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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, Department of Physics and Astronomy, Michigan State University, E. Lansing, MI 48824-1116, 517-353-9179.

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NUCLEAR WINTER AND STRATEGIC DEFENSE INITIATIVE by Caroline L. Herzenberg, Argonne National Lab EES-362, 9700 South Cass Ave., Argonne, IL 60439.

Abstract. This communication discusses the capability of large-scale directed energy missile defense systems in space for causing extensive fire damage if redirected to surface targets, and the potential climatic effects of such fires. The study was undertaken because of the importance of the Strategic Defense Initiative in the national security and arms control areas, and concern that recent analyses in the literature of the advantages and disadvantages of ballistic missile defense systems have had too narrow a focus, addressing only the potential of such systems within the context of their intended application as defensive systems. The conclusions are that such large-scale space ballistic missile defense systems employing high intensity lasers operating at frequencies at which the atmosphere is substantially transparent, may have the potential for causing devastating surface fires so massive that severe climatic effects similar to those addressed in nuclear winter calculations may ensue.

Since 1982, there has been extensive discussion in the literature of the global atmospheric effects of nuclear war, and, in particular, of the possibly catastrophic climatic effects of smoke generated in a nuclear war, the "nuclear winter" effect.[1-3] It would appear to be important to examine large-scale non-nuclear weapons systems to assess their potential effects in ameliorating or exacerbating a nuclear winter, or indeed even their potential for independently causing severe climatic effects similar to those of nuclear winter.

Since the advent of the concept of the Strategic Defense Initiative (SDI) in 1983, it has been clear that this ballistic missile defense technology offers the possibility of limiting the effects of nuclear winter even in a large-scale nuclear exchange, as a collateral effect of ballistic missile defense. This paper directs attention to the circumstance that alternative utilization of a large-scale defensive weapons systems similar to those envisaged in the context of the SDI or similar Soviet systems might in fact have the deleterious effect of leading to nuclear-winter-like effects independent of the occurrence of a nuclear war.

SDI has been characterized as "a new research program...to study how lasers, particle beams, and homing projectiles could destroy ballistic missiles to protect populations against a massive first strike."[4] SDI is based to a significant extent on directed energy missile defense in space, although recently kinetic energy weapons concepts have received attention.[4-6] The possibility of initiating severe climatic effects similar to those of a nuclear winter through use of a large-scale directed-energy missile defense system arises because lasers could be employed in a manner not originally envisaged in SDI, as has been discussed in a recent informal report by Latter and Martinelli:[1] "SDI: Defense or Retaliation?" Specifically, the laser weapons of such a large-scale system, instead of being targeted against offensive missiles and reentry vehicles in space, could be directed against targets on the ground, including cities. Rough calculations indicate that a laser defense system designed to be powerful enough to cope fully with the ballistic missile threat posed by either superpower might also have the potential of initiating massive urban fires and even of destroying the enemy's major cities by fire in a matter of hours. Such mass fires might be expected to generate smoke in amounts comparable to the amounts generated in some major nuclear exchange scenarios. Since it is primarily the effects of the smoke generated by fire in a nuclear war which lead to nuclear winter, it appears that a climatic catastrophe similar to nuclear winter might also result from such a ground-target-directed application of intense laser beam weapons from a large-scale system similar to a ballistic missile defense system.

What is the technical basis for such a judgment? We limit our attention to lasers, and exclude from consideration other weapons proposed for the arsenal of SDI, such as x-ray lasers, kinetic energy weapons, neutral particle beams, and laser-channeled electron beams.[4-7] Only space-based or ground-based lasers operating at wavelengths at which the atmosphere is substantially or appreciably transparent are relevant. (However, since systems information available in the unclassified literature is rather limited, data on laser weapons systems operating at other wavelengths will also be used for illustrative purposes.)

It is necessary to consider some specific examples to provide quantitative information to support the inferences stated earlier. A laser weapon causes damage by concentrating thermal energy on its target in excess of what the target could withstand without malfunctioning.[7] Various informed sources report that a laser beam applied against a missile must direct of the order of 10,000 joules/cm^2 of radiant energy for a time interval of the order of seconds in order to achieve such damage by thermal kill.[4,6,7] In fact, delivery of a burst of laser energy of 10,000 joules/cm^2 to burn through a missile skin in one second at a distance of 3,000 km has been described authoritatively as a reasonable level of lethality and an acceptable range in terms of the size of the constellation of platforms to deal with a massive attack.[4]

It should be noted that the radiant energy exposure of 10,000 joules/cm^2 required for a reasonable level of lethality against missiles far exceeds the radiant energy exposure needed for ignition of fires. The report by Turco et al. on nuclear winter defines the area of urban fire ignition by the 20 cal/cm^2 (80 joules/cm^2) contour,[1] more than two orders of magnitude smaller than the missile lethality value quoted above. Radiant exposures from nuclear weapons thermal radiation as low as 16 joules/cm^2 are reported to cause ignition of fires in some common household and outdoor tinder materials.[3,8]

Let us now examine the capability of a large-scale defensive system similar to what has been envisaged in connection with SDI for employing high-intensity lasers to initiate mass fires. Parameters appropriate to an orbiting chemical laser boost-phase intercept defense system using HF chemical lasers, radiating at 2.7 microns in the infrared, have been treated in the most detail in the open literature.[6] (This case would not be suitable for the incendiary attack mode under consideration here. Infrared radiation of this wavelength is attenuated by the atmosphere; however, most of it gets down to 10 km or so. Such lasers can be considered for a boost-phase intercept system.)[6]

Such a system might consist of 160 separate 20 megawatt HF chemical lasers, with output optics consisting of 10-meter mirrors, orbiting at 1,000 km altitude.[6] The minimum divergence angle for the resulting beams would be 0.32 microradians.[6] The spot from such a laser beam at a range of 4,000 km would be 1.3 m in diameter.[6] Twenty megawatts distributed over this spot size would give an average energy flux of 1.5 kw/cm^2. Thus, to irradiate a missile at this range at the nominal lethal fluence would require a target dwell time of 6.6 seconds. However, to irradiate at the nominal 80 joules/cm^2 for ignition of fires would require a dwell time of around 50 milliseconds. At a range of 2,000 km, perhaps more realistic, the dwell time for ignition of fires would be about 13 milliseconds.

Each such laser would be designed to be operable for at least 150 seconds, the accessibility time for boost-phase intercept for boosters resembling the U.S. MX missile.[6] Thus, assuming a negligible slewing time of the beam from target to target, each such laser could deliver the nominal fluence for ignition of fires at over 10,000 separate locations during the 150 seconds of total use. (These are order-of-magnitude numbers only. For more details, see the Appendix.)

