'Flat Earth Society' mounts feeble comeback

The American Physical Society's study on the Strategic Defense Initiative is reviewed by Robert Gallagher; with a letter by Lyndon H. LaRouche, Jr.

This publication predicted in 1983 that the Trust, the alliance of Western oligarchs and Russian commissars, would ultimately sacrifice the reputation of every scientist and scientific organization it could influence, in its effort to defeat the Strategic Defense Initiative policy of Lyndon H. LaRouche, Jr. Now finally, on April 23, 1987, the American Physical Society (APS) has stepped before the altar of appeasement, and presented its report questioning the feasibility of the SDI, only two days after the Trust-inspired suppression of the LaRouche-initiated Fusion Energy Foundation, the sole scientific association not only to support but indeed to propose an SDI as early as 1979.

Will the authority of the APS discredit LaRouche's SDI policy, or will the credibility of the APS be ground up by the moral and scientific arguments and perfect integrity of the same force that has obliterated the authority of the immoral scientists that the Trust has sent against the development of a strategic defense?

The APS report is the most recent of a long list of productions by scientists who have asserted that the SDI is not feasible today. All previous reports have been discredited. The Trust's first scientific recruits to its war on LaRouche's SDI policy came from the cult dregs of science, with open Russian collaborators like Kostas Tsipis (the former official of the Pugwash Conference) and that magician of questionable proclivities, Carl Sagan; these were discredited even before President Reagan's March 23, 1983 announcement of SDI. Then came and fell, one after the other, the rest, all listed by the APS at the end of chapter one of its report, like an obituary: IBM's Richard Garwin, Cornell's Hans Bethe, Stanford's Wolfgang Panofsky, former Defense Secretary Harold Brown, former Defense R&D chief Herbert York, and other members of the Union of Disturbed Scientists, the Brookings Institution, the Office of Technology Assessment, the American Association for the Advancement of Science, and we now add another, and perhaps close this chapter of fraud in the history of science, with the American Physical Society and the report of its cowardly Study Group on the Science and Technology of Directed Energy Weapons (DEW).

The American Physical Society is the official flagship of physics in the United States today. Among the members of its Study Group are physicists who have made important contributions to the development of the laser and associated optics technologies, such as its co-chairman C.K. Patel of AT&T Bell Laboratories.

Incapable of deciding

I asked Patel just what the report says about the feasibility of SDI and he read to me the following statement on page two of the report's "Executive Summary and Major Conclusions":

> Although substantial progress has been made in many technologies of Directed Energy Weapons over the last two decades, the Study Group finds significant gaps in the scientific and engineering understanding of many issues associated with the development of these technologies. Successful resolution of these issues is critical for the extrapolation to performance levels that would be required in an effective ballistic missile defense system. At present, there is insufficient information to decide whether the required extrapo-

lations can or cannot be achieved. Most crucial elements required for a DEW system need improvements of several orders of magnitude. Because the elements are interrelated, the improvements must be achieved in a mutually consistent manner. *We estimate that even in the best of circumstances, a decade or more of intensive research would be required to provide the technical knowledge needed for an informed decision about the potential effectiveness and survivability of directed energy weapon systems* [emphasis added].

Other members of the Study Group interviewed, emphasized that it was the group's "collective judgment" that they would be incapable of deciding whether a strategic defense based on directed energy weapons was feasible, until after 10 to 15 years of research. When *EIR* asked whether this could be taken as an argument for devoting more resources to this important program, one author said, "Yes, but another conclusion is 'Let's drop it.' It's too complicated and may never work."

If this is the principal "finding" of the study, as the report itself describes the statement quoted above, then the APS has clearly wasted its time and money. This "finding" is a mere assertion that only echoes the opinions of Garwin, Bethe, York, Panofsky, et al. But what could be expected of a report whose official APS Review Committee is packed with such opponents of even the very idea of strategic defense as York, Panofsky, and Charles Townes (of the University of California at Berkeley)?

Lacked important classified data

It might be said in defense of the Study Group's conclusion, that it was incapable of deciding on the feasibility of a strategic defense based on directed energy weapons, because, contrary to press reports, the group was not given access to all relevant classified information, as Edward Teller pointed out at the Lasers '85 conference shortly after the Group was formed.

