PHYSICS and SOCIETY

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PHYSICS AND SOCIETY is a quarterly newsletter of the Forum on Physics and Society, a division of the American Physical Society. The newsletter is distributed free to members of the Forum and also to physics libraries upon request. It presents news of the Forum and of the American Physical Society and provides a medium for Forum members to exchange ideas. PHYSICS AND SOCIETY also presents articles and letters on the scientific and economic health of the physics community; on the relations of physics and the physics community to government and to society, and the social responsibilities of scientists. Contributions should be sent to the Editor: John Dowling, Physics Department, Mansfield University , Mansfield, PA 16933, 717-662-4275.

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THE TROUBLE WITH FUSION

By Lawrence M. Lidsky, Department of Nuclear Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139. (Synopsis of paper presented at April 1984 Washington Meeting of the APS.)

The U.S. Fusion Program has focussed all its efforts on a reactor that will inevitably be large, radioactive, complex and as a result, probably highly unreliable. The trouble with fusion is not that it will not work, it is that no one will want the reactor that we are trying to build.

This strong assertion leads naturally to three questions: How can we be sure? How did we get into this problem? What should we do now?

1. How Can We Be Sure?

The properties of the fusion fuel determine the characteristics of the fusion reactor much as the choice of wood, coal, oil or uranium determines the character of any ordinary power plant. The fusion program has concentrated all its attention on the burning of deuterium fuel, usually via the deuterium-tritium reaction. Both deuterium and tritium are isotopes of hydrogen--the former occurs naturally in great profusion, the lotter is extremely rore, radioactive, and must be generated as a by-product of the fusion reactor.

The D-T reaction releases 80% of its energy in the form of very high energy (14 MeV) neutrons. These neutrons are extremely damaging to a reactor structure, render it radioactive, and require thick structures to slow down and capture them. By contrast, the uranium fission reaction releases only 3 percent of its energy in the form of neutrons and these are typically less than 1 MeV in energy. Thus, even though we don't know exactly what the reoctor will look like, we do know that the neutron damage that is the bane of ordinary fission reactors must be far more severe in fusion reactors. Furthermore, the requirement that the fusion reaction taken place in a vocuum tends to result in higher heat loads and stricter requirements for structural integrity than for an equivalent fission reactor.

Fusion does have some undisputed advantages. For example, a fusion reactor can, in principle, be built that would have substantially less radioactivity than an equivalent fission reactor and the problems of radioactive waste disposal would be substantially alleviated. Nonetheless, the fusion reactor would still be far too radioactive for "hands on" maintenance and so even minor accidents that do not threaten the public could render the plant inoperable for long periods of time.

Fusion also has the advantage that its deuterium fuel is essentially inexhaustable. If no other fuels were available, this alone would make up for fusion's disadvantages. However, it is becoming increasingly clear that we will not run out of uranium within the foreseeable future, if ever.

In simplest terms, fusian has same seriaus disadvantages even when campared ta the present generatian af fissian reactar plants (which have sufficient problems af their own) and its advantages do not seem strong enough to sway the balance.

2. HOW DID WE GET INTO THIS PROBLEM ?

With the very best of intentions: it sure seemed like a good idea at the time.

The D-T reaction that is the root of the difficulty was recognized early on to have substantial engineering difficulties, although the true magnitude of the problem has only become obvious fairly recently. The real question, therefore, is why did we concentrate on D-T to the exclusion of everything else? This scientist had one set of reasons, the program administrators another.

The scientist simply saw the D-T reaction as the fastest route to a self-heating, power producing plasma, a fascinating realm of physics. They believed, as scientists do, that if the scientific problems could be solved, the engineering ones would prove relatively trivial. From the laboratory point of view, this is probably true. However, in the larger world, in which a fusion powered energy source has to compete with other existing or developing power sources, o scientific and technological triumph might be an economic disaster. For example, it might well be possible to build a coal-fired, cast-iron airplane (and a lot of us would have fun trying) but it hardly seems likely to compete successfully with the existing kerosene powered aluminum and steel jef aircraft of today.

The second reason for the early concentration on the D-T cycle was the belief that the public, and especially Congress, needed a near term goal to focus on. It was thought that the necessarily very expensive fusion program could not be supported solely as a scientific endeavor. Furthermore, a self-imposed deadline was set early in the program when it was believed that the successful introduction of the LMFBR into the U.S. economy, providing unlimited uranium, would render worthless fusion's status as an unexhaustible energy source. Thus, the program directors determined to have a fusion reactor ready before too many LMFBR's were installed. The need for haste has vanished but the schedule does not reflect our changed environment.

