Complex Phenomena and the Superior Power of Negative Rules of Order

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Abstract: These notes overview the superior power of negative rules of constraint in domains of essential complexity (as defined by von Neumann's conjecture that in complex systems the simplest adequate model of something is the thing itself, and any attempt at constructing simplifying models does not aid in understanding). Negative rules define such areas by imposing constraints upon potential outcomes a complex system can produce rather than by specifying an infinitude of particulars (responses, behaviors, or actions) that must be achieved. This is how the economy of knowledge characteristic of psychological and social cosmic orders arises and "does so much with so little," as well as how the selfless arises from the selfish behaviors of individuals. Examples of these negative constraints are traced from the evolution of life through the functioning of the human CNS and processes such as language and thought, into the hybrid taxis-cosmos domain of scientific practice, and then into economics and the genesis of social cosmic structures. We conclude by overviewing the complementary duality of "subjective" and "objective" in the scientific study of complex phenomena and the context of constraint that inescapable duality imposes on functional psychological and economic domains. We end by noting methodological consequences: since psychology and economics are functionally and not physically specified, and do not have measurement as found in the physical sciences, they can never be experimental, remaining empirical only. And there is no hope of successfully retreating to an a priori realm, such as proposed by praxeology.

Keywords: negative rules, economy of knowledge, subjectivism, spontaneous complex orders.

Spontaneously ordered complex phenomena constitute the vast majority of processes studied by the biological, psychological, and economic domains. Theoretical understanding of such phenomena is quite different from the theory construction in domains that are simple (i.e., do not involve such essential complexity). One fundamental difference is the centrality of negative rules of order in the creation and operation (and hence in our understanding) of these complex processes. This article overviews how and why negative rules of order are indispensable in the domains of essential complexity. For brevity, discussion is limited to the origin of living systems and examples within the psychological subject and the social order.

Elsewhere I have provided a precise but non-quantifiable definition of complexity (Weimer 1987). Following von Neumann (1966), we see that *essential complexity occurs when the least complex (most concise) rigorous model of a system is at least as complex as the system itself.* As an example, von Neumann discussed the human visual system as being in fact the simplest adequate model of itself—any other adequate model would be *more* complex than the visual system itself. According to von Neumann's conjecture, for simple phenomena we can build (at least conceptually) a model of the particulars involved that is explanatory and aids our understanding because it is less complex than the process itself. For high complexity the reverse occurs—an adequate model is more complex, and does not simplify our understanding. We cannot specify all the particulars involved in complex processes, and consequently our understanding is limited, as Hayek (1978) noted, to specification of abstract rules of determination of the classes of particulars that could constitute its domain. Thus we can never specify or predict the occurrence of any given particulars *per se*. Our understanding is limited to the principles through which the interactions of the system's parts can produce the kinds of outcomes observed.

Our examples explore how negative rules of order function (as explanations of the principle) in a vast range of phenomena and data domains beyond the social and economic areas in which Hayek's work is well known. We shall see the same principles of organization applying in topics ranging from the origin of life itself through to the functioning of the CNS and into the domains of human action, not only in economics and social order but also into the nature of scientific inquiry itself.

What is involved in the origin of life? Life arose with the folding transformation somehow occurring during the boundary conditions obtaining on this planet more than 1 billion years ago (see Pattee 2012). With the origin of life the semiotic realm that had not been present before simultaneously emerged. The folding transformation was simultaneously the first record-keeping operation, and likewise became the first measurement operation. When life was localized into the first cellular structure the issue of agency, or the most primitive delimitation of the self, also occurred. These and similar distinctions force the symbol-matter duality upon us as a brute fact (Pattee 2012; Barbieri 2009). Semantic and pragmatic domains henceforth were literally part of life, along with the "purely" physical.

Life, records, measurement, and self are all semantic or functional concepts. They are not, and never can be, purely physical concepts (see Weimer 1984, Pattee 2012; Abel 2010). Aspects of meaning and how things function can never be explained by physical laws. Recognition of this has led to the emergence of biosemiotics as a separate discipline (this fascinating field should be more followed by readers of this Journal, since its problems mirror many of those found in psychology and economics).

COMPLEX LIVING SYSTEMS AND PROBLEMS OF KNOWLEDGE AND CONTROL

One of the most astounding "facts of life" with respect to organisms and groups of organisms is that they can do so much with so little self-knowledge or explicit control. This economy of knowledge is invariably brought about by negative rules of order. An example is the market order of society, which requires no control structure beyond the local knowledge and intention of its individual participants.

Let us show that this is characteristic of all living complex phenomena. Consider ourselves as examples of the biological evolution of complexity.

The lives of your cells. Lewis Thomas's (1974) essays in *The Lives of a Cell* show that organismic evolution involves the cooperation of cellular components in the genesis of classes or types of cells, and a similar cooperative banding together of types of cells to form what have become organs that specialize in a particular function, such as the liver or heart or stomach. While the linguistic description sounds teleological, attributing a "purpose" prior to that organization actually taking place, the historical perspective is not at all teleological. Over an enormous period of time accidental concatenations of events (typically called chance) occurred which, when viewed from our later perspective, have created results that, had *we or some agent caused them*, would be purposive. Evolutionary history, whether physical or biological or cognitive, consists

almost entirely of *frozen accidents*. They are "accidents" in their initial occurrence, and once in existence they are "frozen" into their constraint upon subsequent events. Once creatures with separate cells and subsequently organs developed, their greater efficiency allowed them to thrive and leapfrog over those with one cell or a relatively small number of less differentiated cells. Once frozen into place these changes provide a context of constraints that limits and guides further changes. This is the context in which evolutionary blind variation, occurring within a prior context of constraint, is never actually random. And the result of this continuous context of constraint is not stifling constriction of future change but rather the opening up of novel possibilities for the direction of future evolution. The conditions (literally the constraints) of prior development have allowed greater and greater degrees of freedom for future development. Biological selection via evolved constraints has produced organisms that incorporate better and better theories of their environment and, in our case, even theories of themselves. What others, initially following Leibniz, have called preestablished harmony is merely the result of the particular history of frozen accidents in this region of the universe.

This is how Thomas put the fact that we are frozen accidents that have resulted from distant past blind variations and selective retentions:

> A good case can be made for our nonexistence as entities. We are not made up, as we had always supposed, of successively enriched packets of our own parts. We are shared, rented, occupied. At the interior of cells, driving them, providing the oxidative energy that sends us out for the improvement of each shining day, are the mitochondria, and in a strict sense they are not ours. They turn out to be little separate creatures, the colonial posterity of migrant prokaryocytes, probably primitive bacteria that swam into ancestral precursors of our eukaryotic cells and stayed there. Ever since, they have maintained themselves and their ways, replicating in their own fashion, privately, with their own DNA and RNA quite different from ours. They are as much symbionts as the rhizobial bacteria in the roots of beans. Without them, we would not move a muscle, drum a finger, think a thought (Thomas 1974, pp. 3-4).

All advanced organisms consist of a congeries of earlier, more primitive components, that at one time existed independently on their own. As a result of their own individual and selfish behavior they have become part of a larger structure or structures as a result of their actions but not as a result of any design. These earlier, initially separate components have come together to function as the parts of the body. And then these bodies have, in their own turn, evolved. It is the evolution of bodies that leads to speciation. In our almost exclusive focus upon the evolution of species we have tended to forget the earlier evolution that Thomas emphasized. From the standpoint of epistemology we cannot afford to do so.

The selfless arises from the selfish. Here we find a direct parallel to Adam Smith's invisible hand. It is crucial to emphasize that the behavior of the "parts" of the wholes we have been discussing is always selfish in the sense that no consideration is ever given to the resultant whole. Indeed it is usually the case that the whole has arisen from competition rather than any form of planned cooperation. The mitochondria Thomas discusses were initially competing to survive in a livable but harsh econiche. The result of that competition is that they survived (and survived very well) as components within a larger cell. And as a result of their output within the cell it in turn was enabled to do things that it could not have done "on its own." But it was never the case that the mitochondria formed something resembling a "committee," and somehow decided to cooperate. Cooperation was the result, the unintended consequence, of their action rather than the cause of it. It is only with the advantage of hindsight that the outcome of such a "frozen accident" ever appears to be purposive. In the case of cellular or other primitive biological phenomena it is clear that no possible cognitive apparatus could have existed to do any selecting in the first place.