Commenting on the APS report, the Strategic Defense Initiative Organization (SDIO) found its "conclusions to be subjective and unduly pessimistic." A top SDI scientist at a national lab told *EIR* that the APS report "uses a narrow, technical definition of feasibility." Indeed, a look into chapter one of the report finds the following revealing statement under the heading "Perspective

development needed in many technological areas important to the [SDI] systems, we judge that deployment of a substantial directed energy weapon component in a ballistic missile defense system cannot be foreseen before the year 2000."

We ask sincerely, if you cannot determine feasibility for 10 or 15 years (between A.D. 1997 and 2002), then how can you talk about deployment shortly thereafter, unless by feasibility you mean such an advanced development of the science and technology that you are able to move into assembly of weapons? Consideration of some historical examples will expose the fraud of the APS metric of "feasibility."

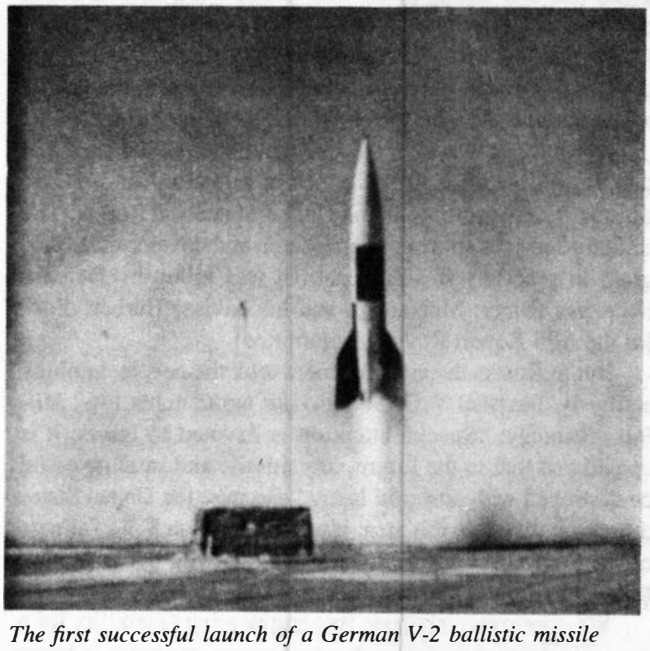
What is feasibility?

Space travel and nuclear power are two examples of scientific and technological undertakings whose feasibility was challenged by skeptics up until the first trip to the Moon and the first atomic explosion. Now that their feasibility is clearly established, it is useful to reflect on the fact that it existed long before man contemplated either space travel or nuclear fission. That is, their feasibility is obviously a property of nature.

Once such projects are contemplated, it is the pedagogical task of scientists and engineers to demonstrate their feasibility to the rest of the human race, which must provide the resources to support the efforts—rather than engage in irresponsible sophistry. Feasibility is demonstrated in principally two steps:

1) *Establishment of scientific feasibility* with a demonstration that in principle the proposed science and technology undertaking is consistent with nature.

The scientific feasibility of space travel was established no later than 1903 when Konstantin Tsiolkovsky published his groundbreaking study, "Investigating space with reaction devices." The establishment of the scientific feasibility of nuclear fission was more experimental in nature. It came out of work performed by Otto Hahn in Germany and Enrico Fermi and others in the United States, that demonstrated fission of uranium and the possibility of making an explosive out of fissionable uranium since fission of a single uranium



The first successful launch of a German V-2 ballistic missile demonstrated the practical, engineering feasibility of space travel, 19 years before Yuri Gagarin orbited the earth.

atom could produce the fission of more than one other uranium atom and thus establish an explosively expanding chain reaction.

2) *Establishment of engineering feasibility* through demonstrations of key technologies required for the proposed venture. Engineering feasibility was demonstrated for space travel no later than with the first successful V-2 rocket launch in 1942. For the first time a rocket traveled through space and its payload successfully re-entered the atmosphere, traveling faster than the speed of sound. The launch of the first artificial satellite, the first man into space, or the first man to the Moon, were based on application of principles of engineering that were demonstrated in that first successful V-2 launch.

Establishment of the engineering feasibility of the atomic bomb and nuclear power occurred *during* the World War II Manhattan Project. At the University of Chicago, physicists built and operated the first "pile" of uranium with a self-sustaining and controllable chain reaction. At the University of California, Ernest Lawrence demonstrated separation of the fissionable uranium-235 isotope from natural uranium, developing the method for concentration of the material for the first uranium bomb. The production of the bombs used in the war and the nuclear reactors built at Hanford, Washington, followed directly out of these two engineering demonstrations.