3. WHAT SHOULD WE DO NOW?

We should carry on the plasma physics and fusion engineering programs with must less regard for their eventual reactor embodiment. The particular reactor type that is the present goal is neither needed nor wanted and our increasingly narrow tunnel vision makes it unlikely that alternatives will be discovered. The fusion program can be justified on the basis of the broad range of application of plasma physics and on its demonstrated technological spinoffs.

REFERENCES

L.M. Lidsky, "The Trouble With Fusion", Technology Review **86**, 32-44. (Oct. 1983).
L.M. Lidsky, "End Product Economics & Fusion Research Program Priorities," Journal of Fusion Energy **2**, 269-292 (1982).

Space-Based Ballistic Missile Defense

by Kurt Gottfried, Laboratory of Nuclear Studies, Cornell University, Ithaca, NY 14853. (This is a summary of a paper presented at the April 1984 Washington APS Meeting.)

The President's Strategic Defense Initiative has created a great deal of interest in space-based systems that could intercept ICBMs in boost phase. We shall concentrate on this portion of ballistic missile defense (BMD) because it is not possible to have a defense of our society without highly proficient boost phase interception. Furthermore, the conceptual systems that have been proposed for boost phase interception are quite closely linked to contemporary physics, and are therefore of greatest interest to attendees at a meeting of the American Physical Society.

The proposed boost-phase interception schemes can be divided into two broad classes: those that use components which are permanently based in space, and those which are launched into space at the time of an attack. We call the former orbiting BMD, the latter pop-up BMD.

The generic advantages and disadvantages of orbiting and pop-up BMD will be discussed. Particular attention will be given to the vulnerability of both types of systems to circumvention, countermeasures, and attack.

As a concrete example of an orbiting system, we shall consider excimer lasers on the ground that use mirrors in low and geostationary orbits to direct their beams towards enemy boosters. The X-ray laser, pumped by a nuclear explosion, and based on submarines, is the only pop-up system proposed thus far, and it too will be described.

We shall show that orbiting BMD is exceedingly vulnerable to devastating attack by relatively simple antisatellite weapons, such as space mines and pellet swarms, and that the X-ray laser could not attack Soviet ICBMs if the Soviets were to modify their boosters so as to burn out as quickly as the MX.

The talk will close with a brief discussion of the implications for existing and future arms control agreements, for crisis stability, and for the arms race. We shall argue that the Strategic Defense Initiative, if pursued, will have serious and deleterious impacts on all of these.

THE ATTEMPT TO CURB SCIENTIFIC FREEDOM

Robert L. Park, The American Physical Society, 2100 Pennsylvania Ave., N.W. Washington, DC 20037 and Dept. of Physics and Astronomy, University of Maryland, College Park, MD 20742.

During the period from 1976 to 1979, the Government of France invested perhaps $200 million in an invention that used the echo from a newly-discovered particle to map petroleum deposits from the air. The device, invented by a Belgian count, appeared to be marvelously successful in its initial tests flying over areas that had already been mapped by conventional geologic techniques. French President Valery Giscard d'Estaing, realizing that such an invention could alter the course of history, ordered tight government secrecy to maintain France's lead in this new technology.

By 1979 there were problems. Despite the spectacular success of the early tests, l'avion renifleur or "the sniffer plane" had failed to uncover any new petroleum reserves. Only then did the government appoint a prominent nuclear physicist, Jules Horowitz, to investigate. Government officials, it seems, had thus far not even had a close look at the device, having been warned of possible dangerous radiation. It took only minutes for Professor Horowitz to devise a test that exposed the machine as a fake. It turned out subsequently to be nothing more than a clever video recorder that stored the images of existing geologic surveys. Count de Villegas and his associates promptly disappeared.

But, if it was secrecy that permitted this deception to go unchallenged for three years, it was also secrecy to which the government turned to avoid embarrassment. Indeed, information about the scam did not leak out until early this year and only then, it seems, because the party in power welcomed the opportunity to expose its predecessor as incompetent.

Before you laugh too hard at this example of Gallic gullibility, consider the acquisition by the United States Navy of a device called a Multi-Spectral Image Intensifier. According to investigative reporter Ron McRae in a recent interview on the National Public Radio program "All Things Considered," the purpose of the device was to amplify the mind power of psychics who had been hired by the Navy to predict the movements of Russian submarines by "remote viewing." With the amplification provided by the new device, they would be enabled not only to see the Russian submarine but to interfere with its operation as well.