An analogous situation holds for the genesis of seemingly teleological or "final cause" behavior. It is never the case that any disembodied and abstract "force" in the future specifies or controls the development

of events in the past or present. Teleological concepts are employed only in perfect hindsight to situations by agents who were themselves conceptually outside the systems of events in question. With perfect hindsight we can ascribe teleological descriptions to behaviors that arose from the unintended consequences of events that were "caused" by nothing except the then current prior states of those behaving systems. The seemingly teleological arises from nothing but an outside perspective on the "logical" (or better, the "merely" physical or behavioral).

Animal behaviorists have been careful to note this fact when studying the behavior of so-called "social" insects such as ants, termites, and bees. In such species it is obvious that there is not enough brain power available to the individuals for them to behave in a purposive fashion. But after their descriptions of the fascinating capabilities of cooperative behaviors these species exhibit, most investigators are at pains to insinuate that such behaviors are merely "precursors" to human behavior. It seems to be against the sensibilities of our "privileged position" at the top of the knowledge chain to consider that these cooperative behaviors could result from the same principles governing our consciously cooperative behavior. Surely our conscious and explicit rationality is vastly different from such primitive mechanisms.[1]

Against this constructivist tradition stands the factual and theoretical basis of evolution. From the standpoint of evolution everything results from the incorporation of frozen accidents that has resulted from blind variation and selective retention due to the winnowing effects of the econiche. Even when evolution has become Lamarckian (stemming from individual learning history), or exosomatic (recorded outside the organism in physical records) in the social realm, it is blind variation and selective retention that provides its ongoing mechanism. There is no designer or purposive agency behind the development of complex social orders. No one ever designed organisms such as horses or chickens or cows (recall the old chestnut that a camel is a horse that was designed by a committee). No one ever designed human languages. No one ever designed our cognitive capacities. No one ever designed the abstract ideals or regulatory rules of conduct that guide human behavior. All such organized complexity is the result of human action but not human design. Even our highest and most "noble" goals and aspirations have resulted from the interplay of many minds in an order that is vastly greater than any individual (or group of individuals) could consciously produce. Our highest and most abstract behavior, our morality, has arisen from following rules of conduct that no one ever designed and most individuals have never comprehended or been able to articulate. The selfless has evolved from the selfish. The task of evolutionary theory and evolutionary epistemology is to explain how and why this is so.

THE ECONOMY OF KNOWLEDGE AND CONTROL IN EVOLUTION

Life was able to arise on this planet because variability in environmental conditions was relatively limited for a sufficient period of time, and when variation did occur it was at a relatively slow rate. The length of the day-night cycle is relatively constant, and has not changed except seasonally. Climate change, although ranging over what we today would regard as extremes, is actually quite small. Even the sea level has been relatively constant, and it appears that fairly warm, shallow seas have always been found somewhere. Thus the task of survival, the adaptation of an organism to an econiche, was one of distinguishing change from relative constancy in a repetitive environment that fits a Goldilocks scenario of not too much nor too little variability. The task of the first nervous systems was to detect two classes of changes: those that were productive of continued well-being for the organism, and those that were productive of harm. The great step in the premammalian nervous system was the orienting response—the detection of change or novelty with regard to the background stimulation. Then learning (or adaptation) had to occur as a result of the consequences to the organism of that response to change. The nervous system learns to match to a standard (by not responding) and to detect change from the standard (by responding). The consequences of behavior reinforce behavior. If the result is beneficial it leads to increased probability of the response. If the result is deleterious to the organism the response probability will decrease, and other responses will be more likely to take its place.

What is learned. That overview distills into a nutshell the theory of learning as a result of reinforcement (or consequences) of behavior. Chordate and mamallian nervous systems in organisms with motor or effector output that allows movement permit what we recognize as learning to occur. We learn to seek "good" or beneficial or desired consequences from behavior and to avoid "bad" or harmful ones. But what exactly is learned in such situations? What *knowledge* does an organism get from the learning situation?

With this question we encounter the famous asymmetry between *modus ponens* and *modus tollens*[2] brought to the fore in methodology discussions by Popper in 1934/1959 in *The Logic of Scientific Discovery* (especially section 15). The import of his discussion is that we can never learn that a theory is true from modus ponens reasoning (1,000,001 "confirming" *modus ponens* instances could always be followed by a "refuting" instance according to *modus tollens*), whereas a *single* falsifying instance (via *modus tollens*) suffices to show that an hypothesis (in conjunctions with its supporting background assumptions) cannot be correct. The process of learning in an organism is exactly analogous: 1,000,001 confirming or positive reinforcements does not mean that the organism's "theory" is correct or "true." Just ask that turkey who on a crisp November morning expected food to always be forthcoming when the farmer entered the pen. The turkey's theory did not include information about a holiday called Thanksgiving.

Organisms learn something *new* only when an expectation, a theoretical hypothesis which it has adopted, is falsified. This is why so-called inductive confirmation cannot exist, whether conceived as knowing "for certain" or merely knowing "probabilistically." This methodological point has been argued extensively by Bartley (1982) and Weimer (1979). What organisms learn is not what is correct or "true," but rather what mistakes to avoid making again. We learn what does not work. And in this respect there is no difference between a scientist's most esoteric conjecture, a rat's deciding to try a new maze alley, or the simplest organism with a nervous system trying to find nourishment.[3] So in an unpredictable world with unforeseen consequences resulting from our behavior it is possible to learn new things about situations when an hypothesis is shown to be falsified, i.e., to not lead to the expected result. But it is not possible to learn more than that the hypothesis is thus far compatible with our expectation (in the event of a positive or confirming instance). What we learn is what mistakes not to make, not that we are "right" or that the hypothesis is "true" or "justified." A similar situation obtains in the interactions of individuals in the social cosmos.

Negative rules of order constrain the social cosmos. This is because positive rules that specify particular actions or results to achieve cannot deal with the indefinite welter of events in the cosmos. Novelty cannot be addressed by positive prescriptions. All successful theorizing in domains of essential complexity utilizes a *context of constraint* consisting of three overarching regulative principles to capture the regularity of what are in essence dynamic equilibrating systems. These systems can exist and evolve only as a delicate balance of essential tensions. Three sets of principles regulate change in every spontaneous order I am aware of. The first principle is *creativity* or *productivity*. Such systems exhibit fundamental novelty, change (at the level of particulars) that is inherently unpredictable. The second principle is *rhythm*, and its progressive differentiation over time. All change is rate dependent (patterned) and should be subject to dynamical laws rather than being rate independent. The third principle is regulation by *opponent processes*. Development fluctuates between extremes that constrain possible changes. A clear example is provided by the nature of cybernetic steering or control: an autopilot helmsman steers a boat by small deliberate swings around a central tendency, thus constraining the deviations from an expectation of direction into as close an approximation of a straight path along the specified course as is physically realizable. Interaction of these three principles creates an *essential tension*, literally a context of constraint, between the previous form of organization, the present state, and future changes. This essential tension between tradition and innovation, stability and change, is a dynamic equilibrating tendency common to all essential complexity. It is a manifestation of the superior power of forces of *disequilibrium* over equilibrium in such structures. It is as Lachmann said of the economic order:

> If, with Mises, we reject the notion of general equilibrium, but, on the other hand, do not deny the operation of equilibrating forces in markets and between markets, we naturally have to account for those disequilibrating forces which prevent equilibrium from being reached. In other words, to explain the continuous nature of the market process is the same thing as to explain the superior strength of the forces of disequilibrium (Lachmann 1971, p. 48).

We see this power first manifest itself in the orienting response to novel stimulation in the CNS. Against a dynamic ongoing pattern of neural activity as a background (as close to an equilibrium state as one can ever achieve in a living system) the occurrence of novel stimulation disequilibrates the ongoing pattern and begins an ongoing process toward re-equilibration. This is a dynamic process which tends toward equilibrium but which, due to the ever-present occurrence of new stimulation, can never attain it.

