

EIR Science & Technology

Scientific method and individual political freedom

Against what must freedom be defended? Lyndon H. LaRouche, Jr. addressed this commentary to a convention of American scientists on Nov. 2, 1986.

Today, few in the United States remember, that, only recently, a distinguished U.S. senator, Harrison "Pete" Williams, was sent to federal prison on "Abscam" charges, although the government's prosecutors themselves presented filmed evidence which proved that the senator was innocent of the alleged offense charged. More recently, a most distinguished rocket scientist, Dr. Arthur Rudolph, was stripped of his citizenship solely on the basis of allegations manufactured by the Soviet government, allegations which have been shown to be fraudulent ones. During the past 12 months, there is a mounting number of individual cases, of U.S. citizens stripped of their legal rights through mental-incompetency proceedings, in which the sole evidence of mental incompetency is their support for some political view, of which a particular judge happens to disapprove.

Happily, recently, a number of distinguished U.S. senators, including Howell Heflin (D-Ala.), David Pryor (D-Ark.), and Dennis DeConcini (D-Ariz.), has sounded the alarm against such dictatorial practices by powerful circles inside the U.S. Department of Justice. Let us hope that those senators pursue this long-overdue investigation both courageously and wisely. I would hope that American scientists would recognize their special qualifications for, and duty of contributing to an urgently needed reaffirmation of what the term "freedom" ought to signify, both in popular opinion and the practice of our judicial system.

For approximately 2,500 years, European civilization has defined "freedom," by adopting Socrates' address to his accusers during that infamous trial which condemned him to death. From Socrates, through John Milton, and among the

leading founders of this constitutional republic, the essential definition of "freedom" has been the right of the individual to pursue the quest for truth, even when this quest incurs the displeasure of overwhelming popular opinion.

Socrates' case has the very special sort of included importance for us, over the ages, that that trial exemplifies the point, that although no man, no judge, no jury, can know truth with absolute certainty; under law, we must resort to a pragmatic substitute for absolute truth, a substitute best named "truthfulness." Respecting the practice of legislators and courts, we must demand of our lawmakers, our judges, and our prosecutors, that they, above all others, be unwavering servants of the cause of truthfulness.

Some, unfortunately, confuse "truthfulness" with the mere appearance of "sincerity." We see the error of relying on sincerity, the moment we pose to ourselves the question, "Is it not possible that Adolf Hitler was sincere?" or "Is it not possible that Josef Stalin was sincere?" Sincerity and political freedom are not necessarily compatible qualities.

If sincerity is not a reliable test of truthfulness, what is? So, our attention is properly turned, again, to the case of Socrates. In this connection, the special role of scientific workers is best spotlighted.

Generally, the history of science is the paradigm of truthfulness. The essence of scientific knowledge, is the accumulation of a succession of valid discoveries respecting the lawful composition of our universe. Yet, the history of science is also a process of successively overthrowing the useful discoveries of yesterday, by less inaccurate ones. Overall, we know that science is the business of truth-seeking, but



Students at Camden High School (New Jersey) working on an ant colony experiment for the Space Shuttle.

"The scientific method, by means of which valid advances in man's power over nature are brought about, serves us as the best point of reference for investigating the faculty of potential truthfulness in mankind."

NSFSP/Carlos de Hoyos

that we never achieve anything better than truthfulness. This is our paraphrase of the same argument, the which occupies the center of the work of the Socrates of Plato's dialogues.

Truthfulness is the human mind's questing for knowledge of that lawful ordering of the universe, that which is a higher authority than the mere opinion of any man, any government, any body of popular prejudice. The special significance of the physical sciences, in this matter of principle of law, is that the practical increase of society's power over nature, per-capita, achieved through scientific and technological progress, is the crucial test, of whether changes in opinion brought about by scientific work, are relatively more consistent with the lawful composition of universal creation, or not. The scientific method, by means of which valid advances in man's power over nature are brought about, serves us as the best point of reference for investigating the faculty of potential truthfulness in mankind. This aspect of science, the proven methods of valid scientific discovery, especially of more fundamental discoveries, is a paradigm of what we ought to signify by the term "human reason." The right of the individual, to enslave his or her will to the employment of that faculty for truthfulness, to become so a less imperfect agent of reason, is the essence of true political freedom.

Inevitably, scientists as a stratum of society, are most occupied with a special aspect of political freedom in general, the freedom of truthful scientific inquiry. What I am doing here, is to underline those aspects of the cause of scientific freedom, the which illuminate most efficiently the proper standards for definition of political freedom in general.

Having said this much by way of introduction, I ask your attention for two key points to be stressed in this connection: 1) the two contrasting definitions of "liberty" commonly found in society today; and, 2) the special meaning of what is called

"fundamental scientific discovery," together with the connection of this special meaning to the more fundamental aspect of Socratic reason.

Two definitions of liberty

If we construct a mathematical economic model for what anthropologists describe as a "pure hunting-and-gathering society," we estimate that approximately 10 square kilometers of our planet's land-area would have been required to sustain an average individual in a very wretched sort of existence. This implies a maximum for the human population of this planet, of approximately 10 million persons.

