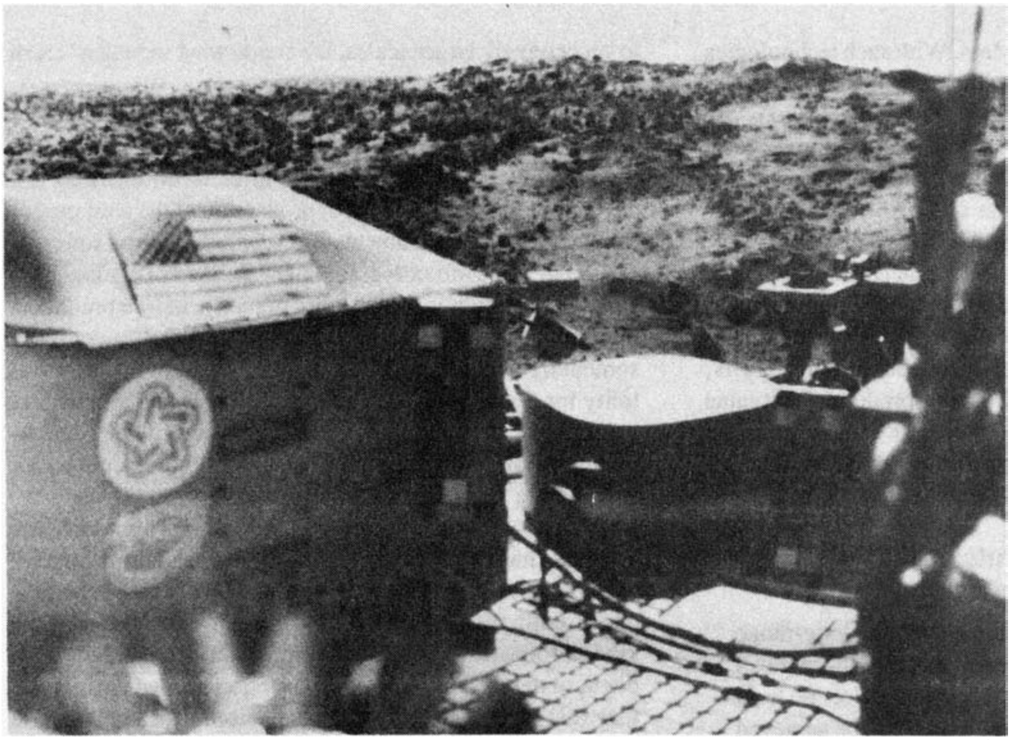
Private initiative for colonizing the Moon and Mars

The following memorandum, titled "International Private Initiative on Behalf of the Successive Colonization of the Moon and Mars," elaborates a proposal announced by Lyndon H. LaRouche, Jr. during the recent (Reston, Virginia: June 15-16) Krafft Ehricke Memorial Conference of the Schiller Institute and the Fusion Energy Foundation. In his June 15th keynote address, LaRouche argued for the adoption of a Moon-Mars colonization project as the guiding mission-assignment for implementation of the SDI and its "spill overs." During the discussion period, he proposed that this approach to fostering of scientific progress be spearheaded by an international private initiative. For further background, see the transcript of the keynote address.[1]

It can be safely estimated, that during the coming fifty years or longer, all scientific and technological progress will be shaped primarily by the interrelationship among three presently well-defined frontiers of scientific research: 1) Controlled thermonuclear fusion, 2) coherently directed electromagnetic impulses, and 3) optical biophysics. Advances in other classifications of technological progress will be indispensable auxiliaries to the application of the three primary classes of developments, but the overall technological progress of mankind will be directed and bounded by the advances effected in these three cited, primary classifications.

The implications of these primary technologies are shown most immediately, most clearly, and most exhaustively, by examining the interdependent role all three perform together in interplanetary colonization. Thermonuclear fusion is the preferred mode for powered space-flight, and is absolutely indispensable for maintaining a permanent colony on Mars. Such coherently directed energy-modes as lasers and particle beams, powered by thermonuclear fusion, are indispensable to constructing and maintaining a permanent colony on that planet. So-called biotechnology is but an indispensable auxiliary for the optical biophysics needed for such colonization. Interplanetary colonization draws upon virtually all of the potentialities of these interrelated technologies, as no other foreseeable choice of application does so to approximately the same degree.



NASA

Humanity's next "mission-assignment": the colonization of the Moon and Mars. With the technologies developed for Mars, the cultivation of the Sahara and Gobi deserts on Earth become relatively child's play. Shown here is NASA's Viking 1, on Mars in 1976.

Therefore, the best way to achieve breakthroughs in each and all of the kinds of applications of technological progress over the coming fifty years or so, is to create a mission-oriented, crash-program task-force, assigned to developing all of the technologies required for beginning the permanent colonization of Mars by some preassigned target-date, such as 2010 A.D. In other words, develop all of the technologies required for the Strategic Defense Initiative, as a by-product of a Moon-Mars-colonization mission-assignment. This applies to not only the SDI, but to every other area of application. In sum, there is no technological breakthrough likely during more than fifty years ahead, the which is not best obtained as a by-product of such a Moon-Mars mission-assignment.