Let me emphasize: these explanatory or regulatory principles are strikingly different from the "positive" principles that prescribe particulars in simple domains—these regulatory principles are essentially negative or prohibitory. The context of constraint manifests its power by *prohibiting* the occurrence of particular (classes of) events. Creativity and complexity can neither be explained nor brought about by the positive prescription of particulars (e.g., commands such as you must do this X in situation Y). Successful theory is negative: it must specify its domain in terms of constraints that its phenomena cannot violate. Consider the difference between two types of directives. First, the "simple" prescription of a positive particular: Sit up straight in your chair. This is algorithmic (computable), and we can all decide whether or not the subject has completed the task. In contrast consider the directive: Lead a just life. This is abstract, indeterminate, and not computable, or capable of fulfillment by specification of positive particular actions. It is a never-ending task whose precise character can never be specified in advance (it would take specification of an infinite number of particulars). Another way of saying this is that it is not a computable function—and thus the computation metaphor of mind so popular now is quite obviously false. The only way this command can be approached is negatively, as a directive prohibiting all forms of *injustice*. The taboos and "don't dos" are the only type of rules that regulate conduct in the spontaneous cosmos. Even when they are given "positive" verbal formulations the mores and conventions we follow are negatives in their import. They can tell us what mistakes to avoid without attempting to delimit in advance what class of particulars must be achieved. They allow novel behavior rather than restricting us to what is already known (the "merely" probable or the predictable). The practice of falsification in scientific praxis is an example. Since all theories worth exploring are productive, i.e., have an infinitude of particulars as their logical consequences, it follows that confirming results (no matter how many) can never show that a theory is true. All we can do is show that a theory is false (which is to say inconsistent with the combination of theory plus background assumptions) if even one of its predicted results fails to obtain. We *know* that we cannot retain both the theory and those assumptions. We have no more information available than this bare minimum.

The power of the catallactic order. Switch gears for a moment. Consider the tremendous power of the impersonal order of human interaction—the market order, or as Hayek called it when applied to all social phenomena, the game of catallaxy—that has created the extended order of civilization in which we live. The human mind is not the creator of that social order, it is instead the product of that order. We are the result of group selection according to abstract rules that we are only beginning to understand. These rules coordinate an individual's actions, and those actions exert selection pressure on group reproduction. Evolutionary epistemology has to tell us how this has come about.

Genesis of the order. Modern society is the result of two evolutionary forces that exist at the social level. The first, long emphasized by economists, is the division of labor. The second, almost universally ignored, is the division of knowledge that inevitably accompanies the division of labor. These are mechanisms of social evolution because they have enabled those who employ them to supplant those who did not. These divisions decentralize control (away from the father figure or mother or tribal leader or ruling council or committees)

and (with the concept of property, freedom of contract, law, and other factors of voluntary cooperation) allow a spontaneous order of action to take the place of consciously directed commands to bring about particular aims. The market order is a means that serves infinitely different ends for indefinitely different individuals, and allows each individual who participates to take advantage of resources (especially knowledge but also their own labor) that vastly exceed the capabilities of any single individual (or tribe). Competition, the mechanism of the market order, is a discovery procedure for the production of new "goods" (whether knowledge, matériel, wealth, or whatever). And competition is also the most effective cooperative procedure when the benefit of all who participate is considered: by competing, individuals are made to cooperate with unknown others to the benefit of all. *From the selfish the selfless arises*. Modern society is abstract and impersonal: we no longer know all the members of our tribe or identity group affiliation, nor do we interact with them directly in the production of goods, or even the conduct of our daily lives. But by participating in this order we bring about benefits to ourselves and to unknown numbers of others that greatly exceed what we could have produced in a face to face or tribal grouping.

The catallactic order arose without planning when small groups stumbled upon the fact that individuals can benefit to *different degrees* from the same goods. To repeat, this was not consciously known to the groups at first. It is rather that groups exhibiting this behavior came to displace those who did not. When different individuals have different uses for the same goods, barter arises as a means by which both parties could benefit in return for providing the other with what they desired. When this procedure is extended to unknown individuals united only by rules which prescribe property ownership and transfer by consent, the market order arises. What is crucial is the open-endedness or productive power of the market order: with the decentralized information processing capacity of the spontaneous order humanity has created all the benefits and drawbacks of our abstract society. This order has unleashed the most powerful force in this region of the galaxy, and it's open-endedness has brought us all our wealth and material goods, all the knowledge of science and power of technology, and all the culture that we possess.[4]

The market order allows us to reap the benefits of knowledge possessed by others (without having to learn all that knowledge ourselves), and is thus the means by which our capabilities for knowing and acting are extended beyond the limits of any single individual. Thus we no longer have to fend for ourselves for everything—in order to utilize a computer or watch a movie or TV program we need not know how to make it ourselves. The market order allows unknown and divergent (often conflicting) ends to be achieved by a common means. It is the tremendous advantage of the market order that it is "*merely*" *means connected* and thus remains open, i.e., requires no agreement whatever on ends for individuals to possess in order for them to participate. The price mechanism provides the signal or information that gives the market its superior efficiency for the achievement of any end. This totally impersonal factor is crucial: all any market participant needs to know is some local knowledge—what goods or services are available at what price. The current price of goods or services is always a signal that indicates what should be procured (or what is too expensive) to realize an individual's given end at a given time. Thus a gain to one's self, purchasing at the lowest available price what one needs, also serves the needs of unknown others. As Hayek (1976) said:

> Each is made by the visible gain to himself to serve needs which to him are invisible, and in order to do so to avail himself of to him unknown particular circumstances which put him in the position to satisfy these needs at as small a cost as possible in terms of other things which it is possible to produce instead (Hayek, p. 116).

This is what underlies Adam Smith's invisible hand: the efficiency of an impersonal order based upon negative feedback controls that arose spontaneously as a result of a context of constraints. Individuals learn what they are able do in the market order of events in terms of what courses of action they cannot afford to engage in. This economy of knowledge transmission (this is too expensive) is the key to the superior power of the order. It is why the (social) selfless arises out of the (individually) selfish.

The indispensability of our ignorance. We can never satisfy expectations in advance in an order that has no common ends—we can only aim at providing the best basis for eliminating unnecessary uncertainty, and thus to secure continual adaptation to what could *not have been known before*. Justice and fairness require only that everyone be allowed to play the game of catallaxy—without the rules being broken to favor anyone. This is the basis of the idea that justice is blind to the particular. Uncertainty and ignorance are indispensable to the game—their elimination would destroy the spontaneous order by turning the social cosmos into what Hayek called a taxis.[5] Adaptation to a cosmos is a never-ending task of trial and error, and it must involve constant risk and disappointment of some of the expectations of all, including those who achieve their ends and come into great rewards. No one can correctly anticipate the particulars of the market order—not even those whom the order rewards. Market participants must remain ignorant in two respects: first, who else (which individuals) are order participants; and what constitutes their local knowledge; second, how the order actually works in any given instance. We should not know the individuals involved because our "tribal" emotions would cause us to overcompensate those we regard as disadvantaged (or shun participating with those we dislike), and thus distort the efficiency of the order. And if we knew the specific workings we would attempt, like the oligarchs and lords of more tribally oriented societies, to rig the outcome for our benefit, and thus replace the spontaneous order with a command structure. We can survive only by strictly adhering to negative rules of order (our social, moral, and occupational taboos). This situation creates a tremendous problem not only in our ordinary day to day activities in society, but also as a factor in the rarefied research communities of science.

