

**SOCIOPHYSICS:
Paradigmatic Metaphors
By
Paris Arnopoulos**

INTRODUCTION

Humans have always tried to understand and communicate their experiences through images and ideas. This human compulsion for expression and explanation gave rise to art, religion, and science. Each of these activities tried in its own way, through spirit, faith, or logic, to give some meaning to the human condition. Over the centuries, first religion and art, then philosophy and science dominated this search throughout history.

The overwhelming success of the scientific approach in modern times has overshadowed all other paradigms and its technological application is now reshaping the face of the Earth. Yet, this very success has spawned many undesirable byproducts, not the least of which is the disintegration of the intellectual community. Due mainly to the proliferation of scientific discoveries and the accumulation of information, there has been a tremendous fragmentation of knowledge and a compartmentalization of the scientific estate.

Unfortunately, learning is now broken up into many narrow isolated disciplines. What used to be said about the two famous solitudes -Arts and Sciences- also applies to the schism between the Natural and Social Sciences. It seems that the few instances of interscientific contact are antagonistic, if not contemptuous, of each other. Specialists are not only uninformed but uninterested in the general state of affairs; a condition that makes for mutual confusion and irrelevance.

This is a pity because there is a lot of room for interdisciplinary cooperation and synergy that would benefit all sides. Increasing communication and coordination would promote the organization and unification of knowledge; hence resolve the problems of disorientation, duplication and insulation of research. Emphasizing transdisciplinarity can bring about a better balance between analytic specialization and synthetic generalization thus advancing knowledge on all fronts.

Scientific progress occurs by reconciling apparent contradictions within a larger framework of ever widening complementarities. This process is reflected in the history of science which records these unification attempts, alternating periodically between expansions and consolidations. For this reason, the search for novel models and grand theories is nothing new. Intellectual history has gone through various alternating analytic and synthetic periods before the present.

Since the Enlightenment, the siren song of science has enchanted many great thinkers to the task of unifying human knowledge. Hegel's phenomenalism, Comte's positivism, Darwin's evolutionism and Marx's socialism, are all examples of the belief that sociology should follow in the steps of physiology. More to the point, Condorcet's and Quetelet's *physique sociale*, as well as Bagehot's *Physics and Politics* provide the outstanding attempts that began with the neo-Platonists and culminate with the neo-positivists.

Last century's few grand theories however were followed in this century by many petty inquiries. The dominant trend of modern science was thereby divisive, until the present resurgence of a new unifying spirit favoring overarching perspectives once again. This cyclic movement illustrates the pendulum effect swinging between the two paradigmatic extremes of science. Thus, after a period of narrow specialization which deepened knowledge in various fields; we are presently witnessing a resurgence of broad generalization which integrate the disparate findings of different disciplines within a global perspective.

The scientific revolution going on right now by a combination of Quantum and Chaos

Theories makes the natural sciences more subjective; at the same time as the social sciences are becoming more objective. As it proceeds, this convergence could counterpose and correct the divergent tendencies of recent generations, thus reuniting and synthesizing knowledge on a new and higher plane.

Taking advantage of this movement, General Systems Theory attempted to demonstrate the coherence and compatibility of all realms of human concern: natural and artificial, scientific and artistic, personal and social. By mid-century, the positivist school tried to integrate all knowledge, culminating in the publication of the International Encyclopaedia of Unified Science. As a result, new transdisciplinary studies arise everywhere. In addition to such well established areas as biochemistry or social psychology; there have recently emerged interscientific fields such as sociobiology and presently sociophysics.

This last development is a renewed attempt to combine the latest natural and social science theories and come up with significant generalizations for both. Using the powerful physics metaphor as an inertial guidance system, Sociophysics emphasizes the underlying similarities between all systems. This new scientific hybrid raises much controversy as well as it reveals great promise. It is therefore chosen to provide the core and focus for this article based on the recently published monograph: **Sociophysics**.

This essay presents the summary and conclusion of that book, whose thesis extends the scientific Principle of Universality into the domain of humanistic studies. As the search for universalism in the natural sciences discovered that fundamental laws apply throughout space and time; so the Theory of Sociophysics (**ToS**) broadens our horizons by encompassing the social realm within this quest for ultimate, all-inclusive principles.

Instead of merely reducing social into natural phenomena, the emerging ToS subsumes both under a larger cosmic order. By doing so, it avoids a one-way metaphor from natural to social sciences and aims at a synergy of mutual benefit by broadening the perspectives of both. Although it is recognized that there are apparent differences between the two realms, it emphasizes that these differences are supported by fundamental similarities. It is these latter ones that are more basic and therefore worthy of special research, which was so far sadly lacking.

This, rather imposing task, is only possible by high abstraction and generalization. To this end, Sociophysics uses a System Unification Model (**SUM**) which was especially constructed for this purpose. SUM provides the overall conceptual framework for both social and natural phenomena, upon which an integrated ToS could be built. The case for such integration assumes the similarity and comparability of the natural and social sciences, without falling into the naturalistic fallacy of unwarranted reductionism.

It seems that the spirit of our age in the turn of the millennium is searching for new paradigms that are large enough to contain the new discoveries of natural science, without destroying the old traditions of human culture. Putting forth a Triadic Interface Paradigm (**TIP**) seems to fulfil this need as well as support our Theory. By combining dialectics and synergetics within a triadic framework, the new paradigm tries to resolve the apparent contradictions of old and new, art and science, nature and culture through an eclectic synthesis of their most significant elements.

This scheme may be seen as a pyramid whose base is formed by the fundamental axioms of TIP and whose peak culminates in the ultimate conclusions of ToS, with the middle structure of SUM bridging the upper and lower parts, thus completing our universe of discourse in a single integrated conceptual construct. Of course, such architectonic structures of Grand Unified Theories (GUTs) are ideal systems devised inside the human mind and may not necessarily correspond to anything outside it. But then, neither can any theory, big or small, replicate external "reality," whatever that may be. Although it seems that the human mind is bound to compare perceived similarities and differences in order to understand anything, these apparent conjunctions and disjunctions must be recognized for what they are: hypothetical abstractions.

The dichotomy between the natural and social sciences is such an artificiality; as is the

division between art and science. Naturally, there may be as much social science in physics, as there is natural science in politics; depending on where one chooses to draw the lines of inquiry. For that reason, these lines should not be solidly drawn, thus permitting maximum intellectual intercourse and cross-fertilization between them.

Interdisciplinary comparisons search for common patterns and persisting regularities in all levels and domains of reality. In effect, this mental exercise discovers patterns and similarities of ever widening scope, on the basis of which one can form scientific laws and frame general theories. This theory-building, model-making and paradigm-shifting process is at the core of scientific advancement, so it becomes a worthy aim of human curiosity.

Having said that, we should be fully cognizant of the difficulty, if not impossibility of such a task. After all, this goal may be unattainable or self-defeating and smacks of intellectual arrogance leading to the sin of *hubris*. Yet, in spite of this *caveat* or because of its challenge, the temptation is undeniable and its attraction inescapable.

To begin with, we perceive phenomena and conceive noumena which compose our reality. From the simple material bodies to the complex social structures and ideal forms; these systems relate the inner world of man and outer world of nature and culture. The patterns that the human mind attributes to reality are reflected in the things we distinguish and examine. Thus, the taxonomy of systems, from the atomic to the cosmic indicates a subjective perspective rather than an objective reality.

According to the Principle of Complementarity, there are various ways of perceiving reality; somewhat different yet complementary to each other. All human images, however, are necessarily partial: because our attention can either focus on the whole picture, thus blurring its details; or pinpoint the particulars, thus losing the generalities. Since this trade-off cannot be avoided, ToS prefers the general-holistic at the detriment of the particular-specific approach.