What would be the efficacy of 10,000 separate simultaneous ignition points within a city in creating mass fires, such as conflagrations or in particular a fire storm? Experience during World War II may provide some guidance.[8,9] Conflagrations, as distinct from fire storms, are mass fires having moving fire fronts which can be driven by the ambient wind. The fire of a conflagration can spread as long as there is sufficient fuel. Conflagrations can develop from a single ignition, whereas fire storms have been observed only where a large number of fires are burning simultaneously over a relatively large area.[8]

In a fire storm, many fires merge to form a single, convective column of hot gases rising from the burning area and strong, fire-induced, inwardly radially-directed winds are associated with the convective column. The conditions under which a firestorm may be expected are not well known. However, based on World War II experience with mass fires in Germany and Japan, the minimum requirements for a firestorm to develop are considered by some authorities to be the following: (1) at least 8 pounds of combustibles per square foot of fire area, (2) at least half of the structures in the area on fire simultaneously, (3) a wind of less than 8 mph at the time, and (4) a minimum burning area of about half a square mile.[8] Since urban flammable material burdens average 10 grams/cm^2 in city centers,[1] corresponding to about 20 lbs/ft^2, under suitable weather conditions there is the potential for creating a firestorm if more than half of the structures in an area of half a square mile or more can be ignited simultaneously.

Staying with actual experience, the Hamburg firestorm was created during World War II when about 700 bombers in two attack phases dropped approximately 2,400 tons of mixed incendiaries and high-explosive bombs on the eastern and southeastern districts of Hamburg.[9] The Overall Report (European War) on the U.S. Strategic Bombing Survey states that two out of three buildings were afire within a 4.5 square mile area, while general fires were started over a total area of about 17 square miles.[9] In less than one hour, the fires in the core area had merged to form a mass fire; the total core of the firestorm embraced almost 4.5 square miles.[9]

If we use these numbers, we can make an order-of-magnitude estimate of the number of initiating points for firestorm formation. Allowing 30 buildings to the 1/8th mile city block, one finds roughly 6,000 equivalent initiating points for the Hamburg firestorm. The minimum criteria for development of a firestorm mentioned earlier appear to require only on the order of 500 initiating points. Thus, the capability of creating more than 10,000 simultaneous ignition points for fires appears fully adequate for creating a firestorm or conflagrations in an urban area under appropriate weather conditions. So it appears that a single laser battle station could have the capability of destroying a city by incendiary attack.

For a ballistic missile defense of the type that has been considered in connection with SDI, there would be a constellation of a large number of such battle stations deployed in orbit above the earth.[6,10] In the example under consideration, there would be 160 separate lasers of the type just examined orbiting in the base case (or possibly even 10 times as many should arsenals increase, or the system be enhanced to cope with fast-burn boosters).[6] Thus, substantially all of the major cities of either superpower could be targeted for radiative thermal attack by intense lasers, with the potential for creating mass fires in all of these urban areas within a matter of hours.

It should be noted that the estimates above take into account only the potential of the boost-phase portion of a large-scale ballistic missile defense system for incendiary attack application. Laser systems associated with post-boost, midcourse, and terminal defense might enhance the incendiary capability of a large-scale missile defense system by an order of magnitude or more.

Prior calculations[11] using somewhat different assumptions, and considering other types and configurations of lasers, indicate the possibility of even greater efficacy of a large-scale laser ballistic missile defense system for incendiary attack, and suggest up to a total of 100 million separate ignition points.

Could severe to catastrophic climatic effects like those of nuclear winter follow such a laser attack? Turco et al. found nuclear winter effects even in their 100 Mt city attack scenario, an attack which corresponded to burning 100 major cities with no other significant destruction.[1] Since an attack on cities by a large-scale laser weapons system similar in characteristics to those associated with directed energy missile defense systems appears to have the potential of creating massive urban fires in over 100 cities within a matter of hours, there appears to be a serious possibility that a nuclear winter could ensue directly from such a large-scale laser attack, without a nuclear war.

References and Notes

1. R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack, and C. Sagan, "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," Science 222, 1283 (1983).
2. R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack, and C. Sagan, "The Climatic Effects of Nuclear War," Scientific American 251, 33 (1984).
3. U.S. National Academy of Sciences - National Research Council, "The Effects on the Atmosphere of a Major Nuclear Exchange," (National Academy Press, Washington, D.C., 1984).

4. G. Yonas, "Strategic Defense Initiative: The Politics and Science of Weapons in Space," Physics Today 39, 24 (1985).
5. U.S. Department of Defense, "Report to Congress on the Strategic Defense Initiative," (U.S. Department of Defense, Washington, D.C., 1985).
6. A.B. Carter, "Directed Energy Missile Defense in Space," (Background paper prepared under contract for the Office of Technology Assessment, Washington, D.C., 1984).
7. K. Tsipis, Arsenal: Understanding Weapons in the Nuclear Age (Simon and Schuster, New York, 1983), pp. 183-211.
8. S. Glasstone and P.J. Dolan (eds.), The Effects of Nuclear Weapons, (U.S. Department of Defense and U.S. Energy Research and Development Administration, Washington, D.C., 1977), third edition, pp. 282-300.
9. C.H.V. Ebert, "The Meterological Effect in the Hamburg Fire Storm," Weatherwise 16, 70 (1985).
10. R.L. Garwin, "How Many Orbiting Lasers for Boost Phase Intercept?," Nature 315, 286 (1985).
11. A.L. Latter and E.A. Martinelli, "SDI: Defense or Retaliation?" RDA Logicon, R&D Associates, Marina Del Rey, CA, 28 May 1985.

Appendix: Notes on Attenuation and Beam Divergence

When laser radiation is transmitted through the earth's atmosphere, numerous physical processes can occur which, generally speaking, alter the nature of the beam. In particular, the beam will be attenuated by absorption and scattering processes. Absorption and scattering result not only from constituent gases of the atmosphere, but also from water vapor, water droplets, and other particulates including smoke and dust. The absorption and scattering cross sections are functions of wavelength; and attenuation of electromagnetic radiation in the earth's atmosphere is strongly wavelength dependent.[A1,A2]

The total beam attenuation is also of course dependent on the total path length through the atmosphere. For the case of a laser beam originating from an orbiting earth satellite and directed at a ground target, the minimum total path length through the atmosphere would occur for the case in which the laser is directed vertically downward (air mass 1, zenith angle 0° as seen from the target).[A1,A3] For this case, the earth's atmosphere would be rather opaque at some wavelengths; however, in certain other wavelength ranges, most notably in the visible as well as in several bands in the infrared, the earth's atmosphere is largely transparent, and the transmission of electromagnetic energy vertically down through the entire atmosphere can in some of the regions, under suitable conditions, exceed 75%.[A2,A3]

Not only can transmission be adequately large for a laser beam directed vertically downward from a satellite battle station; but also, even distant surface targets can be reached with appreciable beam transmission. This is because, for satellites at the altitudes under consideration, most of the beam path is in the vacuum of space, so that targets at even comparable or larger horizontal distances can be irradiated without great increases in the air mass traversed by the beam.

