Columbus, cold fusion, and the new age of discovery

Five hundred years after Columbus's discovery, we are still faced with proving that the world is not flat, as Jonathan Tennenbaum explained to a quincentenary conference in Mexico.

The following presentation was given by Jonathan Tennenbaum to the May 18-22 founding conference of the Ibero-American Solidarity Movement, convened to celebrate the 500th anniversary of the evangelization of America, in Tlaxcala, Mexico. Tennenbaum, the director of the Fusion Energy Forum in Germany, has edited his presentation, originally titled "The Lessons of Cold Fusion: Down with Aristotle, Long Live the New Scientific Renaissance!" for publication.

In his work founding the science of physical economy, Gottfried Wilhelm Leibniz laid down the principle that the only durable form of a human society is one whose activities are centered on the development of science and technology. Such a society must bring forth scientific discoveries in an unending stream, like a fugue of Johann Sebastian Bach which never ends, but continually progresses to higher orders. And the activities of all men and women in such a society will revolve around and be illuminated by the process of scientific discovery, like the motion of the planets around the Sun. The key to such an ordering of human activity is an *Ars inveniendi,* an Art of Discovery, the principle of how to indefinitely continue the Great Fugue of scientific progress, whose mastery realizes our essential nature as *imago viva Dei*.

Fundamental scientific research—in the original sense of the search for truth concerning the lawful ordering of our universe—is the ultimate foundation of every sovereign nation. Fundamental research means, among other things, that nothing is believed on mere "authority" (foreign or domestic), but the basic theories and concepts of science are constantly examined and revised in light of crucial experiments.

It should be obvious, that the "Art of Discovery" is ultimately the central issue of politics. Here, for more than 2,000 years, the battle has been raging between two factions: those who follow the spirit of Aristotle's *Organon,* and those who follow Socrates. The method of Socrates is, in essence, what Leibniz meant by the *Ars inveniendi*. Aristotle's *Organon* claims to be an art of discovery, but is really a method for oligarchical rule over a zero-growth, bestialist society.

Modern science was made possible in the first place by the revolution against Aristotelianism which occurred under the Arab renaissance's Ibn Sina and especially by Cardinal Nicolaus of Cusa. But the battle was not completely won. The old donkey Aristotle survived and has since worked to smuggle himself back into the teaching and practice of science, gradually regaining the lost territory.

Today we find ourselves—in spite of the enormous increase in man's productive powers in the intervening 500 years—once more in an Aristotelian dark age. We are back in the age of donkeys; donkeys are everywhere—in the universities, in the schools, in the churches and the governments! But above all the donkey rules in science. Today, 500 years after Columbus demonstrated that the Earth is round, the most prestigious scientific organizations and publications in the United States and other nations, have come out in support of cultish doctrines of environmentalism, declaring, in effect, that the Earth is flat. The persecution of scientists working on cold fusion demonstrates that real science—the search for truth—has virtually become an underground activity.

So we stand at a point very much like the world before Columbus's voyages. Certain things must be set into motion now, to save mankind from the holocaust which triumphant Aristotelianism will otherwise bring upon us. We need a scientific renaissance. That is the problem I wish to address in my remarks.

It has been demonstrated, that the great European Renaissance associated with the work of Nicolaus of Cusa and Brunelleschi, is inseparable from the process which led to Columbus's voyages and the colonization of the New World. Neither could have existed without the other. So today, I maintain, the work of saving civilization will necessarily be organized around two essential tasks:

First, complete *reconstruction,* based on the most advanced technologies, of the *infrastructure basis for human life on this planet;*

Second, the *colonization of Mars.*

A few remarks should dispel any initial astonishment at this combination.

First note that the colonization of Mars is itself essentially a problem of *infrastructure.* To land a man on Mars is no great accomplishment—the U.S.A.'s NASA had originally planned such a landing for the year 1984, and all the essential technology had been prepared. That is easy: The real problem is not how to *visit* Mars, but how to *stay* there—how to *maintain a significant human population permanently* in a location some 60 million kilometers from the Earth's orbit—incomparably more distant and hostile than the worst deserts or the remotest mountain areas of the Earth.

The key in both cases is what Mr. Lyndon LaRouche has defined as the relative potential population density of the human species, which measures the power to maintain increasing densities of human population in any given natural circumstances. Most importantly, the basic technologies we shall require in order to maintain a world population growing to 12 billion and beyond in next century are the same as those needed to establish and maintain the first cities on the planet Mars. What are these technologies?

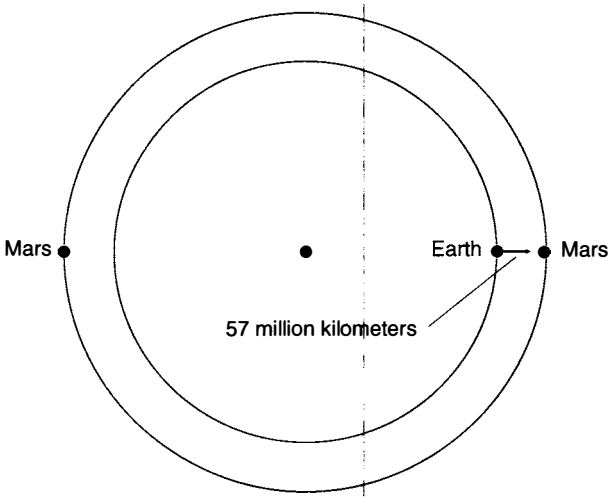
- first, advanced forms of nuclear fission energy, and nuclear fusion is a variety of forms;
- second, the application to mining and industrial processes of various types of directed energy beams—lasers from the infrared through to the X-ray range and beyond, highly coherent microwave and radiowave emissions, particle and plasma beams;
- third, the applications of directed energy and spectroscopic devices to biology and medicine;
- fourth, an improved mastery of the periodic system of elements and isotopes, including novel sorts of processes, intermediate in some sense between fission and fusion, whose feasibility is suggested by the discovery of "cold fusion."