Today, more than 5 billion persons exist. Admittedly, the greater portion of these live in a relatively miserable condition. Yet, that misery is not necessary; it is fairly easily shown, that if state-of-the-art technologies were generally employed, we could sustain much more than 10 billion persons in an average condition equal to or better than that of the United States during the early 1970s. The potential population-density of mankind has been increased by approximately three orders of magnitude above the estimated condition of primitive mankind. With presently emerging technologies, we could begin the permanent colonization of Mars within about two generations, and could surpass all present apparent limitations of so-called natural resources on this planet. This potential has increased by approximately one order of magnitude during the recent four and a half centuries, since the early 15th century, the greatest part of this since the development of economies based on improvements in heat-powered machinery, since the end of the 17th century. Within 50 years or so, we could increase the potential population-density of mankind by more than an entire order of magnitude above present best levels.

From the standpoint of physical sciences as narrowly defined, this mode of potentially exponential rate of increase in man's power over nature, is the fact which best sets mankind absolutely above all lower forms of life. The range of potential population-density of lower beasts is fixed, hereditarily, within a small fraction of one order of magnitude. Only mankind can willfully alter its species' behavior to the effect of limitless increases in our species' potential population-density. From the standpoint of physical science, the interplay between fundamental scientific progress and technological progress, is the aspect of individual human potential in which this absolute superiority of our species is centered.

This quality, the ability to produce and assimilate scientific and technological progress, pertains to a special human quality, a quality most conveniently named "reason."

The wonderful thing about each healthy new-born child, is that that child possesses that divine spark of reason, the potential for cultivating the powers of reason. It is this quality which sets all human individuals above the beasts, and renders individual human life sacred. This is man's potential to discover, and to be governed by knowledge of the lawful ordering of creation, to become in that way, the conscious instrument of the Creator's Will.

If we are wise, this aspect of our individual nature is the essence of what we regard as our fundamental self-interest. We may serve this self-interest in various ways. In one instance, we may effect a valid scientific discovery, which contributes to the foundations of human advancement over generations to come; in that way, we make the fruit of our brief mortal existence an immortal one. Or, we may assimilate such discoveries into our individual practice, and make our individual lives of enduring benefit for future generations on that account. Or, as loving parents and teachers, we may promote the development of such potential in children and youth, and thus also make an immortal contribution.

On this account, wise men and women demand that our society be so ordered, that every new-born child has the right, both to develop the power of reason, and the opportunity to employ that power to some useful purpose. Our awe of universal natural law, combined with our loving regard for such rights of the sacred individual life of the person, are the foundation of a body of natural law absolutely higher in authority than any body of popular opinion, higher than the judgments of any government. The right to live in a manner consistent with such natural law, is the essence of true political freedom.

Unfortunately, among scientists, there is a widespread opinion contrary to what I have just described. Correspondingly, there is a definition of "freedom" contrary to the one I have just outlined.

Each of us is born with two natures. On the one side, there is the aspect of our nature which sets us above the beasts, the divine spark of potential for reason. At the same time, we partake of the irrationalist hedonism of the beasts,

an obsession with the seeking of sensual pleasures and avoidance of pain for their own sakes.

On account of these two conflicting impulses, reason versus irrationalist hedonism, Plato, St. Augustine, and Dante Alighieri, among others, described three categorical types of human character: 1) the purely irrationalist-hedonist individual, the resident of Dante's *Inferno*; 2) the individual ruled by reason, the resident of Dante's *Paradise*; 3) the individual ashamed not to be ruled by reason, but nonetheless significantly enslaved to irrationalist-hedonist impulses: the resident of Dante's *Purgatory*.

With the rise of the converging tendencies, known as empiricism, romanticism, positivism, and existentialism, over the recent centuries, a false definition of "liberty" has invaded popular opinion and the practice of institutions of law. Where natural law demands political freedom for reason, as Socrates did, a hedonistic definition of "human nature," locates "freedom" in the unbridling of irrationalist impulses of hedonistic pleasure-seeking. So, "sincerity of feeling," and popular prejudices to such effect, have displaced the freedom to be truthful in much of common practice, including the practices of courts and other institutions of government.

The most hideous expression of such existentialism recently, has been the Nazi, racialist cult, of triumph of the irrationalist, arbitrary popular will.

Again, the history of science comes to our assistance.

In the proper conduct of scientific inquiry, we measure ideas according to their provable practical consequences. The principle of reason requires that each of us be held morally accountable for the practical consequences of any opinion which we promote, or tacitly encourage by our failure to oppose such policy. If we support a policy which causes great suffering, we are personally guilty of causing that suffering. Rightly, the Nuremberg trials did not consider the sincerity of the Nazis' views as offsetting the enormity of the crimes accomplished.

Not all ideas are equal. Ideas contrary to principles of natural law, are wicked ones. Ideas conceived truthfully, in agonies of a conscience dedicated to natural law, are the best ideas of which mankind is capable at any time. If we are honestly mistaken, in a truthful search for ideas consistent with natural law, admittedly, the error in our judgment may do some damage. However, the fact that we transmit not only such ideas, but also the practice of truthful search for consistency with natural law, bestows to our heirs the capacity for correcting the inadequacies of our fallible judgment.

My field of specialization is economic science. By "economic science," I mean the establishment of economic science by Gottfried Leibniz, in work accomplished over the interval from his first paper on economy, in 1672, until his death. Although all economic science must take the impact of monetary processes duly into account, economic science is essentially a science of physical economy, economic processes treated as physical processes. "Physical economy," as Leibniz's economic science was defined into the early 19th-

century teaching of cameralism in European universities, is the study of physical economic processes relative to technological progress in an energy-intensive, capital-intensive mode. Leibniz's preliminary definition of "technology," is the central point of reference in such studies. The yardstick of measurement of economic performance, is changes in the rate of increase of physical productivity, a rate measured in terms of increase of potential population-density.