We propose, therefore, to put all of our "science-eggs" in one "basket." There is no advancement in the general level of technology which is not subsumed by the Moon-Mars mission-assignment? Very well, for a period of perhaps the next twenty years, let us write "Moon-Mars-colonization mission-assignment" wherever present custom would have us write the words "science" or "technological progress." Every important breakthrough accomplished during that period, or longer, will be either implicitly required for accomplishment of the mission-assignment, or will occur as a by-product of that mission-assignment. Once all the technology needed for a permanent colonization of Mars is completed, perhaps twenty years ahead, we shall then shift the mission-assignment, to a next, more ambitious task to go into construction during the middle of the next century, such as, perhaps, the "earthforming" of the moon Titan.

Let us henceforth define scientific progress as an ordered succession of ever-more-ambitious grand-scale mission-assignments. Let "science" be defined in such a task-oriented way during each generation. Let "science" signify both the current grand-scale crash-program mission-assignment in progress and the work of defining the successor to such a mission-assignment.

This is not an altogether novel proposal. The emergence of modern European science, from the work of Nikolaus of Cusa during the middle of the fifteenth century, until France's Jean-Baptiste Colbert assembled such scientists as Huygens and Leibniz to design the industrial revolution during the 1670s, implicitly adopted geometry and astrophysics as the mission-assignment responsible for all scientific and related progress during those two centuries. The next century and a half, into the work of the 1794-1814 Ecole Polytechnique, on coal-fired forms of steam-power for machinery, had the mission-assignment of creating the industrial revolution. Chemistry and electrodynamics, the growing infants of the eighteenth century, became the mission-assignment of nineteenth-century scientific progress. The creation of an economy based upon submolecular physics, the child of nineteenth-century progress in electrodynamics and chemistry, emerged as the mission-assignment of the twentieth century.

Today, we can foresee the clear possibility that colonies totalling millions of persons will exist on Mars by the middle of the coming century. With sufficient density of energy per capita, with lasers and similar devices as tools, and with aid of optical biophysics, millions of colonists will live, work, and produce trees and foodstuffs, in artificial environments in the cities and greenhouses of Mars. With such technologies developed for Mars, the colonization of the Sahara and Gobi on Earth become relatively child's play. That obvious example, illustrates the general functional relationship between the Moon-Mars mission-assignment and the by-products supplied to solve problems of life on Earth. That is clearly humanity's next mission-assignment.

There is no possibility for the Strategic Defense Initiative which is not implicitly subsumed by the Moon-Mars mission-assignment. There is no advancement in agricultural or industrial technology, perhaps during the coming fifty years, which is not implicitly subsumed as a by-product of that same mission-assignment. That latter fact, is key to our proposal that the Moon-Mars-colonization mission-assignment be undertaken as an international private initiative.

The practicality of a private initiative

In 1953, Wernher von Braun argued:

> Since the actual development of the long-range liquid rocket, it has been apparent that true space travel cannot be attained by any back-yard inventor, no matter how ingenious he might be. It can only be achieved by the co-ordinated might of scientists, technicians, and organizers belonging to nearly every branch of modern science and industry.[2]

With those words themselves, we can imagine no competent objection more than thirty years after that "Introduction" to the 1953 edition of the book was written. However, we do object to a misinterpretation of those words, to the effect that only governmental initiative could begin such a project. Von Braun himself would certainly have been among the first to point out that the accomplishments of Peenemuende were a working out of conceptions already defined as a privately supported undertaking of the collaborators of Dr. Hermann Oberth. If one compares relevant features of Fritz Lang's 1929 film, "The Woman in the Moon," for which Dr. Oberth was technical adviser, with a U.S. rocket-launch today, we have a sense of what private initiative had already accomplished before governments moved into the field.

Attention to the details of ordinary scientific work shows us how private initiative continues directly into those large-scale, government-supported projects we associate with the past forty years' work in rocketry. This shows us how private initiative can undertake, and profit from, the launching of the Moon-Mars-colonization mission-assignment today.

Scientific experiments require appropriate materials and instruments. In modern science, the instruments are assembled largely in tool-makers' shops associated with scientific research-centers. The scientist carries his notion of an experimental design into the machine-shop, and connives with his friends the machinists to whip up instruments which meet the specifications. By extending this traditional practice to successively larger scales, we create what we call a "crash program."

The first step, from ordinary research-practice into the emergence of a "crash program," is the assignment of small portions of capacity of industrial firms to do research and development leading into pilot production of the new species of materials and instruments foreseen as required for completion of some mission-assignment. Instead of waiting until a scientific design is proven academically, before producing the kinds of materials and instruments needed to construct something according to that design, we develop the capability for producing such kinds of materials and instruments at the same time that the scientists are discovering the refinements of principle needed to design the objects which will require such kinds of materials and instruments.

What we wish to avoid, is the situation in which our scientists have proven the feasibility of designing which we very much desire, but that desirable object can not be produced until we first create the facilities for producing the kinds of materials and other components required. So, we begin to develop the lines of production needed at the same time that we launch the scientific research which will require such species of components. For the latter purpose, we assemble some patriotic and otherwise more far-seeing industrialists, and ask each to assign a corner of his facilities to working out the problems of prototype production of one or more of the species of materials and components we know we shall require. We ask far-seeing investors and contributors to assist us in funding the employment of scientists and others, in laboratories, perhaps by investing in joint-ventures of industrialists and scientific teams.

