REVIEWS

The APS's DEW Study: Genesis, Influence on SDI, and Lessons for Renewed APS Involvement During the George W. Bush Administration

By Bernd W. Kubbig. Peace Research Institute Frankfurt, 2001, 58 pages, DM 10 (about $5) from info@hsfk.de. Also available via .PDF file at www.prif.org or www.hsfk.de.

The US is again engaged in a political war over national missile defense (NMD), and the American Physical Society (APS) seems about to become an active participant. . The APS has appointed, in Fall, 2000, a panel to determine whether it should carry out a scientific study on technical aspects of the NMD system. It seems wise to reexamine the previous involvement of the APS in these wars - its production of a report on Directed Energy Weapons (DEW) in response to President Reagan's Strategic Defense Initiative (SDI, also commonly known as "Star Wars"). That at least is the premise of this report, published, in English, by a German Peace Research Institute. Using interviews with the major participants and a thorough review of the written record, the German report seeks to establish lessons, from the previous study, initiated by the APS Council in June 1983, ending up in the DEW report published in Reviews of Modern Physics in April 1987, which may be applicable to future studies by the APS and comparable scientific societies.

Among the issues raised, and successfully answered in my opinion, are: should the study be exclusively scientific rather than include political and strategic issues? should it concentrate on only one proposed technological model (e.g., the previous study examined DEW only, omitting kinetic energy weapons; should the new study look beyond the Clinton-era mid-course-interception model?)? should the study participants be selected only from individuals active in the field who have appropriate security clearance, thus allowing a cooperative study with the Pentagon not hindered by secrecy (but subject to Pentagon preemption and delay)? should financing be sought, in part, from government agencies? Other important issues are not discussed. Three groups were important in creating the previous APS study: the panel of "wise men" who initiated the study and persuaded the APS Council to do it, the study panel itself, and the review panel. How were the members of these three groups chosen? How were they responsible to the APS membership?

The results of the previous APS study had major national and international repercussions. Towards its end, even before release and publication of the report, the Pentagon had drawn back from DEW to concentrate on a kinetic energy weapon defense scheme. Shortly after, the whole SDI was downgraded; NMD was quiescent until the latter part of the Clinton years.

It is clear that "the arguments put forward in the eighties, to the effect that a study should only be conducted on the basis of unlimited access to classified knowledge, ultimately paid off." Even though there were periods of heart-stopping delay and uncertainty, awaiting Pentagon clearance, and even though "the kinetic technology which became the nucleus of all later SDI concepts" was shielded from independent scrutiny, critics of the study (and there were many, inside and outside of APS) were deprived of the "'If you knew what we know...' argument." The coalition, between APS and Pentagon, rendered the critics - politicians and/or scientists - ineffectual. On the other hand, if such cooperation proves infeasible for the next study, this report reminds us that "in the initial stages of the project, the experts involved (many of whom had years of experience of working with governments of various complexions) had unanimously concluded that a study based on publicly available information would indeed be worthwhile."

Also important to the previous successful study was "the balanced composition of the scientist group, the prestige which individual members enjoyed as specialists in their fields, and the authoritative nature of their overall findings, based on consensus." Finally, "The clear demarcation between solid specialist investigation and equally legitimate political pronouncement is one which the APS should continue to insist on."

I think our American readers will gain greatly from considering this European study which concludes by advising the APS to "play it again."

Alvin M. Saperstein
Physics Department
Wayne State University, Detroit MI
ams@physics.wayne.edu

Recent Articles in Science on Global Warming

Before addressing several articles in Science, some web sites should be mentioned.
There is a NASA site at http://gcmd.nasa.gov/, and an NOAA site at http://www.noaa.gov/.
There also is a site by the "Center for the Study of Carbon Dioxide and Global Change" at http://www.co2science.org/. This group opposes action against further warming apparently because increased warming has not been proven to have been caused by human activity, and because a warmer Earth and more CO2 are good for us. While this reviewer also is not certain that human activity can affect warming, a view diminishingly held among Science authors this year, he is forced to note that the Center authors make several common errors in concluding that further warming might somehow be a good thing.

