will necessarily lead to fruitful creativity. It may be just as likely lead to a loss of certainty and confusion. Stepping out is a necessary, but not sufficient condition for mental creativity. But without taking that risk, real creative thinking is extremely unlikely. Byers argues that we have all had the experience of transcending an existing conceptual system in the process of learning about new

ideas. As students we learn to make the leap already made by others before us. Creative thinking requires the ability to make the leap for ourselves. But either way the process is the same.

8.2. Intuitive Knowledge

The instances of scientific discoveries in Physics cited above demonstrate that integration and unification are indeed possible, but they appear to be the work of rare geniuses whose processes we neither understand nor have the capacity to emulate. The testimony of great scientists themselves attributes such discoveries to sudden bursts of insight or leaps of thought rather than linear, systematic rational thought processes. Popper argues that "There is no such thing as a logical method of having new ideas or a logical reconstruction of this process… every discovery contains 'an irrational element', or 'a creative intuition' in Bergson's sense." Einstein speaks in a similar vein with regard to the discovery of universal laws. He refers to an intuitive experience that leads to psychological identification with the object of experience. "There is no logical path leading to these…laws. They can only be reached by intuition, based upon something like an intellectual love of the object of experience."[39] During his brief lifetime, Srinivasa Ramanujan compiled nearly 3,900 mathematical identities and equations, of which nearly all have now been proven correct. The Ramanujan prime and the Ramanujan theta function have inspired a vast amount of further research. When his notebooks were first scrutinized by leading British mathematicians, they responded with skepticism, suspicion and extreme disbelief, for he had arrived at original findings of unparalleled complexity without passing through the traditional process of mathematical proof. When questioned, Ramanujan explained that he saw the theorems in his mind.

Thomas Kuhn regards intuitive thinking as an essential condition for the type of radical change in paradigm associated with scientific revolutions. "Paradigms are not corrigible by normal science at all... normal science ultimately leads only to the recognition of anomalies and to crises. And these are terminated, not by deliberations and interpretation, but by a relatively sudden and unstructured event like the gestalt switch. Scientists then often speak of the 'scales falling from the eyes' or of the 'lightning flash' that 'inundates' a previously obscure puzzle. On other occasions the relevant illumination comes in sleep. No ordinary sense of the term 'interpretation' fits these flashes of intuition through which a new paradigm is borne."[40]

Our understanding of intuitive processes is quite limited, in spite of the fact that throughout history insight and intuition have been cited as the source of new discoveries and new knowledge. We live in times characterized by an unquestioned faith in the power of rational thought, systematic training in logical argument in formal education, and supreme regard for orderly argument based on factual evidence and logical reasoning in judging the validity of any proposition. It is very likely that this extreme reliance on the analytic and synthetic modes of thought impedes the development and exercise of these faculties in our times.

The philosophy and methodology of modern science focus almost exclusively on the tenets of the scientific method to validate hypotheses. So great is the identification of science with analytic and synthetic modes of thinking, that it devotes almost no attention to the creative process of discovery on which its greatest achievements are actually based. One reason for this reluctance to focus on the intuitive process of scientific creativity is the mystique associated with artistic creativity and mystical experiences. If so, then rationality and logic dictate that science should strive to learn as much as possible from these other modes of thinking.

Intuition may be far more common than we think. Today we recognize it only when it is associated with outstanding discoveries recognized by the whole world and in circumstances when it is associated with a number of other traits conducive to high intellectual achievement—high intelligence, the courage to challenge prevailing ideas, an unconditioned mind capable of independent thinking, and intense aspiration that generates the energy and effort for unstinting application and perseverance. It is very likely that the capacity itself is far more prevalent and expressing as creative insight at different levels of society in many fields that go unnoticed. There was a time when the ability to read, write or calculate was considered a sign of genius. Since then humanity has evolved, our minds have evolved and our civilization has evolved so that what was once extraordinary has become the norm. Today the idea of learning to think intuitively may sound outlandish. But it may well be that once we pierce the veil of superstition surrounding it, we will discover means to consciously develop it on a large scale. The first essential step is to remove the stigma or scientific skepticism surrounding ways of knowing that transcend logic and rationality.