The epistemological reason for this choice is that it is the only way to understand the cosmic order. This requires an intuitive *a priori* belief or faith that there is an underlying pattern and unity in the universe that can be discovered, at least up to a point. We contend that the quest for this implicate order, which lends meaning and perspective to our existence, is the supreme function of the human mind.

Sociophysics takes into account the most powerful attempts for a grand synthesis of physical-chemical-biological codes and extends them to the mental-human-social domain. The self-referential nature of this realm has always made such extension particularly difficult and dangerous. Ever since the Cretan Paradox of Epimenides, it was noted that self-referential statements may be vortices of contradictions, so we must learn to live with the antinomies inherent in both nature and culture, thus giving up hope of ever finding the Holy Grail of a Theory of Everything (TOE).

In this unending quest to grasp the nature of things, the latest scientific advances make our task more feasible now than ever before. On this basis, Sociophysics brings together the various ingredients for theory-building and constructs a general model for such endeavor. Although, there may not be a TOE, there could be a GUT, even if it is only valid in a finite SET (space-existence-time).

This symmetry and consistency of Sociophysics is reflected in the structure of this article whose first section summarizes the factors, transformers and products of SUM. The second section relies on this model in order to identify the physical, social, and formal systems which compose TOS. Finally, the third section concludes with the methods, modalities and metaphors as they are coded in TIP.

MODEL

Any creative endeavor must combine at some point three things: raw materials; technical means; and pertinent information. In this case of model-building, the materials correspond to various ideas and data in the real world; the means are tools and training; and the information is the available program and algorithm. Putting them all together, we arrived at the SUM, which provided the conceptual framework or context of ToS.

These ingredients are arranged in a three dimensional SUM matrix. The first aspect is built according to TIP, recognizing three structural archetypes: similarity, variety, and flexibility. The first two confront each other as continuity and change; whereas the third blends them together dialectically. Thus, out of conflict rises concord, combining creation and destruction to mirror the reality of existence. The three segments of this dimension are functionally correlated: i.e. fluctuation is a function of conservation and alteration $F = f(C, A)$.

The second aspect, on the other hand, considers the substance of reality to be divided into Matter, Energy and form or Life. This MEL theorem sees these levels of existence to be the significant realms of this study. Similarly, the third aspect correlates the natural and artificial realms with the general ToS.

We can now extract the main two (CAF-MEL) of the three structural dimensions in SUM to plot the functional Diagram 2. This summarizes the substantive principles elucidated in the book, while the third dimension provides its depth. The Diagram illustrates the cross-cutting interrelations and interactions among the nine conceptual elements of the SUM Matrix, super-imposed upon a spatio-temporal coordinate background. The arrows joining the concept areas are vectors moving diagonally from the lower-left to upper-right of the quadrant. This progression represents the overall development from simple-concrete to complex-abstract systems.

Extending from the zero space-time origin, one can see three waves rippling outwards and upwards towards the periphery. The first arc contains matter-energy-force, as the fundamental factors of nature, which will serve to anchor the infrastructure and generate the independent variables of Sociophysics. The middle sector, containing life-entropy-causality, forms the structure of our conversion mechanism. Finally, the outer arc contains history-syntropy-humanity as the products or superstructure of this transformative process. The next three sections will elaborate the characteristics of the interconnections within each of these phases, corresponding to the systemic ITO; thus setting the foundations for ToS which follow later on.

FACTORS

The fundamental thesis of Sociophysics is that the primordial units of reality consist of matter (quarks), energy (leptons) and force (bosons); everything else is derivative. This MEF thesis within the SET frame became the original axiom of ToS: i.e. matter, as the substance of existence in space and time, is interrelated by energy bonds to form the structures of all physical systems which are activated by various forces that move them one way or another.

This hypothesis is necessary to support a formal theory as well as to construct a real system. On that basis, the above concepts were combined within the space-time context and the static-dynamic codex to form the conservation-alteration laws which underlie reality. These opposing dualities, thus, characterize the state and action of all systems, be they natural or social.

This simple and concrete picture of reality corresponds to the Newtonian universe of classical physics; where matter (matter and energy, much like the Chinese *wu*) interact in Cartesian spacetime fields. Everything here may be described, predicted and explained in a rigorous mathematical language. The systems at this very basic level serve as the infrastructure, upon which everything else rests. Therefore, the simple codes that regulate their positions and movements underlie and precede those more complex ones at higher levels.

The most basic of these codes is embodied in the Conservation Law. This principle of

continuity-in-time and stability-in-space provides the foundation of human knowledge. Without this mental point of reference, our senses could not translate experience in any meaningful way. For this reason, one must accept this theorem as the basis of a SUM.

The application of conservation in social systems is as strong as in natural systems. Societies conserve their cultures and institutions tenaciously. Even when there is apparent change, the essential core remains the same. It is precisely this underlying stability that makes phenomenal change manageable, especially in complex social systems.

Based on this structural stability, social systems have built their complexity, interdependence, interaction and integration. The most significant consequence of this situation is the stratification of society. Beyond a certain level of complexity, every system eventually develops a hierarchy. Social classes and strata in turn contribute to their perpetuation, thus reinforcing the conservation principle. As a result, the law of inertia, lengthens and strengthens their hold through spacetime.

Social systems, like everything else, are basically physical and in so far as they are that, they obey spacetime and matergy laws. Social stability requires high energy bonding and social change results from the application of sufficient force, just as much as molecular structure and nuclear fission depend on the conservation and alteration of force fields. Making and breaking bonds, therefore, is what both physics and politics are all about.

For that reason, the matter-energy-force triad has been used as the independent variable or raw material given by nature and used by ToS. In terms of the Diagram, matter is almost at the origin of the quadrant, flanked by energy and force fields, which together fan forwards and upwards into the central area, where they are converted into the more complex systems described below.

CONVERTERS

The conversion process of our model consists of three distinct but interrelated sectors: organic-entropic-reactive. In the first place, these sectors are attractors of matter-energy-force; so they act as magnets pulling outwards and upwards these three fundamental inputs. This simultaneous attraction towards three different centers creates a conflictual dynamic which is resolved by various combinations or ratios to create different compounds. Finally, the resulting mixture catalyzes certain reactions which in effect transforms them into new systems.

One aspect of this general process concerns the emergence of life. A certain combination of physiostatic and thermodynamic elements produces organic systems. This quantitative and qualitative transformation pushes matergy unto a higher level of complexity. Life is a *gestalt* attribute which infuses itself throughout a system's material particles and energy bonds without belonging to any one of them in particular. This unique trait puts organic systems at the top of the existential hierarchy.

Similarly, the interaction of static and dynamic elements in matergy result in dialectic causality. The application of force causes a change of state which at a certain point leaps from the concrete to the abstract level, thus transforming particles into waves. This action-reaction process, combined with feedback mechanisms can repeat itself indefinitely but not eternally.

The entropy sink, like a black hole, is a powerful attractor which ultimately puts an end to all processes. As systems become more complex and abstract, they also convert greater amounts of matergy from higher to lower potentials. These dissipative systems are, therefore, prone to die hard and fast. By creating local cause and order, life precipitates global chance and chaos.

Every creation contains the seeds of its destruction. Even the strongest bonds eventually deteriorate. Time inevitably affects all, altering forms and changing substances. Both in nature and culture, the underlying stability is topped by an everpresent and everlasting flux. Therefore, variance complements persistence as the fundamental duality of reality.

The existence itself of systems creates differences of potential and degrees of order in spacetime. The differentials in matter-substantiality and energy-availability builds up increasingly

complex systems. The Law of Diminishing Returns, however, gradually catches up and growth slows down to peak and ultimately reverse its course.