Science is a social cosmos constrained by negative rules of order. Science contains taxis and tribal components that are constrained by being embedded in a wider cosmic order. History of science shows these opposing forces of tribalism and infinite ignorance of particulars. The methodology of research tries to reconcile these factors. Kuhn's conception of normal science as paradigm based puzzle solving according to inculcated traditions that arise within the history of the research community is a pioneering account of science as a tribal and not yet market or catallactic order. The power of tradition in the *unverbalized but undergone* initiation into rules of "scientific methodology" is what an apprentice researcher gradually learns from being around more established practitioners. Beginners just "soak up" the rules of practice from exposure to the behavior of more senior practitioners. This is a tacit dimension of research praxis which cannot be captured in explicit methodological prescriptions (as Polanyi 1958 emphasized). The only successful and enduring methodological rules are negative prohibitions—e.g., "do not fabricate data," "do not cook the results." C. S. Peirce (in 1898) put it beautifully in his "supreme Maxim" of philosophy over a century ago:

> Upon this first, and in one sense this sole, rule of reason, that in order to learn, and in so doing desiring not to be satisfied with what you already inclined to think, there follows one corollary which deserves to be inscribed upon every wall of the city of philosophy: Do not block the way of inquiry. (Peirce 1992, p. 178)

Paradoxically, what Kuhn described as normal science puzzle solving, even though it employs essential negatives of abstract order in its methodology, is the attempt by a research community to circumvent the market order or cosmos of ignorance in defense of what one tribe of researchers—the practitioners within that given normal research group—would delimit as acceptable for the entire field. Thus normal science praxis is taxis based, and based in the main on prescriptions of particulars to be achieved. The research community believes that we are at point A and our task is to achieve point B, which although presently unknown will be recognized by all researchers when it is found. The task of normal science puzzle solving is to ingeniously find a way from A to the anticipated but as yet unavailable B. Revolutions occur sooner or later because the inevitability of our ignorance exposes the limits of the taxis approach when the cosmos intrudes at the fringes. But normal science attempts to block out certain avenues of inquiry as beyond acceptability, while accepting only sanctioned others. The history of research in science is the interplay of these

opponent processes. The history of scientific domains is a history of alternating periods of attempts at normal science taxis practice and the intrusion of the spontaneous cosmos at the fringe, which shows the inevitable limits in which that praxis must be embedded. Like the stars at night, revolutions make the cosmic fringe surrounding praxis visible, while the daylight attempts of normal science show only the sun as the center of the enshrined puzzle solving tradition.

Aspects of the essential negatives of abstract order. Spontaneously arisen complex orders cannot be regulated by commands to perform particulars (to achieve particular individual goals). Instead they allow the performance of (potentially infinitely many) unforeseen particulars because they are governed by deep structural abstract rules of determination. The context of constraint provided by such abstract rules is negative in several senses. The first negative sense is that the rules of order are negative or prohibitory injunctions against certain classes of actions. The Scottish moralists knew this better than our generation: "The fundamental law of morality, in its first applications to the actions of men, is prohibitory and forbids the commission of wrong" (Ferguson 1785, p. 189). This is why the regulatory ideals of social conduct are all taboos. Justice, freedom, peace, no less that truth and similar concepts in science and philosophy, are specified in terms of the elimination of their opposites, not in any positive specification of particulars that must be achieved. The second negative sense concerns the predictive or anticipatory power provided by an explicit knowledge of the rules. Here all that is available is explanation of the principle and pattern prediction, and this shows why explanatory theories of complex phenomena can never predict the occurrence of particular events. We can never achieve that infinitely precise specification in complex domains. A third sense concerns the indispensability of our ignorance when acting as agents in complex orders. The tacit dimension of behavior is not conscious and explicit, and in that sense it must remain forever unknown to us while it is guiding our actions. All we can hope to achieve is an understanding of regulatory principles that govern certain classes of occurrences, but we can never understand what is controlling our behavior while it is doing so.[6]

Examples of essential negatives can be extended indefinitely once one realizes their centrality to complex orders. Then it becomes obvious that many prescriptions with positive specifications of particulars our conduct must achieve are actually creating taxis situations that have no applicability at all in complex orders unless they can be "translated" into negative formulations. The "taboo mentality" of catallactic orders is far from the throwback to ignorant ways that rationalist constructivist thinkers assume—instead it is an indispensable aspect of the creativity of cosmic structures.

The founder of modern psychology, Wilhelm Wundt, knew this better than most practitioners of the field today. Wundt defined what he called the law of heterogony of ends as a foundation of morality:

> While it (the law) teaches that every state is the necessary preparation for that which follows, it flatly forbids the setting of bounds to the course of future events for reasons drawn simply from our present outlook over the universe. Reality is always fuller and richer than theory. Hence the most that is allowed to us is to anticipate the general outline of the course that will be taken by the immediate future. Here, then, the law warns us with no uncertain voice that we may not regulate the ends of morality at large to the narrow circle of our personal hopes and wishes. The particular thing must be regarded *sub specie aeternatatis*. At the same time, we may not, with the philosopher who coined this phrase, look upon the infinity as something given and hence directly apprehensible by our idea: we must rather consider it as *becoming*, as an infinite problem, parts of which we come to know by solving them (1902, p. 331).

The greatest freedom and creativity results neither from positive prescriptions of particulars to achieve nor "anything goes" anarchism, but rather from strict adherence to general rules. It is as Hayek said:

> Since our whole life consists in facing ever new and unforeseeable circumstances, we cannot make it orderly by deciding in advance all the particular actions we shall take. The only manner in which

> we can in fact give our lives some order is to adopt certain abstract rules or principles for guidance, and then strictly adhere to the rules we have adopted in dealing with the new situations as they arise. Our actions form a coherent and rational pattern, not because they have been decided upon as part of a single plan thought out beforehand, but because in each successive decision we limit our range of choice by the same abstract rules (1967, p. 90).

This point was put beautifully by a physicist who studies the biology of the origin of life. This is how he noted that all creativity is rule governed behavior within a context of constraint formulated by negative rules:

> What we call novelty, freedom and imagination at all levels of creative activity are, therefore, not to be equated only with escape from objectivity and determinism. Inherent in all innovative visions are the complementary constraints that execute these visions. Many scientists who have been trained only in the classical paradigm of objective theory may find this complementarity difficult to accept, but it is an old idea to the philosopher and artist. I can think of no clearer summary of this creative evolutionary principle, that extends all the way from molecules to the mind, than a quotation from Igor Stravinsky in the *Poetics of Music*: "The more constraints one imposes, the more one frees one's self of the chains that shackle the spirit...and the arbitrariness of the constraint serves only to obtain precision of execution (Pattee 1981, pp.126-27).

The abstract social cosmos is tacit rather than explicit. Consider some consequences of what has been developed so far. The selection of rules of conduct regulating our behavior occurs unconsciously, through the viability of the social order as a whole that results from such rules. If the resultant order is stable and productive, the rules will be selected for survival, and will become part and parcel of the background assumptions that regulate our behavior without our having consciously learned them. We are like the "primitive" studied by anthropologists, who has no idea about the reasons underlying an incest taboo (to use a well-known example) but follows the taboo nonetheless. At each stage the overall prevailing order determines what effect, if any, changes in an individual's conduct will produce. Thus we are stuck in the position of consciously attempting to judge and modify our conduct only within a framework which, although the product of evolution, must remain for us a relatively fixed *result* of evolution. This framework becomes, literally, an abstract context of constraints that regulates our conduct. So long as the system remain spontaneous, regulated only by abstract prohibitions that do not specify particulars to be achieved, it can be creative. In such cases we venture out into and often succeed in coping with the unknown and the unforeseen.[7]

Biological adaptation requires no delimitation of particulars. The concept of adaptation (to an econiche) is the parallel to learning in psychology. But unlike psychology, where learning occurs within a given organism, adaptation is a matter of group selection within a population. It does not matter that one organism has a mutation (or perhaps a random quantum anomaly) and has its structure slightly altered. What matters is the selection pressure in the econiche which in purely negative fashion weeds out what does not contribute to survival worthiness in the population as a whole. This is why species change takes considerable time to occur. There is no selection for individual "hopeful monsters": Frankenstein does not spawn a group of superior monsters, because his mutation is only *one precondition* for speciation. The second necessary condition is spreading it through a population.