Thus, for example, a satellite battle station (or relay satellite) located 1,000 km above the earth's surface could direct a laser beam to attack a target at a slant range of 2,000 km; under these conditions (zenith angle approximately 60° as seen from the target location; target located approximately 1,700 km away from directly beneath the satellite), the air mass traversed by the laser beam would be only approximately twice as great as that traversed by a vertical beam; and the transmission of the beam would still exceed 60%.[A2,A3] Propagation of a laser beam in the earth's atmosphere will also be affected by atmospheric turbulence, and, for the case of high power laser beams, by phenomena such as laser blooming as well.[A4,A5]

Microscale temperature fluctuations, which are due to turbulent mixing, cause the refractive index of the atmosphere to vary by parts per million as a random function of position and time, affecting optical wave propagation in the atmosphere.[A4] Under moderate turbulence, the focal plane distribution of the laser beam retains its diffraction limited beam size, but moves randomly under the influence of the large turbulent scale sizes; in the presence of strong turbulence, the beam breaks up into many spots, each of which is also approximately the spot size of the transmitter's diffraction limit.[A5] Beam wander is a wavelength independent phenomenon, but beam spreading exhibits a weak theoretical wavelength dependence.[A5] Under conditions of severe turbulence, larger experimental values for beam wander can be obtained. Extensive experience with astronomical observations through the atmosphere is that the random behavior of the refractive index limits observations to a few seconds of arc.[A4] Thus, beam widths can be anticipated still to be small, with beam width increasing due to turbulence to the order of an arc second, equivalent to about 5 microradians, within the atmosphere.

Let us examine a beam directed vertically downward through the atmosphere. If we assume a divergence angle of 0.32 microradians at the source, then at the top of the atmosphere the diffraction-limited spot size will be approximately $0.32 \times 10^{-6} \times 1000 \times 10^{5} = 32$ cm. While traversing the atmosphere, the beam size will increase due to turbulence. By using the figure of 5 microradians through a propagation distance of 10 km for the thickness of the atmosphere, one can obtain an estimate of a further widening of the beam spot by about $5 \times 10^{-6} \times 10 \times 10^{5} = 5$ cm. Thus, the diffraction limited beam spot size on the ground will be increased by effects of turbulence in the atmosphere by about 15% to about 40 cm. The total area of the beam spot would thus be increased by atmospheric turbulence by about 50%, and the energy density incident on the target consequently reduced to about 45% of its previous value.

At high laser power levels, absorption of radiation can induce temperature changes in the atmosphere, which in turn result in density changes, and therefore index of refraction changes. These then alter the optical characteristics of the medium, and non-linear phenomena, in particular thermal blooming, result.

Although thermal blooming in air appears to be able to set in as low as a threshold of a power level of about 1 kW, it is at high irradiances that thermal blooming becomes of interest.[A4,A5] A laser beam directed from a battle station satellite toward a surface target will enter the atmosphere only after traversing 1,000 km or more in space. Thus the energy fluxes will be of the order of a few kW/cm^2, fairly small compared to the hundreds of kW per square centimeter characteristic of focal plane irradiances

discussed in connection with thermal blooming.[A5] So it would appear that non-linear optical phenomena may have only minor effects on this case.

An additional effect on the energy density of the laser beam spot is, of course, the orientation of the target surface relative to the laser beam direction. Initially, normal incidence on a target surface was treated for conceptual simplicity. However, consideration of surface orientations at different angles to the laser beam will introduce angular corrections that will reduce the effective intensity by the cosine of the angle of incidence. While this is a minor correction, it is necessary for different zenith angles, and it may be of interest if specific types of targets (e.g. combustible roof structures or combustible vertical external walls or tinder materials on horizontal surfaces) were to be considered.

The efficacy of laser beams operating in incendiary attack mode from space through the atmosphere toward ground targets can thus be reduced by a number of effects. Furthermore, the efficacy of such weapons would be critically dependent upon weather conditions, primarily for efficient transmission of laser energy to surface targets, but also because surface weather conditions (e.g., heavy snow cover) can significantly modify the effectiveness of energy deposition at the target in causing incendiary effects. However, it should be noted that use in offensive rather than defensive mode is envisaged in this application, so that not only the most suitable targets, but also the time (and weather conditions) would be of the attacker's choosing. Under suitable conditions, it would appear that a full-scale incendiary attack from a large-scale system of orbiting laser battle stations or ground-based lasers with relay satellites, might still pose an immense incendiary threat, possibly, as discussed, even marginally capable of initiating nuclear-winter-like climatic changes.

References

A1. R.A. McClatchey, R.W. Fenn, J.E.A. Selby, F.E. Volz, and J.S. Garing, "Optical Properties of the Atmosphere," in Handbook of Optics (W.G. Driscoll and W. Vaughan, eds.), McGraw-Hill, New York (1978).

A2. H.S. Stewart and R.F. Hopfield, "Atmospheric Effects," in Applied Optics and Optical Engineering (R. Kingslake, ed.), Volume 1, Academic Press, New York (1965).

A3. United States Air Force, Handbook of Geophysics, The MacMillan Company, New York (1960).

A4. J.W. Strohbehn (ed.), Laser Beam Propagation in the Atmosphere, Springer-Verlag, New York (1978).

A5. C.B. Hogge, "Propagation of High Energy Laser Beams in the Atmosphere," in High Energy Lasers and their Applications (S. Jacobs, M. Sargent III, and M.O. Scully, eds.), Addison-Wesley Publishing Company, Inc., Reading, MA (1974).

ENERGY CONSERVATION IN LARGE BUILDINGS by A. Rosenfeld and D. Hafemeister*, Energy Efficient Buildings Program, Lawrence Berkeley Laboratory, Berkeley, CA 94720.

* Current address is Physics Department, CalPoly Univ., San Luis Obispo, CA 93491. This article is excerpted from a chapter in the APS/Forum's book, Energy Sources: Conservation and Renewables, AIP 135, 1985 - see page 12 for more information on the book.