Russians disagree with APS

From consideration of these historical examples, a conservative dating would place the establishment of the scientific feasibility of a defense based on directed energy weapons no later than the 1960 invention of atomic lasers. Some might argue that this dating is too late. Much work carried out in electrical engineering in the 1940s and 1950s was deliberately oriented toward extending microwave devices to develop devices that would produce coherent radiation in the visible and infrared regions of the electromagnetic spectrum.

However, it was after the 1960 invention of the laser that the feasibility of the use of coherent radiation for strategic defense was recognized in the United States and Russia. The military services sponsored a research and development program in precisely this area until it was killed by Defense Secretary Robert McNamara and his adviser Herbert York (of the APS Report Review Committee).

But in Russia the establishment took the new technology seriously. Marshal V.D. Sokolovskii wrote in his 1962 *Military Strategy*: "Special attention is devoted to lasers; it is considered that in the future, any missile and satellite could be destroyed with powerful lasers." Because the United States dropped its effort in this area, it was the Russian V.L. Tal'roze of the Soviet Chemical Physics Institute who demonstrated the first hydrogen fluoride chemical laser in 1969.

We conservatively state that engineering feasibility for a strategic defense based on directed energy weapons is being demonstrated now, under the budget-limited SDI research program. The APS report emphasizes the need for improvement in SDI technologies by "orders of magnitude" (factors of 10), and that is precisely what is occurring under the program since it was formally established in 1984. For example, in 1983 the peak output power achieved by free electron laser oscillators operating in the near infrared region of the electromagnetic spectrum was about 1 million watts (at Stanford's High Energy Physics Lab at a wavelength of 1.6 microns). Three years later in 1986, Los Alamos National Lab reported that it had produced 40 million watts of peak output power at 10 microns in the free electron laser oscillator there. This is an improvement in three years by a factor of 40.

Indeed, the APS report itself shows that considerable progress has been made across a broad spectrum of technologies required for strategic defense:

X-ray lasers. Focusing to coherent x-ray beams has been demonstrated.

Laser propagation through the atmosphere. Adaptive optics and non-linear optical phase conjugation techniques are under development to compensate for beam distortion induced by interaction with the atmosphere (discussed below).

Target acquisition, including the difficulty in detecting the exact location of a ballistic missile booster inside of the plume of rocket gases that envelops it as it rises out of the atmosphere.

Target discrimination, the use of lasers or neutral particle beams to distinguish the real warheads from the tens to hundreds of decoys released by each ballistic missile that is not destroyed during its boost out of the atmosphere.

Space-based nuclear reactors, required to power SDI weapons and sensor platforms.

Some program progress admitted in the APS report, is actually quite embarrassing to certain members of the APS Review Committee who last year accused Lawrence Livermore National Lab of reporting fraudulent results on the nuclear-pumped x-ray laser project. The Report's Executive Summary states flatly: "A nuclear explosion-pumped x-ray laser has been demonstrated."

APS assumed current pace of program

At present, the pace of the SDI program is determined by the level of funding. Given the pace of program developments achieved under these circumstances, it is past time to shift the program into a Manhattan Project-type crash R&D program where the pace is determined by how fast we can push the science and technology, that is, where, aside from that, there are no budgetary limitations. As was the Manhattan Project, the program should be "off-budget." Instead, SDIO budget requests have been repeatedly slashed by Congress.

The SDI Organization requested 1.6 billion for directed energy weapons research and development for fiscal year

1987, but ended up with half that amount. Such budget action by Congress forced SDIO to abandon plans to develop prototype missile interceptors based on chemical and ultraviolet lasers in December 1985. Even the program to develop the free electron lasers, now the focus of the DEW effort, has been seriously curtailed. Last October, funding for Los Alamos, Livermore, and Boeing was drastically cut back while funding for the joint TRW-Stanford program was eliminated.

But incredible as it may sound, in the face of the budgetary chaos, APS Study Group members interviewed, insisted that development of directed energy weapons was getting "plenty of money" and that "the funding should not go up by leaps and bounds." (We suggest these individuals append these remarks to the end of their next request for research funds.) Thus the APS Study Group concludes that they would be incapable of making a decision on feasibility before another "decade or more of intensive research" *funded at approximately the same inadequate levels determined by congressional budget cuts today*. And what again, do they mean by feasibility? "That all important physics and engineering questions are answered," one report author told *EIR*. What is an example of that? we asked. "The average power of ground-based free electron lasers must be increased by five orders of magnitude for the SDI."