For example, we know that the next general advancement in industrial technology, for the Moon-Mars assignment and for production generally, will include new qualities of ceramics, tending to replace steel as the material of choice. We know this chiefly for two reasons. First, we know that the next leap in industrial productivity will require modal energy-densities in production approximately four times those prevailing today. Second, we also know that high-temperature fusion processes and use of coherently directed electromagnetic pulses will make possible such increases in energy-density, and will require new kinds of materials suited for operations at such temperature-levels. Therefore, far-sighted industrialists will consider it prudent to assign some corner of their total capacities to research and development aimed at producing and working such materials.

Among the auxiliary technologies we require, are included certain qualitative advances in data-processing techniques. True parallel processing is needed for automatic control at the very high speeds required by applications of the primary technologies. We need to develop analog-digital computer-systems, whose analog component starts from the Leibnizian standpoint of Dr. Vannevar Bush's differential analyzer, but goes beyond that into the geometries of the

Gauss-Riemann manifold: we require that this be done electronically. On the latter, we must free ourselves from the cumbersome algorithms which digital computers require, and from certain mathematical absurdities intrinsic to the Cartesian manifold of arithmetic operations; otherwise, our instrumentation will not be capable of the speed and quality of response we require for foreseeable and important applications of primary technologies. There are absolute limits to the physical potential of digital computers on these accounts, which not even parallel processing can truly overcome: we need the higher speeds intrinsic to synthetical-geometrical substitutes for cumbersome algorithms.

These two examples illustrate the point, that, to a large degree, required new species of materials and other components are presently foreseeable. At least, we can foresee the direction which development-work must take, if we are to have, in time, the qualities of materials and other components we shall require.

Once we have actually assembled new objects, using new species of materials and other components, we must begin to move into larger-scale production. It is at this point in the sequence of events, that the sheer mass of a "crash program" emerges. At this point, the scientists as well as the specialists drawn from the pilot-projects in new materials and instruments move into production on a larger scale, to the effect that a very large segment of national economies is now at the disposal of the scientific teams. Now, science is directly driving technological progress in the economy as a whole: a mature form of "crash program." It is in this "mature" phase, that expenditures on the scale of governmental budgets are required.

What has happened in this process of expansion of the initial research and development to large-scale production, is, essentially, that the scope of the scientist's experimental work has been expanded from the scale of the univerity's machine-shop, to the scale of large-scale production. That process of expansion of scope of scientific experimentation, is the essence of a "crash program."

With certain exceptions, as we shall indicate, the private initiative belongs to the intermediate phase indicated above. At least, this is the case with respect to a project of the scope of a Moon-Mars-colonization mission-assignment. This does not preclude some spill-over of intermediate-phase development-work into larger-scale production within the private sector as such. It must be expected that numerous among the by-products of the intermediate phase will have an economical role to play in the private sector itself.

For example, designs for nuclear reactors as small as 15 MW already exist, designs which permit multiples of such reactors to be combined in a single, modularly expandable complex. There is no good reason that such a reactor could not be installed on a site within a year, rather than the minimum of approximately four years required today, if standardized elements, such as pre-stressed concrete elements, were adopted to make this possible. Usually, folks suggest that only governments could make such programs possible; on the contrary, if private firms decided it were in their common interest to do this, it would happen.

There is no way to increase productivity generally without such proliferation of nuclear-energy plants. The most important limiting factor in efforts to increase productivity, is the energy-density of production, as measured in both energy-density per-capita, and energy-density per-square-kilometer of the class of land-usage involved. Since we can not reach the level of technology needed to launch a thermonuclear-fusion economy without large-scale increases in average energy-density of production, and since no such expansion could be accomplished without proliferation of nuclear energy, the human race is pretty much doomed to starve on the scrap-heap of "post-industrial society" unless a revolution is effected in scale of nuclear installations.

Such expansion of nuclear-energy installations, including high-temperature gas-cooled reactors for industrial process-heat, makes possible and requires improvements in materials. Lasers and kindred instruments make possible the new kinds of machine-tools—for working new ceramics, for example—which improved qualities of materials require. This implies an acceleration in use of robotics, which, in turn, can make good use of qualitative advances in computer technologies.

Or, medical science. The per-capita cost of delivering modern health services is high, and a large component of the market-basket of households and other institutions. Although there is much misguided chatter, alleging that society can not afford high-technology, capital-intensive medical care, the simple truth is that new technologies of this sort decrease the unit-costs of medical procedures per patient, relative to more labor-intensive procedures. There is no prospect today, that such technologies can replace the indispensable function of the physician's clinical judgment, but these technologies enable us to free the physician from more and more of those forms of labor which are not the exercise of that clinical judgment. Considering the scale of medical costs, the profitability of new technologies to society in this area is a large potential incentive for production of relevant by-products of the intermediate phase of a Moon-Mars mission-assignment.

Food is a large part of the market-basket of the world economy, and the costs of malnutrition, in terms of lost productive potential, are presently off the scale and rising. What we have done with chicken-hotels can be done with premium-value vegetables, with aid of the right biochemistry and sufficient energy-supplies. Here is another area of large opportunity for private investment in some of the by-products of a Moon-Mars mission-assignment.

We urgently require both safer motor vehicles, and a shift to a hydrogen-fuel-based mode of vehicular power. Today, hydrogen can be handled as safely as gasoline in various chemical and compressed forms, and the by-product of hydrogen combustion is water—not exactly a pollutant. We can conserve the fossil fuels for use as a petrochemical stock for industry. The combination of new materials, of non-polluting nuclear energy, and the non-polluting hydrogen mode for vehicular power, is the means for rendering urban centers once again desirable centers of both residence and industrial production, and an indispensable response to the continued growth of the world's population.