There have been over 50 relevant papers in Science since Spring 2000--too many to treat individually in a limited space. The Annotated References section given below lists them chronologically. Preceding the Annotated References, I have grouped these articles into two major categories: Trends, and Mechanisms, each with several subcategories. I have omitted papers concerning human hardship or recent political activity because they did not bear on the physics of this complex problem. This reviewer's goal is not to shuffle physics and society together, but rather to provide science for physicists interested in problems affecting society. The recent United Nations IPCC meeting is reported [53] to have concluded that human activity is responsible at least for some of the recent global warming. This seems reasonable, but this reviewer is not entirely convinced. One hopes the IPCC has not made its decision because of mere warming to the idea.

Trends. The following papers present data showing or detailing a trend relevant to global warming:
Human Activity: 1, 6, 7, 18, 19, 22, 30, 36, 37, 38, 43, 44, 53.
Temperature: 7, 13, 14, 15, 16, 17, 18, 20, 22, 26, 28, 30, 33, 35, 39, 40, 41, 42, 43, 44, 46, 49, 53, 54. *Ice Cover*: 3, 8, 9, 10, 12, 13, 14, 16, 17, 20, 39, 40, 41, 42, 46, 49, 50. *Precipitation:* 13, 14, 18, 39, 41, 45, 47, 48, 52. *Solar & Other Astronomical Cycles*: 16, 17, 47, 51.

Mechanisms. The following papers elucidate physical or other mechanisms that might enter into the global warming equation:
Atmospheric aerosols: 2, 4, 34.
El Nino: 3, 5, 25, 33, 35.
Ice Cover: 3, 12, 13, 14, 16, 17, 30, 40, 41, 42, 49, 50.
Carbon Dioxide and Carbon Cycle: 7, 11, 16, 17, 19, 20, 21, 24, 27, 30, 31, 32, 36, 37, 38, 50.
Oceanic Circulation: 12, 13, 14, 30, 40, 41, 42, 49, 50, 54.
Human Activity: 7, 11, 19, 21, 30, 31, 32, 37, 38, 43, 44, 53.
Nitrogen Oxides & Nitrogen Cycle: 19, 23.
Solar and Other Astronomical Cycles: 16, 17, 29, 43, 44, 47, 51.

Annotated References.
The volume, pages, month, and day are given. All volumes are in year 2000, except for Volume 291 which is in year 2001.

1. R. A. Kerr, "[IPCC] Draft Report Affirms Human Influence", 288, 589-590 (4/28).
2. S. E. Schwartz & P. R. Buseck, "Aerosols", 288, 989-990 (5/12). Atmospheric science perspective on [4]: Aerosols do not always reduce surface and near-surface air temperature.
3. T. M. Rittenour, J. Brigham-Grette, & M. E. Mann, "El Nino-Like Climate Teleconnections in New England During the Late Pleisotcene", 288, 1039-1042 (5/12).
4. A. S. Ackerman, et al, "Reduction of Tropical Cloudiness by Soot", 288, 1042-1047 (5/12).
5. A. V. Fedorov & S. G. Philander, "Is El Nino Changing?", 288, 1997-2001 (6/16). A review.
6. M. E. Mann, "Lessons for a New Millennium", 289, 253-254 (7/14). Climate Change Perspective on [7], suggesting that greenhouse-gas warming accounts for the recent global temperature increase.
7. T. J. Crowley, "Causes of Climate Change Over the Past 1000 Years", 289, 270-277 (7/14).
8. D. Dahl-Jensen, "The Greenland Ice Sheet Reacts", 289, 404-405 (7/21). Climate Change Perspective on [9] and [10]. Different high-elevation regions of the Greenland ice are reacting differently. Coastal ice is thinning.
9. R. Thomas, et al, "Mass Balance of the Greenland Ice Sheet at High Elevations", 289, 426-428 (7/21).