Let us look briefly at these technologies from the standpoint of their role in the colonization of Mars, whence we can best appreciate the *lawful ordering of technological progress* which governs our tasks here on Earth.

The Moon-Mars Project

A comprehensive plan was worked out by Lyndon LaRouche in early 1987, and presented to the U.S. population in a half-hour television broadcast in 1988 entitled "The Woman on Mars." LaRouche's plan called for the establishment of a permanent manned colony on Mars by the year 2027 (see *EIR,* Aug. 4, 1989, "The Woman on Mars: A Film Scenario for TV"). The shortest straightline distance between the Earth and Mars is about 57 million kilometers (**Figure 1**). The maximum distance, when the two planets are on opposite sides of the Sun, is of the order of 250 million kilometers. Given this huge distance and the immense cost of transporting food and equipment from the Earth's region to Mars, it is obvious that any manned colony on Mars must be designed to have a high degree of self-sufficiency.

FIGURE 1
Comparison of the distances between Mars and Earth



The physical conditions on Mars are much more hostile to life than the worst deserts on the Earth. Human habitation is initially possible only under a protective dome supplied with an artificial atmosphere and climate; there, food production and a variety of maintenance and manufacturing operations must be carried out in addition to the main tasks of scientific research. We can estimate very roughly the amount of equipment required under such conditions to sustain an single Mars colonist. It is of the order of 10 times more than we would need for a semi-self-sufficient colony in the most isolated region of the Sahara. This, however, does not count the cost of transport of that equipment from the Earth.

The main functions of the Mars colony are defined by the task of constructing and servicing a network of astrophysical instruments and observatories in the general region of the Mars orbit. Optical data links will permit this network to function, in effect, as a single gigantic telescope whose diameter is that of the Mars orbit—460 million kilometers. The Mars colony must provide the essential manpower and logistical base for servicing much of that network. This will

require not hundreds, but thousands, and eventually tens of thousands, of scientists and technicians. If we add to this the number of persons required to sustain the Mars colony itself—its food and energy production, mining and industry, its health services (which will be crucial), plus the immense logistical apparatus for launching and landing of space vehicles, for their repair and maintenance and so forth—if we add all of this together, we see that the future Mars colony must rapidly reach 100,000 persons, and grow from there to half a million and more in the initial decades of colonization.

Counting the transport costs and necessary equipment on Mars, the investment per member of the future Mars colony will be very large. Correspondingly, the productivity of labor of that person—and of the overall work force that sustains the Mars colonization effort—must be very high. We will produce steel and titanium using controlled plasmas at temperatures of 10,000° or more; chemical processes will employ coherent electromagnetic radiation in order to trigger specific reactions and suppress others; machining will largely be done using lasers and particle beams. A much higher input of energy will be required to run these sorts of processes, energy which will have to be supplied by nuclear fusion. With these kinds of technologies, a single worker on Mars will have a higher productive power in the year 2050 than the entire European labor force toward the end of last century.

Our Moon, with its weak gravity and its relative proximity to the Earth—"only" 380,000 kilometers away—provides the ideal "space port" for interplanetary operations. The industrialization of the Moon gives us the possibility of producing *on the Moon* the main bulk of space transport systems required for the voyage to Mars and the equipment required to set up the colony. The technologies used in Apollo were adequate for a few explorative Moon landings, but are far too costly and inefficient to be the basis for developing the Moon as a space port and industrial base. The solution exists, however, in the form of "space planes" such as the Sänger space plane now being developed in Germany.

While it is feasible to use chemical fuels for the short trip from Earth to Earth orbit, we absolutely require more dense power sources for the transport systems for operation between Earth orbit and Moon orbit. Why? **Figure 2** compares the energy density of chemical and nuclear fuels, the energy-flux densities of chemical and nuclear power sources and the exhaust velocities attainable by propulsion systems based on these sources. These parameters determine the attainable fuel-to-payload ratio and other key characteristics of a space transport system.

The fuel-to-weight ratio of chemical propulsion is low. To place one ton of payload into Earth orbit, we must burn up more than nine tons of fuel! That is permissible if the payload is passengers or extremely valuable technology; but it is monstrously inefficient if we want to carry up large amounts of chemical fuels to supply Earth-Moon or interplanetary spacecraft. Isn't it much better to transport enriched uranium or deuterium-tritium fuels, which provide a million times more energy per unit weight? Thinking about this, some of us might understand better why nuclear energy is crucial to us also here on Earth!

FIGURE 2
Chemical versus nuclear energies

Energy per kg of fuel Combustion	Fuel	Energy
Chemical combustion	H_2/O_2	13 MJ
Fission	Uranium	65×10^{26} MJ
Fusion	Deuterium-Tritium	330×10^{6} MJ
Energy-flux densities		
Chemical combustion		1-10 MW/m^2
Fission		10-100 MW/m^2
Fusion		10-100,000 MW/m^2
Escape velocities for various fuels		
Chemical		3,000 m/s
Fission		50,000 m/s
Fusion		100,000,000 m/s

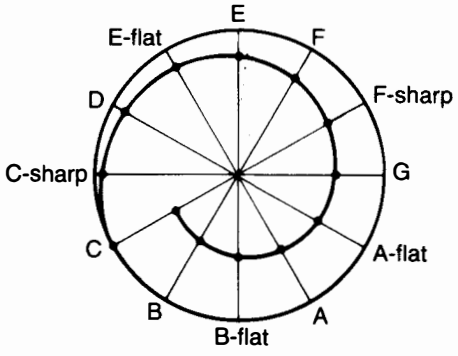
A first-generation fission propulsion system was already developed by NASA for the Mars mission which was originally scheduled for 1984. This type of system can be applied to transport between various Earth orbits and Moon orbits, and also for low-velocity transport of materials to Mars. But to transport large numbers of passengers to Mars, nuclear fission technology will not be adequate. We know from long-term missions by the Russians that long periods of weightlessness can have dangerous, debilitating effects. In addition we must consider risks of high radiation doses. Finally, maintaining passengers during a long flight—many times longer than Columbus took to reach America—requires bringing along large quantities of supplies.