9. Limits to Rationality

The term 'limits to rationality' is inherently ambiguous as well as unsettling, even disturbing. It is ambiguous in the sense that it can be used to imply both limits to the extent to which rationality is being applied in the pursuit of knowledge and also to suggest that rationality is itself subject to inherent limits in its capacity to arrive at certain knowledge. For both these reasons the term is also unsettling and disturbing. It is unsettling because we human beings possess or are possessed by such a strong aspiration to arrive at certain knowledge. It is disturbing because it suggests that the mental instruments so far developed and utilized by us in quest of that certainty are subject to inherent limits both in their application and in their powers of discernment.

This historical narrative on the evolution of mind and civilization supports these conclusions. It confirms that even our most sincere, scrupulous, impartial and disinterested seeking for knowledge is subject to limitations imposed by conscious and subconscious perceptions, conceptions, assumptions and perspectives through which we seek for reliable knowledge. As Byers emphasizes, the very nature of a conceptual system is that it is self-limiting. For regardless of how broad and open its premises, it is a construction built and viewed from inside itself and is unable from the vantage point to fully perceive the foundations on which it is constructed. In setting forth the principles on which his geometry is based, Euclid never conceived of a context in which two parallel lines could meet. That conception belonged to a different conceptual framework that was only discovered 2000 years later.

So too, when Newton presented his laws of motion, he never qualified the limits within which these laws held true. He naturally assumed that space and time were invariable constants. The new paradigm conceived by Einstein challenged assumptions that were so basic they had never before been questioned. Quantum Theory challenged notions so fundamental that even Einstein rejected them as implausible.

Our resistance to entertaining premises that contradict established viewpoints arises not only out of an inability to imagine or conceive something different, but also out of a marked preference for justifying the existing system. So strong is this tendency that our reason carefully selects for its attention ideas and evidence in support of its viewpoint and ignores or discounts that which contradicts it.[41] Science has made great advances in establishing criteria for falsifying hypotheses, but it possesses no remedy to the urge of the scientific collective to admire the clothes of the reigning emperor of scientific authority. A greater awareness of the social and psychological barriers to a truly impartial exercise of reason would be a major contribution.

10. Deep Learning

The perspective that emerges from a historical examination of mind and civilization has important implications for education. This paper argues that the principal challenge confronting humanity today is not to fine-tune the incremental progress of knowledge acquisition, but rather to consciously support and accelerate the development of radically different, more synthetic and integrated ways of thinking and knowing.

History confirms that a change in the way we think is unlikely to be made by those already in the middle or later years of life. Most seminal changes in society occur only with the passing of generations raised in and conditioned by the past and with the coming of new generations unconditioned by earlier experience. Education is the principal means developed by humanity to foster conscious social evolution. Therefore, it must necessarily constitute the core of any strategy to accelerate the development of our mental faculties.[42]

One clear implication is that an exclusive preoccupation with imparting more knowledge content is not sufficient and may even be counter-productive, because it only goes to reinforce the existing conceptual framework and analytic skills, and divert energy from the creative enterprise of enhancing our mental capacities.

A few tentative suggestions can be made regarding how future education should differ in method and content from the prevailing.

1. *Balancing Analysis, Synthesis and Integration:* Reality is multi-dimensional and integrated. Consequently, so should effective knowledge of that reality be. It is always shaped by a multitude of aspects, perspectives, forces. The tendency to condense and compress reality into simplistic formulas is a form of willful ignorance that facilitates transfer of knowledge and multiple choice examinations, but conditions the mind to think simplistically and suppress important dimensions of reality. No single statement, no single theoretical perspective can ever be comprehensive. Therefore, the approach to education in all fields should emphasize the multi-dimensional, many-sided character of reality and our knowledge of it. Education in all subjects should stress the complexity of knowledge rather than reduce it to simple formulas to be memorized. It should encourage young minds to examine contrary, opposing and contradictory perspectives. Precise mental knowledge of the totality is never possible, most especially with respect to the complexity of human experience. Therefore, a precise analytic knowledge of the individual contributing elements should be balanced by a holistic vision of their harmonious integral relationship to and within the whole. The capacity of the mind for differentiation and delimitation must be transcended by also fostering an intuitive faculty for integration and unification.