The stylized *S* curve reflects this typical pattern of structural change. Since order requires energy to sustain itself, the more complex the system, the higher its energy level and the more difficult its perpetuation, thus becoming increasingly vulnerable and dependent on the environment. It is this overextension and hyperdependence that gradually reverses its direction and finally destroys all systems.

Different initial conditions and launching times make for extreme fluctuations in system evolution. Although complexity favors survival, the Law of Retarding Lead reflects the tendency for things to slow down as they succeed, thus giving a chance to the younger and simpler systems to overtake them. Therefore, it may be said that success breeds failure in proportion to its extent.

For that reason, it seems that quality or complexity is inversely proportional to quantity or simplicity. Intricate systems are rare because they are more difficult to make and sustain. As a complex, fragile and exceptional system; life becomes desirable and valuable, not only to the living beings themselves, but to existence at large.

These opposite tendencies of building up and breaking down consequently exist in social systems. The former forces them toward greater centralization and integration whereas the latter degrades and decays. Often, some societies succeed in their upward push to higher levels; most however languish in mediocrity and all of them eventually succumb to the downward pull of entropy.

The Law of Limits operates to keep systems within a restricted range in spacetime, because force or influence diminishes in both dimensions. The Inverse Distance Law discounts spatiotemporal distance by devaluing things or events as they move away from the here and now. Systems, therefore, have difficulty controlling their peripheries: the bigger they become, the harder it gets to pay attention to their remote regions. Similarly with time, the more distant the event, the less interesting or important it appears.

This tendency is the basis of causality, which admits action at a distance only under these constraints. Cause-effect processes must have a medium as well as a message which communicates influence from one body to another. That is why causality is strongest in proximity and tapers off as things move further apart.

At the same time, individual randomness adds up to collective determinism at one level, just as individual determinism is overtaken by the laws of chance and deteriorates into collective randomness at another level. Thus, both in natural and social systems the laws of certainty and probability combine to offer the best explanations of individual and collective behavior.

EFFECTS

Trying to make some sense out of all these opposing forces and contrasting principles is not an easy task. Human reason which created these contradictions is also driven to resolve them. Whether it is constance versus variance or cause versus chance, a resolution is possible through the notion of *coincidentia oppositorum* which unites these antinomies into a isonomic reality.

Two opposite but parallel processes: the dialectic and syntropic effect such feat, either by the synthesis or resolution of contradictions or the elective or eclectic accumulation of complementarities. Both these two outcomes complete the transformation of matter into mind. Natural evolution and social history are presently converging to form such idea of humanity at the apex of this developmental process.

The search for the laws of history is still going on and most likely they could be found in that gray area between determinism and incidentalism where atomic unpredictability overlaps systemic positivism. Just as individual rationality does not necessarily coincide with collective logic, so a double standard to accommodate different levels of existence could be the best one can get.

Between micro-randomism and macro-determinism, lies meso-voluntarism. The position of humanity mid-range along the timespace continuum, as well as man's unique attribute of self consciousness, adds a third explanation to the above two. Human will-power could account for at least some of its freedom of action. Man's capacity for choice and collective decision-making has to be taken as if it were a significant factor in social evolution. Therefore, historical dynamics may be considered as a combination of objective systemic laws as well as subjective personal intentions.

Postulating some teleonomic principle seems to be the best way to explain either human behavior or global evolution. The existence of an overall plan or program accounts for macro-determinism without contradicting micro-incidentalism. As long as there are limits to the range of choice, man can have some margin of maneuver within the bounds of necessity.

It is here that the political process operates to determine where these boundaries happen to be. Politics, forever test the limits of collective choice by probing the extent of social tolerance. Striking the balance between freedom and order or stability and change, therefore becomes the goal of political compromise between the possible and desirable.

This diacritic gap between ideal and real distinguishes human thought and action from those of other creatures. It is the everlasting attempt to fill this gap that leads humanity to accumulate power in order to control social and natural systems. Yet the elusive gap not only has not been bridged but widens along with that of knowledge and wisdom. The imperfect development of the human brain has created this congenital separation and hence cannot possibly bridge it at this early stage of its development.

Only if there is enough time for further evolution of a social mind can these discrepancies be erased. By now, the population of the world as well as its interconnections are reaching the order of magnitude (10^{10}) required to cross the threshold from individual to collective awareness. If and when this happens, social synergics could replace power politics and humanity will be able to transcend to the next and higher level of being.

THEORY

Within the context of the above SUM matrix, we can now proceed to summarize ToS which provides the central content of this article. Although, it is necessarily idealized, Sociophysics describes and explains human motivation and behavior on the basis of the natural and social factors given above. It, thus, summarizes and consolidates the various points made so far into a single theory of human action.

The important thing is that ToS has heuristic as well as exegetic potential, so that it can trigger chain reactions of inexhaustible potential. Cogent theories must penetrate beneath mundane phenomena to reveal novel and surprising connections. It is upon the shoulders of such theories that this attempt was undertaken. What emerges from the work presented here follows this tradition of abstract order in classical simplicity and will be summed up now in its essential unity.

Any theory should contain three systemic parameters: structural; procedural; functional. The first describes the spatial components; the second follows the temporal behavior; and the third explains the existential code of its subject-matter. Thus, a complete systems theory is itself a function of these spatial-temporal-formal parameters.

The parameters of ToS are based on the SET axiom, which postulates Existence as a function of Space and Time. As being arises out of the void of space-time, so does humanity emerge out of the fusion of nature-culture, at the same time as culture springs from the complexity of human nature. Similarly, this human spirit juxtaposes the natural and social sciences and then generalizes their common features by the mediating impact of the humanities.

The resulting ToS combines the *Physis-Anthropos-Polis* triangle in the functional-feedback relationship. Thus, the uniqueness of humanity lies somewhere between the constancy of nature and the variability of culture. The PAP principle may be considered as the third dimension of the SUM matrix because it framed the three sections (natural-social-general) of each chapter in the book, thereby guiding the sequence of our discourse.

These two parameters of ToS enunciate the general context (SET) and content (PAP) of the human condition. Based on the central dogma of social psychology that behavior is a function of personal and situational variables and following Habermas' attempt to reconcile exegetic and hermeneutic thinking by critical theory; we have resolved the apparent contradictions between the physical and mental realms by the mediation of the social system. Thus, natural determinism was accommodated with human voluntarism by including both within a more broad and profound understanding of reality made possible by the new scientific thinking.

In order to illustrate this claim, Diagram 3 contains all the elements of our model, as well as their interrelations. These are grouped fractally into the two basic categories of natural and social systems which dichotomize reality throughout this work. Supported by this double foundation there is a third system of mental qualities which completes the picture and culminates our theory. It is our concluding thesis here that human behavior results from various factors emanating from these three systemic realms as shown in the Diagram.

Complementing its pictorial representation, the Sociophysics also has a mathematical translation which is given by simultaneous regressive equations which represents the behavior of the entire system at any particular time. Let us then look into each of these aspects in the following sections.

NATURAL

Like everything else, man is basically a creature of nature. As such, the existence and development of mankind rides upon the natural waves of evolution. These waves proceed all the way from elementary particles, through complex molecules, to living cells. Human beings are made up of all these stacked systems and thus partake the traits of each one.

To begin with, humans are physical systems whose building blocks are atoms. This means

that they have material bodies which must obey the mechanical laws of nature, just like any other collection of mass. Newton's three laws of motion as well as that of gravity apply to man as they do to stars and apples. As a result, natural forces dictate the physical behavior of people and impose the constraints within which they can act.

Because of their physical limitations, humans can only be in one place at a time, much as they would like to do otherwise. These temporal and territorial imperatives of material existence underlie human behavior. The structural configuration of our bodies is directly related to the functional operation of our selves. Thus, as land creatures of limited speed and power, our physical behavior reflects these restricted capabilities.