These kinds of considerations dictate the need for transport systems which can bring us to Mars in a few days. To do this, we must reach very high velocities, of the order of 1,000 kilometers per second. The energy densities required for suitable propulsion systems are far beyond what we can generate with fission power. There is only one technology within reach today—nuclear fusion.

For the period of establishment of a first city on Mars, LaRouche calculated requirements for a fleet of large interplanetary vehicles. These vehicles would be constructed largely from components manufactured on the Moon and assembled at a suitable orbital location. The fusion engines of a single such ship will generate a power comparable in order of magnitude to the total power production of the entire world economy today! Impossible? Not at all—that is the potential inherent in fusion technology.

FIGURE 3a

Frequencies for the notes of the well-tempered scale



Harmonic ordering of technological progress

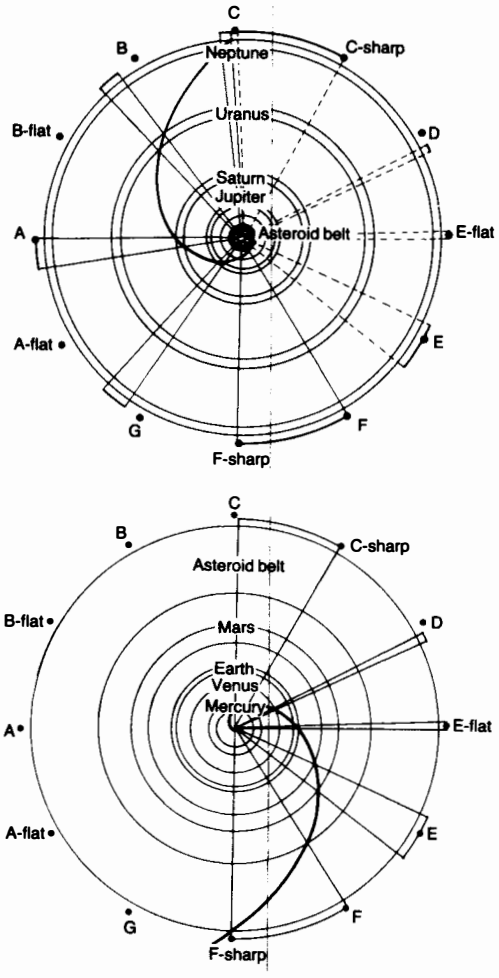
Most people nowadays would ask: Why are you proposing to make such a fantastic effort to colonize Mars, when we have so many urgent tasks here on Earth? Christopher Columbus, if he were here, would certainly have something to say about that. First, can we do it? Well, look at this world of 6 billion people. Look at what could be mobilized, after we get rid of the insane policies of the International Monetary Fund, of Kissinger, and Bush. Look at the what the U.S. could do under a LaRouche administration. Look at the technological capabilities of western Europe and Japan. Add to western Europe the highly qualified labor force in eastern Europe, which we will mobilize with the Productive Triangle (see *EIR* Feb. 2, 1989, "Paris-Berlin-Vienna Triangle: Locomotive of the World Economy"). Add in the vast aerospace capability and science capability of the former Soviet Union. Add India, already a technological power. And above all, look at an integrated Ibero-America, at the kinds of capabilities which Argentina and Brazil have demonstrated. Add in rapidly growing capabilities all over the developing sector under the condition of a New World Economic Order.

The total expenditure involved will amount to less than 1% of the necessary investment into modern infrastructure development here on Earth. But that 1% or less of investment directed toward Mars will have a relatively enormous beneficial effect on everything we have to do on Earth. The economic significance of Mars for the Earth begins to come into focus when we examine *how technology is developed.* Technology is not created by the "free market." Nor does it spontaneously develop just because there is a need for it. *The generation of technology is a lawfully ordered process,* as Lyndon LaRouche's work on physical economy has demonstrated in the most comprehensive manner.

Let me abbreviate the discussion by presenting to you three figures. The first (**Figure 3b**) presents the harmonic

FIGURE 3b

The harmonic ordering of the planetary orbits

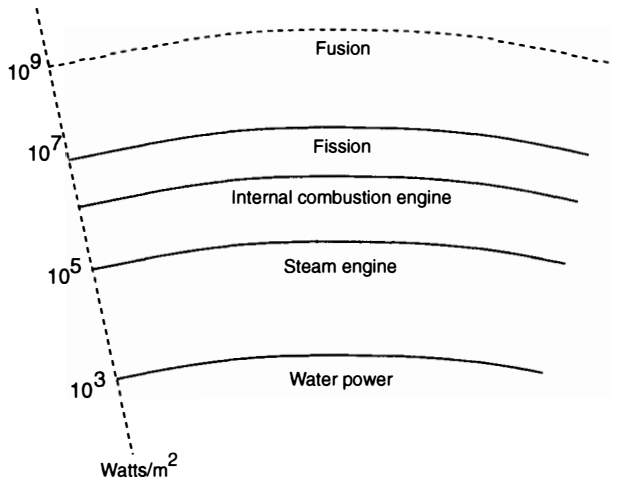


ordering of the planetary orbits according to the self-similar, logarithmic spiral principle. The use of the names of musical notes to indicate angular displacement along the spiral reflects the fact that the tone values in the well-tempered system of tuning are also ordered by a logarithmic-spiral principle (**Figure 3a**). The next graph (**Figure 4**) plots the historical development of power-producing machines as a function of their energy-flux density. The last graph, **Figure 5,** shows the development of coherent sources of electromagnetic radiation, plotted against the characteristic length scales associated with molecular, atomic, and nuclear and subnuclear levels of organization of matter.