These examples merely illustrate the point: a private initiative in support of the intermediate phase of a Moon-Mars mission-assignment will in and of itself inevitably produce an array of by-products readily suited to immediate large-scale production within the economy.

Not only is private initiative implicitly an economical proposition; it is also more or less indispensable. A summary of certain highlights of the history of industrial capitalism in Western Europe and the United States is most relevant.

Beginning with the collaboration between Cosimo de Medici and Plethon, the Golden Renaissance was both a moral and cultural revolution, and a directed shift of European culture toward a "science driver" mode of development of economy. In order to free mankind from feudal socialism, the socialism of feudal agriculture and urban guilds, enlightened monarchs, including France's Louis XI and the English Tudors, used the royal power to issue patents, to grant limited monopolies (patents) to consortia of inventors and their partners; out of this came the modern industrial-capitalist firm. Out of this, the independent entrepreneurial farmer replaced the feudal peasant, the technologically progressive manufacturer replaced the progress-resistant guilds, and the free citizen as employed operative replaced the emmiserated "proletariat" of the feudal urban centers.

Those creative powers of mind, by means of which individuals discover or assimilate and apply scientific principles, are, by their nature, uniquely the powers of individuals. Progress is sustained, therefore, by those who run ahead of, and often contrary to existing habits and prevailing opinion, by those who always appear initially as the few.

Science itself is characterized by great rigor. No scientist is a scientist if he pits his "free opinion" against the laws of the universe. Yet, as long as the scientist enslaves his judgment to such rigor, it is the nature of all scientific progress, that each important discovery opposes and overthrows previously prevailing opinion among scientists. It is the right of the scientist to be free, as long as he is also rigorous, which is indispensable to scientific progress.

True, there are certain aspects of economy which must never be left to random choices of private investors. Whenever the state fails to exert a monopoly of responsibility for issuance and regulation of its currency, disaster ensues. Basic economic infrastructure, such as large-scale water-management, general transportation, production and distribution of energy, general communications, and essential urban-industrial common services, must be either provided by the government, or provided by governmentally-regulated utilities. Otherwise, disaster ensues. On this point, President George Washington and other leading architects of the 1787 Federal Constitution were emphatically persuaded, and rightly so.

However, governmental bureaucracy is usually an abomination on several counts. As a collectivity, a bureaucracy reduces the net behavior of its members to a lowest common denominator, stifling creativity. Only military institutions tend to be an exception to this, and those effectively so only under capable leaderships, and under the passion of determination not to lose whatever wars might be foreseen as possible. In agriculture and in industry, most emphatically, governmental bureaucracies, both the politicians and the permanent bureaucracies, are traditionally a disaster in every area but the management of arsenals.

Hence, outside of currency, of banking, of military affairs, of regulation of foreign and interstate commerce, and of provision and maintenance of basic economic infrastructure, a prudent nation prefers private entrepreneurship: wherever government's role in the economy is not indispensable, wise nations prefer that government and politicians not be present. This is not always possible, notably in developing economies, where the state sector performs an irreplaceable role in the industrial sector; but it is most desirable wherever feasible.

This has been shown in the recent years experience with entrepreneurship which has taken up the challenge, while the politicians and governmental bureaucracies either seek to sabotage the efforts or vacillate. The enlightened private sector recognizes readily, that a technological revolution is urgently needed, if economies are to recover from the "post-industrial" decay destroying our civilization today. Governments, which tend to prefer the rhetoric of assumedly popular ideologies to reality, are more concerned with the sound of the words in a policy than the practical consequences of either implementing or refusing to implement such a policy.

It is the minority of dedicated professionals and industrialists, who are either already taking the lead in the general implementation of the SDI's technologies, or are seriously considering such steps. If those private forces are brought into international cooperation, the aggregations of those persons and of relatively small corners of industrial capacity alloted to development, add up to the order of several billions of dollars in effective impact. For the initial and intermediate phases of a "crash program," cooperation on such a scale promises very impressive results.

We must also consider the important fact, that various nations not part of the Atlantic Alliance do not have the political option of participating in the SDI as nations, although some among these do desire to have use of such technologies for their sovereign purposes. It were an error, to delimit the development of SDI technologies to the U.S.'s own SDI program; this excludes the valuable contribution from nations not part of the Atlantic Alliance.

No matter, the adoption of a Moon-Mars mission-assignment subsumes implicitly every technology required by the SDI, and more. It provides each participating nation the "spill-over" benefits otherwise peculiar to SDI development. It bypasses the political obstacles to participation in SDI development. It puts the research and development in the task-oriented form which coincides with the fundamental interests of each and every nation.

Economic feasibility

It is a commonplace error, to attempt to judge the merits of investment in a new technology in terms of one specific application, without considering beneficial chain-reaction effects of the spread of that type of technology in the economy more generally. It is, similarly, a commonplace error, to attempt to estimate the profitability of such an investment solely in terms of priced-out output of production, without due regard to the more profound impact of technologically progessive investments, the increase of the quality of the productive process itself.

It is a fair rule of thumb, that to sustain high rates of profitability in modern economies, the portion of the labor force employed in support of scientific research and development ought to be not less than 5% of the labor-force. This is helped by taxation-policies which foster financial incentives for high rates of investment in research and development in private firms.