2. *Reuniting the Surface and Depth, Objective and Subjective Dimensions:* As there are multiple dimensions to reality, there are also multiple levels or depths. Effective education should simultaneously cultivate observation, perception and perspective at multiple levels of reality. These levels are represented in the natural sciences by the physical, chemical, biological, genetic, metabolic, neurological and other processes present in the functioning of all living beings. The discoveries of Copernicus, Einstein and Heisenberg arose from a willingness to reexamine fundamental premises. In the human sciences, reality is governed by myriad mental, emotional, vital, social, cultural, technological, organizational and environmental factors that provide the foundation and context for all social phenomena. A comprehensive study of the factors leading to the Italian Renaissance, abolition of slavery, the Great Depression, the two world wars, the end of colonialism, the founding of the UN, the beginning and end of the Cold War, the hippy movement, the birth of the European Union and the Internet, climate change, the 2008 financial crisis, Occupy Wall Street, and the European refugee crisis would be illustrative. In each case comprehensive knowledge must necessarily include an understanding of prevailing ideas, intellectual atmosphere, beliefs, aspirations, anxieties, threats, emerging evolutionary social forces and values, opposing vested interests and reactionary forces, and emotional sensibilities. It should include a view of surface movements, distinct and separate elements, oppositions, conflict of forces, fine shades of variation and individuality. It should also include a perspective based on the underlying oneness, inner unity, harmony in law of movement or being, greater reconciliation, the center from which all aspects emanate and to which they return.

3. *Reconciling Contradictions:* As Niels Bohr said, "It is the hallmark of any deep truth that its negation is also a deep truth."[43] In each area of observation, education should cultivate a sense of the complementarity between difference and oneness, subjective and objective, individual uniqueness and collective type. Rather than categorizing reality in terms of simple polar opposites, education should develop varying perspectives arising from different viewpoints and different levels of consciousness and experience. What appear as contradictions at one level and from one perspective represent complementary aspects of reality from a

wider or deeper perspective. Studying things from the differing perspective of the mental, vital-social, and physical planes will foster a capacity to clearly distinguish these movements, separate and better control them.

The approach will naturally vary and is too complex to be dealt with in this paper. One example may suffice to illustrate some of these aspects. In March 1933 Franklin D. Roosevelt become President of the United States in the midst of the most severe banking crisis the country had ever faced. Since the Great Crash in 1929, more than 6000 US banks had failed and closed. Daily millions of Americans were lining up at the remaining banks to withdraw their savings before their bank also declared bankruptcy. During the previous three years every economic policy initiative thought to be relevant had been applied, but failed to stem collapse of the system. FDR knew that the principles of economics he had studied at Harvard were inadequate to stem the crisis. He understood that the collapse of the system was the result of subjective factors that could not be readily addressed at the institutional or policy level. So he addressed the American people on radio in the first of what became known as his fireside chats. He explained to them that all the objective factors that had made America prosperous were still present—the rich natural resources, hard-working people, huge industrial infrastructure and continental market. He diagnosed and told them that the real problem was not any objective factor. It was rather their own loss of self-confidence and faith in America. He appealed to their courage and national pride. In immortal words, he told them that the only thing they had to fear was fear itself. During that week legislation was passed instituting insurance on bank deposits and other safeguards. He asked the people to return to their banks on the following Monday and redeposit their hard earned savings. Once again long lines grew in front of the banks, but this time most of the people had come to redeposit their money and the bank crisis subsided.

This famous event illustrates several important aspects of the change needed. First, it illustrates that economy, politics, society, and culture are inseparable dimensions of a single integrated reality. The perennial public debate over the role of government in regulating markets is misplaced. There are no markets without government regulation. Without an infrastructure of law to protect property and contract rights, without a judicial system to enforce those rights, without public institutions to prevent collusion and monopoly control, no market can be free and functional. So too, any economy is dependent on the prevailing social norms, values, educational system, and a host of other social factors. Development of a real science of economy will only be possible when economics is viewed as a subset and integral aspect of the larger society of which it is a part.

Second, this event illustrates the equal or greater importance of underlying subjective factors in the effective functioning of society. Every economics student is taught that the economic system is founded on trust and confidence. Without it money has no value and financial institutions cannot function. But although it is recognized as a necessity, it rarely figures in the prevailing conceptual framework of economy, because economic theory is so strongly grounded in objective, material factors. Like every social institution and activity, economic performance is the result of conscious choices of countless conscious individuals. Those choices depend not only on their confidence in the system but also on their theoretical understanding of how it works. Money is commonly regarded as an objective reality, a thing in itself. In fact, money is merely a convention adopted by human beings as a symbol of social power. Money has no value outside of a social context, e.g. on a desert island. Like language, it is a networking tool to facilitate interactions between people. The value of money depends on the overall productive capacity of the society which is founded on the knowledge, skills and values of its individual members.[44]