I indicated that the extension of human activities, first, into Earth orbit, then into the industrialization of the Moon, and finally to Mars colonization necessarily required "quantum jumps" in the energy density of the technology employed

FIGURE 4

Development of power-producing machines as a function of their energy-flux densities



for propulsion. Observe that the fusion propulsion technologies which permit us to reach Mars within the acceptable period of a few days, will not allow us to do the same for the region of Jupiter and beyond, where the distances are an order of magnitude larger and entirely new sorts of difficulties arise. The singular region of the asteroid belt (between F and F-sharp) seems to mark a boundary where we must go to a higher level of technology, beyond ordinary fusion as presently known. This circumstance reflects a lawful relationship between the ordering of technology and the ordering of the solar system.

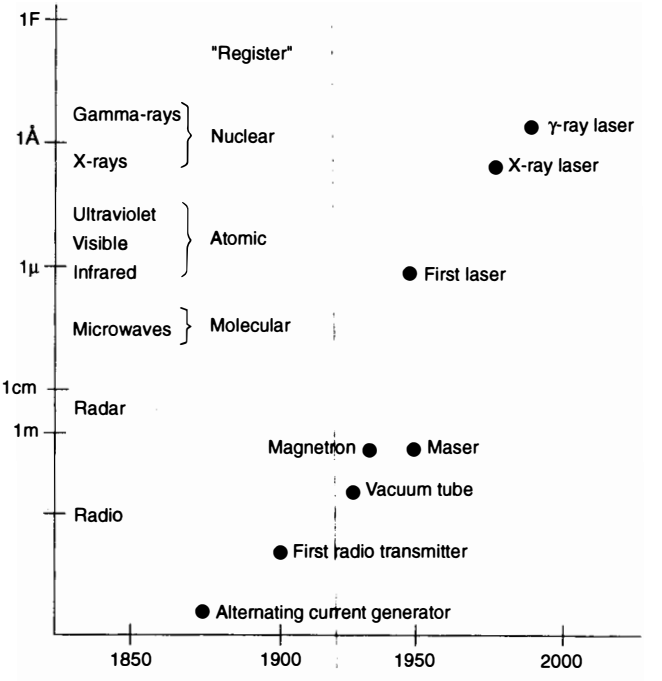
Figures 2 and 4 indicate a relationship between increases in energy-flux density as technology develops, and the mastery of ever-shorter wavelengths of coherent radiation, whereby we move progressively from molecular, to atomic and subatomic levels of action. Observe the *reciprocal* relationship involved here: In order to extend human activity to ever-*larger* concentric regions of our solar system, we must go toward higher energy-flux densities of technology, which in turn are achieved through the mastery of physical action on ever-*smaller* length scales! Thus, we could not colonize Mars without nuclear fusion, i.e., without technological mastery of processes on the subatomic scale.

All of this should suggest to us the reason why the Mars project is uniquely suited as a "technology driver" for the world economy as a whole. It is because the task of colonizing Mars brings together in an organic, coherent unity every single branch of science and technology—from fundamental physics to biology and medicine—and pushes all these areas together into a "quantum jump" onto a higher level. For that reason, for every penny invested, the Mars project brings relatively by far the greatest effect in terms of development of

FIGURE 5

Development of coherent sources of electromagnetic radiation

(Scale of electromagnetic radiation)



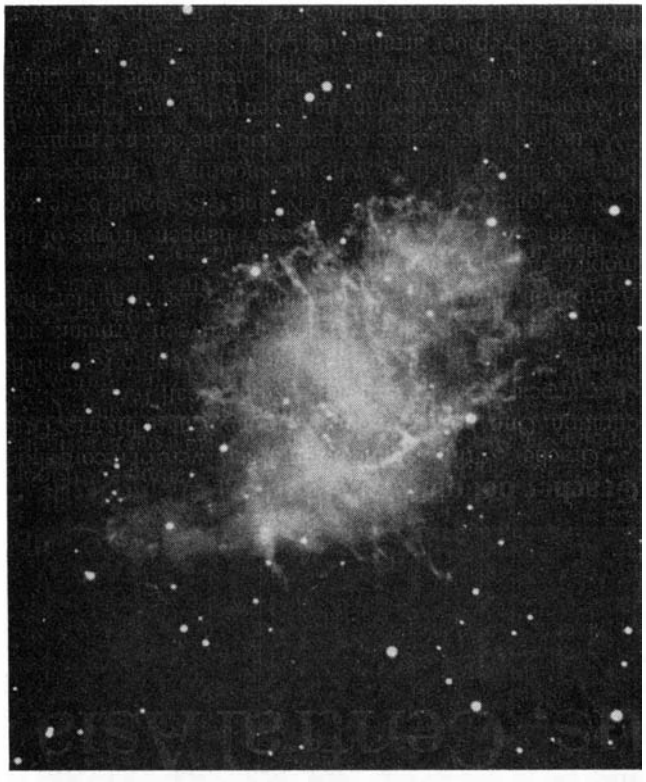
new, urgently required technologies for the world economy, compared to any other investment.

There is a deeper level of the matter, however. I shall simply raise it as a question leading into the subjective domain—subject of the second part of my remarks. Let us imagine we are living in the year 2030 and that the image I show you now [of the Crab Nebula, **Figure 6**] is one of the first to be produced by the new astrophysical network set up and managed by the Mars colonists (actually the picture you are looking at comes from an Earth telescope). Imagine that we are looking at something that has never been seen before—a strange, anomalous object. What attitude should we take toward it?