As Fitch (2010 2010, pp. 48-49) summarized:

> It is difficult to over-emphasize the importance of population-level thinking in the neo-Darwinian synthesis. For naturalists, ecologists, and population biologists this perspective seemed to come quite naturally, but geneticists, systematists, and developmental biologists before the modern synthesis often saw species as "ideal types"—Platonic perfect forms—and the variation seen in real life as simply error or noise. For such typological thinkers, the essence of speciation was the birth

> of a new individual, possessing a "macromutation." In contrast, the architects of the modern synthesis recognized the generation of a mutant was only one precondition for the origin of a new species. That variant then had to spread through the population, until the population was different enough from some sister population that they could not, or would not, interbreed, and only then could a new species be said to have been born. Thus *population level change in allele frequencies* was the key factor underlying speciation (Mayr 1982; Gould 2002).

The fate of the novel allele will be to mix with other genetic backgrounds. Many novel instances will simply disappear with no discernible phenotypic expression. But if that mutation possesses a survival advantage, its descendants may gradually help form a new species. Negative winnowing is all that is involved in that gradual selection process. And exactly the same situation holds in the social realm, where group selection, not individual prowess or competence, determines acceptance of new "ideas" and patterns of behavior through a gradual winnowing of patterns that can only be regarded as having "survived" with the aid of hindsight.

This slow growth of novelty or new ideas is also characteristic of both science and change in the market order. This is intrinsic to situations in which *populations rather than individuals* are central. There are all manner of things that impede the introduction of new ideas and work against the continuing framework of an ongoing order. Individuals attempt to block the output of other individuals or groups with whom they disagree, or whose position would put them at economic disadvantage. In science this is obvious in the extent to which revolutionary thinkers' views are resisted and sabotaged by the practitioners of the "old guard." Scientific revolutions take considerable time, effort, and often just plain luck. There are "power grabs" by the entrenched that attempt to deny sources of funding, research facilities, and opportunities for publication to those whose positions and results oppose what their normal science paradigm regards as the only acceptable conduct. In the social cosmos entrenched political views attempt to stifle those of any competitors. Patents and other restrictions upon free access to new ideas or products are characteristic of modern economic order. But such factors, while they affect the speed and extent to which views and positions are held, and products are brought to market, have nothing to do with the one and only mechanism that accounts for change in the overall order. The same negative winnowing process that is involved in the gradual change from one species to another, the method of trial and error elimination, is involved. In the economic marketplace products are winnowed out by the choices of consumers. In the intellectual marketplace products are winnowed out by the selection pressure of the views of competing researchers. And in both cases the functioning of the evolutionary order of choice can be destroyed by political factors, cataclysmic events in the environment, the destruction of populations by plague and other bacterial or viral infestations, and myriad other apocalyptic situations. We must never forget the fragility and the perilous nature of our position, and be thankful that we have been presented with the opportunity to study these complex phenomena in the first place.

Psychological organization depends upon inhibitory constraints. Above we noted instances of how psychology is based on negative rules of constraint. Let me elaborate only one aspect of that. Consider not our "in the head" cognition but the more mundane problem of how you move and "do things" in the world. We are not Leibnizian monads passively and unmovingly sitting around resonating to the environment—we act within it and on it. This is how the complexity of the market order and social cosmos has come about—by our active movements and "doings." What controls or regulates our voluntary movement? While we may *initiate*, in cerebral activity, our thought about what to do and how to do it, it falls to the cerebellum to *regulate* the more mundane task of how that is realized in muscle movement through the environment. The cerebellum controls the shape of all movement and skilled behavior. It accomplishes this by purely inhibitory control—the output of the cerebellum consists entirely of negative prohibitions to extremes of cerebrally initiated abstract commands. Like the cybernetic helmsman, it steers movement into precise patterns of skilled behavior by stopping "wild" swings (too far in one or another direction) down into economical re-

alizations of the general and nonspecific directions the cerebrum specifies. This is been known for decades. What we must realize is its significance for understanding complex orders.[8]

Cerebellar control results in skilled movement in a manner that is very similar to the overall pattern of the market order. Just as the individual market participant need not know anything more than a small amount of restricted local knowledge, the cerebrum need not do more (in initiating behavior) than issue a very abstract and undifferentiated directive. The cerebrum leaves all the messy details to cerebellar fine-tuning. The individual market participant leaves all the messy details of how the price or service he or she is interested in arises entirely to the fine-tuning functioning of the market order. The net effect in both situations is the tremendous economy of knowledge required to bring about very abstract and complicated things. This is another example of the indispensability of our ignorance when confronted with complexity. If we had to consciously worry about all those "messy details" and thus had to specify positive particular responses to be achieved, in either the workings of the market or the workings of the mind, we would never be able to do even the simplest physical tasks, and the market order could never have come into existence.

SUBJECT AND OBJECT: THE INESCAPABILITY OF "SUBJECTIVISM" IN SCIENCE

At the beginning I noted that the problem of *agency* arises with the effective separation of the first cells from an extracellular environment, and directed attention to the relatively new field of biosemiotics. Agency begins with life. Subject and object *arise in unison* when an organism is localized in space (and of course, in time). You cannot conceive of one except in opposition to the other. The subject of cognition is an inevitable compliment to the object of inquiry. The complementarity of subject and object is an inescapable dualism in epistemology. The role of the subject is central to any "objective" approach to psychological, economic or other social domains (exactly as the physicists have discovered in facing the "measurement problem" in the quantum domain). Let us overview this and tie it in to the essential negatives of our prior themes.

Subject and object. Whenever an object comes into existence it is within the conception of some sapient subject-of-conceptual-activity. The universe "out there" has neither subjects nor objects: it just "is." The epistemic judgment that an object exists is the ascription by a subject of meaning to an aspect of the phenomenal flux. Subjects and objects come into existence together, with neither temporal nor conceptual priority assignable to either. Subjects cannot stand outside the objective order—they are part and parcel of its creation. As creators of that order they are inextricably linked into it. Separation of subject and object is prior to all cognition and all judgmental attribution. Thus when we try to ascertain what they are independently of each other, we are stymied—study of the subject requires objectifying it. Study of an object presupposes a studying subject. Thus subjects and objects, though they arise in unison in conceptual thought, are inherently ambiguous and under-determined in both intension and reference.[9] Selfhood is a problem precisely *because* of the relational equivalence of selves in objectivity or ontology. The problem arises at this point because the "objective approach" and its entailed ontology creates an intolerable ambiguity for epistemology: "I" and "thou" can never be the same in the orders of knowing (or meaning) and being.

The usual conception of objectivity is backwards. This issue traditionally concerns avoiding the specter of solipsism. The picture presented is that of each individual as an island separated from everything "else" by an impossibly vast epistemic sea that can never be crossed. Scientists are not immune to this interpretation of subjective isolation. Here is a clear example:

> Like all children I began with a naïve realist outlook and never thought about how our senses, our brains, and our language affect what we tacitly accept as "out there" in the world. Years later I read the essay by the physicist Max Born (1969), *Symbols and Reality*, and I recalled that while reading Pearson's *Grammar* I had experienced the same shock that Born describes in his essay: "Thus it dawned upon me that fundamentally everything is subjective, everything without exception. That was a shock." Born went on to point out that: "symbols are the carriers of communication between

> individuals and thus decisive for the possibility of objective knowledge". The physicist's concept of "objective knowledge" means only that knowledge that appears the same for all conceivable observers, as tested by the invariance and symmetries of the symbolic expression of laws (Pattee 2012, p. 6).

But are we in fact these subjective "islands in the sun" (to recall Hemingway) or does that view depend on mischaracterizing the nature of both subject and object? What can we say about the subjective versus objective dualism? From the standpoint of epistemology when we move beyond the mere having of acquaintance (which is in fact totally tenseless and not localizable as either subjective or objective) to the language of description—which is always the case in any natural human language and the language of science—in which we characterize that subjective realm, we have inevitably abandoned subjectivity for *intersubjectivity*. This must be so because language is inevitably social. There are no private languages. Any attempt to construct a private (i.e., totally uniquely subjective and available to one individual alone) language results in a code—like braille—rather than an actual language. Codes transform or "encode" an already existing linguistic system. They do not constitute a new or unique language.