10. W. Krabill, et al, "Greenland Ice Sheet: High-Elevation Balance and Peripheral Thinning", 289, 428-430. Estimates a net loss of ~51 cubic km of ice per year. As water, this would raise sea level by ~0.13 mm/yr, but the measured rise is ~0.02 mm/yr.

11. P. H. Abelson, "Limiting Atmospheric CO2", 289, 1293 (8/25). Editorial suggesting carbon disposal mechanisms.

12. E. Bard, et al, "Hydrological Impact of Heinrich Events in the Subtropical Northeast Atlantic", 289, 1321-1324 (8/25). A Heinrich event is a massive surge of icebergs, implying ice sheet melting.

13. D. Nurnberg, "Taking the Temperature of Past Ocean Surfaces", 289, 1698-1699 (9/8). Paleoclimate Perspective on [14].

14. D. W. Lea, D. K. Pak, & H. J. Spero, "Climate Impact of Late Quaternary Equatorial Pacific Sea Surface Temperature Variations", 289, 1719-1724 (9/8).

15. J. J. Magnuson, et al, "Historical Trends in Lake and River Ice Cover in the Northern Hemisphere", 289, 1743-1746 (9/8). Records imply air temperature increased ~1.2 C/100 yr since 1850.

16. R. A. Kerr, "Ice, Mud Point to CO2 Role in Glacial Cycle", 289, 1868 (9/15). News Focus on Climate discusses [17]. Antarctic ice and deep-sea cores suggest that orbital cycles couple through CO2, not ice-sheet area, to drive ice-age phase: So, eccentricity --> greenhouse gas change --> temperature change.

17. N. J. Shackleton, "The 100,000-Year Ice-Age Cycle Identified and Found to Lag Temperature, Carbon Dioxide, and Orbital Eccentricity", 289, 1897-(9/15). Oxygen-18 ratios used to track ice ages.

18. L. G. Thompson, "A High-Resolution Millennial Record of the South Asian Monsoon from Himalayan Ice Cores", 289, 1916-1919 (9/15). Tibetan ice reveals human activity and warming.

19. G. P. Robertson, E. A. Paul, & R. R. Harwood, "Greenhouse Gases in Intensive Agriculture: Contributions of Individual Gases to the Radiative Forcing of the Atmosphere", 289, 1922-1925 (9/15). Analysis from 1991 to 1999.

20. J. Kaiser, "Ecological Society of America", 289, 2031-2032 (9/22). News Focus on annual meeting: Lake-bed cores showed short-term climatic extremes during the warm, arid midHolocene ~8000 ypb when compared with ~2000 ybp. Also, live trees can warm ground under snow by ~5 C, suggesting an early spring CO2 sink in tundra.

21. E. Schulze, C. Wirth, & M. Heimann"Managing Forests After Kyoto", 289, 2058-2059 (9/22). Climate change perspective on CO2 dynamics.

22. D. R. Easterling, "Climate Extremes: Observations, Modeling, and Impacts", 289, 2068-2074 (9/22). An atmospheric science review estimating warming effects on civilization.

23. M. T. Lerdau, J. W. Munger, & D. J. Jacob, "The NO2 Flux Conundrum", 289, 2291-2293 (9/29). An Atmospheric chemistry perspective describing the plant and soil regulation of nitrogen oxides. 24. U. Fehn, G. Snyder, & P. K. Egeberg, "Dating of Pore Waters with 129I: Relevance for the Origin of Marine Gas Hydrates", 289, 233- 2335 (9/29). The methane at Blake Ridge, Atlantic ocean, probably is from the early tertiary.

25. R. A. Kerr, "Second Thoughts on Skill of El Nino Predictions", 290, 257- 258 (10/13). This News Focus on Climate Prediction reports a Meteorological Society evaluation showing that complex supercomputer climate models did no better than rudimentary ones.