Apart from my work respecting the measurability of the cause-effect relationship between technological progress and increase of physical productivity, my prime application of this research has been the question of unnecessary misery within our own nation, and, most emphatically, among the so-called developing nations. My work has thus brought me into conflict, not only with those prevailing policies which cause this unnecessary misery, but with very powerful financial agencies which esteem prevailing policies as representing their own most vital interests, and with a Soviet government whose foreign policies affect developing nations to similar effect. On this account, my friends and I have become extremely controversial, the targets of escalating oppression by Soviet agencies, and also powerful financier interests inside and outside our own government.

The political argument arrayed against my efforts by the relevant financier agencies, contains two leading elements. More narrowly, these financier agencies have denounced me and my friends as constituting a "serious potential threat" to what certain financial institutions consider their vital interests. Second, more broadly, respecting my complaints against the economic injustice caused by their policies, they insist that their economic policies represent a principle of "freedom of the marketplace," their right to take a hedonistically self-interested view of their immediate economic self-interests, in disregard for the practical consequences of such policies respecting the poor in our own nation and the developing nations generally.

Their argument is a wicked one, and is scientifically absurd. We have in reach, the means to increase the energy-density cross section of primary sources of energy by an order of magnitude or more. With aid of these technologies, some already state of the art, others in reach within a decade or more, we can declare today that there are no limits to primary resources of production. Obviously, if we can foresee controlled energy-density cross sections of applied energy, sufficient to transform tungsten ore into a controlled plasma-state, and can create paracrystalline structures out of such energetic processes, there are no longer any limits to inorganic resources. With improved sources and applications of energy-stocks, all limits on production of an excellent diet for all persons are exceeded.

Following this track of technological progress, every nation could become rich beyond the imagination of most today. Every well-managed enterprise could become profitable beyond the dreams of today's entrepreneurs. Employed labor could enjoy a standard of life soon to become an order of

magnitude higher than average per-capita market-basket standards of today. There is no longer the need to think in terms of policies which condemn the majority of humanity to such forms of repetitive toil as liken the human condition to that of a beast. We have within the reach of a generation or so ahead, the practical means to make the development of the individual's powers of reason the dominant aspect of human labor everywhere.

Such an improvement in the characteristic feature of human labor is directly expressive of true human freedom. This is not some idealistic communist's dream; it is the fulfillment of the principle upon which the modern form of entrepreneurial economy was founded, during the 15th and 16th centuries.

By the nature of the responsibility, that side of a nation's physical economy which pertains to basic economic infrastructure, must remain the work of the state: the management of water-supplies, the production and distribution of energy-stocks for general use, general transportation, communications, public sanitation, education, and the basic economic infrastructure of urban-industrial life. These are improvements of the general environment, upon which depend the possibilities of entrepreneurial agriculture, industry, trade, and of private life. However, during the 15th and 16th centuries, modern European society established a system of entrepreneurship in agriculture, manufacturing, and general commerce. This change was introduced in Cosimo de Medici's Italy, put into practice in Louis XI's France, and was the great contribution of Tudor England. The reason for this institutional change, bears directly upon the issues of political freedom before us today.

The enlightened governments issued patents to inventors and their business partners, to encourage the proliferation of the benefits of useful inventions. This action freed human creativity from the mind-dulling practices of the medieval guilds, establishing the technologically progressive institution of the modern independent farmer and industrial enterprise, as the driving-force of economic progress.

This action recognizes the principle, that innovations of discovery and application of scientific progress flow from the exercise of the principles of reason by the individual human mind. It should be our desire, that farmers invest retained earnings of production in improvements of agriculture, and that the industrial entrepreneur and operatives share a commitment to employing retained earnings of production in modes of capital-intensive technological progress. It should be our desire, that the greater portion of the accumulation of wealth in society, be concentrated in such employment of retained earnings, rather than as commercial profits from mere buying and selling, and that profits from usury be strictly contained. It were sufficient merely to unleash that policy of entrepreneurship, including the improvement of the well-being of a well-educated and hardy labor force, to accomplish more or less automatically all the things which need to be done to improve the material well-being of the human popu-

lation.

The center of the problem of morality is, that the nations of Western civilization have shifted away from a society based so on the principle of fostering human reason, to imitation of the usury-dominated processes of economic and moral decay which characterized the fall of both the Roman and Byzantine empires.

The economies have shifted from profits of useful production, to profits of the buying and selling of money and other financial paper, as the dominant mode of accumulating economic, and political power. This shift has increased the influence of irrationalistic hedonism in the following leading fashion.

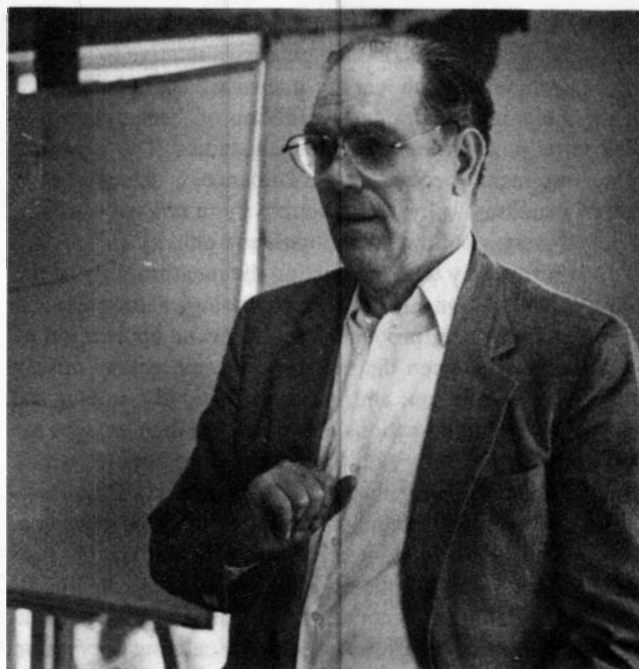
The first step in examination of the health of a national economy, as a physical economic process, is to view a nation's economy as of the form of a consolidated agro-industrial enterprise. As for any productive enterprise, we distinguish those activities which are directly responsible for production of physical output, from the sundry necessary and wasteful forms of activities fairly described as "overhead expense." In a healthy agro-industrial economy, "overhead expense" is minimized, relative to promotion of improvements in basic economic infrastructure and growth of allotments to direct production of useful physical output.