Newton the magician

For thousands of years, oligarchical power has rested on magic—on the art of inventing and propagating lies and mythical beliefs. Few popular myths have been more useful to the oligarchy in recent times than the belief that modern natural science represents "objective knowledge," whose authority derives from its supposedly rigorous independence from the "subjective" domain of religious and philosophical thought. So today, students are taught to believe that natural science has already come very close to "the objective truth" concerning such profound matters as the "secret of life" and the "ultimate building-blocks of matter." Leading

FIGURE 6
Crab Nebula in Taurus



spokesmen of the oligarchy are very clear on the fact that "objective science" is a covert form of religious cult. Let us merely quote the famous Cambridge University economist John Maynard Keynes concerning Isaac Newton. Keynes, himself an accomplished magician, spoke with amusement about the successful fraud his predecessors had accomplished in promoting Sir Isaac Newton as the model for modern science. In a famous speech in 1946, Keynes said:

"In the 18th century and since, Newton came to be thought of as the first and greatest of the modern age of scientists, a rationalist who taught us to think along the lines of cold and uncolored reason. I do not see him in this light. Newton was not the first of the age of reason. He was the last of the magicians, the last of the Babylonians and Sumerians. . . .

"In vulgar modern terms Newton was profoundly neurotic of a not unfamiliar type, but—I should say from the records—a most extreme example. His deepest instincts were occult, esoteric, semantic—with profound shrinking from the world, a paralyzing fear of exposing his thoughts, his beliefs, his discoveries in all nakedness to the inspection and criticism of the world. . . . Like all of his type he was wholly aloof from women. . . .

"Why do I call him a magician? Because he looked on the whole universe and all that is in it as a riddle, as a secret which could be read by applying pure thought to certain evidence, certain mystic clues which God had laid about the world to allow a sort of philosopher's treasure hunt to the esoteric brotherhood. He believed that these clues were to be found partly in the evidence of the heavens and in the constitution of the elements (and that is what gives the false suggestion of his being an experimental philosopher), but also partly in certain papers and traditions handed down by the brethren in an unbroken chain back to the original cryptic revelation in Babylonia. . . ."

Should we believe Keynes, who was himself, as we said, a magician, or we should say "mathemagician" (*matemágo*) in the time-worn British tradition of Malthus and Adam Smith's "invisible hand"? Fortunately, we need not take Keynes's word concerning the cultish origins of Newton's physics. Already Gottfried Wilhelm Leibniz had demonstrated this based on the internal evidence of Newton's own published scientific writings.

Fallacy of 'complete' mathematical physics

Newton, like the modern "Big Bang" cosmologists, presented his physics as a comprehensive theory of the universe as a whole. He proposed that his mathematical laws were universal for all regions of space and time.

But Newton himself noted that the universe described by his laws would be prone to various kinds of catastrophes. Firstly, all the matter would tend to fall together in a great clump. God would have to intervene from time to time to prevent this. So Newton wrote in his *Principia,* "lest the systems of the fixed stars should, by their gravity, fall on each other, God hath placed those systems at immense distances from each other." This would require God to intervene, as Leibniz remarked jokingly, and "wind up his clock" which had run down under its own law of entropy. Also Newton's system is afflicted with the so-called "three-body problem," which points to a potentially fatal instability in the solar system. Now, are the sorts of paradoxes built into Newton's universe caused by some special defect in Newton's mathematics—such as might be remedied by later improvements—or are they intrinsic to *any* formal mathematical theory which claims to completeness in representing the laws of nature?

Let me make what at first glance might appear as a mere analogy. Consider a straight line which is tangent to a circle at some point (**Figure 7**). Near that point, the line appears to be an excellent approximation. But if we follow the track of the line, it diverges out into empty space while the circle curves around! The only way can get back to the circle, to restore approximation, is by "breaking" the line at some point and forming a polygon. Observe, however, that nothing within the internal universe of the straight line tells it when to make the vertex and change direction; this correction can

FIGURE 7
The problem of linearity

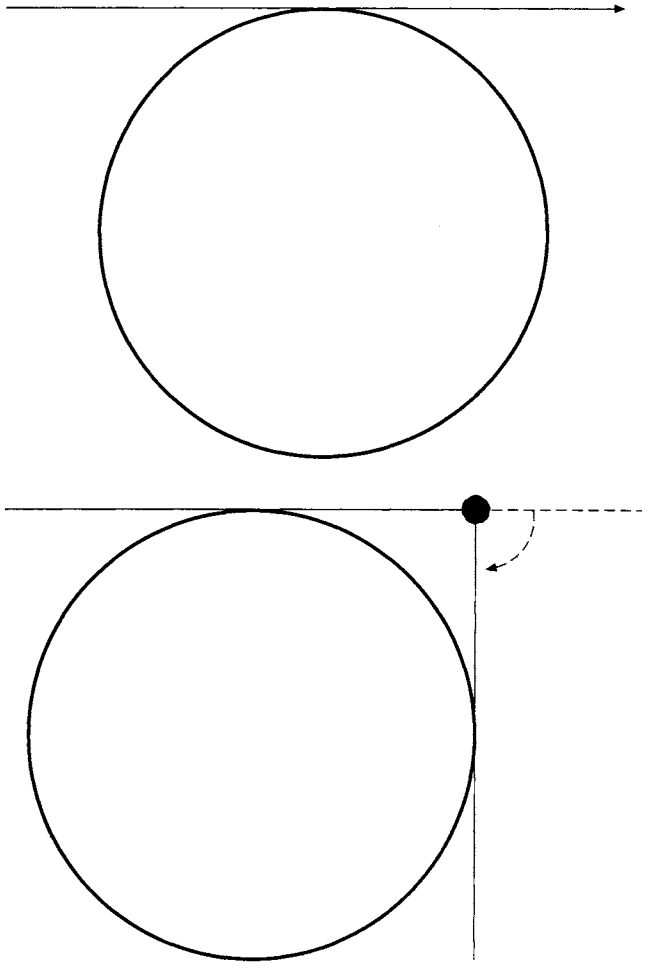
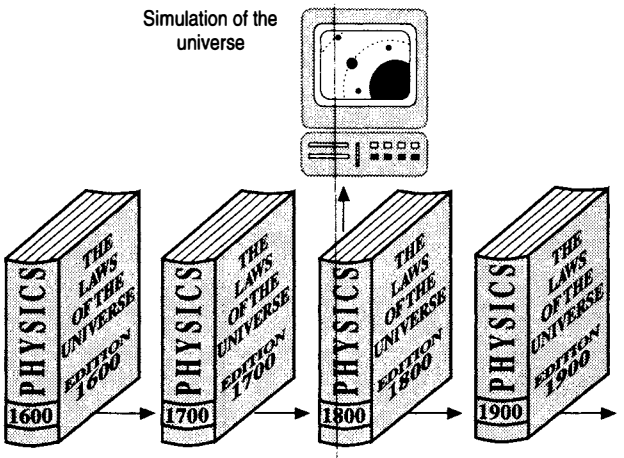