26. D. T. Rodbell, "The Younger Dryas: Cold, Cold Everywhere?", 290, 285-286 (10/13). Paleoclimate perspective on evidence in [28] that the ~1000 year YD cooling was local to the North Atlantic.

27. P. Falkowski, "The Global Carbon Cycle: A Test of Our Knowledge of Earth as a System", 290, 291-296 (10/13). Climate change review, recommends a system approach, concludes we don't know enough yet about the global increase in CO2.

28. K. D. Bennett, S. G. Haberle, & S. H. Lumley, "The Last Glacial-Holocene Transition in Southern Chile", 290, 325-328 (10/13). Lakebed sediments in southern Chile show no Younger Dryas cooling.

29. R. A. Kerr, "Does a Climate Clock Get a Noisy Boost?", 290, 697-698 (10/27). News Focus on Climatology discusses stochastic resonance and locally stable states.

30. R. A. Kerr, "Can the Kyoto Climate Treaty Be Saved From Itself?", 290, 920-921 (11/3). Global maps of surface temperature changes, projected CO2 emissions, and a brief summary of the mechanisms believed to affect temperature.

31. J. Kaiser, "Soaking Up Carbon in Forests and Fields", 290, 922 (11/3). News Focus describing measurement and monitoring problems, which differ between forest and rangeland vs. cultivated or populated areas.

32. K. R. Redeker, et al, "Emissions of Methyl Halides and Methane from Rice Paddies", 290, 966 -969 (11/3).

33. M. A. Cane & M. Evans, "Do the Tropics Rule?", 290, 1107-1108 (11/10). Cites [35] in a climate variability perspective, that tropical decadal variations drive those in the north Pacific. Trends given from ~1700 to 2000.

34. S. J. Smith, T. M. L. Wigley, & J. Edmonds, "A New Route Toward Limiting Climate Change?", 290, 1109-1110 (11/10). A climate perspective summarizing the effects of haze and soot in countering the radiation- trapping effect of greenhouse gasses.
35. B. K. Linsley, G. M. Wellington, & D. P. Schrag, "Decadal Sea Surface Temperature Variability in the Subtropical South Pacific from 1726 to 1997 A. D.", 290, 1145-1148 (11/10). Sr/Ca ratios in coral.
36. J. P. Caspersen, et al, "Contributions of Land-Use History to Carbon Accumulation in U. S. Forests", 290, 1148-1151 (11/10).
37. I. Fung, "Variable Carbon Sinks", 290, 1313 (11/17). Climate change perspective pointing out data in [38] showing that known carbon sinks seem to vary greatly year to year.
38. P. Bosquet, et al, "Regional Changes in Carbon Dioxide Fluxes of Land and Oceans Since 1980", 290, 1342-1346 (11/17).
39. S. W. Hostetler & P. U. Clark, "Tropical Climate at the Last Glacial Maximum Inferred from Glacier Mass-Balance Modeling", 290, 1747-1750 (12/01).
40. L. Labeyrie, "Glacial Climate Instability", 290, 1905-1907 (12/08). Paleoclimate perspective, suggests that trends in [41] and mechanisms in [42] might support thermohaline oscillations as climate drivers. However, higher-resolution dating of the evidence is called for.
41. L. C. Peterson, et al, "Rapid Changes in the Hydrologic Cycle of the Tropical Atlantic During the Last Glacial", 290, 1947-1951 (12/8).
42. K. A. Hughen, et al, "Synchronous Radiocarbon and Climate Shifts During the Last Deglaciation", 290, 1951-1954 (12-/8).
43. F. W. Zwiers & A. J. Weaver, "The Causes of 20th Century Warming", 290, 2081-2083 (12/15). Citing simulations in [44], there must be some natural and some anthropogenic forcing. Trends are given from ~1860 to 2000.
44. P. A. Stott, et al, "External Control of 20th Century Temperature by Natural and Anthropogenic Forcings", 290, 2133-2137 (12/15).
45. M. A. Maslin & S. J. Burns, "Reconstruction of the Amazon Basin Effective Moisture Availability over the Past 14,000 Years", 290, 2285-2287 (12/22). 46. J. R. Marlow, et al, "Upwelling Intensification As Part of the Pliocene-Pleistocene Climate Transition", 290, 2288-2291 (12/22). Deep-sea cores off southwest Africa show radically different Atlantic circulation than at present.
47. F. E. Mayle, R. Burbridge, & T. J. Killeen, "Millennial-Scale Dynamics of Southern Amazonian Rain Forests," 290, 2291-2294 (12/22). Recent rain forest expansion is explainable by Milankovitch forcing.
48. N. Shackleton, "Climate Change Across the Hemispheres", 291, 58-59 (1/5). Paleoclimate Perspective shows trends for past 10,000 years and speculates on the importance of a Panama water-vapor crossing.
49. T. Blunier & E. J. Brook, "Timing of Millennial-Scale Climate Change in Antarctica and Greenland During the Last Glacial Period", 291, 109-112 (1/5). Speculates on an atmospheric and oceanic coupling.
50. E. Monnin, et al, "Atmospheric CO2 Concentrations over the Last Glacial Termination", 291, 112-114 (1/5). CO2 and methane seemed to covary.
51. C. H. Stirling, "Orbital Forcing of the Marine Isotope Stage 9 Interglacial", 291, 290-293 (1/12). Milankovitch predicts coral reef data to ~630,000 ybp.
52. P. A. Baker, et al, "The History of South American Tropical Precipitation for the Past 25,000 Years", 291, 640-643 (1/12). Lake Titicaca cores.
53. D. Voss, "It's Official: Humans are Behind Most of Global Warming", 291, 566 (1/26). Climate change news reporting IPCC conclusion and a simulation trend.
54. J. W. Hurrell, Y. Kushnir, & M. Visbeck, "The North Atlantic Oscillation", 291, 603-601 (1/26). A climate perspective suggests the ocean may store heat to carry over atmospheric changes from year to year.