I. Scaling Laws for Buildings

As one might expect, big commercial buildings have quite different energy characteristics from small buildings, or residences. In large buildings the main source of heat gain is internal (equipment, people, lighting, solar, etc.). In small buildings the main heat gains and losses are external, the heat/coolth from the outside climate passing through the envelope, or shell, of the building. Let's roughly examine this transition from small to big by considering some scaling laws for energy gains and losses. Our building will be a cube of length L and of volume L^3.

The rate of winter heat loss from our building is proportional to its surface area, or $L^2\Delta T$, where ΔT is the inside-outside temperature difference. If the thermal conductivity of the building envelope (and fresh air) is K then $\dot{Q}(\text{loss}) = KL^2\Delta T$. On the other hand, the internal heat gains in our building are proportional to the floor space of the building which is proportional to the volume of a multistory building, or L^3, or $\dot{Q}(\text{gain}) = GL^3$. We ignore a term SL^2 for solar gain in winter. Without space heat or air conditioning, the steady state gains and losses are equal, or

$$\dot{Q}(\text{gain}) = GL^3 = \dot{Q}(\text{loss}) = KL^2\Delta T(\text{free}), \qquad (1)$$

and the building floats above the ambient temperature by an amount

$$\Delta T(\text{free}) = (G/K)L. \qquad (2)$$

Obviously the thermostat will not call for heat until T(ambient) drops ΔT(free) below the comfort temperature T(thermostat). This temperature when the furnace turns comes on (ignoring thermal mass) is called the "balance point" of a building, when T(ambient) = T(thermostat) - ΔT(free). At the balance point, the internal heat gains are exactly balanced by the heat losses without auxillary space heat and the occupants are at the thermostat temperature.

As we scale up the size of the building, $\dot{Q}$(gain) raises ΔT(free). For a "free heat" of 15 °C (30 °F), the length L must be about 15(K/G) = 10 m for the example in Section II. Even in winter, the internal heat gains in a large building can overwhelm the loss of heat through the walls, overheating the building. In summer the air conditioning used to remove the excess heat from the buildings causes most U.S. utilities to experience their peak demand in the afternoon. On the other hand, the internal gains can be beneficial since they are sufficient to heat a large building or a

superinsulated small building. In the next section we will equate the gains to the losses, using the appropriate numerical parameters and determine the amount of "free heat" available in a building.

II. Free Heat, $\Delta T(free)$, for Buildings

The average (sensible) power of a person is 75 to 100 watts (350 BTU/h). In a large building the density of people is such that they provide a heat intensity of about 11 W/m^2 (1 W/ft^2). The lighting and equipment gains can be about three times (or more) this amount, or 33 W/m^2 (3 W/ft^2). Since the internal and solar gains can vary widely, we shall use a range of values for the internal gain of 66 ± 22 W/m^2 (6 ± 2 W/ft^2). The floor area of a building is $nL^2 = L^3/H$ where n is the number of floors in the building and H is the interfloor height of about 3 m (10 ft). The internal gain of the occupied building in SI units (watts, mks) is:

$$\dot{Q}(gain) = (66 \pm 22)(nL^2) = (22 \pm 7)L^3. \quad (3)$$

The steady state loss rate from a building is

$$\dot{Q}(loss) = \sum U_i' A_i \Delta T + \dot{\rho} V c \Delta T \quad (4)$$

where A_i is the area of each envelope component, $U = 1/R$ where U is the conductance and R is the thermal resistance, ρ is the density of air, $\dot{V}$ is the flow of incoming air (m/s), and c is the specific heat of air. The metric R values are obtained from the English values with

$$R(m^2K/W) = R(hr\ ft^2\ {}^\circ F/BTU)/(5.69). \quad (5)$$

The following SI (English) parameters represent a medium level of energy tightness for high-rise office buildings (one version of the 1985 California standards):

Ceilings: R=2.62 (R=14.9)
Walls: R=1.14 (R=6.5)
Single Glazing: R=0.158 (R=0.9) 30% of wall area
Basement (about 50% of ceiling loss)
Infiltration/Ventilation (about 30% of total UAΔT)

The loss rate from the cubic structure is

$$\dot{Q}(loss) = 1.3\{\dot{Q}(ceiling/basement) + \dot{Q}(70\%\ of\ walls) + \dot{Q}(windows)\} \quad (6)$$

$$\dot{Q}(loss) = 1.3L^2\, T(1.5/2.62 + 0.7(4)/1.14 + 0.3(4)/0.158)$$

$$= 13.8\, L^2 \Delta T. \quad (7)$$

Equating the steady state losses (Eq. 7) to the internal gains (Eq. 3), we obtain:

$$\Delta T(free) = (1.6 \pm 0.5)\, L \quad (L(m), T({}^\circ C)) \quad (8)$$

$$\Delta T(free) = (0.9 \pm 0.3)\, L \quad (L(ft), T({}^\circ F)). \quad (9)$$

The "free temperature rise" $\Delta T(free)$ for our balanced (occupied, unheated) new office building of 10 m (33 ft) on a side is 16 ± 5 °C (29 ± 10 °F). If the thermostat was set at 20 °C, the furnace would turn on at the balance point of 4 °C (20 °C - 16 °C). These values of free heat would be 30 °C (60 °F) by doubling the product of internal gains and the net thermal resistance. A large building (or a superinsulated building) can have a balance point close to the average winter ambient temperature. Of course, this example is pedagogical in nature, but the basic physics is correct; large office buildings have useful free heat in winter, and too much heat in summer (and often in winter) that necessitates either air conditioning or thermal storage. Because the internal loads dominate in large buildings, the annual energy intensity (kWh/m^2, BTU/ft^2) of large buildings does not depend very much on the climate. Proper controls can minimize heating and cooling by ventilation, thermal storage and heat recovery systems so that in actual practice large buildings can consume less energy/area than small buildings.

Houses have 1/5 to 1/10 the intensity of internal heat, perhaps 1 kW for a typical house of 120 m^2 (1300 ft^2), or less than 1 W/ft^2, compared with 6 W/ft^2 for an office. Houses also can lose their internal energy more easily since they have a larger surface to volume ratio, thus the energy intensity of a house is much more dependent on its climate than for a large building. These physical facts require that houses have considerably higher insulation standards than big buildings in order to have balance points similar to large buildings.

UCS SPEAKERS' BUREAU PACKAGE by Michael J. Harrison, Department of Physics and Astronomy, Michigan State University, E. Lansing, MI 48824.

The Union of Concerned Scientists (UCS) has for some time published a series of succinct and well documented briefing papers on a variety of topics pertinent to strategic nuclear weapons, their proliferation, and also the problems of arms control and verification of compliance. These documents, which are two to four pages long, provide excellent summaries of intrinsically complex issues. They contain graphical and tabular material which assists understanding rather than overwhelm it, and consequently these papers have served as an invaluable resource for those who seek to prepare informal talks or more structured series of course lectures dealing with nuclear arms issues. Since 1981 the UCS Speakers' Bureau has actively worked to educate the public about the nuclear arms race by placing knowledgeable speakers in response to requests from national conferences, seminars, radio and TV talk shows, etc., interested in learning more about the problems of arms control.