FIGURE 8
The problem of 'simulating' the universe from existing knowledge



only come as an anomaly created by a *deus ex machina* from outside the flat world of the line. Note also, that if we attempt to approximate the circle more closely, by increasing the number of such vertices, then the number and density of such anomalies increases.

Let us look at the history of physics. Let us make the following simplification. Imagine that every century, the entirety of existing scientific knowledge concerning the physical universe were to be codified in a single textbook. We get a series of textbooks, extending backward into ancient times and forward into the future (**Figure 8**):

. . .T(1600), T(1700), T(1800), T(1900), T(2000), . . .

Now let us suppose that these textbooks are composed in the formal mathematical manner on the model of Newton's *Principia*. Implicitly, we could for each such textbook construct a computer program which would simulate the whole universe according to the equations contained in the book. This is exactly what is done, in principle, with the cosmological models used in present-day debates concerning the alleged "Big Bang." Firstly, we observe that the computer programs are prone to certain kinds of behavior: If we run them sufficiently long, either in the forward or backward direction we either encounter a singularity, where the program has to stop because some parameter becomes zero or infinite (this is the sort of behavior typified by the "Big Bang") or the program goes into a repeating loop (which corresponds to so-called cyclic cosmological models) or, in some cases, the computer will display nonsensical, chaotic behavior.

Now, no sane person would confuse such typical computer behavior with the real universe. Rather one should suspect, that such features of the hypothetical universes represent, as we suggested before, *artifacts* inherent in the nature of the computer procedures used to generate them.

But, we must also consider the implications of the progression of knowledge which gave us the series of textbooks. The circumstances of this progression demonstrate, that no particular state of knowledge corresponds to the "absolute truth" concerning the laws of the universe. For example, between the state of knowledge in 1800 and in 1900 fundamental scientific discoveries were made, which completely changed even the formal features of mathematical physics. This process of discovery was entirely *external* to the formal system of knowledge embodied in T(1800): That is, nothing in T(1800) could have allowed us to deduce, logically, the discoveries which led to the next state of knowledge T(1900), and then to T(2000) and so on. What does that mean? Examine the simulated universe according to textbook T(1800). We have just seen that this hypothetical universe does not

contain certain real physical events: It does not contain *the scientific discoveries which occurred between 1800 and 1900!* Each hypothetical universe omits the process of creative discovery which leads "out" of that universe into the next one!

Are scientific discoveries physical events? In any sane physics they must be, because they are also *causes* of potentially very large changes in the universe. Why? Because the process of scientific discovery is the essential cause for the continual *increase of man's power over nature*.

The result of this is, that we are obliged to admit that human reason—the *subjective* domain of human creative reason—is a powerful *physical force* in the universe, a *force whose effect is potentially larger than any given physical quantity*. But this force cannot be subsumed by any set of mathematical equations. Why? Because the process of scientific discovery, upon which the force of human action on nature is based, successively overthrows any given form of mathematical physics. Therefore, any physics which ignores the process of scientific discovery, the process which generates the transformations T(1500)→T(1600), T(1600)→T(1700) and so forth, is axiomatically defective.

What are we doing, then, if we insist that physical reality must be in the form which Newton represented it to be, as today's cosmologists do with their "Big Bang" models? What we get when we do this is a species of *cult belief, deification of a fixed state of knowledge* or *worship of the negation of creative human reason*. It is computer worship!

The anomaly of 'cold fusion'

Without any doubt, "cold fusion" is one of the most revolutionary experimental discoveries of this century—this much we can say for sure, even though we don't know exactly what it is that has been discovered! Cold fusion is an *anomaly*—a paradoxical event, which seems to contradict much of what physicists *thought* they knew about the atomic nucleus and the behavior of matter in general. In terms of those expectations, the process of cold fusion confronts us with an apparently *impossible* combination of characteristics: A nuclear process appears to occur at room temperature, which physicists thought only could happen at temperatures of a billion degrees; the heat generated is a million times larger than what nuclear physics predicts on the basis of observed emission of neutrons; in apparently completely identical pieces of palladium, cold fusion is found to occur in one, and not in the other. It is as if nature were deliberately playing a joke on the nuclear physicists, laughing and making fun of them.

For those who would like physics to become a perfect logical-deductive system of the sort Newton attempted to construct, the emergence of a powerful anomaly can be an embarrassing or even terrifying experience. Our science textbooks are often written as if anomalies didn't exist, or at most only played a role in the past; they try to present today's knowledge as a polished facade, keeping the really interesting problems—the anomalies—carefully concealed from view. And yet, if we look at the history of science going back thousands of years, progress has always lived on anomalies.