John Michael Williams
<JWILL@ASTRAGATE.NET>

Has Radiation Protection Become a Health Hazard? by Gunnar Walinder, 2000, 167 pages (soft cover), Medical Physics Publishing Corporation, Madison, WI 53705, USA. ISBN 91-630-92622-X (Sweden) and ISBN 0-944838-96-0 (USA).

[This review is reproduced from the journal *Health Physics,* with minor alterations, with permission from the Health Physics Society.]

This book is the second edition of a book published by the Swedish Nuclear Training and Safety Center. The author began his career as a physicist and health physicist before taking up biological and medical studies leading to a Ph.D. in radiobiology, a field in which he conducted research for over 30 years. In good scientific manner, the first chapter is a statement of the problem: "Could a complex biological phenomenon, such as the dose-response of radiogenic cancer, really be adequately described by an equation of the first degree, or, in other words, by an expression that geometrically describes a straight line?" Walinder also asks whether the simplification of complex phenomena "result in recommendations and measures which could lead to considerably greater health hazards than those which one sought to avoid in the first place?" He notes that severe mental and psychosomatic diseases following the Chernobyl accident have already surpassed the estimates for late effects of radiation exposure for people living in the Ukraine and Byelorussia.

Chapter 2, the largest chapter, is a discussion of the biological effects of ionizing radiation and human biological complexity. Genetic effects, radiation-induced effects in the fetus, and cancer are the main topics. The complexity of carcinogenesis is highlighted as a "…process which includes a series of genetic, epigenetic and adaptive cell changes. Therefore it is affected by a hereditary propensity for tumor formation, for physiological-organismic conditions, and external factors (living habits, food, carcinogenic substances and promoters in our environment, etc.)." Walinder cites an experiment where the thyroid glands of mice were exposed to a certain radiation dose. It was possible, by merely changing the mice's diet, to determine whether or not tumors will arise in the thyroid gland, whether the tumor will be benign or malignant, and even the degree of malignancy of the tumor. The author suggests that in light of current knowledge, the old Target Theory (where a single event in the genome could transfer a cell into a malignant precursor) is limited in that the basic theory may be correct but that reality is more complex than theory. "A low radiation dose cannot, on its own, cause a malignant cell transformation but, together with other carcinogenic factors, can contribute to such a process. Malignant conversion of a cell is not a stochastic effect of radiation but a highly conditional one…It is impossible to predict, by means of a mathematical expression, the specific outcome of a low radiation dose."