These educational efforts have now received most welcome encouragement in the form of a new "Briefing Package" from UCS. The package consists of carefully prepared basic materials designed to provide the bureau's public speakers and others with accurate background information useful in developing, writing, and giving talks on nuclear arms issues. Each unit of the package generally consists of five components: a short introduction to the topic, a sample outline around which a talk can be developed, frequently asked questions about an issue together with suggestions for answering them, useful quotations, and finally a short bibliography for futher reference. These units are also only two to four pages long, and yet contain an impressive amount of information,

Footnote from the Secretary-Treasurer

A favor to ask you the next time we have a mail ballot: let's specify that ballots must be sealed with one piece of tape at a specified point. This business of staples is driving my automatic opening machinery (ages 8 to 12) nuts; furthermore, we're getting lots of staples which fall out of the paper and lodge in the carpet. Would you believe someone found it necessary to seal the ballot with eight staples! I'm not sure I understand what the object of such measures to ensure privacy are - to keep me or the mailman from reading the ballot? The mail is ferocious, but not one single taped ballot arrived open or ripped. On the contrary, some of the staples have become snagged and pulled out of the paper.

FORUM ELECTIONS

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PHYSICS AND SOCIETY
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Please place an X in the box for the candidates of your choice.

For VICE-CHAIRPERSON (VOTE for one)

☐ Mark Ross
☐ Dietrich Schroeer

For SECRETARY-TREASURER (Unopposed)

☐ Peter Zimmerman

EXECUTIVE COMMITTEE (Vote for two)

☐ Evans Harrell
☐ Chris Hohenemser
☐ Ruth Howes
☐ Herb Lin

Please fold and tape this ballot and return it to Peter Zimmerman by 15 February 1986. The reverse side is already addressed.

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FORUM ELECTIONS

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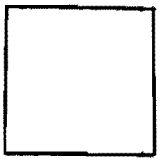

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The objective of the **Forum** is the advancement and diffusion of knowledge regarding the interrelation of physics, physicists and society.

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WHY JOIN?

1) Membership is free to APS members.
2) Members receive **Physics and Society** which keeps you informed of **Forum** activities.
3) Members have the opportunity to play a role in promoting the interactions between physics and society.

FROM THE CHAIRPERSON OF THE FORUM

Dear **Forum** member:

The last decade has seen a period of involvement of physicists with issues of science and society. The **Forum** has shared this concern and hopes to do more with your help. The **Forum** has been instrumental in the development of the Congressional Fellows Program, the **Forum** Awards, Conferences on Physics Education and Employment Concerns, symposia at national meetings, and the establishment of the APS Panel on Public Affairs.

There are approximately 4000 **Forum** members. Presently there are no **Forum** dues for current APS members. The **Forum** is given $2 per member to support the newsletter and other **Forum** initiatives. As a member of the **Forum**, I would like you to invite your colleagues to join the **Forum**. Have your colleagues send this form to the **Forum's** Secretary. The reverse side is already addressed.

Regards,

Dave Hafemeister, Chairperson
Forum on Physics and Society

Yes, I want to join the **Forum on Physics and Society** and I'm a member of the APS.

NAME _____ **NAME** _____

ADDRESS _____ **ADDRESS** _____

_____ _____

_____ _____

_____ _____

The Last Six Years of the Forum - A Quick Look

The Forum has sponsored sessions at nearly every regular APS meeting. Here is a rough tally over the last six years:

Arms Control	13
Science/Technology	6
Education	4
Nuclear Power/Energy	9
Human Rights	1
Minorities	2
Contributed Papers	2

The Forum has published Nuclear Energy, Nuclear Weapons Proliferation and the Arms Race ($2.50) and Nuclear Weapons and Nuclear War ($2.00). Both are available from the Publications Dept., AAPT, Suite 101, 5110 Roanoke Pl., College Park, MD 20740. The Forum has sponsored two short courses on the Arms Race which were both huge successes. The last one was published as AIP Conference Proceedings 104 Physics, Technology and the Nuclear Arms Race. The Forum sponsored a short course on energy in April, 1985 which is available as AIP Conference Proceedings 135, Energy Sources: Conservation and Renewables.

The Forum is currently sponsoring studies on SICM and Electromagnetic Pulse. The study on Civil Defense has been submitted for publication. The Forum has been active in promoting Women's, Minorities and Human Rights issues.

Physics and Society goes to all Forum members. In April 1980 there were 2613 Forum members, in November 1985 about 4000. In addition the newsletter is sent free to over 300 physics libraries. Newsletters go to about 50 foreign countries. Physics and Society regularly publishes Letters to the Editor, the Forum Councillor's report, COPS reports, and Forum questions to APS Candidates.

.....(FOLD HERE).....

PETER ZIMMERMAN
7208 LUDWOOD CT.
ALEXANDRIA, VA 22306

carefully organized. They serve well as guides for speakers addressing general audiences, or as resource material for college and university faculty seeking to develop curricula for regular coursework intended for students at any level. Users of the briefing package may either upgrade or simplify the content of any unit, depending on their own teaching purposes and the sophistication of their audience. The topics addressed in the seven units are as follows:

The Threat of Nuclear War/Nuclear Winter
The Bilateral Nuclear Weapons Freeze
"Star Wars"
Proliferation of Nuclear Weapons
A Comprehensive Test Ban
Verification of Compliance with Arms Control Agreements
No-First-Use of Nuclear Weapons

The introduction to the package even contains suggestions on effective public speaking, making television appearances, as well as legal considerations in public speaking! At $7.50 this "Briefing Package" is a bargain. It is available from: Speakers' Bureau, Union of Concerned Scientists, 26 Church St., Cambridge, MA 02238.

ANNOUNCEMENTS

William C. Foster Fellows Program for 1986-1987

The United States Arms Control and Disarmament Agency (ACDA) is accepting applications for visiting scholars. This program is designed to give specialists in the physical sciences and other disciplines relevant to ACDA's activities an opportunity to participate actively in ACDA and to give the Agency the perspective and expertise such persons can offer.