In a rentier economy, as opposed to a production-oriented economy, the rentiers' practice treats use of retained earnings for improvements in physical capital of production and infrastructure, as a diversion of funds from rentier income on the profitable buying and selling of money and other financial paper. So, under rentier-oriented policies, not only is technological progress in an energy-intensive, capital-intensive mode aborted; the percentile of the labor force employed as operatives, in combined basic economic infrastructure and production, declines relative to a growth in the percentile employed for both necessary and wasteful forms of administrative and service occupations.

The social and moral effect of such a shift in economic policy of practice, is to foster a shift from a productive economy, to a pleasure-seeking economy.

Naturally, a productive economy requires improved market-basket standards of per-capita households' income, as well as of producers' income. However, in both forms of consumption, market-basket requirements are a means to an end, not the end in itself. The goal served is the individual's pride in effecting useful contributions to the material and moral conditions of life of present and future generations, in the same way a scientific discoverer's goals are defined. Pleasure is not an end in itself; one takes pleasure in those activities which are necessary means to a moral end.

In a rentier society, momentary pleasure as such, tends to dominate, as the current content of increasingly popular "soap operas," both daytime and evening varieties, underscores such a trend. Ever freshly jaded appetites seek new objects and forms of momentary pleasure-taking, in an irrational hedonist's mode of pleasure-seeking.



The author teaching a class on physical economic processes relative to technological progress.

In this latter state of moral decay, "liberty" is defined as license for whatever is momentarily perceived as pleasure-taking. The campaigns for "decriminalization" of such formerly despised practices as today are seen as the pleasure of some, exemplify this.

Under the rule of such a rentier policy, the state and private financier interest, both, protest strongly against every effort to measure the performance of monetary and economic policy against the consequences of such policy for physical economy. The nominal profitability of the rentier interest, replaces physical productivity as a measure of performance of fiscal, monetary, and economic policies of states. It tends to be asserted, as Professor Milton Friedman asserts this, that unbridled rentier practices will in some way, magically, lead to a prosperous state of affairs.

Since nearly all policies of both government and business are dominated, either directly or indirectly, by the impact of monetary and economic policies, the sheer irrationalism of a rentier policy invades every realm of practice. From a moral standpoint, the collapse of urban infrastructure is an intolerable policy; yet, to arrest this decay would require actions which defy and tend to overthrow rentier monetary policies. So, in every aspect of policy, either rational morality or the rentier doctrines of Professor Friedman must give way to the other.

In each case rentier policy is not overthrown by rational morality, the entire area affected is removed from the domain of rational policy-making. So, rentier policy makes every aspect of life more or less irrational.

Doctrines such as Friedman's insist, as Friedman himself insists categorically upon this, that, in matters bearing upon

monetary policy, we must never permit the precalculable physical effects of a policy to be used as factual premises in opposition to the axiomatic tenets of monetarist dogmas.

This rentier undermining of reason in public policy has been aggravated by the wild irrationalism of the so-called "radical ecologists." If a nuclear-fission plant should even be as much as suspected as representing the same concentration of radiation as three human bodies in the same bed, certainly even less than the radiation from a brick fence, these fanatics would shut down that plant. If the policies of these radicals were adopted, the shutdown of technology effected would lower the effective carrying-capacity of this planet to levels approximately those of the 14th century, causing the genocidal death of literally billions, through combinations of famine and epidemic. Yet, such forms of literally paranoid irrationalism prevail in our courts.

In this state of affairs, true scientific and political freedom are threatened with extinction. Once the individual is no longer protected by natural law and reason, ephemeral fads in opinion among authoritative institutions or so-called popular opinion, become a substitute for principles of law.

The history of the emergence of Nazism in Germany, is the classic example of the kind of moral decay we are undergoing presently.

According to the leading modern apologist for fascism, former SS volunteer Dr. Armin Mohler, the roots of German fascism are found in the irrationalist doctrines of Jean-Jacques Rousseau and Madame de Staël. The spread of combined Romanticism and cultural pessimism in Germany, as typified by such cases as Arthur Schopenhauer and Friedrich Nietzsche, are the precursors of fascism. The key predecessor of Nazism is Berlin Professor of Law Friedrich Karl Savigny, the single greatest influence in promoting irrationalist dogmas of law and culture in Germany.

Savigny, among other things, the teacher of Karl Marx and the author of Marx's conception of "historical materialism," outlawed natural law, and demanded the substitution of what he called the *Volksgeist*, an irrationalistically ordered succession of ephemeral moods of popular opinion. Savigny was also the most influential, in decreeing that matters of law, social sciences, and such, be freed from scrutiny by the forms of reason associated with the physical sciences.