Chapter 3 is a short discussion of epidemiology and pitfalls that often occur when trying to seek "proof" of a causal relationship in a biological context.

Chapter 4 shows the breadth of this book in that it contains an excellent discussion of epistemology. Mathematicians and physicists seem to understand the distinction between what is possible, and what is impossible, to know. But no corresponding analysis has been carried out within biology or medical science. It is suggested that a dose response relationship cannot be determined solely on the basis of taking reductionism to its furthest extreme, i.e. to the level of events in individual genetic molecules. Quantitative determination of the effects of non-dominant radiation doses (amounts low enough that their effects are masked by other competing factors) or non-dominant concentrations of carcinogenic substances cannot be made.

Chapter 5 discusses the biological premises of the recommendations of the International Commission on Radiation Protection (ICRP). The author feels that in the 1977 recommendations of the ICRP (report #26), the ICRP was cautious in warning against a too-literal interpretation of the assumption of a linear dose relationship in the low dose range, but that this caution was abandoned in their 1990 recommendations (report #60). The ICRP view of radiogenic cancer is in conflict with important features of modern oncology highlighting the complexity of the onset of cancer. This is followed by an interesting discussion on the inhibitory effects of accepted doctrines. The author highlights how long it took to correct the value of the charge of the electron because the original determination of the value lead to a Nobel Prize. Many noticed a slight difference, but tended to feel their value was in error because it did not agree with the accepted value. A similar phenomenon occurred with the determination of the number of chromosomes in the human cell. It took a long time to correct the number from 48 to 46. The current radiation protection philosophy, that ionizing radiation induces cancer even at very low doses, produces a similar hinhibition: If a study reveals any evidence to the contrary, something has to be wrong with the study. Most health physicists are well aware of many studies that do not support the linear non-threshold hypothesis, but these studies, including those suggesting hormesis (a beneficial effect), are dismissed by many because they do not fit the prevailing doctrine.

Chapter 6, "Consequences of the Official Approach to Radiation Risk," argues that very cautious approaches to radiation lead the public to believe that if we have to be so extremely cautious, radiation must be much more dangerous than anything else we can be exposed to. High risk figures computed from small doses extrapolated to large populations contribute to the anxiety the ICRP has said it wished to avoid. By 1994, 1,250 people who had

been initial responders to the Chernobyl accident had committed suicide. Also, following the Chernobyl accident, the International Atomic Energy Agency estimates 100,000 to 200,000 abortions were carried out in western Europe as the result of advice from physicians who were so ignorant about elementary radiation biology that they gave completely disastrous advice to an anxious people. The author concludes that we must openly admit we cannot have any science-based knowledge of the negative or positive effects of low levels of ionizing radiation. What can be known is that "a non-dominant radiation dose does not involve a greater risk than what is the case when we subject ourselves to many of the living and working conditions necessary for life and which society already accepts and often demands of us…. It has obviously been recognized that the assertion of knowledge about the effects of extremely low radiation doses will probably lead to more harm than protection."

The book does suffer from a number of editorial flaws, which could be corrected by good technical editing. That notwithstanding, it is excellent reading for those who wish to expand their views regarding the response of humans to low-level doses of ionizing radiation.

A. John Ahlquist
MS-51-208
Lawrence Berkeley National Laboratory
One Cyclotron Road
Berkeley, CA 94720

3860 words