Free electron laser experimentalists only pulse the laser once a second to save power and other costs. As a result, average power is low. Technology already exists for increasing the pulse rate to about 1,000 per second; this would increase average power by three orders of magnitude. "But it hasn't been tested yet," the APS author whined. In animal husbandry, this activity is called "nit-picking."

Feasibility in the APS sense, means we would be ready to assemble weapons. If we had waited that long in starting up the Manhattan Project we might have been the *second* country to explode an atomic bomb—after Russia. Of course, the argument is made that the SDI is a more formidable job than the Manhattan Project, that the A-bomb project had far less problems to deal with. In retrospect, after 42 years' experience with the nuclear science and technology that came out of that effort, this may appear to be true. But imagine convincing someone who actually worked on the A-bomb project of that, during its breakneck course!

Absence of military thinking

In the technical sections of the report, the authors present arguments against the survivability of directed energy weapons that may in part originate from their lack of access to certain classified data. The Study Group attempted to make judgments about whether a technology is feasible for the military mission of strategic defense without knowing or considering how the technology would or could be used in a military engagement. Their treatment of the nuclear-explosion-pumped x-ray laser is incompetent for this reason.

With regard to the survivability of either defensive or offensive weapons systems, anyone can dream up ways to knock out systems that are *deployed in a predictable manner*. Thus a good part of the problem of the successful military use of technology is the development of effective modes of deployment.


American Institute of Physics

Enrico Fermi, Leo Szilard, and others at Columbia University in 1939 showed that fission of uranium U-235 can lead to a nuclear chain reaction, providing one of the necessary demonstrations that nuclear power was scientifically feasible. This photo shows Fermi strolling with Nils Bohr.

The revolution in military strategy and tactics forced through by French Minister of War Lazare Carnot from 1793 onward, derived from Carnot's use of existing artillery technology in a novel way. Instead of relegating the artillery to a fixed position and one open to attack from whatever flank the enemy might threaten, Carnot violated the preconceptions of European commanders, and put the artillery on the march. With this innovation of mobile artillery, he expelled the Austrians, British, and Prussians from France.

The importance of directed energy weapons, and the x-ray laser especially, is that their high power densities and rapid "time of flight" to their targets, makes a wide range of deployment modes possible. Because of its high power-to-mass ratio, the x-ray laser will be so mobile that it will be able to "appear from nowhere" without warning. The device

The development of the cyclotron by Ernest Lawrence and his collaborators in the 1930s (shown here inside the magnet of the 60-inch cyclotron), provided the technology for a separation of atomic isotopes, and so demonstrated the practical engineering feasibility of separating uranium-235 (for the first uranium bomb) from natural uranium. To this day, Lawrence's machines, dubbed the "Calutron," are used at Oak Ridge to separate rare isotopes in small quantities. (Ernest Lawrence is in the center of the first row.)

Source: M. Stanley Livingston, Particle Accelerators: A Brief History *(Harvard, 1969).*

may be "popped up" into space, or the upper regions of the atmosphere, by missiles on submarines or aircraft, or from silos. SDI scientists claim that x-ray laser power levels are so high, that the device can even be based on the Moon. The "pop-up" surprise attack quality can be engineered into interceptor systems based on ground based lasers. Mirrors that focus the laser radiation on enemy objects, may be popped up in the same fashion as x-ray lasers. Relaying the tremendous powers of ground-based lasers, their effective power to mass ratio will be enormous.

Countermeasures against such devices have not yet been conceived. Because the APS Study Group assumed predictable modes of deployment, they overlooked the inherent deployment flexibility of directed energy weapons. Their discussion of the survivability of the components of an SDI system is incompetent for this reason. They argue that an x-ray laser would be the perfect SDI countermeasure, since it could shoot out from the upper regions of the atmosphere against SDI platforms in space. This point in fact defeats their argument against survivability; for an x-ray laser capable of shooting out of the atmosphere at satellites, can just as well destroy Russian boosters, the buses from which warheads are deployed, and the warheads themselves, from the same position.