Assuming that there is sufficient increase of energy-intensity, in the case that two comparable economies each employ 5% of their respective labor-forces in support of scientific research and development, the higher profitability will occur in the economy in which the research and development is relatively more science-intensive, in which relatively greater emphasis is placed on breakthroughs in the frontiers of science.

Thus, to estimate the impact of a Moon-Mars mission-assignment on the growth-rates in economies of participating nations, we must consider, in first-approximation, the marginal increase in research and development introduced, and also, in second approximation, the increase of science-intensity of that economy's research and development as a whole.

The increase of productive powers of labor is effected through the following causal sequence:

1.Fundamental scientific research generates the principles which ultimately cause increases in the productive powers of labor;

2.Incorporation of improved technologies, produced by fundamental research, into capital goods, especially in the machine-tool sector, transmits the technological improvement to production more generally;

3.The improvement in productivity is transmitted to the average operative's work-place in proportion to both the relative capital-intensity of production, and the development of the mental potential of the operative to assimilate that new technology.

The introduction of the new technologies generated by fundamental scientific research into production, is radiated through the economy as a whole in a form fairly described as "technology waves." These "technology waves" may be better understood through aid of the following series of observations.

It is implicitly feasible, to restate the per-capita market-baskets of inputs and outputs of producers' and households' goods of an economy in terms of the putative energy-cost of those market-baskets. The total amount of energy so attributed to either inputs or outputs, whichever is greater, defines the usable energy-throughput of the economic process as a whole.

This energy-throughput we divide, in a conventional way, into two general components: "energy of the system" and "free energy." The "energy of the system" is an estimate of the amount of energy-throughput, expressed in those market-basket forms, required to maintain the per-capita output of the economy at the current level. Any residue remaining after deducting this estimated "energy of the system," is the "free energy" component. Designate "energy of the system" by S, and "free energy" by E. We examine the economic process, in first approximation, in terms of functions of the ratio of $(S+E)/S$: total energy-throughput in ratio to "energy of the system."

In the rise of productive powers of labor in actual economies, the per-capita magnitude of S increases, but $(S+E)/S$ also rises. In other words, the quantity of energy-throughput per-capita increases geometrically, but the per-capita social cost of the enlarged amount of total energy-throughput either drops or does not rise.

Not only is an increase of the per-capita energy-throughput a precondition for increase of the productive powers of labor. There is also a generally required trend to increase the modal energy-flux density of both energy-supplies produced and at the point of production. In modern industries, such as the case of the iron and steel industry ably illustrates the point, the rise of productivity correlates with jumps in the modal energy-flux density of the productive process.

It is well known that the first-approximation measure of increase of productivity of an industrial society, is a reduction in the percentile of the labor-force required to produce needed agricultural output of food and fiber. It is also the case, that the ratio of labor-force employed in producers goods' output to household-goods output must increase. Also, the ratio of persons employed in physical (including biological) research and development, to combined agricultural and industrial operatives, must increase.

These, foregoing, are the principal, rough constraints defining the preconditions for increase of the productive powers of labor. The "reinvestment" of the "free energy" component of total energy-throughput, must be allotted to the effect, that the relative increases in ratios of employment and energy-composition, indicated by these constraints, result.

The increase in energy-intensity and capital-intensity, required by these constraints, is expressed topologically as an increase in density of singularities. In layman's language, this signifies a change in the structure of the economic process, a change in structure correlating with increase of energy- and capital-intensity. The average amount of S per-capita increases in this way. However, if this occurs in a technologically progressive mode, the quantity $S+E$ increases more rapidly than S: the average rate of profit on investment increases.[3]

As a result of such a pattern of investment, measured in energy- and in capital-intensity, an average unit of economic action, per-capita, in the economy costs more energy, but the per-capita cost of producing this increased energy, is less than the cost of producing the smaller market-baskets of the preceding investment-cycle.

This transformation occurs in the manner outlined for the progress through intermediate to full-scale phases of a "crash program," above. Scientific progress affects most directly the use and improvement of machine-tools and other capital-goods. This connection occurs typically in the production of improved species of materials and instruments. The application of these new prototypes, including new kinds of materials and components, to production in general, "transfers" technology from capital-goods production to the productive process more generally. This transfer prompts the general increase of the productive powers of labor.

In addition, the addition of new species of materials and components, increases the complexity of the social division of labor in the economy as a whole. The development of the automobile reduced the demand for buggy-whips, but the new branches of production required by the automobile's development were more numerous than those branches made obsolete.

The spill-over of new technologies into the economy as a whole, through the intermediate phase of the process, occurs in several ways. New materials and instruments, proliferate as additions to the repertoire of the producers' goods market-baskets. New materials and instruments, mean new specializations in production of materials and components for producers' goods. Intrinsically less productive elements of the division of labor are replaced by more productive elements. These effects radiate in "technology waves."

The hydrodynamic imagery is the proper choice. The characteristics of the production and investment cycles, relative to capital-intensity, are metrical characteristics of the investment-process. It is proper to speak of the "tuning" and the "resonances" of the economic process as a whole.[4] The steepness of the wave-front is chiefly a function of two subfunctions: 1) Combined increases of energy-intensity and capital-intensity; and 2) Science-intensity. The possibility of realizing the implicit advantages of a certain level of science-intensity, is bounded by the levels and rates of increase of combined energy-intensity and capital-intensity. Science-intensity, in turn, is a combined function of the relative portion of the labor-force employed in support of research and development, and the degree of emphasis upon fundamental scientific progress, as distinct from concentration on relatively well-established scientific principles. In sum, the greater the percentile of the labor-force usefully employed in research and development, and the greater the emphasis upon fundamental advances, the steeper the wave-front radiated from research and development into the investment-process.