When, under the terms of the Versailles Treaty, Weimar Germany was prevented from rational forms of economic practice, and subjected to rentier law in the extreme, the cultural pessimism so engendered fostered the spread of irrationalist movements feeding into Nazism.

The Jacobin Terror in France, was a bloody tyranny also born of what is an apparent "excess of democracy," of rule by what passed for ephemeral moods of popular opinion of the Paris mob. As the trial of Socrates merely exemplifies the point over the centuries since, an excess of democracy always leads to the cruelest forms of tyranny. This occurs not because of democracy as such, but occurs wherever popularity of irrationalist pleasure-seeking wages war against the con-

straints of natural law.

It is that natural law, which protects the right of the individual, to assert truthful inquiry even in opposition to prevailing opinion, which is the most indispensable prerequisite of true political freedom of the individual. The right of the scientist, employing the truthful methods of scientific inquiry, to challenge the most popular contemporary assumptions of scientific opinion, is the exemplar of the principle of individual political freedom.

We are each accountable, politically, and absolutely, for the rightness or wrongness of those ideas which inform our practice. Since no man nor institution is capable of knowing absolute truth perfectly, the law must find a knowable surrogate for absolute truth, in the form of a rigorous set of standards for truthfulness. That rigor is the essence of all law as law must be practiced by society, whether in the community of scientists, in legislative proceedings, or in courts of law. The political freedom of the individual lies in the individual's rights and obligations to acquire, and to be self-guided by the developed powers of reason, and in the obligation of the state to judge the individual's challenge to prevailing opinion by no standard but this one.

Freedom from the higher standpoint

Those trained in mathematics are acquainted with the most essential principle of formal deductive logic, a principle sometimes described as the "hereditary principle." In such a formal logic, any theorem consistent with that body of logic is nothing but an elaborated tautology, in terms of the axiomatic assumptions implicitly underlying that logic as a whole.

If we choose constructive geometry, rather than formal deduction, as the basis for mathematics, we have a different sort of "hereditary principle." In elementary constructive geometry, such as the curriculum Prof. Jacob Steiner prescribed for secondary education, circular action, as defined by the topologist's isoperimetric theorem, is the sole axiom from which all theorems in that geometry are derived, by means of nothing but successive constructions originating in this isoperimetric principle. Most simply, Gauss and his successors extended synthetic geometry to encompass the construction of the theorems of the complex domain, substituting conic self-similar-spiral action as a higher form of circular action. Thus, there is an "hereditary principle" in constructive geometries, which seems at first glance analogous to the "hereditary principle" of formal logic.

Assuming that the theorems of scientific opinion are adequately consistent, true freedom can arise in scientific work only in two ways. First, we may demonstrate that some postulate implicitly underlying prevailing opinion is itself in error. The correction of such an underlying error tends to effect a scientific revolution, by virtue of the fact that all scientific thought must be brought into consistency with the new principle. Second, we may demonstrate that the underlying assumptions are erroneous in a different way, that they are not an adequate view of the universe, although correct up

to a point within more limited scopes of application. This second consideration pertains to the higher form of individual freedom, both in scientific work, and in political freedom generally.

This higher form of freedom has been the principal subject of my life's work in economic science.

The conventionally taught view today, is the assumption that our universe is so constituted, that the sense of time and of increasing general entropy are congruent in the large. Issac Newton, among the first moderns to discuss this view, admitted it to be somewhere founded upon an absurd assumption. In the Leibniz-Clarke correspondence, Leibniz placed heavy emphasis on this observation of Newton's: that the Cartesian view, of discrete bodies interacting within empty space-time, leads to the formal judgment, that our universe is winding down, in the sense of a mechanical timepiece. Kepler, among others, had insisted that the universe was elementarily negentropic, not entropic. It is only from the standpoint consistent with Kepler's, that we can locate the deeper meaning of true freedom in a thoroughly rational way.

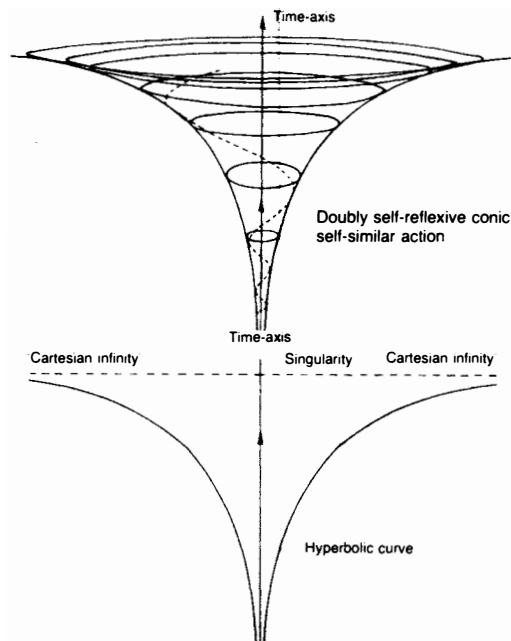
The two successive approximations of the definition of true freedom, are best located within the bounds of Socratic method. Reason's elaboration begins with uncovering the implicit assumptions upon which any assumed belief depends, much as the formalist's "hereditary principle" implies this. The most profound, deeper level of this exploration, is the criticism of the most fundamental among the implicit assumptions "hereditarily" underlying the general thought of an entire culture. On the deeper level of Socratic reason, we search for a single hypothesis which supplies, "hereditarily" the correct theorem for every aspect of experience.

The most fundamental of the questions posed to science, is the array of questions associated with the most elementary notions of the mere fact of human existence.