Hopefully these are isolated examples. But because of government secrecy, we can never be certain. In any case they serve to illustrate the extent to which erroneous or even fraudulent science may go unchallenged and the foolishness of government officials unrevealed behind the cloak of official secrecy. Yet, most of us would concede the necessity for governments to guard closely certain information. In seeking the correct balance between security and openness, however, the consistent trend for more than three decades has been to relax the use of classification. In early April of 1983, however, just one year ago, the Reagan Administration issued a new Executive Order on Security Classification Policy and Procedures. This Directive, Executive Order 12356, significantly expands the categories of classifiable information and makes it possible for the first time to reclassify information that has been previously declassified. The Directive prohibits the classification of basic scientific research information not "clearly related to the national security," but since neither relation to national security nor basic research is defined, the effect is unpredictable.

Scientific secrets are, of course, quite unlike other state secrets. They are held first by Nature, and our opponents can learn them as we do, without violating our security. The futility of attempting to permanently lock up scientific and technical information is widely, if not universally, recognized in the responsible federal agencies. As an alternative, the emphasis in recent years has been on attempts to restrict the flow of information to our adversaries by means that fall short of actual classification. The object is simply to slow down the acquisition of our technology by our opponents. The danger, of course, is that in denying the information to our opponents, we may inadvertently deny it to ourselves.

Consider, for example, changes to the Export Administration Regulations proposed by the Department of Commerce. Under the proposed regulations a Validated Export License would be required to export any new information on microcircuit fabrication, including such fundamental topics as epitaxy. Among the actions taken to constitute "export of data"are:

--Teaching in a classroom containing foreign nationals.

-- Presentation of technical papers with foreign nationals in attendance.

-- Informal communication with foreign nationals, including visits, private letters and other oral exchanges.

What effect will these xenophobic restrictions have on industry seeking to compete in an international marketplace?

-- The supply of engineers and scientists trained in state-of-the-art microcircuit fabrication would be effectively cut off, since it appears that few universities would be willing even to consider conducting classes restricted to U.S. citizens only. Perhaps half of all graduate students in physics and engineering are foreign nationals.

-- Many industries involved in consumer electronics employ significant numbers of technical people who are not U.S. citizens and do not have permanent status. These regulations would appear to make that impossible.

-- Industries would be barred from communicating new developments to their own foreign subsidiaries.

-- These regulations would severely restrict discussions with potential foreign customers and even domestic customers if they employ foreign nationals.

These are all obstacles that our economic competitors do not face. Mircrocircuit fabrication is not an area in which the United States enjoys a monopoly, and these new regulations, if imposed, would give a distinct competitive edge to the Japanese.

It seems quite clear that these changes were drafted by people who have little idea of the workings of the research and development enterprise, and indeed there is no identification that if left unchecked these people will stop here. In addition to the MCTL, which is classified, and hence not even available to industry in its entirety, there is an additional list bearing the acronym "METAL" which is the Militarily significant Emerging Technologies Awareness List. It is a list of new technologies that should be considered for inclusion in the MCTL. Included on that emerging list is biotechnolgy, the one area in which the United States enjoys a clear and even overwhelming lead over the rest of the world. It seems reckless in the extreme to experiment with regulations that might well have the effect of destroying that lead.

In addition to such major statutory authorities for the control of scientific information as the Export Administration Act, there are other regulations -- ranging from the Joint Committee on Printing Rules to the Federal Acquisition Regulations -- that could be used to restrict scientific communication. More disturbing is an amendment to the Defense Authorization Act of 1984 that would authorize the Secretary of Defense to withhold unclassified technical information in the possession of the Department of Defense from the provisions of the Freedom of Information Act. Moreover, a report by the Department of Defense Steering Committee on Export Control recommends that the DoD serve as a depository for other agencies wishing to shield documents from the FOIA.

In a recent editorial in **Physics Today**, Robert Marshak, past-President of the American Physical Society, wrote "Americans have never been comfortable with secrecy. It is too apparent that oppressive governments have the most to conceal. We have prided ourselves on the openness of our society, and when even our constitutional safeguards seemed inadequate to insure that openness, we invented the Freedom of Infomation Act, a totally unprecedented testament to the self-confidence of a nation." It would be unfortunate if the act of openness in government were to be circumscribed by amendments aimed at export control.

All of this has taken place in a general atmosphere of increased secrecy in government. Government actions, ranging from a clumsy attempt at censorship of an academy award winning documentary from Canada to the barring of the press from the Granada invasion, suggest a concerted effort to control the flow of information to the American people. The most serious case is the infamous National Security Decision Directive 84, issued in the spring of '83, requiring government employees and contractors with access to Sensitive Compartmented Information to sign a lifetime prepublication review agreement and authorizing the use of polygraph examinations on a

massive scale to prevent government leaks. Facing severe criticism from Congress, the White House has suspended implementation of the Directive but stopped short of withdrawing it.