The economic measure of relative "fundamentalness" of research and development, is analogous to measurement of increase of firepower and mobility in those instruments we call weapons. Firepower and mobility, in the military sphere, is the analog of increase of productivity in the productive process. It is more than merely an analog. In each case for comparisons, the two are but different expressions of the same level of technology. "Firepower and mobility," so situated, is measured in terms of:

1. Per-capita usable energy-throughput;
2. Energy-flux density at the point of application;
3. Relative coherence of energy-application modes, according to the geometrical definition of a physical Principle of Least Action.

The rate of increase of these, in a form implicitly increasing the ratio $(S + E)/S$, for increasing per-capita values of S, is a reflection of relative "negentropy."[5]

Thus, on condition that a society's investment policy is energy-intensive and capital-intensive, the steeper the "technology-wave," and the more broadly this "wave" is directly integrated with research and development, the higher the rate of increase of productive powers of labor in that society.

Therefore, to increase the relative percentile of employment in research and development, to increase emphasis on fundamental research, and to deploy this in a manner approaching a "science-driver" mode of "crash program," is to ensure the highest rate of increase of the productive powers of labor, and therefore the highest rate of profitability of technological progressive investments in physical output for market-baskets in that economy.

This is the proper approach for projected estimated return on investment in improved technologies. Plainly, therefore, a Moon-Mars-colonization mission-assignment is implicitly the most profitable form of technology-policy for any society today.

Some concrete considerations

The most general problem of interplanetary colonization arises from the limited amount of supplies which can be ferried from one planet to another even with the best foreseeable kinds of interplanetary powered trajectories. This difficulty is somewhat reduced for Mars-colonization, by converting the Moon into the principal manufacturing logistical base for fashioning essential products to be delivered to Mars parking-orbit. On principle, the difficulty remains the principal obstacle to interplanetary colonization.

The general form of required solution, is the development of means for economically converting whatever materials and conditions exist on colonized planets into the primary materials and food-stuffs required by the colonists. On the first count, primary materials, the basic solution includes relatively very large energy-supplies per-capita, relative to present Earth modes of production, energy-flux densities at least four times those in use at present, and liberal reliance on the super-high energy-flux densities realized by aid of the self-focusing properties of coherent electromagnetic impulses. On the second count, the subsumption of currently developing biotechnology with optical biophysics, defines the general form of solution.

As early as 1948-1953, as we have referenced this, Wernher von Braun demonstrated the medium-term feasibility, even then, of launching a space-assembled flotilla of interplanetary craft, for a round-trip from Earth-orbit to a kind of "Antarctica station" set up by this expedition on the surface of Mars. Von Braun's preface to the 1962 edition of that proposal, is most usefully thought-provoking for those undertaking a fresh approach to the project today.

Krafft Ehricke has elaborated to a large degree the necessary plans for developing a manufacturing colony on the Moon, a colony based on fission technologies. It would be feasible to launch that Moon colonization as soon as the means can be mustered, without waiting for new developments in thermonuclear-fusion technologies. However, although von Braun's approach, using fission technologies, would suffice for establishing on Mars an analog of the "Antarctica station" under Rear Admiral Richard Byrd, fission technologies are not an adequate basis for establishing a permanent sort of more or less self-sustaining colonization.

As we have indicated, the general principle of interplanetary colonization must be the availability of technologies adequate to transform any materials and conditions abounding for the landing parties into primary materials of construction. This can be solved by sufficiently high energy-flux densities of thermonuclear plasmas, and by focusing such energy into suitable forms of high-energy coherent beams. The energy-regimes needed, are those which enable us, so to speak, to boil and distill any sort of raw material, to transmute some of the distillate, and to create new states of organization of matter. In broad principle, the nature of such requirements is already known, and the feasibility of meeting such requirements in the early future, known with sufficient precision to warrant a "crash program" in related matters.

Excepting biophysics-matters as such, every problem of technology on the present frontiers of scientific progress on Earth, is implicitly solved by solutions to this cited materials problem of Mars-colonization.

Now, let us shift our point of attention to biophysics.

It was already implicit in the cited discoveries of Pacioli and da Vinci, as in the later work of Pasteur, that the mastery of living processes requires us to shift the emphasis from particle-chemistry to hydrodynamics. Of greatest interest to us today, is the fact that organic molecules are tuned to receive and to emit characteristic frequencies of the electromagnetic spectrum, to the effect that we must stress the electrohydrodynamic properties of atomic and subatomic structures, rather than assuming an axiomatically statistical or dynamic interaction among discrete particles. Of special interest are those negentropic forms of tuned excitation-emission, in which the energy-flux density of the electrohydrodynamic action is increased by several orders of magnitude. This is optical biophysics.

Dear old chlorophyll dimers, are among the obvious targets of optical-biophysics research, especially as we prepare to colonize the Moon and Mars. This is less exotic than negentropic electrohydrodynamics of DNA and RNA, but not less essential. On Mars, we shall be obliged, at least to a very large degree, to rely upon hydroponics, and to supply the plants the energy they require, in appropriate doses of selective radiation created by artificial sources, from thermonuclear fusion. They shall also require the proper sort of paramagnetic regimes amid their dosages of nutrient. We need to master the designing and redesigning of chlorophyll dimers, to tune their little antenna-tails appropriately, and so forth.