Anomalies and paradoxes play in the progress of science exactly the same role as contrapuntal dissonances in great music. Each wave of anomalies is "resolved" by the invention of new scientific hypotheses, under the condition that humanity's power of existence—its relative potential population density—is increased. The new hypotheses, incorporated as a new state of scientific knowledge, push us forward toward the discovery of new anomalies.

Nothing could be more revealing of the New Dark Age in science today than the response of the so-called scientific community to cold fusion: "It doesn't exist! It doesn't exist! It can't exist, it's an error, it's a fraud; don't talk about it, or you will lose your job!"

Cold fusion was not discovered by accident. Its chief discoverer, Martin Fleischmann, likes to call himself a "scientific archeologist." He studied the history of science, and particularly of his special field, electrochemistry, and located the anomalies—especially anomalies which tended to be ignored or disregarded for one reason or another. He was also interested in those reasons: What are the—often unconscious—assumptions which cause scientists to overlook what should be obvious or at least very suggestive?

Fleischmann seemed also aware that much of nuclear physics and elementary particle physics nowadays has become a kind of bluff, a situation reminding one of the famous story about "the emperor's new clothes." The fancy mathematical apparatus, the formidable particle accelerators and other elaborate experimental equipment employed in these fields, helped build up the impression, that physicists had figured out nearly everything—when in fact they know next to nothing! We could call it "macho physics."

'Macho physics'

There is an amusing background to this, which is relevant to many of the points I am trying to emphasize here. The single most important contribution from the field of nuclear physics up to now, in terms of its impact on mankind as a whole, has been the development of controlled nuclear fission—the process used in today's nuclear power plants. Now at the time of its discovery in late 1938, fission was regarded as *impossible* by the leading theoretical physicists of the day.

Already in 1934, Enrico Fermi had generated fission reactions. But, blinded by the prevailing theory, Fermi misinterpreted the experiment. The famous German chemist Ida Noddack pointed out Fermi's mistake, and proposed for the first time in letters and in a scientific article published in the same year, that the bombardment of uranium by neutrons could lead to the splitting of the nucleus into large fragments: fission!

Fermi and the other leading nuclear physicists treated Ida Noddack's hypothesis the same way "cold fusion" is treated today: They ignored it or dismissed it as obvious nonsense. Otto Hahn was one of those who repeatedly ridiculed Noddack. Hahn followed the erroneous lead of Fermi in a series of experimental investigations stretching over more than three years. The results of his experiments became more and more bizarre, until finally he was forced to realize the mistake he, Fermi, and others had made. The "impossible" fission of uranium had occurred! That is the "discovery" for which Otto Hahn received the Nobel Prize. Interestingly, Hahn neglected to mention Ida Noddack in the report of his results. He also failed to give any credit to his chief collaborator, Lisa Meitner, who had originally proposed the series of experiments leading to the demonstration of fission, but who was forced to flee Germany three months before Hahn's embarrassing discovery. "Macho physics!"

Let me add a comment to this in parenthesis: If we follow the history of nuclear fission back to the original work of Marie Curie on the radioactivity of uranium, we find that women scientists played a crucial role at nearly every point. I like to say—because it makes the environmentalists very upset—that nuclear energy is the feminine technology! Let us briefly honor some of these women: Marie Curie, her daughter Irène Curie, Ida Noddack, Lisa Meitner, Marietta Blau and Herta Wambacher, Marguerite Perey, Leona Marshall, Marie Goeppert-Meyer, Elisabeth Rona, Berta Karlik, and many more.

What is important is not the mere fact that Ida Noddack was correct in her hypothesis, while the macho nuclear physicists were wrong. What is important is the reason that Ida Noddack put forward her hypothesis in contradiction to the prevailing theories of the physicists.

The centerpiece of Noddack's work was the periodic system of elements, and a way of thinking about that system which actually goes back long before Mendeleyev, to Johannes Kepler. In modern language, Kepler asserted that physical space-time has a characteristic geometry, which shapes every process within it—from the microscopic organization of matter to the astrophysical domain.

Within Kepler's constructions there is a "missing orbit" located between the orbits of Mars and Jupiter; Kepler hinted that this would be a region of instability, an anomalous region for the system as a whole. And in fact this is where, two centuries later, the first fragments of what became known as the asteroid belt were discovered; these represent either the remains of a planet which was torn apart, or material which could not condense into a planet because of the unstable nature of the orbit itself. Incidentally, the asteroid belt corresponds exactly, in the universal geometry underlying both the organization of the solar system *and* the classical system of music, to the interval between F and F-sharp, which is the crucial area of transition in music.

Kepler himself emphasized that the microscopic states of matter must be organized on the same principles as the solar system. This hypothesis of Kepler (and earlier, in more rudimentary form, of Pythagoras and Plato) was absorbed into the tradition which flowed into modern chemistry and into the work of Mendeleyev in particular. With his invention of the periodic system—the direct equivalent in chemistry to Kepler's harmonic ordering of the planetary orbits—Mendeleyev was able to predict the properties of many chemical elements *which had not yet been discovered*.

This is where Marie Curie's work came in, focusing on the anomalies of the periodic system, which led to her discovery of the radioactive elements radium and polonium. Such unstable positions within the system of elements obviously correspond to the asteroid belt in Kepler's solar system. The problem became to elaborate a deeper level of harmonic ordering, underlying Mendeleyev's system.

This is where Ida Noddack and her husband Walther concentrated much of their work. They summed up this standpoint in the following words:

"If we chose any material system, sufficiently large and sufficiently free from material differentiation, then we always arrive at the same percentage distribution of the chemical elements." The Noddacks continue with the key sentence: "This distribution function is a universal function of matter."