Although people act like other objects under similar circumstances (i.e. free-fall), they do much more than that in normal conditions. Humans are not only physical but chemical systems; so in addition to their mechanical operation, they also have an energetic activity. Their body chemistry obliges them to follow certain cycles and avoid others. Physical attraction or repulsion is, therefore, supplemented by the chemical compatibility of particular mixtures or compounds.

The state of one's mind as well as body depends on the chemical balance and composition of the myriad of molecular substances which mix and circulate in the human system. Moreover, our experience of the environment as well as much of inter-personal communication is based on chemical pheromones which act as information media of sense perceptions. Thus, from headaches and indigestions to poisons and illnesses, chemical factors are another root of human behavior.

Inorganic reactions are even more significant when they become biochemical and thus bridge the physiological with the biological nature of man. As living beings, humans share many common traits with those of all creatures. From the cellular structure of the organism to the genetic make up of reproduction, human forms and personalities are dictated by biological factors common to all life.

Although we cannot fix the proportion of human disposition due to genetic causes, there is no doubt that a significant part of it is inherited and hence instinctive. This means that man's behavior is to a large extent biologically determined. The basic human needs for food and sex, work and rest, motivates our most primitive actions, as it does those of all animals. The instinct of self-preservation alone, serves as a powerful drive for much of human conduct and can explain a lot of its practices.

Altogether, these physical-chemical-biological determinants must account for the first part of the causes of human structure and function. These factors form both the hardware of our organs and the hardwired programs which motivate us. They provide the infrastructure which has been given by the laws and forces of nature.

The above three levels interrelate and interact in a hierarchic manner: with the physical level at the bottom, the chemical in the middle and the biological at the top. This sequence follows the evolutionary process from the simple inert matter to the complex living being. So, as systems become more complex, they superimpose more layers and interconnections, culminating in the triadic super-system which is man.

Of course, the reverse process also takes place as a feedback which forms a closed loop. The complete cycle not only builds upwards more complex systems but eventually pulls them down and disintegrates the systems back into their simpler components, so they can start the cycle all over again. Evolution and entropy, then, combine to perpetuate the life and death cycle of nature. Human existence and activity is inextricably tied to this inescapable cyclic process.

ToS does not pretend that nature determines exclusively or directly the totality of human conduct. Rather, it proposes that nature predetermines that certain cultural traits become institutionalized in society. These natural inclinations favor particular social directions to be taken and others to be avoided by predisposing some to succeed while the rest are likely to fail.

Traditionally, natural factors formed the autonomous parameters of our existence because they were practically beyond any control. But, evolving capabilities such as high manual skills, metaphoric thought and mutual relations developed in humanity *sui generis*. Increasingly, human

ingenuity and dexterity is bringing these factors within the realm of technological manipulation.

This development creates strong socio-feedbacks which affect natural systems and thus downgrade their primacy. It is this evolution that gave us the insatiable urge to keep reshaping both our internal and external worlds. Although all organisms affect their environment somewhat, humans alone acquired the ability to modify it to such unprecedented extent.

Yet, we still a long way from influencing nature as much as nature influences us, so we have used natural factors as the independent variables of our model and the prime movers of its dynamics. As the exogenous inputs to our system, we consider these natural factors to be the basic causes of human behavior and therefore to underlie the social factors which shall be examined next.

SOCIAL

Although mankind is a creation of nature, it is not solely that. As Aristotle said, man is primarily a social animal (*zoon politikon*). To natural origins, one must therefore add social conditioning as the other side of the coin. For a more complete explanation of human behavior, cultural as well as natural factors must therefore be taken into account.

The nature-nurture debate has been going on at least since the *nomos-physis* dichotomy of the ancient Greeks; so we do not expect to settle it here. Rather, we conclude that the essence of humanity rests on the twin pillars of nature and culture; thus, human behavior derives more or less equally from both sources.

Nevertheless, the more civilized or urbanized people become, the greater the influence that society has upon them. Although *homo sapiens* originated as a completely natural creature, our species has progressively moved away from nature to recreate itself artificially as a predominantly social being. So, as cultural evolution continues in the future, we can expect a further increase of human socialization and its accompanying process of denaturalization.

Be that as it may, the conduct of modern man is already to a large extent learned. Once natural forces have been taken into account, the remaining part of man's behavior should be attributed to social factors. The proposition which underlies all social theories is that *homo habilis* behaves according to a multiplicity of specific roles established by convention. Whenever there is a conflict among them, the role with the strongest positive or negative sanctions tends to determine human action.

According to our model, such action takes place in three social arenas: economic, cultural and political. Role playing in each of these sectors is programmed by different scenarios which go a long way in explaining human acts in society. Let us then summarize the principle rules of the play.

Starting with the economy, one can see how the natural instinct for self-preservation translates itself into the social drive for wealth-accumulation. Individual self-interest dictates that everyone tries to maximize one's resources by exclusive control or ownership of the means of production. Thus, the natural proclivity of egocentrism is compounded by the economic drive for financial values and material goods.

The strength of economic motives, of course, varies according to the specific circumstances of time and place. But, paradoxically, materialism does not subside with the possession of great wealth. It seems that the Agglutination Law increases the appetite of those who already have a lot to hunger for even more. Whether they are individuals or societies, the desire for economic growth can be as addictive for the haves as it atrophies for the have-nots.

Closely related to the economy is the polity. Like the drive for wealth, the drive for power is enhanced by human socialization. Supplementing the innate tendency for environmental control of all organisms, the political struggle for power is a means of fulfilling one's needs and wants by seeking to affect the behavior of others. To this end, the use of violence, opulence, or intelligence, have combined or alternated in various ways at different times and places.

Since the manner in which people enrich, empower, and enjoy themselves are interrelated, there must be some consistency among them; otherwise society becomes dysfunctional and even

self-destructs. Social development, therefore, means the consistent improvement of economic, cultural, and political structures and processes to respond to evolving human needs.

In this respect, political motives arose from natural insecurity but have been cultivated into social necessity. Since it is a more sophisticated activity than economics, politics requires a higher level of socialization. Ideally, political man behaves in such way as to influence others by the dialectical process of mutual accommodation. Accordingly, differences of opinion and conflicts of interest can be equitably resolved and policy decisions collectively taken. Within these parameters, the accumulation of power becomes a means to an end: i.e. optimizes moral behavior in society.

The question of morality brings us to the third social sector. As the way of life and determination of values in a society, culture is reflected in the famous LARK (language-art-religion-kinship) variables which exclusively define human uniqueness. These traits are found in every human culture but nowhere else. It is on the basis of these universals of human nature that the incidentals of different cultures flower.

Consequently, the acculturation-civilization of man implies programming people artificially to think and act in a manner which is contrary to their natural-animal inclinations. But since, in contrast to the singularity of nature, there is a plurality of cultures; as nature accounts for the basic similarities of human behavior, so culture is responsible for their superficial differences.

Nevertheless, within each society, a modicum of cultural homogeneity is necessary to establish and maintain the common values which underlie moral behavior. Since morality means considerate action, the shared education in a culture makes comity easier and thus contributes to the cohesion of society. To the extent that they replace natural forces, cultural factors become increasingly important in human behavior and are thus responsible for a greater part of social dynamics.

Together with economics and politics, culture completes the external sources of human conduct by adding the software programs of society to the hardware structures of nature. Social behavior, therefore, results from the combined effects of its three sectors which complement as well as contradict the natural behavior of man.