We must also produce the right proteins within balanced nutrition, in light of the shortage of animal-protein supplies on the Moon and Mars. This touches some currently very important challenges of medical science here on Earth.

Relatively less critical, but very important nonetheless, for interplanetary flight, constant acceleration in order of 1 G of alternating acceleration and deceleration is needed for flights much longer than those between Earth and Moon geostationary orbits. For this, thermonuclear fusion is needed.

With foreseeable improvements in ceramics, the largest single component of a nuclear or fusion reactor could be reduced in weight to significantly less than 25 tons. Krafft Ehricke worked through some shrewd schemes for using fission on the Moon, but for Mars-colonization, we shall have to transport the components of reactors to the Mars surface, and assemble them there. For reasons given by von Braun, this expedition will involve a flotilla of manned interplanetary craft, kept in the same tunnel of trajectory at no more than space-boat distance from one another during the flight.

Probably, we shall construct most of the components of the Mars expedition's flotilla on the Moon, assembling the components into interplanetary craft in parking orbits. This will make the Mars expedition far more economical, but certain fundamental problems persist even so.

Probably, it were prudent to use 10 MW to 50 MW fusion reactor modules of common standard design, both to power the interplanetary craft and for power plants on Mars itself. These modules would be of a type which, not coincidentally, would have a large scale of general usage on Earth, too.

On Mars, it would be most convenient to have tunable lasers and particle-beams: one type of tool for the most varied of required applications. "Distilling" raw material, isotope separation of the distilled plasmas, and assembling such isotopes into desired states of matter in the form of primary materials, illustrate the point. The certainty that we shall have to manufacture water and oxygen, and so on, on colonized planets, also illustrates the point.

Imagine the impact of such technologies to economies on Earth.

There is another aspect to interplanetary colonization. Conventional physics today assumes that what we call "force" is a self-evidently primary existence in our universe. The work of Kepler, and of Gauss and his collaborators, implicitly argues that this is false, that the primary lawful composition of our universe is metrically force-free action, and that "force" is introduced as the correlative of work against a force-free pathway of action. We shall not discuss the possible solutions to this antinomy here, but merely stress that the advantages of practicing astrophysics beyond Earth, and outside the solar ecliptic, too, is among the indispensable measures required to settle fully the highly practical, as well as theoretical importance of this antinomy. We must observe the astronomical domain in the fullest range of the electromagnetic spectrum, and correlate what we learn on the scale of astrophysics with corresponding metrical invariances at the opposite, sub-atomic microphysical extreme. From this will come many practical benefits, as well as the new directions of fundamental physical research beyond the scientific frontiers essential to Mars-colonization.

The extraterrestial imperative

Kraftt Ehricke laid particular stress on the moral importance of space-colonization, upon what he termed "The Extraterrestial Imperative." The point is, to shift man's sense of identity, above hedonistic, Hobbesian squabbling over the mud of our home-planet, and to prompt mankind to locate its destiny in work in the universe more generally. At first glance, some may not think this aspect of the matter of much practical bearing upon a private initiative; a small amount of further reflection on the point ought to show that this is a very practical, as well as a moral consideration.

It is a profoundly mistaken, but unfortunately popular view today, to estimate that scientific work is essentially "logical," and therefore dispassionate. In other words, scientific work is judged to be "academic," in the worst sense of that term.

Any intelligent and reflective person, must recall as the most joyful moments of his or her life as a pupil in primary and secondary schools, as those moments of discovery, in which the act of discovery was associated with an emotion at once impassioned and sublime. We sometimes speak of such moments as "a light going on in the head." It can best be described as a "beautiful experience." When we, as happy children, relive some discovery of the past in the course of our studies, we experience a kind of joyful excitement akin to the most profound sense of love, the quality of love summed up by Dante Alighieri in the concluding, empyreal canto of his *Commedia*.

Examining the matter more closely, we should be able to recall, the joy of discovery was inseparable from the fact that acceptable solutions to the problem posed were delimited to solutions fully consistent with a definite degree of scientific rigor. There is nothing arbitrary, as nineteenth-century Romanticism is arbitrary, in the peculiar sort of joyful excitement associated with genuinely reexperiencing a discovery by one of our scientific forebears. There is a godliness in such experiences: the essential thing, is that we delimit creative solutions to problems to those definitions of problems and solutions which are constrained by a sense of the universal and rigorous lawfulness of Creation as a whole.

Friedrich Schiller's profound attack upon Immanuel Kant's miserably philistine and Romantic notions of irrationality in creative discovery and the aesthetical sense, is a most useful reference on this point.

Exploring those childhood moments of great delight a bit further, we should recall that the lingering quality of that excitement was delimited to our anticipation of the practical benefits of the discovery we had just experienced. In our experience of the power within us, as individuals, to effect creative discoveries which are both consistent with a most rigorous and universal lawfulness of Creation, and which contribute increased practical power implicitly to all mankind, we experience in ourselves our divine potentialities, that which sets man apart from the hedonistic, existentialist, beasts and existentialist beast-men alike. Creative discovery partakes of the immortal individual action, that produced by one individual, of implicit benefit to all present and future generations.