Third, this event dramatically illustrates the role of the individual in social development. Mainstream economics and social science deal with broad generalities and statistical averages. The individual is just a number. But in reality, the individual is the source of all creativity and innovation in society. As education is the instrument for conscious social evolution, the individual is the catalyst for the evolutionary process. History documents the fact that a single individual thinker, leader, inventor or entrepreneur has the power to change the world. Indeed, as Margaret Mead once said, all significant changes in human history have been the result of actions by small groups of individuals.[45]

This incident also illustrates the fundamental paradox that crises are opportunities. FDR's remedy for the banking crisis of 1933 led to measures which provided for the stable development of the American financial system for more than six decades until the protective measures were systematically withdrawn in the 1990s, resulting in the 2008 financial crisis. So too, history confirms that virtually every tragic event has had positive consequences. The Black Death in Europe led to the collapse of feudalism, paving the way for the rise of democracy. Two horrendous world wars led to the founding of the UN and the international charter of universal human rights. This brief narrative is only intended to illustrate that every known fact, event and concept acquires greater significance when viewed from a more comprehensive, integral perspective.

11. Evolution of Knowing

This narrative traces broad developments in the history of mind, its faculties and the quest for knowledge. It highlights some of the relationships between the evolution of our subjective faculties for self-awareness and knowledge and the evolution of the external facets of human civilization. The historical record reveals a one to one correspondence between inner and outer. The development of mental faculties and mental conceptions has led to the progressive development of our collective social existence. It also reveals the dependence of that mental development on the openness, tolerance and active support that society offers to the exploration, dissemination and application of new knowledge. This interplay between inner and outer, mind and civilization, the individual and society, human consciousness and the institutions we create has been a central determinant of the course of human evolution.

Today humanity confronts intractable existential challenges. Given our history, it seems plausible to assume that the problems we face correspond to limitations in the ways we are employing our mental faculties. Given the extraordinary developments that have taken place in the past, it seems equally reasonable to assume that we have not yet exhausted the limits of human consciousness, individually or collectively. Challenges are opportunities. Crises are a spur to evolution.

Mind has a remarkable capacity for adaptation and development. But it also reveals a tendency to tenaciously cling to its past achievements, adamantly persist in its present line of activity, resist evolutionary departures and circle around for long periods in repetitive affirmation of what it already knows and believes. Our current preoccupation with physical, technological and organizational solutions to problems is an instance of that repetitive tendency. The perspective of history reveals larger movements and longer cycles that vary from age to age, civilization to civilization. It may well be that we are approaching the end of one of those cycles and need to prepare for a more significant reframing of the basis for knowledge and civilization in the age to come.

11.1. Science, Philosophy and Religion

Symbolism, intuitive insight, metaphysical intellect and experiment science have all made important contributions to the evolution of civilization. Stages can be identified in which each of them has played a dominate role in deciphering and representing reality. The profound truths of existence arrived at by the great religious traditions were the result of direct spiritual experience which could not be rendered into logical discourse or confirmed by the experimental methods of modern science. So too in great periods of philosophy, the rational mind sought for answers to questions that still and in all likelihood will always lie beyond the purview of experimental science. Science in turn has uncovered patterns, laws and formulas in the mysteries of physical nature that generate a sense of wonder as profound as the visions of mystics and logos of sages.

All three have contributed to the collective quest of humanity for knowledge. At different periods of history, each has attempted to dominate the other two, even to the extent of nearly or completely eclipsing their role. Science and philosophy developed side by side in ancient Greece and during the enlightenment. The breakdown of dialogue between them acquired the character of a divorce only in the second half of the 20th century.[46] Today intellectual discussion regarding fundamental questions of nature has very largely been supplanted by experimentation and data-based analysis within existing conceptual framework of modern science.

Experimental science, philosophic speculation and spiritual experience represent developments of three different and complementary powers. They only appear contradictory from the narrow vantage of any one perspective. That explains why even in our advanced scientific culture, great scientists point to intuition as the source of their greatest creative contributions to the progress of knowledge. Thus, the cryptic formula in the Upanishads "*One indivisible that is pure existence"* and in the Bhagavad Gita *"Indivisible, but as if divided in things",* were rendered into intellectual statements about oneness, unity, and union by the classical Greek philosophers more than a thousand years later and confirmed by science in the discoveries of physicists two thousand years after that.*

The persistent intellectual and practical problems humanity confronts today are an opportunity to recall that our powers of knowing as well as our body of knowledge are evolving simultaneously. The apparent limitation of present knowledge is a reminder that the progress of knowledge depends on expanding our field of vision to encompass wider ranges of reality and deepening our perception from the observation of external appearances to integrate and unify the objective and subjective dimensions of reality.