The issue of scientific communication and national security is not a simple one. In recent years the Soviets have acquired our technoolgy at a rate that some regard as alarming. We are all concerned when developments paid for by the American taxpayer are acquired at little cost by our opponents. They have done this in large measure through the collection of unclassified technical information. In an attempt to stem this flow (it has been called a "Hemorrhage"), the government has taken or is contemplating measures that threaten our most cherished values, and will in any case prove harmful to the very system that has given us our lead in technology. It would be far more serious if we were forced to rely on the theft of Soviet technology.

SOME THOUGHTS ON THE X-RAY LASER AS PUMPED WITH A NUCLEAR WEAPON by David Hafemeister, Physics Dept., Cal Poly University., San Luis Obispo, CA 93407.

Physics and Society would like some contributions from the Forum membership on physics and society issues. One way to do this is to excerpt a section from a paper or report that is being published elsewhere. Here is my input from SPIE **474** (1984); now it is your turn.

This brief note on Excalibur will assume the best possible values for resolution and efficiency, and it will ignore countermeasures, basing modes, surprise scenarios, legalities, etc. In other words, this brief note calculates the lower limit on the necessary yield; it is easy to indicate mechanisms that would reduce the effectiveness of Excalibur.

I. Angular Resolution and Size of the X-ray Laser

There are two competing optical phenomena which tend to spread the x-ray laser beam: (1) geometrical ray optics, and (2) diffraction broadening. These two effects act in the opposite direction. A laser rod that is too broad in diameter will tend to have a wide angular resolution dictated by simple ray optics: $\theta = D/L$, where D is the diameter of the laser and L is its length. A laser that is too narrow in diameter will suffer from diffraction broadening; the angular resolution from a circular aperture is $\theta = 1.22\ \lambda/D$ where λ is the wavelength of the x-rays. By properly combining these effects, one can obtain the minimum angular resolution

$$\theta_m = 1.6\ (\lambda/L)^{0.5} \qquad (1)$$

and the diameter of the rod to obtain the minumum resolution,

$$D_m = 1.1\ (\lambda/L)^{0.5} \qquad (2)$$

Using $\lambda = 1.4$ nm and $L = 2$ m, $\theta_m = 4.1 \times 10^{-5}$ radians for the half angle and 8.3×10^{-5} for the full angle. The diameter of the rod needed to obtain this value of θ is $D_m = 58$ microns; this value is similar to the diameter of 30 microns suggested by Chapline and Wood. This is about the 1/e depth in zinc for 10 keV photons from the weapon. These authors indicate that it is quite difficult to design an x-ray laser which would allow values of D much less than $(\lambda L)^{0.5}$

These narrow rods have a very small volume of about 0.005 cm^3 which would contain only about 4×10^{20} atoms of zinc at normal densities (more when compressed). If each atom contributed only one x-ray of 1 keV to the pulse, this would imply a total energy of about $Q = 6 \times 10^4$ J per pulse. Since a burst from the x-ray laser must have about 10^{11} J (Sec. IV), it is clear that each atom must contribute many x-rays to the pulse of x-rays. One way to enhance the process would be to use many "fibers" of Zn to develop multiple parallel poths.

II. X-Ray Energy On Target

It is generally accepted that energy densities of about 1 kJ/cm^2 should be able to disoble a missile booster, The Fletcher report on Defensive Technologies [8] has used the range of 0.4 to 2 kJ/cm^2 for present booster hardness; other Department of Defense Studies indicate that the USSR might be able to harden their ballistic missile booster to about 20 kJ/cm^2. A re-entry vehicle (RV) would have a greater hardness of about 150 kJ/cm^2. As an initial requirement for destroying missiles in the boost phase, we will use the value of 1 kJ/cm^2, and then allow for an additional hardening of a factor of 20 for the booster and 150 for the RV.

The x-ray laser is intended to have a kill radius of about 1000 to 2000 km. Using a full-angle width of the laser beam at 1000 km is $W = (10^6 m)\ (8.3 \times 10^{-5}) = 83m$, which gives an area of $W = 7 \times 10^7\ cm^2$. In order to destroy a missile booster at this distance, it would require a beam of energy of

$$Q = (1000\ J/cm^2)\ (7 \times 10^7\ cm^2) = 7 \times 10^{10}\ J \qquad (3)$$

for the unhardened booster, and 1.4×10^{12} J for the hardened booster, and 10^{13} for the RV. Alternatively, this would require a beam intensity per steradian of

$$(Q)/(2\ O_M)^2 = 7 \times 10^{10}\ J)\ (8.3 \times 10^{-5})^2 = 10^{19}\ J/steradian \qquad (4)$$

for the unhardened missile, 10^{20} J/steradian for the hardened missile, and 10^{21} J/steradian for the RV. These results are consistent with the report on Fletcher Report which "requires validation at moderate brightness -- 10^{19} J/steradian, plus upgrading to three orders of magnitude."