MENTAL

From what has been said so far, nature provides the environment and culture the system in which human beings exist and act. As such, they make up the outer reality of mankind and the context in which it operates. But, human ideals may rise above both nature and culture, thus approaching a transcendental realm of self-consciousness. This implies that there is an inner world for human beings which identifies their individuality and of which everybody is separately conscious. This world of self-awareness constitutes human mentality and defines the particularity of our species.

The mind can be considered as the totality of functioning processes for which the brain along with the rest of the nervous system provide the supporting structure. Since this physical system is a product of evolution, there is no doubt that human mentality is deeply rooted in natural reality. The organization of matter in the complex network of interacting causal paths making up the human brain has created a holistic synergy which gives this total entity a mental quality that does not belong to its components separately. In the final analysis, it is this complexity which allows some freedom of action by presenting us with multiple possibilities for choice.

Human nature can be defined in terms of its constituent aspects: emotional; logical; spiritual. The three characteristics are based in the three parts of the human brain: right; left; center; so there is a fair correspondence between structures and functions. The human mind is in effect the operational synthesis of this triadic configuration. Let us see how this synthesis is arrived at.

In the first place, the emotional aspect identifies the psychological sources of human behavior, which are to a large extent dependent on the chemical reactions in the brain. These natural processes are somewhat controlled or cultivated and suppressed or enhanced by social conditioning.

It may thus be said that human dispositions are a dynamic combination or rather a dialectical synthesis of both impulsive and compulsive forces.

Undoubtedly, much of human behavior can be explained as emotional responses to various stimuli. Passionate reactions to particular situations and attitudinal expressions of different impressions fall in this area of psychology. These manifestations of human feelings indicate the unique idiosyncrasy that distinguishes individual personalities; while at the same time unite mankind by a common fundamental mentality.

Counterbalancing the emotional side of the right brain is of course the logical side of the left. Man is both a rational and an emotional animal; sharing these two qualities to a much larger extent than other living beings. The high development of human rationality is a result of nature and nurture; so it is both similar to all men and different to each culture.

Rational behavior is characterized by calculating the most efficient means to attain given ends and thus finding optimal solutions to well-defined problems. In such cases, the superior intellect of man has marked many milestones of both theoretical and practical significance. Whenever they conduct themselves rationally, human beings enhance their natural capabilities and extend their social systems.

The two opposite but complementary sides of man are finally supplemented by the third and highest aspect of mind which characterizes the human psyche. It is at this spiritual summit where man reaches the outer limit of ordinary reality and sometimes surpasses it. When this happens, humans may transcend both nature and society and attain a glimpse of whatever lies beyond.

Although rare, there are enough instances of inspired behavior to justify the inclusion of this ultimate quality in the definition of humanity. As the *summum bonnum* of human attainments, this mental phenomenon is impossible to describe fully or explain adequately because our consciousness is too limited to contemplate it. In accepting this intellectual self-limitation, one gives the benefit of the doubt to supernatural existence and leaves open the possibility of its influencing human thoughts and actions.

Finally, we should not forget the random factors entering the equation of human behavior. Since all action cannot be explained deterministically, we must allow for an element of chance in human affairs. The playfulness of nature is also reflected in *homo ludens* who is the product as well as the producer of both law and luck.

With that admission, we end this brief summary of the anthropomorphic model which emerged from the present work. From it may be concluded that the basic human needs are physiological, sociological, and psychological; their fulfillment therefore requires natural, cultural, and spiritual values. On the basis of an all-inclusive natural infrastructure, ToS builds upon the intermediacy of social structures to culminate with the exclusive mental superstructure of mankind. This scheme explains in generic terms the causes of human behavior and thus locates intentional conduct in both its deterministic and stochastic context.

PARADIGM

The major premise supporting our conclusions rests on the conviction that human reality can only be understood and appreciated in the context of general laws which give it order and meaning. Yet, one must admit that general laws, may have no facticity because they are mental abstractors rather than phenomenal descriptors. Quantitative and qualitative generalities are ascribed to substantive or indicative specificities by the human mind and may not exist independently.

Moreover, human concepts depend to a large extent on the social conditions within which they arise. In that context, how we form and what we call natural laws may be reflections of artificial circumstances. As such, there is some correlation between social change and scientific revolution. So, with the modern acceleration of history, toleration of eternal truths and laws has declined significantly, although the need for them in this instable situation has increased correspondingly. It is these relations among the mental, social and natural realms that have been emphasized in Sociophysics and must be kept in mind when our conclusions are drawn.

To the facticity proviso, should also be added the conditionality warning which admits exceptions to laws in direct proportion to their generality. That is to say: although everything and everybody is constrained by certain laws; particular behavior, be it of atoms or men, is not determined in any absolute or detailed manner. There is always some degree of freedom to be found everywhere. Thus, both natural and social laws contain implicitly or explicitly the *ceteris paribus caveat*.

Although there may not be a strict hierarchy of laws but only loops and networks of them; some laws are older and broader than others, thus they have priority over the newer and narrower ones. For this reason, we assigned the precedence of primogeniture to natural over social laws and paid them due respect. This position represents the focus of the anthropocentric perspective and serves as the foundation of ToS.

The third and last section of this article will deal with the canonic aspects of TIP, as they operationalize both the SUM context and ToS content of this book. By this we mean the *modus operandi* in which inputs are transformed into outputs. After the substantive conclusions given above about the social system and its natural environment, an explicit summary of the modalities that led to them is therefore necessary.

The central theme of TIP combines Spinoza's monism and Decarte's dualism, thereby building the triadism of this study. This triadic paradigm is superior to either of its components because it resolves their opposition by integrative interactionism, thus providing a more rational and pragmatic framework for both theory and praxis.

The triadic hypothesis underlying Sociophysics has been amply supported by the evidence offered in the book. The numerous trilateral interactions presented therein should be sufficient indicators of the validity and utility of TIP, as it offers a systemic metaphor among the natural, social and human sciences.

This metaphoric phenomenon is manifested in many ways: as entropy or syntropy; fluctuation or continuation; idealization or actualization. All these and other dyads emphasized in Sociophysics were found to be best manipulated by the dialectical process. Dialectics, as processed by the thesis-antithesis-synthesis sequence may be related by the function: $S=f\{T,A\}$, thus establishing the main conduit taken in ToS.

Accordingly, our general dialectic algorithm proceeds as follows:

Thesis: Preparation of a defensible position;

Antithesis: Identification of a problematic opposition;

Synthesis: Resolution of the two in a viable combination.

Assuming, on the basis of Newton's Third Law, that to every position, real or ideal, there is an equally held opposition, political dialectics require a negotiated accommodation through mutual exchange and compromise.

We shall now go over this process by first juxtaposing its two opposing elements (Analytic and Axiomatic) and then integrating them into their Synthetic compound. In their functional relationship, these functions may be depicted in very schematic form in Diagram 4.

Supported by the TAS process as applied in the above steps, TIP provides a comprehensive convergence process. Its operating procedure involves various parallel and sequential phases beginning with any subject or object to which is juxtaposed either its complementary or contrary interlocutor. From this binary dyad and other intermediate locations, one can arrive at a final position by a process of elimination and recombination.

These procedures are followed in one instance or another by Sociophysics. Together, they form the total inventory of the available methods in the systematic study of any topic. Of course, as an ideal model, this methodological complex could only be approximated in carrying out this particular or any project. In what follows then, we recapitulate the salient points of our argument in logical rather than chronological order.

ANALYSIS.

The process of analysis carried on here means that the subject-matter of this essay was broken down into its constituent units and then each one was examined separately. By using this analytic method of decomposition, one can render a complex topic into a number of simpler ones and so deal with them in a manageable way. As a result, one can learn something about the whole by knowing its parts.