Fellows will be appointed for 12 months beginning in the summer or early fall of 1986. They will be compensated in accordance with the Intergovernmental Personnel Act which allows the Agency to reimburse a university for the services of its employees. Fellows must be citizens or nationals of the U.S. and on the faculty of a recognized institution of higher learning. Prior to appointment they will be subject to a full-field background security and loyalty investigation for a top secret security clearance. Applications should be made in the form of a letter indicating the perspective and expertise which the applicant offers accompanied by a curriculum vitae and any other materials such as letters of reference and samples of published articles which the applicant believes should be considered in the selection process. Deadline for applications is 31 Jan 1986. Applications and requests for information on available assignments should be sent to: Willian C. Foster Fellows Program, Attn: Personnel Officer, Room 5722, U.S. ACDA, Washington, DC 20451 (202 632 2034).

Call for Papers

1986 Carnahan Conference on Harmonizing Technology with Society, June 26-27, 1986, U. of Kentucky, Lexington, KY.

Appropriate Topics: Computer driven automation and the collapse of work. Production and distribution in the work-free society. Prosperity through technology driven abundance. Peace through technology driven prosperity. Economics of scarcity in an ambience of abundamce.

Abstract deadline is March 31, 1986. Mail abstracts to:

John Jackson, Conference Director
Electrical Engineering Department
University of Kentucky
Lexington, KY 40506-0046
606 257 3926

UPCOMING FORUM SESSIONS

APS Annual Meeting, Atlanta, Georgia 27 - 30 Jan 1986

Technology and Risk: 28 Jan at 7:30 pm

Chairperson/Organizer: Evans Harrell, School of Mathematics, Georgia Institute of Technology, Atlanta, GA 30332 (404 233 3381).

J. Donald Millar, Director, National Institute for Occupational Safety and Health, Atlanta: Risk Assessment - the Challenge for the Future.

Richard Wilson, Harvard: A Physicist Looks at the Hazards of Life.

Irving Mintzer, World Resources Institute, Washington: Living in a Global Greenhouse: Societal Impact and Policy Responses.

Fred R. Mynatt, Oak Ridge National Laboratory: Pressurized Thermo Shock in Nuclear Reactors - Integrated Analysis of the Risk.

APS Las Vegas Meeting 31 Mar to 4 Apr 1986.

Visit to the Department of Energy Nevada Test Site: On Wednesday 4 April 1986 the APS Forum will sponsor a visit to the Department of Energy's Nevada Test Site (NTS). The NTS is the location of all U.S. nuclear weapons testing. You will see giant drilling equipment (precision 12 foot diameter holes to depths of several thousand feet) and state-of-the-art high speed measuring gear.

All of the following information must be provided by 15 March 1986:

1) Full name or initial (no nick-names)
2) If you have no middle initial so state or write "NMI"

3) Social Security Number
4) Date of Birth
5) Home address
6) Statement that you are a U.S. citizen
7) Home and office phone numbers
8) If you go by initials, e.g., R.B. Jones write R(only) B(only) Jones.

If you are uncertain, but there is a chance you will wish to go, be sure to provide the above information on time. Send it to:

Paul Craig, Department of Applied Science, University of California, Davis CA 95616 (916-752-0360/1782).

Information must be received in Davis by Monday, March 15, 1986.

The visit will last all day (6:30 am until 6:00 pm). It will leave from the MGM Grand Hotel (entrance to be announced at the meeting). U.S. citizens only may visit the NTS.

Contributed Papers Session: Each year at the Washington Meeting the **Forum** tries to arrange a contributed papers session. If you have papers of particular interest to the **Forum** then please submit them to the APS office by 31 Jan 1986. This year's meeting is from 28 Apr to 1 May 1986.

SPECIAL PROJECTS - A GROWING ROLE FOR THE FORUM by Paul Craig, Department of Applied Science, University of California, Davis, CA 95616.

In the past several years the **Forum** has been involved in a number of activities which have given rise to publications. These include conferences on energy conservation and the arms race (published as AIP Conference Proceedings) and **Forum** sessions on nuclear proliferation, the arms race, and acid rain (published as AAPT booklets).

The success of these activities has led to a growing interest among **Forum** members in undertaking larger studies. The first of these, on Civil Defense, is chaired by John Dowling and is now approaching completion. A second study on the outlook for small mobile ICBM's is in the proposal stage. There seems to be considerable enthusiasm within the **Forum** for this kind of project, and more proposals are anticipated and encouraged.

Since the civil defense study is the first **Forum** study to approach completion, it is not surprising that we encountered some confusion on how to deal with it. We raised the issue with APS Chairman Robert Wilson, who referred it to the APS Council, which asked the Panel on Public Affairs (POPA) to suggest guidelines. POPA has made a proposal, which is now under consideration by the Council.

The key question is how activities undertaken by the **Forum** are to mesh with the APS procedure. The issue is tricky. The APS has undertaken a series of major studies (e.g. the reactor safety study, the reactor source term study, and (currently) the SDI Directed Energy Weapons Study). These studies are screened by POPA and recommended to Council for approval. All members of the studies and of the study review panel are appointed by the APS council. Release of APS studies is carefully orchestrated. The final documents carry the endorsement of the APS.

The guidelines the APS uses for approval may be summarized as follows: a) The study topic must have solid physics content; 2) The topic should be important to society as a whole; c) There must be a good reason why the project should be examined under APS sponsorship. APS studies focus on technical matters, and policy conclusions are treated carefully. Typical reasons why APS sponsorship is appropriate include APS credibility in assembling balanced panels, the perceived objectivity of the APS, and the absence of any other organization capable of performing a needed study credibly.

Until the **Forum** civil defense project, no Division of the APS had ever considered its own study. At issue was whether the **Forum** could

undertake a study not approved by the APS Council. There would be many problems with such an approach. The chief of these relate to quality control and responsibility - the public would not be able to readily distinguish between an APS approved study and a **Forum** or Division study.

The APS Council is exploring the possibility of broadening the range of types of studies it will sponsor. POPA has recommended to the Council that the APS not only undertake large studies such as those listed above, but also smaller and narrower activities. If this proposal is approved it will simplify things considerably, and open new avenues for **Forum** involvement.

Guidelines suggested by the **Forum** would operate as follows: Any APS member who wishes to do so may submit a proposal to the **Forum**. Proposals will be reviewed by the **Forum** Executive Committee. Proposals found to have merit will be placed in one of two categories:

1) The first category will be **Forum** encouraged projects. These projects will generally be educational in character. They will be eligible for partial support using **Forum** funds. The **Forum** Executive Committee will approve the panel chairman and members and determine the level of support. The final report need not be reviewed by the **Forum** or the APS, but the **Forum** will offer editorial review. If accepted by a publisher the report will be published over the names of the participants, in exactly the same way as is done with research articles. These reports will be expected to acknowledge **Forum** support and will include the statement **"The American Physical Society has neither reviewed nor approved this study"**.