By assuming predictable deployments, the APS Group follows the thinking of adherents to the doctrine of nuclear deterrence, such as McNamara, who in their commitment to only deploying a "standing army" of ballistic missiles, are committed to the fixed deployment pattern "cabinet warfare" doctrines championed by the British and Austrians in the 18th century—until these were finally defeated by the mobility of Carnot's forces.

Lack of the right atmosphere

Otherwise, aside from its "Executive Summary" and the first couple of chapters, the authors present the report to be a "physics textbook" on how far technology for a strategic defense based on directed energy weapons has gone. To some degree this is true. Authors of sections that report on aggressive experimental programs like the free electron laser, for which there are many research papers published in the open literature, could not credibly avoid being accurate. However, sections on technology areas where little experimental work has been done, such as the propagation of high power laser beams through the atmosphere, at best summarize a consensus of ignorance on these issues. In these sections, the report's authors join with pessimistic theoreticians and curse our ability to solve problems. In the sub-section on "Atmosphere Turbulence," the authors write: "A second source of beam degradation is atmospheric turbulence. This is a very important source since we know of no way to avoid it. . . ."

The APS discussion is based on theory that experiments indicate, may exaggerate the effects of turbulence by a factor of 10 to 50. (We refer the reader to *EIR*'s Dec. 13, 1985 issue

for a more detailed discussion of this matter, or the March-April 1986 issue of *Fusion* magazine.)

Near the surface of the earth, the atmosphere encounters a discontinuous boundary, characterized by irregular surface features. The smoother aerodynamic flow of upper regions of the atmosphere breaks up into vortices, upon encountering this surface. This turbulence, produces spatial and temporal variations in the density of the atmosphere and, consequently, in the index of refraction, and thus the speed of any light traveling through it. As a result, according to contemporary models, different portions of a beam emitted from a source coherently, propagate at different varying speeds, with the result that the coherence and intensity of the beam is destroyed by the turbulence.

Existing optical theories practically rule out the possibility of a solution. Some *experimental* results reported since the SDI inception, have indicated that these models are overly pessimistic and have demonstrated that a solution to these engineering difficulties is feasible.

The properties of beam-atmospheric interaction—absorption, scattering, turbulence, and thermal blooming—can be compared to a highly differentiated electromagnetic lens that changes its shape with time. At the physical dimensions of light rays and of the molecular constituents of the atmosphere, the interaction is not percussive and irreversible, as suggested by contemporary theory, but electrohydrodynamic. Turbulence, for example, changes the local electrohydrodynamic properties of the atmosphere, and it is such transformations that change the characteristics of light propagation through it.

In nature, beam propagation is perfect

There exists a phenomenon *in nature,* known as nonlinear Optical Phase Conjugation, that demonstrates, in principle, that beams of laser light can be preformed and directed through the atmosphere to arrive on target with near-perfect coherence and intensity.

R.C. Lind and G.J. Dunning of Hughes Research Laboratories, directed a coherent dye laser beam through experimentally produced, intense atmospheric turbulence into a preparation of atomic sodium pumped by counterpropagating beams of the same wavelength, reported *Laser Focus* in September 1983. Upon arrival at the atomic sodium phase conjugator, the beam displayed severe aberrations and phase distortion from its original coherent profile, as a result of the instantaneous refractive properties of the atmosphere. The conjugator then returned the phase conjugate of the beam back through the precise path along which it had propagated from the transmitter. Along this return path, the aberrated beam reformed into one almost perfectly coherent. The time to conjugate the beam (10 billionths of a second) and cover the path twice, was far less than the time in which the refractive properties of the atmosphere changed. *Laser Focus* reported:

> These data indicate near-diffraction-limited correction capability. In addition, while the aberrated beam shows severe wander and on-axis intensity nulls, the corrected beam stays locked to a particular spatial position.

According to one source, Hughes holds that the technique will work for beam propagation distances up to at least 50 kilometers in the atmosphere.

The task of "adaptive optics" is thus to employ directly, or otherwise recreate, the capabilities of the natural process of optical phase conjugation in engineering hardware that transmits a beam through the atmosphere.

Fallacies of the Flat Earth Society

The APS report and other contemporary models rest much of the argument upon a construct known as the "atmospheric coherence length" of light. "Atmospheric coherence length" is the distance r_0 perpendicular to the beam path, across which the beam is phase correlated.

Its complete definition implies that a beam *must* become increasingly incoherent with distance, or with shorter wavelengths, or with increasing turbulence. The case of optical phase conjugation demonstrates that this conception is worthless.