Analysis is effected in three distinct ways: diagnosis; anagnosis; prognosis. This DAP modality is related by a common epistemology which emphasizes the empirical knowledge of a system through the temporal investigation of its present, past and future states. Situated in the present, one makes regressions into historical records, on the one hand and incursions into conditional scenarios, on the other. In this way, a chronological sequence can followed to show the dual tendency of things both to remain and change through time.

The diagnostic aspect of Sociophysics describes reality as perceived here and now. It is a complex, dynamic and multifaceted reality which requires some conceptual paradigm to take on human significance. This paradigm systematize observations into a taxonomic scheme and puts matters into a comprehensible form. As a result of the diagnosis, one infuses some meaning into the present situation and finds an order in things.

But, the perception and conception of a picture or painting depicting the *status quo* does not explain how it came to be. For that one needs to make a historical anagnosis which will discern a cause-effect sequence of events leading from the past to the present. This is done by establishing a chain of causality based on both the entropic and syntropic processes. In this chain, the present state of affairs is explained as a result of the flight by the arrow of time in history.

By determining the velocity and direction of this arrow, it is theoretically possible to extrapolate its flight path from the past into the future and so predict when and where it will land. This calculation purports to result in a prognosis of an event before it actually occurs and thus gives a glimpse into its future state. Of course, reality is too complex and we are too ignorant to be able to treat temporal processes so deterministically. Thus all one can do is to discover some heavy trends and project their alternative probabilities.

The above analytic method could ideally give the proper pathology, etiology and melontology of any given condition. Although practical and theoretical constraints reduce its application in various degrees, Sociophysical analysis proceeds by establishing the facts and explaining their significance. In doing so, it relies on the three existential conditions of stability, variability, reactivity, which combine to form the CAF principle. At the same time as the cosmic tendencies of MEF lead to the laws of position, action, and function.

Within this primary nomothetic framework, Sociophysics formulates a secondary group of natural laws reflecting the behavior of its nine distinct system domains: physical, structural,

deterministic, entropic, organic, syntropic, chaotic, historic, human. As one moves from general conditions to particular cases, systems and their laws become more intricate and exclusive, thus complicating and multiplying our work at the tertiary level, where nonetheless, a number of particular-situational theorems and hypotheses were accumulated to reflect the polyvalent nature of reality.

All of these interrelated principles built up ToS according to the general algorithm of TIP. This procedure, however, cannot be performed in isolation. Analysis requires axiosis as its parallel and complimentary method to which we now turn.

AXIOSIS

Along with analysis, Sociophysics also engages in axiosis. This procedure permits the evaluation as well as the explanation of any subject-matter. In distinction to the natural facts involved in the analysis, axiosis brings human values into our equations. In this way it supplements reference with preference and combines understanding with appreciating.

Axiosis requires the use of critical faculties in order to judge between alternatives and opt for one or another course of action. This implies a decision-making capacity to select among a given variety of different positions or offerings; as well as a free-will to exercise this choice. Given these assumptions, the process of axiosis has been carried out by three distinct routes: syncrisis; anacrisis; and diacrisis.

The first and simplest process is that of verification as to the truth of something. This involves a comparative assessment between the accepted rules of evidence or validity and the actual procedures of a given case. As such, this epistemological test can determine the facts of a situation and estimate the methodological correctness of an operation.

In this case, the syncretic approach is used mainly in fitting natural processes to universal axioms. Thereby, the deterministic rules of causality circumscribe the realms of possibility and necessity. The borders of this realm, however, are quite fuzzy because of the inherent indeterminacy of randomness which infuses some chaotic traits to even the most orderly of systems.

The critical question here is to distinguish the borderline between inescapable and improbable occurrences. Although, we do not pretend to have a decisive answer for this question, Sociophysics can show the various levels and sectors where causality predominates. Accordingly, it is possible to make valid estimates of the probable scope of the world of necessity as opposed to that of coincidence.

The next level of anacrisis deals with even more imponderables than that of syncrisis; because the human element is much more pronounced in valuation than in validation. In this area, the question is no longer of whether something is true or false but rather good or bad. In order to answer such questions, one moves from the natural world of physics to the social world of ethics or from the possible to the desirable.

Since humanity took the evolutionary road of consciousness, it also fell into the autonomous dictates of conscience. As human beings tried to free themselves from the determinism of necessity, they had to develop equivalent self-imposed constraints to guide legitimate behavior. Cultural norms, thus, gradually supplemented natural laws as to what is permissible and prohibited. Hence, social ethos became individual ethics.

This movement from nature to culture, however, is not completely arbitrary. The hierarchical connections between the two worlds still exist, so the influence of natural laws continues to be reflected in social legislation. As Sociophysics attests, the gap between *lex civile* and *jus naturale* can be bridged by a naturalistic ideology.

In this endeavor, the capacity for language as part of human nature leads to the freedom of expression as part of social culture; in the same way as physical integrity leads to human dignity. It is not too difficult to translate the Conservation Law into the *pacta sunt servanda* principle or the Alteration Law into the *rebus sic stantibus* clause. These two opposite rules expose the

contradictions between security and opportunity or tranquility and creativity, thus reflecting the same antinomies in both intranatural and international laws.

According to TIP, these contradictions can be resolved by the Third Law which translates as the principle of reciprocity whose validity spans both rational and moral grounds. From that, it is only a short step to the concept of justice as the proper natural and social equilibrium between antagonistic positions and antithetic claims.

The ultimate criterion of what is good and valuable is usually whatever promotes the quality of life. For that reason, the central question here concerns the perennial conflict between individual volition and collective existence, which could only be answered in dialectical terms.

Finally, beyond the external worlds of syncrisis and anacrisis lies the internal world of diacrisis. Here one enters the spirit of man to confront the realm of beauty and mystery. The natural principles of symmetry, proportionality and fractality contribute to our esthetic sense; just as those of infinity, indeterminacy, and complexity demonstrate the limits of human reason. Since diacrisis depends on charisma and inspiration, very little can be and has been said about it. The rules and canons of this process are the most inexplicable, so one can only touch upon them peripherally and merely speculated on their operation.

From this brief encounter with DAS, we can conclude that on this threshold where the outer and inner worlds meet, one can see no limit to the possibility and potentiality of the human spirit. Here again, the most likely direction of natural evolution and social development is a convergence of individual and collective mentality which will transcend the constraints of physical laws to unite the atom with the cosmos.

SYNTHESIS

Combining the analytic and axiomatic phases of TIP, we finally come to its synthetic conclusion. Unlike analysis, synthesis proceeds to integrate a number of parts into a whole. In this way, it draws the different lines of argument into a consistent overall result. This is done by syllogical, analogical and dialogical methods as appropriate in the various contexts.

Based on the Aristotelian logic of the Covering Law, the hypothetico-deductive process used in Sociophysics begins with the premise of general principles into which are fitted particular phenomena and ends with valid conclusions relating the two. The major premise postulates well-known universal laws which underlie the structures and processes of reality. The explanation of specific things or events depends on their proper identification with one of these laws. ToS, therefore, proposes simple syllogisms to explain the existence and behavior of complex systems.

Related to this logical process, Sociophysics also uses analogy to build plausible metaphors between the natural and social sciences. This process of bissociation is the conjunction of at least two frames of reference and is indispensable to any creative thought, brought about by resolving the tension between similarities and differences in a new paradigm.

Finally, the above methods are incorporated to the dialectic which accommodates opposite entities into a single reality. This ultimate synthesis of contradictions into consistencies goes beyond logical deductions or analogical metaphors to create new and counter-intuitive systems. Recognizing the two fundamental contradictions of continuity and variability, Sociophysics fuses the overriding plasticity of reality and thus builds its theory thereon.