2) The second proposal class includes projects with direct policy relevance. These projects will be forwarded by the **Forum** to POPA. The **Forum** will provide information on the proposer, and a list of names of persons the **Forum** Executive Committee believes suitable to staff the project. POPA will review the proposal, suggest changes, and eventually reach a decision on whether to recommend the project to the APS Council. From thence onward the project will be handled in exactly the same way as all other APS studies. Specifically, study members and review panels will be appointed by the APS Council, and final report approval and release procedure will be by vote of the Council.

Note that under both the present and proposed APS Council rules any APS member may submit proposals to the Council. These proposals are reviewed by POPA and recommendations made to the Council. Thus the procedures proposed both by POPA and by the **Forum** offer clarification of opportunities, but are not changes in basic policy.

This procedure provides a well defined pathway by which **Forum** members (and other APS members) may propose projects, and be assured of having these projects carefully considered. It provides overall flexibility, and enforces quality control in areas of policy relevance.

Individuals with ideas for projects which may fit into either of the two pathways are encouraged to contact any member of the **Forum** Executive Committee for discussion prior to submission of your proposal.

JOIN THE FORUM

FORUM ELECTIONS

Now is the time for all good Forum members to elect their officers. This year the offices of Vice-Chairperson, Secretary-Treasurer, and two Executive Committee Members are up for election. This issue of Physics and Society features a centerfold which contains a ballot for the Forum elections as well as an application for Forum membership (which you as a Forum member should give to your APS friends and encourage them to join). The ballot can be folded and is already addressed. Please return it to Peter Zimmerman, 7208 Ludwood Ct., Alexandria, VA 22306, before 1 March 1986. The nominations committee included Dave Hafemeister (chair), Ken Ford, Irene Engle, John Dowling, and Allan Hoffman.

MARC ROSS: VICE-CHAIRPERSON

Background: Professor of Physics at the University of Michigan and Senior Scientist at Argonne National Laboratory. B.S. Queens College, N.Y., Ph.D. University of Wisconsin, 1952. Research in particle theory until 1971; energy policy and physics of energy use, especially by industry, since then. Some of my experience relative to the Forum is membership on the executive committee of the Division of Particles and Fields, codirector of APS study of "Efficient Use of Energy," 1974; and just completed membership on Panel on Public Affairs. Coauthor of Our Energy, Regaining Control (McGraw-Hill, 1981).

Statement: The Forum is a focus of concerns of physicist other than physics as such: their concerns as citizens, such as weapons policies, energy policy, and their concerns for the health of the profession such as R&D policies, manpower policies, and educational policies. The APS is active in all these areas, but members need to be able to learn more about the issues and to develop and express their views. The Forum, through Physics and Society, the many sessions it organizes and in workshops, has been relatively effective in providing general information to the membership. One effort which should be strengthened is informing members on R&D and manpower policies. As new technologies and R&D policies develop the shape of physics is going to change, as it has in the past. Physicists should be able to play a thoughtful role in that change. The Forum could also strengthen its efforts to enable APS members to follow the actions of the APS and AIP and to have an input to those activities.

DIETRICH SCHROEER: VICE-CHAIRPERSON

Background: Dietrich Schroeer is Professor of Physics at the University of North Carolina at Chapel Hill. His background includes a Ph.D. (nuclear physics) from the Ohio State University; NATO Postdoctoral Fellow at the T.H. Munich, 1965-66 (Mössbauer spectroscopy); National Endowment for the Humanities and Fulbright fellow, Munich (Social Responsibility of Scientists); Research Associate, International Institute for Strategic Studies, London (directed-energy weapons and arms control). He has organized various symposia and short courses for the Forum (often together with the AAPT) on "teaching physics-and-society courses," "the physics and technology of the nuclear arms race" (AIP Proceedings #104 with David Hafemeister), etc. He was Secretary/Treasurer of the FORUM 1980-84. He has developed and taught courses on "physics-and-society," "science, technology and the nuclear arms race," "science and public policy," and "energy and policy." The textbooks PHYSICS AND ITS FIFTH DIMENSION: SOCIETY (Addison-Wesley, 1972, AIP-US Steel Science Writing Award) and SCIENCE, TECHNOLOGY AND THE NUCLEAR ARMS RACE (Wiley, 1984) are the outcome of that teaching. The former book led a Dutch physicist to label him the godfather of physics-and-society courses in Holland.

STATEMENT: The FORUM has become an accepted part of the American Physical Society. I am anxious to preserve its integrity, and to improve its standing within the physics community as an impartial aid to members interested in physics-and-society issues. It could look more beyond the current interest in the arms race to prepare members for other issues as well, such as renewed energy concerns, computerization of everything, the relationship between science and technology, the effect of secrecy on the operation of the physics community, and peer review as our way of life. The FORUM could strengthen its relationships with the APS Panel on Public Affairs, the American Association of Physics Teachers, and other science-and-society groups.

The FORUM should emphasize three major functions: (1) Its primary goal should be to assist its members with self-education on physics-and-society issues, through organized sessions at APS meetings, short courses and symposia, studies, and publications. The FORUM can help identify those aspects of issues where physicists can contribute as technical experts. (2) The FORUM is the "home" within the APS of some physicists who are not obviously a part of one of the other divisions. It could be more supportive of these teachers, applied scientists, policy analysts, and administrators, and improve their integration into the physics community. It can legitimize activities in physics-and-society issues, by giving recognition through speaking invitations, participatior in studies, or nominations as APS fellows. For example, the Szilard and Forum Awards ought to be upgraded. (3) The FORUM can help physicists whenever they want to participate in public affairs on the basis of their technical expertise.

PETER ZIMMERMAN: SECRETARY/TREASURER

No statement available at press time.

EVANS M. HARRELL: EXECUTIVE COMMITTEE

BACKGROUND: Evans Harrell is Associate Professor of Mathematics at Georgia Tech, specializing in quantum tunneling and perturbation theory. B.S., Stanford, 1972, and Ph.D., Princeton, 1976, both in physics. Previous employment in physics and mathematics: Haverford College, University of Vienna, M.I.T., and Johns Hopkins. Sloan Fellowship, 1983. Forum activities: After several years of attending Forum symposia, I volunteered for more active participation in the Forum Arms Control Study and was assigned to the civil defense subgroup. We will shortly be the first such group to have succeeded in producing educational materials, under my co-editorship. I also participated in a nuclear winter symposium last spring and have contributed to Physics and Society. Most recently, in a different vein, I organized and will chair a session at the Atlanta meeting in January, on Energy Technology and Risk.