First of all, it matters little whether the beam measures, or *appears* to be, coherent at any point along its path of propagation. What matters is whether the beam is organized, in its propagation, to arrive coherent at the target. The work at Hughes Laboratories shows that, practically speaking, we can make the coherence length as long as we wish, as large as the size of the "collecting optics" of the phase conjugator; in other words, potentially infinite. Lind and Dunning carried out their experiments with turbulence at the highest end of the spectrum of intensities of turbulence in the atmosphere.

Second, Luc R. Bissonnette of the Canadian Defense Research Establishment has shown that the Fried construct probably underestimates even the *apparent* atmospheric coherence length by a factor of at least 10 to 50.

The notion of coherence length is not the only regressive concept dominating optics in the United States and Europe. For example, J.E. Pearson, R.H. Freeman, and H.C. Reynolds wrote in *Applied Optics and Optical Engineering* that "an adaptive optics system can only compensate for phase errors that occur at some fraction of the focal plane distance," i.e., relatively close to the laser transmitter. In other words, turbulence that is farther away from the controlling optics is harder to correct for. The Hughes experiments also refute this claim: In defiance of theory, optical phase conjugation compensated for intense turbulence that occurred along the entire path of the beam.

Unlike the APS report's conclusion on atmospheric turbulence, other of the Group's reasoning does not enjoy even such "theoretical" backing, and degenerate to mere asser-

tions. In the "Executive Summary" we find among its list of major issues:

> III. Terminal phase
>
> We do not expect directed energy weapons to play an important role in the terminal phase of the trajectory of ballistic missiles.

That is, as the warheads descend over the United States. Then the authors add:

> We have examined most of these issues in some detail, except for item III.

A universal notion of feasibility

All such fraud and technical issues aside, what funda-

An open letter to the American Physical Society

April 24, 1987

American Physical Society
335 East 45th St.
New York, N.Y. 10017

Re: *New York Times* report, April 23

Dear Sir:

I am pained to read in the *New York Times*, that the American Physical Society will be used to conduit misleading political propaganda, disguised as science, against the development of a U.S. Strategic Defense Initiative (SDI). It is sadly appropriate that such a report should be conveyed through the same *New York Times* which pronounced unworkable the electric light, powered flight, and rocket-flight above the atmosphere.

The question of physical principles has been settled satisfactorily. The doubts which I have seen expressed by putative scientists on this matter, are of the same general species of scientific merit as the assurances given to us at the beginning of this century, and even later, by Rayleigh, von Karman, and others, that Bernhard Riemann's prescriptions for the conditions of transsonic powered flight were bad physics.

The problems of actually developing successful measures of ballistic missile defense, are chiefly those of an adequate level of funding of research and development, whose upper limit is more or less determined by the constricted number of professionals qualified for such work. In 1982 I estimated an annual level of between $7-9 billion to be appropriate for perfecting prototypes of basic weaponry, and a level of between $35-40 billion annually for a combined development and deployment program. The question of "scientific feasibility" is no longer a question of principles of physics; it is a practical question, which should be posed in terms of the impact of those, or lesser magnitudes of expenditure upon rates of progress.

The situation with AIDS research is comparable. The AIDS pandemic is in relatively small proportion a matter of medical research, and overwhelmingly a matter of biological research. We are spending, internationally, disgustingly little on relevant biological research, and are actually cutting back on the most promising avenues of biological research, the optical biophysics of non-linear spectroscopy. There is a parallel between the feasibility of a BMD based on what arms-control jargon terms "new physical principles," and the feasibility of the human race's surviving the presently rapid spread of the rapidly evolving "AIDS" virus. In both instances, if we fail to spend enough on the right spectrum of research activities, the goals of neither could be realized.

If the pacifist consciences of some physicists make work on any sort of weapons-system abhorrent to them, let them speak politically on this matter, and not distort physics wishfully for a political purpose. If they wish "alternative service," let them turn their eyes to optical biophysics, a field which carries us way beyond molecular biology, and which is one of the most challenging and useful to any really serious, gifted professional looking for breakthroughs along new frontiers.

Let them grasp the point, that AIDS now poses a greater threat to humanity than a balanced estimate would assign to the prospect of an actual thermonuclear war. Indeed, if we develop an SDI soon enough, a thermonuclear war is virtually excluded.