The combination of these methods served as a confirmation of the validity of each one; since their conclusions all point in the same direction: i.e. that reality is simple and complex, concrete and abstract, random and deterministic, constructive and destructive, uniform and distinct, static and dynamic. Out of all these antagonisms arise the space-time coexistence of all events and things. The conflict and cooperation within and between men therefore faithfully reflects this greater reality above and beyond them all.

From physiological attraction and repulsion of positive and negative charges to psychological love and hate between compatible and competitive people, one finds a direct

metaphor connecting nature and culture. Similarly, the facts of atomism and holism reflected in the traits of egoism and altruism, translate to the ideals of liberty and fraternity. All these oppositions can be attenuated by the cyclic waves of equitable morality in civil societies.

Extracting an essence of order out of the semblance of chaos permeating reality has produced the triadism which underlies ToS. Accordingly, the functionally interacting effects of reality (Y) result by combining some constant parameters (k) with certain variable factors (X): i.e. $Y=f\{X\}$ or $Y=kX$. The most profound scientific theories we have encountered, including $E=mc^2$, are all reducible and tersely symbolized by this elementary archetype of CAF.

CONCLUSION

In wrapping up this article, we wish to reiterate the inescapable coexistence of art and science or culture and nature in the evolving human condition. This sociophysical resumé forms our ultimate synopsis and may be succinctly stated in a complex of dialectical syllogisms illustrated in Diagram 5. As shown therein, the broad lines of our argument are delineated in three parallel but interconnected channels: substantial, essential, canonical; corresponding to the content, context and codex of Sociophysics. Starting from the top and leading towards the bottom, the arrows point to the three step reasoning followed in the study.

In all cases, the first step is the major premise (Thesis; Physis; Gnosis); followed and opposed by the minor premise (Antithesis; Praxis; Axiosis); converging finally in a common conclusive theory (Synthesis). This combination of logical and dialectical means arrives at identical ends via different methodological roads. Let us take each one in turn.

Starting with the basic postulate of the natural environment, we accept its existence by empirical epistemology. Within this all-encompassing context, we juxtapose the existence of society, as both a natural and artificial creation; whose attributes combined the rationality of *cosmos* and the humanity of *nomos*. These two different, but interacting realms fuse in the mind of man to produce meaningful explanations in the form of general theories. This line of thought, formed the *colone vertebrale* of our model, as shown in the Diagram.

Flanking it on the left is the dialectical essence of reality which manifests itself in the confrontation and conversion of opposites. Based on the existence of matter-energy-force; first, we posit the major premise or thesis: i.e. all systems tend to conserve the *status quo* and resist change. Next, taking into account the opposite tendencies of life and death or order and chaos; we compose the minor premise or antithesis: i.e. all systems tend to change the *status quo* and leap into new positions. Last, we draw the logical conclusion or synthesis: i.e. all systems embody contradictions, manifested temporally as alternating cycles and spatially as conflicting structures which are eventually transcended by the combination of natural syntropy and human history.

Finally, on the right side is drawn the third line of argument which juxtaposes facts and values to arrive at a higher synthesis containing both. In the first instance, the analytic study of reality requires information of the past, present and future states of being. This objective knowledge of science, however, becomes useful by a critical axiosis where value judgements establish priorities and preferences. This process of evaluation combines with that of discovery to form the third and last step of this road, which along with the other two lead into the synthesis of ToS.

The convergence of these three channels into the same pool of synthetic theory indicates the comparability and complementarity of every system: physical, social and mental. Although they differ in their superstructure, they all share the same infrastructure and thus they follow the same laws. At the center of all that is the human mind trying to understand as well as to shape the world. This dual role makes man the paragon of creation as well as the ultimate creator of reality.

The contribution of Sociophysics in this human endeavor is to probe the limits of human actions as they take place in social systems within the constraints of all-encompassing natural environment. Only by determining our margin of maneuver, can we be most efficient and effective

in trying to change what could and should be changed.

Having said that, however, we must sound a final note of caution regarding the limitations of the human mind and the confines of its reasoning. As logicians already demonstrated: there cannot be any universal language or formal code that will prove the truth of everything. On the contrary, reason inevitably leads to doubt, only implacable faith can give certainty.

Throughout history, these two conditions alternated in dominating human mentality. From traditional beliefs to classical logic, or Pauline faith to Cartesian reason, the dialectic proceeded along with its Thomistic syntheses until the present juncture. In spite of the progress made along the way, there is no end of the historical dialectic in sight. One must therefore accept that the human condition by its very nature is forever blessed or condemned to exist in ambiguity and amphiboly.

For that reason, we should abhor certainties and extremities in either exposing or explaining reality and be always on guard against simplistic views of complexity. Scientific prudence dictates great circumspection in what is taken for granted and continues questioning of established dogmas. So, Sociophysics strives for a balanced and eclectic position which combines the knowledge of the present with the wisdom of the ages.

In this way, our inability to obtain perfect knowledge does not mean that all opinions are equally good or bad. As was argued here, adequate criteria can be found for making reasonable distinctions and thereby minimizing the risk of wrong conclusions. Since an essential trait of human reason is its axiomatic basis, proper premises are the *sine qua non* of avoiding Simmel's trilemma of circular arguments, infinite regressions, or arbitrary opinions.

Contemporary science has already hinted at the possibility of narrowing the gap between natural absolutism and cultural relativism by blurring the differences between explicative and interpretive knowledge. This development converges the various strands of thought towards the common sense of human nature, thereby providing a shared criterion for a global culture which is coextensive with planetary nature.

Having completed this endeavor, however, we end by admitting that the search for scientific truth, like artistic beauty and philosophical wisdom, should always combine a healthy skepticism with a modicum of irony and a lot of humility. After all, what characterizes our common humanity are the evolving answers we give to the persisting questions of our nature: *whence, whither, why*.

100 SELECTED BACKGROUND BIBLIOGRAPHY

- Adams, R.N. **The Eighth Day**. Texas U.P. Austin, 1990.
Adorno, T. & Horkheimer, M. **Dialectic of Enlightenment**. Verso, London, 1979
Aida, S. et al. **The Science & Praxis of Complexity**. UNU, Tokyo, 1985
Arnopoulos, P.J. **Sociophysics**. Nova Science Publishers, N.Y. 1993
Bailey, K.D. **Social Entropy Theory**. SUNY U.P. Albany, 1990
Barel, Y. **Le Paradoxe et le Systeme**. Presses Universitaires, Grenoble, '79
Barnes, B. & Shapin S. (Eds). **Natural Order**. Sage, London, 1979
Barrow, J.D. **Theories of Everything**. Vintage, London, 1991
Bartley, W.W. **Evolutionary Epistemology**. Open Court, Peru, Ill. 1986.
Bhaskar, J. **The Possibility of Naturalism**. Brighton, 1979.
Berkowitz, L. & Walster, E. (eds), **Equity Theory**. NY, Academic Press, 1976.
Berger, P.L. **Social Construction of Reality**. Doubleday/Anchor, N.Y. 1967.
Black, M. **Models & Metaphors**. Cornell U.P. Ithaca, 1962.
Bohm, D., Peat, F.D., **Science, Order and Creativity**. Bantam, N.Y. , 1987.
Boudon, R. **L'art de se persuader**, Fayard, Paris, 1990.
Brown, D.E. **Human Universals**. McGraw-Hill, N.Y. 1991