All our knowledge by description of the subjective is actually intersubjective. Intersubjectivity is the essential feature of objectivity. Thus subjective experience is actually objective and abstract rather than particular and concrete. Human conception never touches raw experience. As Körner (1966) put it, the disconnection between theory and experience is total and complete. Experience is linked to theory only by postulation. That postulation requires the construction of abstract idealizations to substitute for the actually unique, unrepeatable and the totally subjective elements which no longer appear in it. The subjective realm can be described (and thus can become known to be such) *only* by being objectified. All objectification is conceptual, and thus transcends its alleged basis in the subjective and the unique.[10]

Max Born was right about the intersubjective nature of scientific knowledge, and when it is understood that the only subjectivity in the universe is the raw acquaintance we undergo, it is obvious that our individual models of reality, despite their location only in our heads, are as objective as the "external" realm they attempt to portray.

So the subjective is intrinsically objective. How can this be so? Because there is no such thing as a private language or a private symbol, and the symbols of our thought are cast intrinsically in the language of description. There are no symbols that can have meaning for only one subject and can never be communicated to anyone else. Any language can and must convey knowledge by description. Any description always presupposes thing-kind identification and idealization from momentary particulars, and this is always objective. Those identifications are *trans situational* and *trans temporal* due to the evolution of our nervous systems. This is one of the most important lessons to be learned from Hayek's *The Sensory Order*.[11]

The meanings of our concepts become more and more determinate as they become more idealized and trans empirical, which is to say, more objective. Cassirer and Körner made this point quite obvious and I presuppose their in-depth discussion at this point. As Cassirer said in 1910:

> The problem is not how we go from the "subjective" to the "objective," but how we go from "objective" to the "subjective." … The "subjective" is not the self-evident, given starting-point out of which the world of objects is constructed by a speculative synthesis; but it is the result of an *analysis* and presupposes the permanence of experience and hence the validity of fixed relations between contents in general (1923, pp. 278-79).

In sum:

> The conditions and presuppositions of "objective" experience cannot be added as a supplement, after the subjective world of presentations has been completed, but they are already implied in its construction.… Without logical principles, which go beyond the content of given impressions,

> there is as little a consciousness of the ego as there is a consciousness of the object. … The thought of the ego is in no way more original and logically immediate than the thought of the object, since both arise together and can only develop in constant reciprocal relation. No content can be known and experienced as "subjective," without being contrasted with another content which appears as objective (ibid., p. 295).

There is simply no point in assigning primacy to subjectivity or to objectivity in any either-or fashion. There is only one correct perspective: both-and. This is a duality that comes into existence *as such*: subjects and objects arise in unison and cannot be understood as independently specifiable singularities. But all knowledge, cast in the objective language of description, counts as objective when it comes to the tasks of scientific analysis.

Economics can be both an empirical science and a subjective one. It is perfectly possible to have an *empirical* science in the psychological and social—economic domains. But there are two things that such accounts can never be: experimental, or a priori. Neither the positivistic "social physics" model nor the attempt at a priori axiomatization of human action will ever succeed. There are negative constraints upon complex human and social phenomena that prevent the achievement of true experimentation, and axiomatization as a procedure in natural science has been abandoned since it was realized that only the timeless or rate independent realm of purely syntactic mathematics and logic can be successfully axiomatized. No dynamical or rate dependent theory of semantic content in any scientific domain can be axiomatized except after the fact of full development by prior empirical means (and then only provisionally).

The quickest way to understand why neither psychology nor economics can be experimental is to note that experimentation requires *measurement*, and not just the mere assignment of numbers to records of events. An experiment is the construction of a "repeatable" situation by an experimenter with the use of artifacts (the experimental apparatus and a constraint situation in which the apparatus is employed) in order to eliminate sources of "error" due to two classes of events—first, fortuitous changes in boundary or initial conditions (usually called "chance" factors); and second, systematic factors in the subject matter (which can then become the focus of subsequent inquiry). The intent of experimentation is to determine lawful regularity in dynamical variability by factoring out of consideration all but the lawful relations. This requires *measurement* of the essential variables or factors under consideration. Measurement requires that conditions of *quantity* be satisfied (see Stevens 1951, Nagel 1960, Michell 1997, Trendler 2009). A quantity is a kind of property possessed by empirical objects (in physics, length, width, height, mass, temperature, etc.) which admit variation in terms of magnitudes (specific levels or amounts). We interprete experimental relations in terms of relations of magnitudes of a quantity (e.g., relations such as equality, order, additivity (see Nagel 1960, for one generally accepted list of axioms or "conditions" of quantity). Now consider this: It must be stressed that "the hypothesis that some attribute is quantitative is a quite specific hypothesis, one never logically necessary" (Michell 1999, p. 67). That is, *quantitative structure can be ascribed to an attribute only if it empirically satisfies the conditions of quantity.* The scientific task therefore always implies testing empirical hypotheses. The first and therefore most basic condition of quantity structure demands that "*any two magnitudes of the same quantity are either identical or different*." (Trendler 2009, p. 582).

What happens if we try to test even this first condition of quantity in the social realms? Clearly, if we cannot achieve this "easy" one, none of the others will be obtainable either. We can cut to the end of the chase:

> *Psychological phenomena are not sufficiently manageable. That is, they are neither manipulable nor are they controllable to the extent necessary for empirically meaningful application of measurement theory. Hence they are not measurable…* Contrary to physical phenomena, psychological phenomena cannot be *made* to depend on a small set of manageable conditions. In other words, the very effective method used in physics of manipulating and controlling phenomena through apparatus

> construction is not applicable in psychology. This difference explains in my view the success of quantification in physics since Galileo and conversely the failure of similar attempts in psychology since Fechner, and this is also the reason why I believe that the Galilean revolution never happened in psychology (ibid., p. 592).

And it is quite obvious that if this is the situation for the *individual* in psychology it must be the same when inquiry moves to the economic realm with the simplest situation of barter between two people and the potential extension to the indefinite number of individuals in the market order. This means that we must reinterpret studies in economics that purport to be genuinely "experimental," such as those of Vernon Smith (1962, 1982, 1991, 2000). Their true status is as demonstration studies, as we must now note. Noting this does not diminish their value, but it does relocate how they should be interpreted.

Social science is just fine with demonstration studies. So where is the field without the equivalent of natural laws and physical science measurements? *Where we have always been*. We are good at keeping records, and when we assign numbers to records we will continue, albeit quite misleadingly, to call them measurements. But we must realize that the field is *empirical and demonstrational* rather than being experimental. What we do in psychological research is set up demonstration situations (call them demonstration "experiments" if you will) in which we look for happy accidents, i.e., "clear cases" that make manifest, with minimal constraint imposed by our apparatus and research situations, what the regularities or rules seem to be. The seemingly more advanced field of economics does exactly the same thing. Empirical research in economics looks at differences in results that have arisen as a result of different initial conditions. The "testing" of an economic hypothesis is thus always after the fact. Even in cases of looking at the differences between "command" or directed economies and more "market oriented" situations, it is obvious that all we can do is look for patterns of regularity that differ between the situations chosen for study. And we do this "looking" only after recording, which is to say, only after the fact. We need to come to grips with Trendler's (ibid., p. 593) conclusion:

> The application of measurement theory, irrespective of whether it is construed as deterministic or probabilistic, is also not relevant to achieving substantial progress in psychology. Other, more suited methods for the domain of psychology must be found. It might therefore be wise to seriously reconsider Johnson's recommendation: "Those data should be measured which can be measured; those which cannot be measured should be treated otherwise. Much remains to be discovered in scientific methodology about valid treatment and adequate and economic description of non-measurable facts (Johnson 1936, p. 351).

The situation in the social sciences is as Hayek reminded us: in physics all the individual phenomena are regarded as exactly alike and totally interchangeable. One electron is exactly the same as any other electron, and can substitute for any other in an experiment. But when dealing with social phenomena that is never the case: no two human individuals are ever exactly the same, and they are usually completely different in terms of their prior experience and learning history, their values and needs, and in general, all the variables we wish to study. We will never be able to measure these differences. All we will ever be able to do is record their existence. That does not mean that serious scientific study of these domains is not possible.