Obscurity is heavily populated with mobs of supposed experts who avowed the absolute impossibility of that which workers of more impassioned competence have contributed. Perhaps, the pacifists include some otherwise gifted persons; if so, to those, I emphasize again: Consider the new frontiers of optical biophysics; here is an area in which good physicists are invaluable, and could make a substantial contribution to the survival of the human species.

Sincerely,
Lyndon H. LaRouche, Jr.

mental concepts underlie the feasibility for a strategic defense based on directed energy? Lyndon H. LaRouche, Jr. has emphasized on numerous occasions that the feasibility of the SDI does not rest on any one or group of technologies, but rather on the proven coherence of action in the universe as a whole, and on the ability to transform the laws of the universe that is characteristic of the relativistic physics that underlies directed energy weapons. As LaRouche wrote in a 1982 essay, "The Cultural Determinants of an Anti-missile Beam Weapons Policy":

> The general technology under which a spectrum of many kinds of beam-weapons is subsumed is what appears to most at first to be a specialized aspect of physics, relativistic physics. Actually, if we trace out the history of modern science, from its roots in the grounding-work of Leonardo da Vinci nearly five centuries ago, we are obliged to recognize that all the fundamental accomplishments of modern science are rooted directly in the conceptions of relativistic physics already understood in broad principle by da Vinci. If we study closely, as we have been elaborating this in recent times, the functional interdependency between da Vinci's discovery of hydrodynamics and his work in relativistic geometry of visible space, something very important begins to become clear to us.
>
> Insofar as science and technology have been more or less limited to the mechanical or mechanistic aspect of physical processes, scientists and engineers, for example, have been able to manifest competence while relying upon the defective mathematical apparatus associated with Descartes, Newton, Cauchy, Maxwell, Helmholtz, and so forth. In relativistic physics, such reliance upon the so-called analytical or inductive method is not permissible. We are obliged to prefer the kind of physics typified by the work of Bernhard Riemann, and by such predecessors of Riemann as Gauss, Legendre, Carnot, Monge, Euler, Leibniz, Desargues, Kepler, and da Vinci. . . .
>
> The geometrical view of the universe, is typified by da Vinci, Kepler, Leibniz, and Riemann, who were explicit on this connection. The universe is proven to be not a "Big Bang" creation of a mechanical manifold. The universe is proven to be an endless process of continuing creation. In this universe lawfulness lies not primarily in fixed, mechanical sorts of laws, but rather in the consistency of certain higher principles which govern the way the universe is transformed from one entire general state to a higher state.

Only atheists who curse God's creation and would condemn mankind to eternal nuclear terror and Russian domination, would question this, as do ultimately the APS report's authors and other running dogs for Yevgenii Velikhov and the Soviet Academy of Sciences.

The SDIO's reply

Excerpts from the "Strategic Defense Initiative Organization Comments on the American Physical Society report on Directed Energy Technology":

Although the chapters in the report prepared by individual panels represent an objective independent appraisal of various technologies, we find the conclusions to be subjective and unduly pessimistic about our capability to bring to fruition the specific technologies needed for a full-scale development decision in the 1990s.

The report has the additional problem of being a "snapshot-in-time" that dates to the preparation of the report. We have made significant progress in the intervening period. In fact, some technologies have shown several orders-of-magnitude increase in performance. . . . [W]e would not have made several of the assumptions that they made in defining the technical requirements.

Specific examples:

1. With respect to the free electron laser (FEL), the report states that "scaling to short wavelengths at high powers is more difficult problem than simply increasing average power." During the period over which the report was being prepared,

- [W]e have operated our FEL in the visible light spectrum.
- Scaled the FEL down in wavelength by a factor of 800 (almost three orders of magnitude).
- Improved the brightness of the electron beam injector for the FEL by two orders of magnitude.

2. With respect to the neutral particle beam (NPB) program, the report states that "NPB accelerators . . . must be scaled up to two orders of magnitude in voltage and duty cycle," and further, "ion sources . . . have not be reported to operate continuously."

- In fact, we have demonstrated a continuous wave ion source that produces 50% more current than required and has already met our beam quality goals.
- A demonstration on the 5 Mev (Million Electron Volt) accelerator test stand at Los Alamos National Laboratory that the full beam current can be produced and accelerated with no significant emittance growth.
- The remaining issue of scaling up from 5 Mev to higher energies is now a modest extrapolation of beam accelerator technology.