STATEMENT: The Forum sessions on arms control, environmental issues, etc., at APS meetings are popular among those who attend the meetings and should remain one of our central activities. Yet many more physicists than

can participate in APS sessions are concerned about these topics and can potentially contribute something valuable to education and policy making. We need creative ways to involve these people. The Forum Arms Control Study has been a somewhat successful experiment along these lines; volunteers of diverse opinions have peaceably gotten together over the last three years to survey the literature on a selection of arms-race topics and to draw up reports that could be used, for instance, in a college physics curriculum. The experiment should continue with new study groups. An example of a new topic that could be studied by a group of volunteers is the effect of the recent dramatic militarization of our nation's research effort (next year SDI research alone will have almost twice the budget of the NSF). While this may at first seem a narrowly parochial concern for scientists, over the long run it could have tremendous effects both on the intellectual life in this country and on the economy.

Secondly, we should find ways to increase the influence of physicists on public opinion and on Washington, where there is little convincing evidence of scientifically sound thinking. In any such enterprise, the Forum should, of course, preserve strict political neutrality as far as possible.

CHRISTOPH HOHENEMSER: EXECUTIVE COMMITTEE

Background: Currently Professor of Physics and Chair, Program on Environment, Technology and Society, Clark University. B.A. Swarthmore 1958, Ph.D. Washington University, 1963. Brandeis University, 1964-71, Clark University, 1971-present. Two year-long research visits to the University of Groningen, the Netherlands in between. Physics research: experimental study of critical phenomena with over 50 papers published, 9 Ph.D.s supervised. Elected fellow of APS for this work, 1985. Science/Society work on arms control, energy policy and hazard management, with more than 40 articles published. Co-editor of two recent books: Risk in the Technological Society (Westview, 1982), and Perilous Progress: Managing the Hazards of Technology (Westview, 1985). Involved with teaching courses on energy, environment and arms control for 15 years. Active in nuclear weapons education, peace movement. Recent interest: risk in developing countries.

Statement: The voice of physicists is important wherever understanding of science and technology crosses with policy concerns and human values. The most important area of this kind is the nuclear arms race. Other areas are assessing and managing the risks of technology, optimizing the use of scarce resources such as energy, and developing a level of scientific literacy among the public so that they can judge these issues themselves. The Forum for Physics and Society should serve as a prod and stimulus to the larger physics community by raising questions, conducting debates, and on occasion, taking action on these issues. In doing so, the Forum should educate, inform and illuminate, while avoiding overt politicization.

RUTH HOWES: EXECUTIVE COMMITTEE

BACKGROUND: Ruth Howes is a professor of physics and astronomy at Ball State University in Muncie, IN. She obtained her B.A. from Mount Holyoke College (1965) and her M.A. (1967) and Ph.D. (1971) from Columbia University. Following a year at the University of Oklahoma working on a program to interest women in the physical sciences, she taught as a part-time instructor at Oklahoma City University for four years before coming to Ball State. In 1984-85, she served as a William C. Foster Fellow at the United States Arms Control and Disarmament Agency. She has participated in Forum Arms Control Study Groups on Civil Defense and the Midgetman Missile. This year she chairs the Fellowship Committee for the Forum. Her research interests are the application of nuclear physics techniques to problems in art and archaeology. She has taught courses in a variety of formats on the interaction of science and technology with national security policy since 1976.

STATEMENT: The Forum's major mission must be to encourage physicists to concern themselves with the impact of technology in general, and physics in particular, on society. The technical issues found in arms control, energy policy, and policy for protecting the environment are complex and of immediate importance to physicists as well as the rest of society. The recent changes in the implementation of policy on the classification of scientific work carried out in universities affects the physics community directly. Formation of intelligent national policy in these areas will need input from physicists.

To this end the Forum should continue to provide information to the physics community (through its newsletter and sessions at APS meetings); to offer physicists an opportunity to study these issues (through study groups and maintaining a list of opportunities for summer appointments etc.); and to provide professional recognition to physicists working on problems of physics and society (through APS sessions, the Szilard Award, and election to Fellowship in the APS). In addition, the Forum needs to make an effort to reach a larger portion of the physics community. This might be done through working in cooperation with a group from the APS or the AAPT. Finally, the Forum must maintain its standing as a source of reliable, unbiased technical information and analysis and avoid becoming a platform for the varied political views of its members.

HERBERT LIN: EXECUTIVE COMMITTEE

BACKGROUND: Sc.D., Physics, M.I.T., 1979; Instructor, Physics Department, M.I.T., 1979-80; Research Associate, Physics Department, University of Washington, 1980-82; Lecturer, Physics Department, Cornell University, 1983; Visiting Scholar, Peace Studies Program, Cornell University, 1983-84; Post-Doctoral Research Fellow, Defense and Arms Control Studies Program, Center for International Studies, M.I.T., E38-616, Cambridge, MA 02139, 1984-Present.

STATEMENT: The APS Forum should continue its efforts to educate physicists on pressing issues of national policy that have significant technical aspects. Two of these issues concern the impact of new technologies on national security policy and the growing concern over transfer of technology to potential adversaries. In addition, two fields traditionally outside the physicist's primary domain of expertise--information technology and biotechnology--are likely to increase in prominence over the next several years; physicists should not allow themselves to be caught unprepared to comment intelligently on these fields. Finally, the Forum should assist physicists in communicating effectively their concerns to policy makers; to this end, symposia and seminars on effective interfaces between experts and policy makers should be conducted.

NEW ENERGY BOOK FROM AAPT AND THE FORUM: Energy Sources: Conservation and Renewables. Edited by D. Hafemeister, H. Kelly, and B. Levi.

The AAPT and the Forum cosponsored a conference on energy in Washington after the April APS meeting last year. The American Institute of Physics published the proceedings in the AIP Conference Series 135, Energy Sources: Conservation and Renewables, edited by D. Hafemeister, H. Kelly, and B. Levi (680 pages). It is available from AIP, 335 E. 45th St., New York, NY 10017 for $55.

Abstract The technical progress on the conservation and renewable technologies since the oil embargo of 1973-4 is reviewed in these proceedings. The experts from the national labs, academia, and industry have combined their efforts to describe new lighting and appliance technologies, smart meters to "spot price" electricity, off-peak cooling to reduce peak power demands, and much more. Conservation (enhanced end-use efficiency) has far outpaced production in the past decade, and these technologies are likely to continue that trend. AIP 135 complements the highly successful earlier study of a decade ago, Efficient Uses of Energy (AIP 25), the most popular AIP book sold which indicated useful ways to apply physics and technology to reduce the energy problem. This new book of 28 chapters and 10 appendices is intended for a physics-based audience in that it emphasizes equations and data bases.

ENERGY SOURCES: CONSERVATION AND RENEWABLES

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