This current of work in modern science, was set into motion by the scientific works of Nicolaus of Cusa, Cusa's 1440 *De Docta Ignorantia (Of Learned Ignorance)* most notably. This appeared during the 15th-century's Golden Renaissance, as a general continuation of St. Augustine's policies, and of the work of Dante Alighieri and Petrarca. This became known as "Christian humanism," as opposed to the dogmas of self-styled "secular humanism" today.

The most direct application of this work of Cusa, was accomplished by the circles of Luca Pacioli and Leonardo da Vinci, toward the close of that same century.

In the course of elaborating the principles of a constructive geometry, Pacioli and Leonardo demonstrated that the characteristic distinction between living and non-living processes, is the fact that the morphological elaboration of growth of living processes is harmonically congruent with the Golden Section of elementary constructive geometry. This is otherwise a geometrical definition of negentropy as a physical principle in its own right. This is central to my own work in economic science, and this in a manner which bears directly upon the higher principle of freedom.



The effect of technological progress in an economy is to generate a series of Riemannian shock-wave-like discontinuities, as these diagrams of conic, self-similar spiral action show. The growth of per-capita potential relative population density generates a bell-mouthed horn, whose cross-section describes a hyperbolic curve, seeming to zoom off into Cartesian infinity. The diagram on the right shows a harmonically ordered series of discontinuities. At the flaring mouth of the hyperbola, a new curve, in an altered "economic physical space-time" begins. The second curve flares into a discontinuity, as did the first.

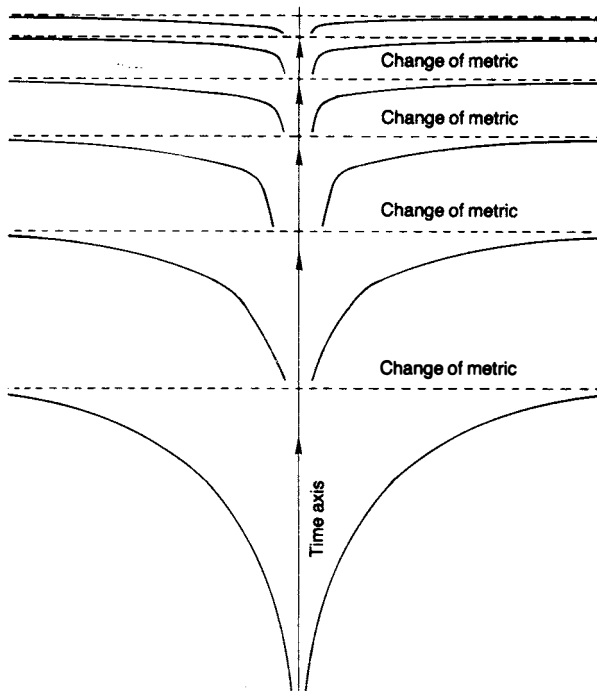
This elaboration of the principle of living processes, was the axiomatic center of Kepler's elaboration of a mathematical physics. It would be correct, and is relevant, to make the following descriptive observations on Kepler's work.

During the discussions of special and general relativity, it was acknowledged by some, retrospectively, that the notions of physical space-time associated with relativity, were anticipated by Kepler. In other words, that cause-effect relationships are efficiently situated in physical space-time, rather than as causal relations among discrete bodies in Cartesian, empty space-time.

The notion of planetary orbits, as lying within harmonically ordered least-action pathways, and no arbitrary orbits in between these available least-action pathways, expresses a characteristic, efficient feature of such physical space-time.

The characteristic harmonic orderings are ordered by a topological principle of physical space-time, the which underlies also the uniqueness of the five Platonic solids and the Golden Section as the metrical characteristic of the construction of those solids. Gauss's treatment of harmonically ordered elliptic functions, pivoted upon his treatment of the arithmetic-geometric mean, addresses this underlying principle.

If, then, the fundamental laws of astrophysical motion



are determined by such a topological principle, the universe as a whole is negentropic in the large. The notion of negentropy as a statistical fluctuation within a process, the which is deemed entropic in the large, is rejected as a notion characteristic of an axiomatically wrong, Cartesian manifold.

The characteristic of multiply-connected conic (self-similar-spiral) action, within the domain of a constructive geometry, is that such a universe is a negentropically evolving process, in a self-subsisting way. This negentropy is most typically represented by a succession of phase-states, each of a respectively higher order than its predecessor states. This ordering is associated with the generation of singularities intrinsic to such a multiply-connected construction. Two of Bernhard Riemann's most famous papers address this in an exemplary way: his 1854 dissertation "On the Hypotheses Which Underlie Geometry," and his 1859 "On the Propagation of Plane Air Waves of Finite Magnitude."

This aspect of Gauss-Riemann physics performs a central function in my principal discovery in economic science.

My brand of economic science is subsumed by the pioneering work of Leibniz, and the "American System of political-economy" incorporating central features of Leibniz's work, the latter as represented by Treasury Secretary Alexander Hamilton's 1791 "On the Subject of Manufactures." This American System bases U.S. economic policy upon the fostering of increases in physical productivity per-capita through technological progress in an energy-intensive, capital-intensive mode. Within this context, I attacked a previously unsolved problem: How might we express the cause-effect between technological innovation and increase of productivity in a mathematical way? This inquiry led directly to a more rigorous definition of freedom, permitting an implicit

measurement of both such freedom and its practical consequences.