Definitional formalisms are not explanatory of dynamical behavior. The Austrian or "subjective" theory of value must be separated from the a priorism proposed by Mises (1966) in *Human Action,* originally 1949, and in *Epistemological Problems of Economics* (1960, originally 1933), and at least partially by his followers (e.g., Rothbard, 1976). It is not possible to divorce human action (as a functional concept) from the empirical study of either psychological or economic behavior. The result of utilizing only functional concepts is infinite circularity and ambiguity. The nature and range of human action cannot be specified *in advance*

from the armchair. Theoretical explanation in any science must relate the cognitive (syntactic and semantic) content of the theory to reality in some fashion, and that can never be done by specification of logical syntax alone, with the postulation of it being an a priori true axiom set of concepts that, like laws of nature, apply every-where and every-when. Sooner or later what Kuhn called a revolutionary reconceptualization will force itself on the domain, and many "a priori truths" of the old view will disappear, to be replaced by what are to the new look very different concepts.

Misean praxeology can avoid that fate only by making vague circularly defined concepts apply to all *possible* events, thereby depriving its system of axioms of any determinate meaning at all. The praxeological approach is vacuous—like saying a circle is a geometric figure. Of course circles are geometric "figures"—now tell us something we do not *yet* know, such as what *is* a circle. Think Euclid already took care of that for us? What about the entire continuum of non-Euclidean geometries, where functional concepts such as "circle" or "parallel" are defined very differently? What is that "figure" over there? You cannot tell without two things: first, specification of the type of geometry involved; and second, a structural analysis of the genesis of its physical realization. That is because all purely functionally specified concepts are intrinsically ambiguous. To disambiguate purely functional concepts we must have a concomitant *complementary* structural analysis (see Weimer 1984).

The other side of this intrinsically two-sided coin is that physical analysis of behavior alone, as Mises so correctly emphasized, is totally impotent to specify functional concepts such as those found at the heart of psychology or economics. Just as it is *impossible* (not just hard) to physically define the concept of *sentence* in language, so it is with the concept of *action* in both psychology and economics. No explicit physical definition is possible, no matter how complete or thorough the specification of physical particulars. An example shows the inherent problem of ambiguity involved. Suppose a man walks up to a building, goes in, takes out a pen and piece of paper, makes marks on the paper with the pen, and then hands the paper to someone else. Elaborate this into the most exhaustive physical specification of what occurred that one can imagine, even down to the quantum physical level. One can then ask: What action was involved? Or was it even an instance of the concept "action"? The answer is that there is no human behavior or action at all unless *more information* is empirically determined: movement is physical, and although it *constrains* action, it cannot *explain* it. This is far more than the well-known point that functional specification is compatible with an indefinite range of physical events. The same physical movements could exhibit the *economic* act of cashing a check, the *political* act of signaling a spy, the *Freudian* act of exhibiting latent hostility towards one's mother, and literally countless other acts or even the non-act of a "Boltzmann brain" collection of random thermodynamic assemblages of bits. Without a concomitant theory of the structural determination of behavior, a syntax of action, there is no specifiable determination of action from any theoretical or functional point of view at all. Any adequate concomitant structural determination will have to utilize the distinction, familiar from the transformational revolution in linguistics, between surface and deep structures. The underlying rules of determination are always at a deep structural level. The problem with the Misean approach is that it cannot make the deep-surface distinction in any principled manner, and indeed cannot make it at all.

One can grant Mises any "a priori" specification he would choose as an ex post facto rationalization of what function is represented in physical events. It will never provide an explanation of action (or any other function). The problem is that there is no bridge to reality from praxeology. The ambiguity of action is its unexplainability in terms of any physical realization, and its complete circularity in purely functional specification. To disambiguate action (or any functional concept) one must provide an empirically adequate structural analysis of its generation. And that structural analysis at deep conceptual levels will provide enough constraints on possible semantic interpretations to rule out the indefinitely large number of potentially available but incorrect interpretations that physical movements leave completely underdetermined and ambiguous. The promise of the structural analysis of (psychological) behavior or (economic) action is that it can potentially provide, for the first time in history, an explanatorily adequate account of the functional psychological and economic domains. Human action can never be an a priori domain that is only circularly defined by functional concepts. Knowing what action means requires a structural deriva-

tion of its surface components from a theory that ranges over fundamentally deep and abstract entities. The rules of determination governing that determination of what eventuates into our surface structure behaviors will always consist of a context of constraint specified by negative or inhibitory rules.

SUMMARY

The superior power of negative rules of order in complex phenomena has been discussed and exemplified in cases ranging from the very small (cells in living organisms) through the control of activity by the central nervous system and then into the social realm (the market order in economics and aspects of science). Also explored as related to negative rules of order are aspects of the human epistemological predicament (the nature of objectivity and "subjectivity" in the nature of knowledge) with methodological problems and caveats (the problems of scaling and mensuration, and a priori theorizing) pertaining to the scientific study of spontaneously organized complex subjects. Key points are:

1. Negative rules are the only means possible for the control of indefinitely extended or potentially infinite domains. These rules allow for novelty and the productivity or creativity of behavior because they constrain outcomes by prohibiting general classes of behaviors without becoming bogged down in attempting to specify an indefinitely large number of particular behaviors that would otherwise have had to be achieved.

2. Negative rules are the most economical or efficient means by which one's finite knowledge can interact with and thus contribute to ongoing spontaneous complex orders. This is why all that is necessary for market participation is the price of goods or services according to their individual value as determined by different subjects. All you need to know is that if the cost is too great you should allocate your resources in some other fashion.

3. The effects of the possibility of novel behavior (freedom arising from the context of constraint) are found throughout evolution, from the speciation of organisms through to the most esoteric scientific and intellectual pursuits. Individual differences ("subjectivism") are "What makes the world go around."

4. Because of the uniqueness of *subjects* (as opposed to the generic nature of physical *objects* which are always identical and interchangeable) we cannot have enough knowledge to utilize the same scaling and measurement procedures that physical science employs. We are limited (very definitely negatively constrained) to empirical studies (demonstration "experiments") rather than the fully controlled experiments of the so-called hard sciences. Equally impossible for the psychological and social domains to realize is any a priori fossilization of the concept of action, as was attempted earlier in economics.

NOTES

1. Nowhere is this attitude better expressed than in the development of the philosophies of rationalism that have arisen, primarily from the Renaissance on up, and that found their classic expression in the concept of Cartesian rationality. Thinkers in the Cartesian mold wish to supplant everything that is the result of "blind tradition" or mere "habit" or an unintended consequence with the consciously thought out and thoroughly planned in advance. For them no course of action could actually be rational if it is not planned out completely in advance. For the Cartesian mentality our superiority over the social insects is that our rationality is conscious and directly pur-

posive. Thus Cartesian explanatory models of a domain are cast in terms of specifying positive prescriptions of particulars that their theories postulate must occur.

This attitude of rationalist constructivism (as I have called it, following Hayek) underlies a great deal of the modern attitude toward the social and political realms. It has led to interventionist policies in economics (stemming especially from Keynes in the modern era), to the desire for a made up universal language (Esperanto, from Neurath and the positivists of the 1930s), to the perennial infatuation with socialism, even to the Charter of the United Nations. It underlies the philosophy of progressivism in social and political thought that has been current among "intellectuals" since the mid 19th century. It is that thought that has infected biology and psychology in the form noted in the animal behaviorists above.