III. Efficiency and Yield for the X-ray Laser

Let us assume that there is one x-ray system attached to a nuclear warhead. Let us **optimistically** speculate that 1% of the black-body radiation is able to be contained in the laser system, and that the laser can covert 10% of that energy into the laser pulse; this give a speculated all-over efficiency of 0-1% of the system. If 70% of the energy of the warhead is emitted as black-body radiation, the lower bound yield of the weapon would be

$$Y = (1.4)(10^3)\ (7 \times 10^{10}) = 10^{14}\ J = 25\ \text{kilotons}, \qquad (5)$$

against an unhardened booster, a yield of 500 kilotons against a hardened booster, and 4 megatons against an RV. Some drawings have indicated that the x-ray laser system might have as many as 50 laser weapons for 50 separate targets; then the required yields would have to be a factor of 50 times larger.

Deterrence - a split moral track.
We can threaten but may not attack.
Is possession excused
If weapons aren't used?
On such questions we can't
turn our back.

Barbara Levi

FORUM PROGRAM COMMITTEE WANTS YOUR SUGGESTIONS

The Forum Program Committee would like suggestions from the membership for future invited paper sessions at APS meetings. Please describe the topic and some suggested speakers to the Committee:

David Hafemeister, Physics Dept., Cal Poly University., San Luis Obispo, CA 93407.

Henry Kelly, Office of Technology Assessment, Washington, DC 20510.

Barbara Levi, Center for Energy and Environmental Studies, Princeton Univ., Princeton, NJ 08540.

VERY TENTATIVE FORUM SESSIONS

FOR 1984-85

Please give your comments to Dave Hafemeister, Physics Dept., Cal Poly Univ., San Luis Obispo, CA 93407.

I. Annual Meeting in Toronto, Canada (Jan. 20-24, 1985)

1. Physics/Chemistry/Policy of Acid Rain.
2. Midgetman Missiles: A Viable Alternative?
3. The Electromagnetic Pulse: Physics and Effects.

II. March Solid State Meeting in Baltimore (March 25-29, 1985)

1. Strategic Materials: Jugular veins and Stockpiling
2. Technology and Communications
3. Anti-submarine Warfare

III. Washington Meeting (April 25-27, 1985?.

1. The Nuclear Winter.
2. Forum Awards Session.
3. Policy Session of the Forum Energy Short Course
4. SHORT COURSE ON PHYSICS OF ENERGY: PRODUCTION/CONSERVATION (below)

IV. Fall Meeting 1984, etc.

V. Short Course on Physics of Energy: Production/Conservation.
(Sat/Sun, Ap. 23-24, 1985; 7 sessions, 600 page AIP Book, $40)

3. POPA Studies

Summary of Minutes of the Executive Committee Meeting of the Forum 24 April, 1984 submitted by Peter Zimmerman, Physics Dept. Louisiana State Univ., Baton Rouge, LA 70803.

I. Outgoing Chairman W. Chinowsky described the events of the preceding year:

a. Five of the Forum's nominees to APS Fellowship were approved by Council; awards were made on 23 April 1984. Further nominees, including those not yet acted upon, will be reviewed by a super committee to scrutinize "non-traditional" nominees from the **Forum**, the Division of History of Physics, and those who cannot be properly classed in any one division.

b. Some minor difficulties having to do with awards were discussed.

c. Dr. Chinowsky recommended changing the "regular" meeting of the Executive Committee to the Washington (area) meeting. He noted that the number of full National Meetings of the APS had been reduced; only three remain.

d. The CIFS (Committee on International Freedom of Scientists) did not share in the sponsorship of a symposium this year.

e. There was discussion on what made a good (high impact) symposium. The one held on Monday, 23 April, was a good one and confounded previous ideas since it was almost wholly technical. It seems that technically oriented symposia can do well if there are good abstracts in the **Bulletin.**

f. Co-operation with other societies; some letters were sent out over the signature of President Marshak of the APS.

II. Treasurer's Report:

The treasurer's report was read and approved. Because all records have not (still -- 25 May) been received at LSU, the report was compiled by George Carroll of the APS. Members of the Committee asked if it would be possible to put the Awards Fund in an account which bears a higher rate of interest. The question of payment to speakers for travel to Symposia was also raised. There seems to be general agreement that we can only pay for non-physicists, and then only under special circumstances.

III. It was moved and seconded that an appropriate resolution be sent to Joe Burton on the occasion of his impending retirement from his post as Treasurer of the APS thanking him for his long service to the Society and for his special friendship for the Forum.