This inquiry was prompted by contempt for the assertion of an "information theory" dogma by such figures as Profs. Norbert Wiener and John von Neumann. These persons mis-defined human intelligence's negentropic aspects in terms of the doctrine of statistical fluctuations of Ludwig Boltzmann, denying any actually creative aspect for such intelligence. My refutation of Wiener and von Neumann on this and related points, began with two elementary facts: 1) that the growth of healthy economies is itself negentropic (in the sense stipulated by Pacioli, Leonardo, Kepler, et al.); 2) that human beings are living processes, intrinsically negentropic. The added clue, was my hypothesis, that those functions of the human brain which account for valid creative discoveries, represent a form of consciousness (or near-consciousness substrate of consciousness) which echoes the negentropic principle of reproduction of tissue.

My general hypothesis, based on these and related considerations, was that the negentropy introduced to economy through technological progress, is a direct reflection of the negentropy of those aspects of human brain functions typified by valid scientific discoveries. Hence, I concluded, the cause-effect relationship between scientific discovery and increase of productivity must be mathematically comprehensible in these terms of common reference.

This implied, but did not adequately identify, the feasibility of measuring the cause-effect connection involved. For reasons which should be obvious to those familiar with the work of Georg Cantor on transfinite orderings, a study of Cantor's work led me to a correct appreciation of the most relevant features of Riemann's work. Riemann's elaboration of the work of Gauss, Dirichlet, and Weierstrass (most notably) points to the mathematical solution desired.

What is implicitly required, is a function subsuming "non-linear," negentropic ordering of successive phase-states of the economy. Most simply, given two input-output matrices, each referencing one of two successive states of development of an economy, we require the non-linear function subsuming the transformation of the two linear systems so represented. This must be generalized, to subsume a more or less indefinite ordering of this type.

My own work, since 1952, and my collaboration with others in this effort during recent decades, has been focused upon three lines of endeavor:

- 1) The elaboration of such non-linear, Riemannian functions for economic processes, including selection of methods of approximation required for computer simulations.
- 2) The implied case, that the economic process is a special aspect of the general function for the biosphere.
- 3) The analysis of the congruence between valid discovery in physics and valid creativity in the arts.

It is the third of these three matters reflected principally

here: a general notion of human freedom.

At first glance, it might appear that the limit of Socratic reasoning is to reach a set of perfect axioms, corresponding to perfect laws of a fixed universe. More deeply, we should recognize, that the universe is not of the fixed character which the mechanistic tradition of Descartes, Newton, Cauchy, Boltzmann, et al. implies. The universe as a whole is evolving negentropically, such that as each higher phase-state is generated, the apparently fixed laws of the universe are modified in the manner argued by Riemann.

Rather than fixed laws, we must discover a set of evolutionary principles which subsume the generation of those arrays of temporarily fixed laws, the latter which are seemingly applicable to any one state of physical space-time. These are of the form of the fundamental laws of the universe; they are also, necessarily, of the form of the fundamental principles of valid scientific discovery, fundamental discovery correctly seen in its most primitive form, as an act of the individual human mind.

The chief source of the difficulty of efforts to identify the principles of creative thinking, is the mistaken assumption, that the rational mind is logical. I mean "logical," in the sense of consistency with some form of deductive logic, such as a deductive algebra. The center of the problem, is the fact that the very principles of deductive logic preclude a method of accounting for the coming into existence of the discrete elementarities of a physical process.

This problem does not exist in an advanced constructive geometry, such as that of Gauss, Dirichlet, Weierstrass, and Riemann, since, in that sort of constructive geometry, elementary existences are generated as singularities. The combined, relevant discoveries of Dirichlet, Weierstrass, and Riemann render solutions for such cases elementary in principle.

Hence, the form of mathematics so indicated is in and of itself a mapping of those creative processes of mind, through which valid scientific discoveries are effected.

We have the same picture of technological progress from the side of its effects. It is conventional, but wrong, to measure the performance of an economy in terms of a quantity of market-basket objects produced. We do and must make such measurements as a matter of first approximation, but we commit a fundamental fallacy if we define "economic value" as something which might be measured in terms of scalars such as prices or quantities of objects produced. It should be obvious, that what ought to concern us, is how the result of current production affects the characteristics of tomorrow's production. In other words, we must view consumption as an intermediate action, between two successive cycles of production, not as a final result.

The raw magnitude we must measure, is a rate of increase of a society's potential population-density. To measure this properly, we must discover a cause-effect relationship between the rate of increase of productivity today and the rate of increase tomorrow. Only in this way, do we examine the

physical-economic process as a process.

As I have indicated, we may imagine that at each of successive points A and B, the economy may be described in terms of an input-output matrix, of respectively different levels of productivity. This is associated with a modification of the array of rows and columns, and of coefficients of the included terms. Given a succession of such matrices, our first attempt must be to measure a rate of increase of productivity. Beyond that, we must discover a function which accounts for the effect of a change in the rate of increase at point A, on the rate of increase at point B. The changes in rows and columns of the matrices, represent singularities. These are crude illustrations, but they indicate the fact that the required function is non-linear.

The increase of productivity through technological progress in an energy-intensive, capital-intensive mode, is bounded by six general constraints, as follows:

- 1) As Leibniz indicated in his first paper on economy, his 1672 "Society and Economy," sustaining productivity under conditions of technological progress, requires that the per-capita market-baskets of consumer and producer goods must improve in quantity and quality.
- 2) The quantity of usable energy per-capita supplied must increase (energy-intensity in the first degree).
- 3) The energy-density cross section (and relative coherence) of applied energy must increase secularly (energy-intensity in the second degree).
- 4) The percentile of the labor force employed in urban occupations must increase, on condition that the per-capita supply of food and fiber increases (capital intensity in the first degree).
- 5) The percentile of the urban labor force employed in production of producers' goods must increase, on condition that the per-capita market-basket of households' goods increases (capital-intensity in the second degree).
- 6) The level of technology, as Leibniz defines technology, must be advanced: the action of the creative processes.