2. Modus ponens is the logic rule that if a conditional statement (if P then Q) is accepted, and the antecedent (P) holds, then the consequent (Q) may be inferred. Modus tollens is the logic rule that if a conditional statement is accepted, and the consequent does not hold (not-Q), then the antecedent (not P) must be inferred.
3. There can only be cases of "positive" learning in totally artificial situations in which a finite number of choices is possible, and the choices are specified in advance to, or can be discovered by, the organism. This would be like counting cards in a card game in order to determine whose hand holds which cards. This is so-called eliminative induction, as each successive round eliminates more possibilities from the deck of cards and thus limits the possibilities for which cards remain in a given player's hand.
4. It is, of course, a double-edged sword: while having given us our knowledge and our wealth it has produced not only the weapons of war that have the potential to exterminate us but it is also the source of the alienation and malaise of modern humankind, since our emotions and feelings were determined by our long history in the tribal or face to face order. At present we live in an increasingly abstract and impersonal order in which the traditional forms of "small group" support are less and less available to us. We have suddenly lost all our "comfort food" and the "family life" support structures that have shaped our emotions and group cohesiveness. This is increasingly exhibited in contemporary society, for example by the now epidemic phenomenon of addiction to so-called social media that so many cling to in order to provide a pale reflection of the comforting interpersonal situation and relationships that existed in more primitive forms of social organization.
5. Hayek contrasted two fundamentally different types of order. A taxis was a made up order, such as, to use his example from the ancient Greeks, an order of battle (planned out by a general), or the design of the city laid out by a city planner. So a taxis is an order directed by individuals to serve some purpose. In contrast a cosmos is a spontaneous ordering of events that occurs without conscious planning or direction, and indeed often without any knowledge on the part of human beings. Hayek's contention was that when dealing with the realms of complex phenomena, comprising more particular facts than any brain could ascertain or manipulate, one was always dealing with a cosmos—a spontaneously arisen ordering of events that no individuals had thought out in advance.
6. This indispensable negativity takes on a ubiquitous character when one collates examples from disparate areas. From the Moralists such as Hume, Smith and Ferguson we learn that justice can be defined only as the elimination of injustice, and that its achievement can never be attained for once and for all, but requires a standing order of obligation throughout our lives. Similarly, political and intellectual freedom depends on adherence to a framework of rules that delimit how creativity can occur. Creativity itself, whether in social or economic conduct, or in the ability to use language productively, or in the genesis of behavior, is regulated by a context of constraint that consists entirely of inhibitory or prohibitory rules. To such examples one may add the negative definition of "economic" in terms of scarcity of what is not ultimately available. Also the concept of cost, as the importance of the next most urgent want that can no longer be satisfied, and also the concept of marginal utility. As noted above, theory of science exhibits many instances. Popper even defined the empirical domain negatively, equating empirical content with possible states of affairs that a theory *forbids* to occur. There are also numerous negatives familiar from Popper's slogans, such as "Don't attempt to justify," or "Do not argue about linguistic definitions," and so on.
7. Should we attempt to make explicit (fully conscious and directed) this tacit matrix in which our reason has arisen we will be limited to a taxis order that is no "smarter" or more adaptive than the particular individual who consciously specified it. It is our inevitable ignorance of the infinitude of particulars that constitutes the consequences of our actions that rules out the possibility of any such conception of "rationalism." Should we attempt to limit

reason and permissible conduct to what is available to us from an analysis of what is in our consciousness we would find ourselves thrown back to the tribalism of the face-to-face society that most of our species left long ago. Proponents of such views abound, especially in psychology. Consider the remarks of B. F. Skinner's protagonist in his utopian novel *Walden Two* (originally published in 1948): "Frazier: We're in the throes of a great change to positive reinforcement—from a competitive society in which one man's reward is another man's punishment, to a cooperative society in which no one gains at the expense of anyone else" (1976, p. 245). This sentiment echoes rationalist constructivist philosopher Bertrand Russell, in *The Scientific Outlook*: "No society can be regarded as fully scientific unless it has been created deliberately with a certain structure to fulfill certain purposes" (1931, p. 211). These and similar views are part and parcel of the "common sense" background views of the 20th century. What needs to be remembered is that there is no support whatever for such views forthcoming from any scientific theory in either the physical or biological sciences, nor from neuropsychological and cognitive psychology, nor from the study of spontaneously ordered complex orders in the social domain.

8. By performing an enormous number of computations, the cerebellum acts as a comparative computer to control skilled movements. There is immediate input to the cerebellum from the motor cortex, and the cerebrum cannot initiate any action without informing the cerebellum. J. C. Eccles exhaustively investigated the cerebellum (Eccles 1969, 1973a, 1973b), and this is his summary of its functioning:

> what you do with ordinary movements is to give a general command-such as "place finger on nose," or "write signature," or "pick up glass"—and the whole motor performance goes automatically. For example, you don't have to spell out your name letter by letter when you're writing your signature—if you did, the bank manager would not recognize it! You just give the general command from the cerebrum and let the cerebellum take over in order to give the fine characteristic details. Normally our most complex muscle movements are carried out subconsciously and with consummate skill. The more subconscious you are in a golf stroke, the better it is, and the same with tennis, skiing, skating, or any other skill. In all these performances we do not have any appreciation of the complexity of muscle contractions and joint movements. All that we are voluntarily conscious of is a general directive given by what we call our voluntary system. All the finesse and skill seems naturally and automatically to flow from that. It is my thesis that the cerebellum is concerned in all this enormously complex organization and control of movement, and that throughout life, particularly in the earlier years, we are engaged in an incessant teaching program for the cerebellum. As a consequence, it can carry out all of these remarkable tasks that we set it to do in the whole repertoire of our skilled movements in games, and techniques, and musical performance, and speech, dance, song, and so forth (Eccles 1973b, pp. 122-23).

9. Many philosophers have tried to avoid or resolve this necessary dualism by employing a relational framework. This has been popular since Leibniz proposed a relational metaphysics. He held that from the point of view of science these concepts are relational, since they arise in unison as a product of conceptual analysis, linked by relations specifying invariance in appearances. Thus the "I" of consciousness appears, from the perspective of objectivity (or better, intersubjectivity) as but one of many of its kind. But it is all too obvious that in epistemology the priority is undeniable. The I is the absolute subject, unique in spite of the objective equivalence of all other subjects. Weyl put this issue clearly in 1927:

> the postulation of the ego, of the 'thou,' and of the external world is without influence upon the cognitive treatment of reality.… Yet this belief is the soul of all knowledge… Leibniz believed that he had resolved the conflict of human freedom and divine predestination by letting God (for sufficient reasons) assign existence to certain of the infinitely many possibilities, for instance to the beings Judas and Peter, whose substantial nature determines their entire fate. This solution may objectively be sufficient, but it is shattered by the desperate outcry of Judas, "Why did I have to be Judas?" The impossibility of an objective formulation of this question is apparent.… No answer in the form of an objective insight can ensue. Knowledge is incapable of harmonizing the luminous ego with the dark erring human being that is cast out into an individual fate (1949, pp. 124-25).

10. First emphasized by Kant, the objective nature of the subjective is beautifully explicated by neo-Kantian philosophers such as Cassirer (1923, 1957). Speaking of the "ingredients" of the act of visual perception Cassirer noted: "it should be realized that this mode of ideation is no secondary and as it were accidental factor, by which vision is for the time being partly determined, but that, from a psychological point of view, the symbolic ideation first constitutes vision. For there is no seeing and nothing visible which does not stand in some mode of spiritual vision, of ideation. A seeing and a thing seen outside of this "sight," a "bare" sensation preceding all formation, is an empty abstraction. The "given" must always be taken in a definite aspect and so apprehended, for it is this aspect that first lends it meaning" (1957, p. 134). And as a counter to the physicist's sentiment noted above, this rebuttal: "In natural science it may seem meaningful and even necessary to let knowledge of the parts precede knowledge of the whole, to ground the reality of the whole in that of the parts. But this road is closed to the investigation of language, for the specifically linguistic meaning is an indivisible unity and an indivisible totality. It cannot be built up piece by piece from its components, from separate words—rather, the particular word presupposes the whole of the sentence and can only be interpreted and understood through it. If we now apply this point of view to the problem of perception—if we take the unity of linguistic meaning as our guide and model—we gain an entirely new picture of sensibility. We then recognize that the isolated "sensation," like the isolated word, is a mere abstraction" (ibid., pp. 31-32).
11. For more on Walter Weimer and his discovery of and promotion of Hayek's *The Sensory Order*, please see Weimer 2011. — [ed.].

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