In adult life, the individual's creative powers are an extension and maturation of such joyful experiences as young pupils. The adult scientist strives to reexperience those beautiful moments of childhood experience, within the scale of reference assigned to his practical duties as an adult member of society. To be able to retain such motives and creative powers, is to love oneself, is expressive of the highest degree of happiness an individual can attain in this mortal life. No matter how crabbed, peevish, or other the personality defects with which a scientist may be adorned in social practice in the classroom or in other practice of the profession or personal life, what makes him a fruitful scientist is a childlike quality within him, the sweet fruit among the worms of his personality defects.

The essence of science is such passion, such task-orientation. Herein lies the source of energy for sustained concentration-span in rigorous re-examination of prevailing assumptions. Herein lies not only the passion indispensable to creative-scientific fruitfulness; herein lies the capacity of the layman, as factory operative, or other, to assimilate scientific progress efficiently, creatively.

It is such so-impassioned "task-orientation," situated within a fierce attachment to Socratic rigor, which is the wellspring of great upsurges of scientific creativity, and upsurges of the enlarged capacity of populations for "imparting and receiving profound and impassioned conceptions respecting man and nature." To afford to scientific progress, the unifying form of task-orientation supplied by a proper choice of grand mission-assignment, is the optimal circumstance for high rates of productions in the advancement of applications of fundamental scientific progress.

Herein lies the singular importance of that Peenemuende task-force born out of the civilian Moon-mission-assignment of Professor Hermann Oberth. It is the irony of modern history, that the larger-scale implementation of "crash programs" is fostered only under circumstances of military expediency; so, Professor Oberth's progressed beyond its initial private phase under the patronage of a German military which, in turn, fell prey to the mystically anti-rationalist, anti-scientific Nazi state. So, the continuation of that group's mission-assignment in the United States' aerospace program, was linked to a military expediency. The unpopular, and unhappy, features of the military destinies of Professor Oberth's group, have tended to prejudice judgment against sorting out what was and is primary, from amid the unpopular predicates of circumstance.

The lesson of Professor Oberth's task-force is the role of the Moon mission-assignment in forcing into play a wide range of the best fruits of nineteenth-century German science, and to force that German science to deliver a comprehensive solution to the tasks of bringing mankind into space. The "Extraterrestial Imperative," excites the professional popular view of scientific progress as perhaps no other foreseeable choice of mission-assignment might do this. If we wish the highest rate of productivity in laboratories and in production, these benefits will be supplied as by-products of an impassioned commitment to master all of the tasks of the Moon-Mars mission-assignment.

---

1. Lyndon H. LaRouche, Jr., "Krafft Ehricke's Enduring Contribution To The Future Generations of Global and Interplanetary Civilization," in *Colonize Space! Open the Age of Reason*, Proceedings of the Krafft Ehricke Memorial Conference of the Schiller Institute, Reston, Virginia, June 15-16, 1985. New Benjamin Franklin House, New York, 1985, 384 pp.
2. Wernher von Braun, *The Mars Project*, Urbana, 1962, p. 1.
3. This process has a precise mathematical form in the LaRouche-Riemann Method of economic analysis.
4. In the LaRouche-Riemann Method, the metrical characteristic of an economic process is a rate of increase of a definite value of potential relative population-density. The appropriate extension of Leibniz's Principle of Least Action to this function, is the Gaussian conic self-similar-spiral action, as the elaborated form of circular (isoperimetric) action. The first-approximation of technological progress in an energy-intensive, capital-intensive mode, is such a form of Least Action acting everywhere upon itself. This is reflected as an hyperboloid projected upon the surface of a Riemannian sphere.

   This hyperbolic function reflects the resonance of the economic process respecting that "technology wave" under those conditions. The zooming of the hyperbolic curve into the vanishing-point of the sphere, correlates with a "jump" of the economic process as a whole to a higher state, with altered metrical characteristics, a new function in terms of $(S+E)/S$, at a higher level of per-capita energy of the system. Since, in this case, perimetric action (surface displacement) subtends a partial volume of the sphere as the measure of work accomplished, the jump to a higher state of the system corresponds to a larger concentric sphere. At the hyperbolic singularity, the action continues on the larger sphere. The Least Action form of successive such jumps determines an harmonic series. Actual transformations of economic processes are measured against this normative, Least Action, case.
5. By "negentropy," we do not mean the statistical definition according to Boltzmann's theory of statistical fluctuations. We signify the distinction between living and non-living processes, first elaborated by the collaborators Luca Pacioli and Leonardo da Vinci, as adopted by Johannes Kepler for his own synthetical-geometrical construction of the least-action pathways of planetary orbits. In the range of phenomena lying between the astrophysical and microphysical extremes, living processes are distinguished from non-living by the fact, that the morphologies of growth and function of healthy living processes describe a self-similar harmonic series which is congruent with the Golden Section. All processes, in this range, which exhibit that harmonic characteristic, are either living processes or a special class of products of action on nature by living processes. The Golden Section, in turn, is the characteristic of projection of conic self-similar-spiral action in the Gaussian manifold onto the Euclidean manifold of brain-synthesized sensory images of physical processes. This Gaussian synthetic-geometric view of Pacioli's and Leonardo da Vinci's discovery, is the definition of "negentropy" employed. In economic processes, this correlates with the cumulative density of the kinds of singularities of technological progress which our ideal model associates with hyperbolic singularities and "jumps."