Thus, an economic process is elementarily non-linear in this sense. If we define "economic value" as a measurement of the characteristic feature of an economic process, then economic value is a non-linear magnitude associated with such a function.

Economic progress generates the material and cultural preconditions fostering the power of the society to generate, and to assimilate efficiently, new levels of technology. It is from this vantage-point, that creative discoveries by individuals and economic value are commensurable magnitudes.

It can be demonstrated, that the relationship I have described, between scientific and economic progress, applies equally to other creative productions of the individual mind. This is true for painting, sculpture, music, poetry, and ar-

chitecture. Leonardo's application of principles of constructive geometry to the idea of beauty as defined by reason, is exemplary. From the standpoint of the ancient Panini's principles of philology, it can be demonstrated, also, that language itself has a constructive-geometric basis consistent with the methods of Gauss-Riemann.

The human mind is not only capable of behaving according to the principles of reason; reason can know itself as a subject-matter.

Conclusion

The hideous epidemic called Nazism, is but typical of a species of horrors humanity brings down upon itself, whenever the bestial aspect of human nature, irrationalist hedonism, suppresses rule by the search for reason. This wretched state of affairs is fostered by the substitution of irrational popular opinion for the principle of natural law, or when an irrational interest, such as a rentier interest, is permitted to subjugate society to its oligarchical whims. The pathological condition manifest in a population being lured into such moral depths, is what is often called cultural pessimism, the loss of confidence in the ability to solve society's problems through the guidance of reason.

We have seen that cultural optimism and technological optimism are closely interrelated. Certainly, today, there is no material problem of mankind which could not be overcome by an energetic promotion of science and technology. Apart from the obvious fact, that the material well-being of society depends upon such progress, there is a moral aspect to such work which is more fundamental. As science and technology require the development and exercise of those powers of the mind we associate with human reason, so a society so ordered esteems individual persons for those qualities of the mind. In a society locked in the bestial embrace of "zero-technological growth," the individual person generally is degraded to likeness to the moral condition of a beast, and tends to be valued only as a beast of burden is valued.

The abominations in practice of law by our government which today remind us of Nazi or Soviet practice, are the fruit of 20 years of destruction of our former commitment to technological progress, by the combined forces of rentier policies and an anti-science counterculture. Because the results of rentier and countercultural policies are miseries contrary to every humanistic principle of Western Judeo-Christian civilization, the habit of tolerating such policies, the habit of viewing as respectable those persons and institutions which foster such wicked policies, has either destroyed or greatly anesthetized the consciences of a growing number of our people. We are tending to be bestialized, because we have too long tolerated policies which are themselves inherently bestializing.

The clearest examples of this process of bestialization, are two. Today, approximately 31 of the 50 U.S. states are predominantly in depression conditions akin to those of the

1930s; yet, the worsening of this condition over the recent years has been officially described as a momentous upsurge of prosperity. In the name of "conditionalities," degrees of austerity have been externally imposed upon developing nations, the which have caused a spiraling collapse of the per-capita productivity of labor in those nations, fostering the spread of hunger, epidemics, and impulses for internal social chaos. In both these cases, the prosperity of the mere policies bringing this misery about, has been used as the yardstick for measuring the prosperity of society. Thus, our government has rejected the most elementary of moral standards of policy-making, that the value of policies is their precalculable, or experienced impact upon the general welfare of persons and nations.

Such flights from reason remind us of "soap opera," or, more precisely, mass-paranoid-schizophrenia. The principle of "soap opera," is a morbidly irrationalist obsession with the existentialist side of interpersonal relations, in the form of a neurotic's fantasy-life, all real aspects of life are of relatively no consequence: clinically speaking, paranoia. In matters of economic policy, fantasy, in the expressed form of a policy alien to reality, becomes the ruling principle of policy-shaping action. The defense of an irrational policy, for the sake of that fantastic policy, is counted as everything, and the moral impact of the policy judged as relatively nothing. This is paranoid-schizophrenia in the strictest clinical sense of the term. It is, otherwise, simply described as evil, as irrationalist hedonism run amok.

Thus, there has been fostered that irrationalist state of mind, under which influence our republic has been recently increasingly invaded by practices fairly described as Soviet-style violations of elementary human rights. Whenever some faction, controlling relevant elements of the Department of Justice and courts, deems the influence of some person or organization to be inconvenient to its own interest, the legal process is perverted to accomplish the victimization of that person or organization, in a manner which differs not at all, in principle, from the Soviet manner of dealing with "political dissidents."

It is necessary and meritorious, to work to eliminate such forms of tyrannical caprice from our Department of Justice. However, we shall not succeed in uprooting such bestialization of our national life, unless we address and correct the conditions which have made such abominations a present possibility.

Respecting the principles of reason, much of what I have set forth above will be generally accepted among scientific professionals; other features, depending upon the premises of a constructive geometry, will be debated. On the latter count, this report may be faulted as alien to a spirit of consensus. I suggest that that is no fault; it is only when the search for truth brings one into opposition to the terms of a general and easy agreement, that the spirit of true freedom is evoked. For that latter reason, I have written this report as I have done.