IV. Newsletter: Editor John Dowling explained the large fluctuations in the cost per page and cost of the newsletter. Going to 3-column format with smaller type will hold down the rise in price. The APS has said that they could take over some of the production, but John is not sure it would save any money.

V. Report of the Forum Councilor: Ken Ford reported as follows:

a. New "Star Wars" study to be headed by N. Bloemgergen and K. Patel with George Pake heading the review committee.

b. Richard Wilson's reactor safety study should be reporting out soon.

c. There will be an APS-wide committee to review the proliferation of APS and Divisional prizes. Ken will be the Forum's representative.

d. Ken proposed that the Forum request that L. Sartori be appointed to the Star Wars study. Motion passes.

VI. Panel on International Scientific Affairs (PISA).

This is a bit confusing, and confusing to Council as well, I think. There is some desire that it be an "action group", but nobody is quite sure what that should mean. Many foreign societies ask APS's advice on various topics. There is talk of making PISA at the same high level as POPA, but it is not clear why it should be. PISA will take over CIFS's duties. PISA is to "Promote co-operative international efforts, particularly in physics..."

VII. Report of the Fellowship Committee by P. Zimmerman with Ken Ford:

The criteria which were adopted and approved by Council were distributed. There was some committee discussion, but upon Dave Hafemeister's motion, the criteria were accepted unanimously by the Executive Committee. John Dowling will publish the criteria in the newsletter.

VIII. Dave Hafemeister reported on POPA Task Groups:

Groups will cover (a) federal R&D funding and policy, (b) science education, (c) the scientific community and national security and (d) arms control and nuclear deterence. Dave suggested adding **energy** and making a joint study with the American Geophysical Union on monitoring a comprehensive test ban agreement.

IX. Motion to amend by-laws to make the Washington meeting the "Regular Meeting;; of the Exec. Comm. passed unanimously.

X. John Parmentola reports he can no longer serve as Forum rep. on CIFS. He has recommended **Julian Heickelen** as his replacement. Agreed to by Exec. Comm.

XI. Reports on Forum Studies in Arms Control:

a. P. Zimmerman discussed proposed study on land-based missiles. He distributed a pre-proposal document asking for help from the members of the Exec. Comm. to improve it before transmitting it to POPA and ultimately Council. (note: as of 25 May only D. Hafemeister has made any comments...help!) Carol Crannell suggested deleting the request for salary funding.

b. J. Dowling discussed the civil defense study project. They held a successful symposium at the Detroit Meeting. They will have a briefing from FEMA in the Washington area on 15 June (tentatively) and work at George Mason University for a few days. He requests travel to DC for 4 or 5 people for his June meeting. About $3,000. The Committee agreed to pass the request forward to the Society.

c. EMP: this study ran into security problems, and C. Vittitoe of Sandia Labs was forced to step down from it. Wanted to do a 2-part study covering both the "Hawaii Incident" and the production mechanisms. Project is now more-or-less on hold trying to find a replacement for C. Vittitoe. Sid Drell suggested we should be able to find people in the Forum.

XII. It was announced that the 1985 DC meeting would not run Monday-Thursday.

XIII. Short Course on energy:
Dave Hafemeister is authorized to try to set up a course but is asked to keep in touch before committing funds. The course should be confined to the subject of "energy conservation".

Criteria For Nominating Forum Members To Fellowship In The American Physical Society

The constitution and bylaws of the APS state that Members elected to Fellowship shall be those "who have contributed to the advancement of physics by independent original research or who have rendered some other special service to the cause of the sciences. The fulfillment of these qualifications shall normally be determined by an examination of the published works of the candidate."

The **Forum on Physics and Society**, wishing to encourage the nomination of Fellows from among the membership of the **Forum**, has interpreted the very brief constitutional requirements and developed a set of criteria to guide **Forum** members and the **Forum** Committee on Fellowships. The **Forum** considers that there are two principal categories of achievement to be recognized in nominating Fellows. These are (1) distinguished original research in fields of physics with direct relevance to society at large, and (2) distinguished public service, especially when based on training or skill in science. Under exceptional circumstances, distinguished service to the APS in fields relevant to the **Forum's** activity may also justify nomination to Fellowship.

1. The standard of excellence in research applied to candidates from the **Forum** shall be the same as applied to candidates for election to Fellowship from other Divisions of the Society. This research may illuminate an issue of public policy or itself provide the answer to an important public policy question. Such research should be both significant and sustained.

2. The category of distinguished public service is intended to recognize members of the Society for their leadership and significant contributions, individually or through work in organizations, to the efforts to solve problems of public policy using science. This category is also intended to recognize those physicists who write, lecture, edit, or otherwise contribute with distinction to public understanding of physics and the relationship between physics and society; or who per-

form unusually valuable public service in government or industry; or who distinguish themselves in fields in which physics is directly applied to public problems and policies. Public service, to be recognized by election to Fellowship, must be sustained and distinguished. It is anticipated that such work will ordinarily result in a substantial body of tangible achievements which lend themselves to objective examination. Public advocacy, no matter how visible or influential, is not by itself a basis for nomination of Fellowship.