The point is, as I understand it, the following: We must reject the idea of *simple matter,* of an "elementary particle" considered as something more simple than so-called composite matter. Instead, following Mendeleyev and Noddack (and before them, Kepler) we should regard only the *periodic system as a whole* as elementary. More fundamental still is *the "universal function of matter" which,* according to their implied conception, *continuously generates the system of elements*. Once we have grasped this, we begin to understand why Ida Noddack expected that an enormous variety of nuclear processes would be discovered—not only fusion and fission as we know them today—out of which chemical elements and isotopes are continuously synthesized.

This is, I think, the proper standpoint from which to locate the anomaly of "cold fusion."

Once more: Aristotelianism and 'macho physics'

Unfortunately, nuclear physics has essentially abandoned the line of approach defined by Kepler, Mendeleyev, Curie, Noddack. Instead, it degenerated in the post-1930s period into the "macho" mode exemplified by the so-called scientific community's rejection of cold fusion. This "macho" mentality in science is the same thing as Aristotelianism.

The essence of Aristotelianism is the belief that human knowledge develops linearly, as a gradual accumulation of empirical facts organized according to a relatively fixed system of definitions and axioms. Today's science student is typically led to believe that the goal of science is to *eliminate*

all anomalies. According to that view, science is gradually approaching a hypothetical final state where no more anomalies exist and every event in nature can (in principle) be explained. Just as a hyperbola comes closer and closer to its asymptote, without ever touching it, so also our knowledge—as exemplified by the hypothetical series of textbooks discussed earlier—supposedly comes ever closer to an assumed "objective reality," to "objective truth."

But human knowledge does not converge! Our hypothetical series of textbooks does not converge on any ultimate "true" set of laws of nature, but tends to *diverge*, in the sense that the gap between any two successive states of knowledge, a century apart, will tend to grow (Figure 4). Far from eliminating anomalies, in healthy periods of progress, every breakthrough in scientific *knowledge* leads to a more intense proliferation of *anomalies*.

In fact, scientific discoveries lead to the emergence of new technologies which increase the productive powers of labor, and accelerate the growth of the potential population density of the human species. The effect of that acceleration, as intensified and extended human activity in the universe, and through the propagation of new technologies and development of culture, goes hand in hand with the increase in what we could generally call the *resolving power* of the human activity. As technology progresses, the scientific experimenter (and the human race in general) becomes able to distinguish and potentially to generate an increasing density of *singularities*—that is, distinct changes—*in every given region of physical space-time*.

But: what we are "seeing" in effect with this increasing resolving power is not a supposedly "objective" universe outside of ourselves; what we are observing are singularities of the universe in which our own activity is an irreducible, increasingly dominant feature *which is implicitly efficient at all locations*, even those which appear to be "millions of light-years" away!

In this process, the textbook knowledge of today will be gradually undermined by an accumulation of anomalies. Entirely new basis concepts are introduced, and old ideas are given up and fall into obscurity. So the knowledge of today will be appear more and more incorrect, or even wildly false, to future generations. Does that mean that truth is inaccessible to us? Or perhaps that truth does not exist? Certainly not!

For although present-day knowledge has no claim to truth, it can still be a *necessary step* in a *truthful process* of scientific progress. The *truth* lies therefore not in any particular state of knowledge—which is going to be overthrown by anomalies sooner or later—but in the *change*, in the movement upward through a lawful process of development.

Let us take a closer look at this change, this motion of creative discovery, whose lawful ordering is the subject to which Lyndon LaRouche has devoted his life's work. LaRouche demonstrated that the quality of emotion which accompanies fundamental scientific discovery is none other than *agapē*, or charity.

Let us throw away the textbooks, and with them the idea of an objective universe. Let us recognize that the momentary states of knowledge are only occasional chords in the ongoing Great Fugue of scientific progress. Such knowledge is as nothing: Substance—the substance of the universe—is located in the change, in the creative motion itself.

What is crucial, is that each moment of fundamental discovery carried within itself the *cause* of all future discoveries. All moments of fundamental discovery stand in immediate relationship to each other, throughout all of history, past, present and future. And, LaRouche emphasizes, these moments are ordered as transfinites.

Hence, if we wish to master the art of discovery, the *Ars inveniendi*, we must seek to relive the crucial moments of discovery of our predecessors. We must get to know Plato and Augustine, Nicolaus of Cusa, Kepler, and Leibniz as personal friends. They live on, so to speak, in our own creative activity—however minor and insignificant it might seem to be—as so also future creative minds are born before they are born, in possibility, within that same activity.

So let us turn our eyes upward to the heavens, to the stars. No animal does that, only human beings do that. Let us look at this wondrous image, this anomaly, this metaphor. What does this image [of the Crab Nebula] tell us today? What will it say to our children, some of whom will study the heavens from Mars? And what will it mean to future generations who might populate other stars and galaxies?

There is no objective universe, but only a continuing process of creation, of which we are a part and above all an instrument. We are necessary to this process, because the process of generation, assimilation and propagation of scientific progress occurs only through acts of individual human minds.

So Nicolaus of Cusa wrote in his *Idiota de Mente*, that we cannot know God by abstracting or separating our minds from everything corporeal. On the contrary, the visible universe has a purpose, and through our active participation in ongoing creation, we may find God.

In his encyclical *Laborem Exercens*, Pope John Paul II emphasized God's command to man as expressed in Genesis: to be fruitful and multiply, and subdue the Earth and exert dominion over it; and the Pope added that in this passage, the term "Earth" should be understood to mean the entire visible universe, which we are constantly developing and expanding. And this is not an arbitrary religious doctrine but a universal truth, demonstrated by all of human existence up to now. This is the truth, this is the spirit which inspired the discovery and evangelization of the New World. And the evangelization succeeded because it drew its methodological strength from this conception of man and the universe. So, today, that same necessary action we must take to crush the satanic enemies of mankind, carries us upward to Mars and toward a new Golden Renaissance.