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10. Sri Aurobindo, *The Life Divine* (Pondicherry: Sri Aurobindo Ashram, 1955), 507.
11. Donald, *A Mind so Rare*, 262.
12. Sri Aurobindo, *The Human Cycle* (Pondicherry: Sri Aurobindo Ashram, 1962), 7.
13. Watson, *Ideas,* 6.
14. Watson, *Ideas,*52.
15. "Mind is an instrument of analysis and synthesis, but not of essential knowledge. Its function is to cut out something vaguely from the unknown Thing in itself and call this measurement or delimitation of it the whole, and again to analyse the whole into its parts which it regards as separate mental objects." Sri Aurobindo, *The Life Divine,* 127.
16. Watson, *Ideas,* 8.
17. Watson, *Ideas*, 160
18. Watson, *Ideas*, 539

* Chhandogya Upanishad translated and quoted by Sri Aurobindo in *The Life Divine,* p.70, 159,231.

19. Watson, *Ideas*, 394
20. William Byers, *Deep Thinking* (Hackensack: World Scientific, 2015)
21. Herbert Weisberg, *Willful Ignorance: The Measure of Uncertainty* (Hoboken: Wiley, 2014)
22. Weisberg, *Willful Ignorance.*
23. Although, as Popper points out, probability statements are neither verifiable nor falsifiable, they came to occupy a central place in the practice of science. Karl Popper, *The Logic of Scientific Discovery* (New York: Routledge, 2002), 183.
24. Byers, *Blind Spot.*
25. Byers, *Blind Spot,* 103-104.
26. Orio Giarini, "Science and Economics: The Case of Uncertainty & Disequilibrium," *Cadmus* 1, no.2(2011): 25-34.
27. Nassim Nicholas Taleb, *The Black Swan: The Impact of the Highly Improbably* (New York: Random House, 2010), xxii.
28. Taleb, *Black Swan,* xxvi.
29. Weisberg, *Willful Ignorance.*
30. Garry Jacobs and Ivo Šlaus, "Recognizing Unrecognized Genius," *Cadmus* I, no.5(2012):1-5.
31. Byers, *Deep Thinking.*
32. Byers, *The Blind Spot.*
33. Garry Jacobs, Winston Nagan and Alberto Zucconi, "Unification in the Social Sciences: Search for a Science of Society,"*Cadmus* 2, no.3 (2014): 1-22
34. Winston Nagan & Garry Jacobs, "New Paradigm for Global Rule of Law," *Cadmus* 1, no. 4 (2012): 130-146.
35. Garry Jacobs & Ivo Slaus, "From Limits to Growth to Limitless Growth: A Revolutionary's Vision of Wealth and Welfare," *Cadmus* 1, no.4 (2012): 59-76.
36. Garry Jacobs, "Need for a New Paradigm in Economics," *Review of Keynesian Economics* 3, no.1(2015):2-8.
37. Popper, *The Logic of The Social Sciences*, 90
38. Sri Aurobindo*, The Life Divine* 965.
39. Popper, Logic of the social sciences, *8.*
40. Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970),122-123
41. "Reason, on the contrary, proceeds by analysis and division and assembles its facts to form a whole; but in the assemblage so formed there are opposites, anomalies, logical incompatibilities, and the natural tendency of Reason is to affirm some and to negate others which conflict with its chosen conclusions so that it may form a flawlessly logical system." Sri Aurobindo, *The Life Divine,* 69.
42. Garry Jacobs, "Overcoming the Educational Time Warp: Anticipating a Different Future," *Cadmus* 2, no.5 (2015):.1-13.
43. Max Delbrück, *Mind from Matter: An Essay on Evolutionary Epistemology* (Oxford: Blackwell Scientific Publications, 1986),167.
44. Garry Jacobs and Ivo Šlaus, "The Power of Money," *Cadmus* 1, no.5(2012): 68-73.
45. Garry Jacobs, "The Emerging Individual," *Eruditio* 1, no.1 (2012): 9-30.
46. Popper comments on the efforts of Positivism to overthrow and annihilate metaphysics. Popper, *The Logic of Science*, 13.