3. In exceptional cases, distinguished service to the APS could be recognized by election to Fellowship. Such service must be relevant to the role of the **Forum** and must be sustained and in a leadership role. It will ordinarily produce results which can be examined as if they were part of the published works of the candidate. The holding of elected office in the **Forum** or APS shall not, by itself, be considered cause for advancement to Fellowship.

REPORT OF THE FORUM COUNCILOR TO THE FORUM COMMITTEE by Kenneth W. Ford, Molecular Biophysics Technology, 3508 Market St., Philadelphia, PA 19104.

Items from the Council meeting of 15 April 1984:

1. European Physical Society/APS Cooperation. As part of the April 1985 Washington meeting, there will be a symposium on "international physics".

2. Prizes. Prizes in the APS--both Society prizes and divisional prizes--are proliferating. Millie Dresselhaus will appoint a task force on prizes. At my request, she will include a Forum representative on this task force.

3. POPA Studes.

(a) The reactor safety study ("source term" study) chaired by Richard Wilson has had several meetings and hearings. Preparation of a final report is scheduled to take place in late July-early August in Snowmass.

(b) The study on directed energy weapons now has two co-chairmen: N. Bloembergen and K. Patel. G. Pake will chair the review committee. Proposals for NSF and private foundation support will go forward shortly. Council approved $25,000 as seed money to get things started. The estimated total budget is $660,000.

Suggestions for study panel membership are needed.

It is hoped to have the study begin with a summer residence period in August.

(c) A possible joint study with the American Geophysical Union on implications of a nuclear test ban treaty is under discussion.

4. PISA-IPG. The concept of the Panel on International Scientific Affairs (PISA) is still evolving. It could be "imbedded" as part of the Executive Committee of the International Physics Group (IPG); it could be a separate, Council-appointed body analogous to POPA; or it could be a committee, analogous to the Committee on International Freedom of Scientists, the Committee on Education, etc. The Forum Executive Committee should offer its opinion on this question to Council. The question is what importance attaches to international scientific affairs **relative** to the importance attached to other concerns such as education, minorities, women, public affairs, international freedom, etc.

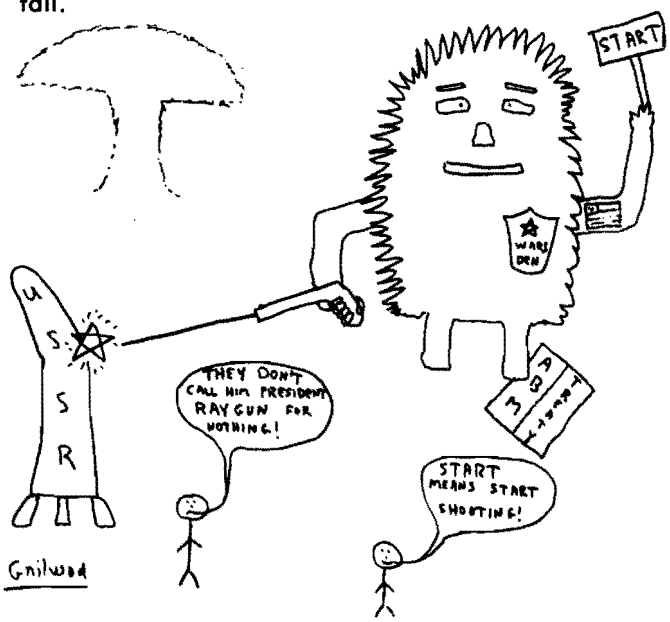
5. OPA. On a trial basis, starting this summer, the Office of Public Affairs (Bob Park) will issue a "What's New" electronic bulletin board on Telemail, updated weekly, and free to interested APS members. His "What's Happening" newsletter will continue. POPA's four issue-oriented task forces will oversee the activities of OPA in the areas of

Federal R & D policy and funding,
Science Education,
Scientific communication and national security,and
Arms control and nuclear deterrence.

6. CIFS. A written report on activities of the Committee on International Freedom of Scientists (CIFS) is available from Pierre Hohenberg. "Small committees" are now supporting 63 individuals a la Amnesty International. Millie Dresselhaus suggests re-establishing more CIFS-POPA links.

7. APS Fellows. (a) Fellowship for several Forum members based on public service and/or research related to physics and society was approved. (b) Criteria for Fellowship for Forum members were approved (see attached).