Bucke, R. **Cosmic Consciousness**. Dutton, N.Y. 1969.
 Bunge, M.A. **Method, Model, Matter**. Reidel, Boston, 1973.
 Callenbach, E. **Ecotopia**. Pluto Press, London, 1978
 Casti, J.L. **Paradigms Lost**. Morrow, N.Y. 1989.
 Corning, P. **The Synergism Hypothesis**. McGraw-Hill, N.Y. 1983
 Csanyi, V. **Evolutionary Systems & Society**. Duke U.P. Durham, N.C. 1989
 Crowe, M.B. **Changing Profile of Natural Law**. Nijhoff, The Hague, 1977
 Davies, P. **The Cosmic Blueprint**. Simon & Schuster-Touchstone, N.Y. 1988.
 Davies, P.C.W. & Brown, J.R. **The Ghost in the Atom**. Cambridge U.P. 1986.
 Dogan, M. & Pahre, R. **Creative Marginality**. Westview, Boulder, 1990.
 Dumond, L. **Homo Hierarchicus**. Chicago U.P. 1980
 Dupuy, J-P. **Ordres et disorderes**. Seuil, Paris, 1982.
 Ferris, T. **Coming of Age in the Milky Way**. Morrow, N.Y. 1988.
 Feyerabend, P. **Farewell to Reason**. Verso, London, 1987.
 Field, H. **Realism, Mathematics & Modality**. Blackwell, Oxford, 1989
 Finnis, J. **Natural Law & Natural Rights**. Clarendon Press, Oxford, 1980
 Fiske D. & Shweder, R. **Metatheory in Social Science**. Chicago U.P. 1986.
 Flood, R.L. **Liberating System Theory**. Plenum, N.Y. 1990.
 George, R.P. (Ed). **Natural Law Theory**. Oxford UP. N.Y. 1992
 Geyer, R. & van der Zouwen. **Sociocybernetics**. Nijhoff, Leiden, 1978
 Gualtieri, A.R. **Search for Meaning**. Guernica, Montreal, 1991.
 Gibbins, P. **Particles & Paradoxes**. Cambridge UP. 1987
 Grinker, R. (Ed). **Unified Theory of Human Behavior**. Basic Books, N.Y. 1976
 Haken, H. **Synergetics**. Springer, N.Y. 1978
 Harris, E.H. **Cosmos & Anthropolos**. Humanities Press, N.J. 1991
 Hesse, M.B. **Models & Analogies in Science**. Notre Dame U.P. 1970
 Hofstadter, D.R. **Godel, Escher, Bach**. Random House (Vintage), N.Y. 1980.
 James, S. **The Content of Social Explanation**. Cambridge U.P. 1984.
 Judson, H.F., **The Search for Solutions**. Holt Rinehart-Winston, N.Y., 1980.
 Kearney, M. **World View**. Chandler & Sharp, Novato, 1984.
 Klapp, O.E., **Models of Social Order**. National Press, Palo Alto, 1973.
 Koestler, A. & Smythies, J. **Beyond Reductionism**. London: Hutchinson, 1969
 Kuhn, T.S. **The Essential Tension**. U of Chicago Press, 1977.
 Lakoff, G. & Johnson, M. **Metaphors**. Chicago U.P. 1980
 Landau, L. **Science & Values**. U. of California Press, Berkeley, 1984.
 Laszlo, E. **Evolution: The Grand Synthesis**. Shambala, Boston, 1987
 Little, D. **Varieties of Social Explanation**. Westview, Boulder, 1990.
 Loeb, E. **Humanomics**. Random House, N.Y. 1976
 Lukes, S. **Rationality & Relativism**. Blackwell, Oxford, 1982.
 Malinowski, B. **Scientific Theory of Culture**. North Carolina U.P. C H., 1944
 Marks, L.E. **The Unity of the Senses**: N. Y., Academic Press, 1978.
 Maturana, H. & Varela F. **The Tree of Knowledge**. New Science, Boston, '87
 Mayburg-Lewis, D. **Millennium**. Q.P.B. 1991
 Mitcham, C. & Macky, R. **Philosophy & Technology**. N.Y, Free Press, 1972.
 Miller, J. **Living Systems**. McGraw Hill, N.Y. 1978.
 Morris, R. **The Edges of Science**. Prentice-Hall, N.Y. 1990.
 Nagel, E. , **Teleology Revisited** . Columbia U. P., N.Y., 1979.
 Nash, R. **The Rights of Nature**. Wisconsin U.P. Madison, 1989
 Pagels, H. **The Cosmic Code**, Bantam, N.Y. 1983.
 Peat, F.D. & Briggs, J. **Chaos & Order**. Harper & Row N.Y. 1989
 Popper, K. **Unended Quest**. Open Court Publishing Co. , ILL., 1976.

Progogine, I. & Stengers, I. **Order out of Chaos**. Bantam, N.Y. 1984
 Proctor, R.N. **Value-Free Science**. Harvard U.P. Cambridge, 1991.
 Potter, V.R. **Bioethics**. Prentice-Hall, N.J. 1972
 Raskin, M. et al. **Reconstructive Knowledge**. Rowman & Littlefield, N.J. '87
 Reeves, H. **The Hour of our Delight**. Freeman, S.F. 1991
 Rescher, N. **The Limits of Lawfulness**. Pittsburg U.P. 1983.
 Resnokoff, H.L. **The Illusion of Reality**. Springer Verlag, N.Y. 1989
 Rorty, R. **Philosophy & the Mirror of Nature**. Blackwell, Oxford, 1980.
 Rosnay, De J. **The Macroscope**. Harper & Row, N.Y. 1979
 Rothchild, M. **Bionomics**. Fitzhenry & Whiteside, Toronto, 1991
 Runciman, W. **A Treatise on Social Theory**. Cambridge U.P. 1983.
 Rosen, R. **Anticipatory Systems**. Pergamon, London, 1986.
 Russell, R.J. et al. **Physics, Philosophy, Theology**. Notre Dame U.P. 1988
 Ryan, A. (Ed). **The Philosophy of Social Explanation**. Cambridge U.P. 1973.
 Salk, J. **The Anatomy of Reality**. Columbia U.P. N.Y. 1983.
 Schutz, A. **Phenomenology of the Social World**. Heinemann, London, 1972.
 Serres, M. **Le Contrat Naturel**. Francois Bourin, Paris. 1990.
 Sheldrake, R. **The Rebirth of Nature**. Bantam, N.Y. 1991
 Simon, H. **Models of Thought**. Yale, N.H. 1979.
 Skinner, Q. **Return of Grand Theory in Human Sciences**. Cambridge, 1985.
 Smith, J.W. **Essays on Ultimate Questions**. Avebury, Aldershot, 1988
 Spencer-Brown, G. **Laws of Form**, Dutton, N.Y. 1972.
 Stamps, J.S. **Holonomy**. Intersystems, Seaside, Cal. 1980.
 Stinchcombe, A.L. **Constructing Social Theories**. Harcourt-Brace, N.Y. '68
 Stretton, H., **The Political Sciences** . London, 1969.
 Suppe, F. (Ed). **Structure of Scientific Theories**. Illinois U. Urbana, 1977.
 Theobald, R. **Beyond Despair**. Seven Locks Press, Washington, 1981.
 Thompson, E.P. **The Poverty of Theory**. London, 1978.
 Turner, J.H. (Ed). **Theory Building in Sociology**. Sage. London, 1989.
 Van Foerester, H. *et al.*, **Purposive Systems**. Spartan, New York, 1968.
 Van Gigch, J.P. (Ed). **Metasystems & Metamodels**. Pergamon, London, 1986.
 Watzlawick, P. (Ed). **The Invented Reality**. Norton, N.Y. 1984
 Weinreb, L. **Natural Law & Justice**. Harvard U.P. Cambridge, 1987
 Weizsacker, C.F. **The Unity of Nature**. Farrar-Straus, N.Y. 1980
 Wilson, E.O. **Sociobiology**. Harvard U.P. Cambridge, 1975
 Young, M.F.D. (Ed.), **Knowledge & Control**. Collier-Macmillan, London, 1971
 Zukav, G. **The Dancing Wu Li Masters**. Bantam, N.Y. 1979