Incidental information: APS members will all receive the directory of physicists and astronomers free this fall.



QUESTIONNAIRE FOR THE ROSTER OF WOMEN IN PHYSICS
COMMITTEE ON THE STATUS OF WOMEN IN PHYSICS
THE AMERICAN PHYSICAL SOCIETY

The information from this questionnaire will be used to compile rosters of women in physics, to form a mailing list for the CSWP Gazette, to select women to receive announcements of probable interest to them, and to compile demographic data on women physicists. This information will not be made available to commercial or political organizations as a mailing list. Being listed on the roster only identifies the woman as a physicist and does not imply agreement with or support for the activities of the Committee on the Status of Women in Physics.
INSTRUCTIONS: Please indicate your responses to the following by printing one character within each pair of tick marks. Abbreviate as necessary.

NAME: (last) (first)
(middle) optional: (maiden)

My Roster of Women in Physics data provided is:
☐ A new entry ☐ A revised/updated entry ☐ I don't know which
If this is a revised/updated entry, please provide your Roster Registration number, if known _____
(Your Roster Registration number appears in the upper right hand of mailing labels produced from the Roster.)

On the following line, please enter your full name and title exactly as you wish it to appear on your mailing label.

Please enter the address and phone number at which you prefer to be contacted and indicate whether: ☐ Home or ☐ Business

ADDRESS line 1:
Address line 2:
Address line 3:
City/State/Zip: (city) (state) (zip)
Primary phone: (area) / (number) Alternate phone: (area) / (number)

DEGREES	YEAR received or expected	INSTITUTION
BA/BS		
MA/MS		
PhD		

THESIS TOPIC (highest degree)
(continue if necessary)
EMPLOYER NAME:
DEPT/DIV ETC:
POSITION TITLE:
COMMENTS: _____

Highest Degree (check one)	FIELD OF PHYSICS	Current Interest (check one)
1 ___	Astronomy & Astrophysics	1 ___
2 ___	Acoustics	2 ___
3 ___	Atomic & Molecular Physics	3 ___
4 ___	Biophysics	4 ___
5 ___	Chemical Physics	5 ___
6 ___	Education	6 ___
7 ___	Electromagnetism	7 ___
8 ___	Electronics	8 ___
9 ___	Elementary Particles & Fields	9 ___
10 ___	Geophysics	10 ___
11 ___	High Polymer Physics	11 ___
12 ___	Low Temperature Physics	12 ___
13 ___	Mathematical Physics	13 ___
14 ___	Mechanics	14 ___
15 ___	Medical Physics	15 ___
16 ___	Nuclear Physics	16 ___
17 ___	Optics	17 ___
18 ___	Plasma Physics	18 ___
19 ___	Physics of Fluids	19 ___
20 ___	Thermal Physics	20 ___
21 ___	Solid State Physics	21 ___
22 ___	General	22 ___
23 ___	Condensed Matter Physics	23 ___
24 ___	Space Physics	24 ___
25 ___	Other (please specify below)	25 ___

_____
_____

CURRENT WORK STATUS
(Please check one or more as applicable)

1 ___ Student
2 ___ Post Doc/Res Assoc
3 ___ Unemployed
4 ___ Retired
5 ___ Employed
6 ___ Self-employed
7 ___ Full time
8 ___ Part time

FOR HIGHEST DEGREE (Please check one)

1 ___ Theoretical
2 ___ Experimental
3 ___ Both
4 ___ Neither (please explain below)

_____
_____

TYPE OF WORKPLACE FOR CURRENT OR LAST WORK (Please check one or more)

1 ___ University
2 ___ College—4 year
3 ___ College—2 year
4 ___ Secondary School
5 ___ Government
6 ___ National Laboratory
7 ___ Industry
8 ___ Non-Profit Institution
9 ___ Consultant
10 ___ Other (please specify below)

_____
_____

TYPE OF ACTIVITY
(Please enter a 1 for the activity in which you engage most frequently, 2 for the second most frequent, etc. for all significant aspects of your current or last work)

1 ___ Basic Research
2 ___ Applied Research
3 ___ Development and/or Design
4 ___ Engineering
5 ___ Manufacturing
6 ___ Technical Sales
7 ___ Administration/Management
8 ___ Writing/Editing
9 ___ Teaching—Undergraduate
10 ___ Teaching—Graduate
11 ___ Teaching—Secondary School
12 ___ Committees/Professional Org.
13 ___ Proposal Preparation
14 ___ Other (please specify below)

_____
_____

Thank you for your participation.
Please return the questionnaire to:

Dr. Irene Engle
Physics Dept., U.S. Naval Academy
Annapolis, MD 21402

Are you interested in receiving information on employment opportunities? ___Yes ___No