PHYSICS & SOCIETY NEWSLETTER
OCTOBER 2005

IN THIS ISSUE

Physics and Society is the quarterly of the Forum on Physics and Society, a division of the American Physical Society. It presents letters, commentary, book reviews and reviewed articles on the relations of physics and the physics community to government and society. It also carries news of the Forum and provides a medium for Forum members to exchange ideas. Opinions expressed are those of the authors alone and do not necessarily reflect the views of the APS or of the Forum. Contributed articles (up to 2500 words, technicalities are encouraged), letters (500 words), commentary (1000 words), reviews (1000 words) and brief news articles are welcome. Send them to the relevant editor by e-mail (preferred) or regular mail.

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ELECTIONS

Please vote at:

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Candidates for Vice-Chair 2006

Lawrence Krauss
Maury Goodman

Lawrence Krauss

Background:

Prof. Lawrence M. Krauss is Ambrose Swasey Professor of Physics, Professor of Astronomy, and Director of the Center for Education and Research at Case Western Reserve University. He is an internationally known theoretical physicist with wide research interests, including the interface between elementary particle physics and cosmology, where his studies include the early universe, the nature of dark matter, general relativity and neutrino astrophysics. He received his Ph.D. in Physics from the Massachusetts Institute of Technology in 1982 then joined the Harvard Society of Fellows. In 1985 he joined the faculty of Physics at Yale University, and moved to Case Western Reserve in 1993 as Chair of the Dept, a position he held until 2005. He is a Fellow of the American Physical Society and of the American Association for the Advancement of Science. Prof. Krauss is the author of over 200 scientific publications, as well as numerous popular articles on physics and astronomy. In addition, he is the author of six popular books, including the international bestseller, The Physics of Star Trek., and Atom, for which he was awarded the AIP Science Writing Award in 2002. Krauss has been awarded the Lilienfeld Prize of the APS, the Gemant Award from the AIP, the Public Understanding of Science Prize from the AAAS, and the Oersted Medal from the AAPT. In 2005, the APS awarded Krauss the Joseph P. Burton Forum Award for his work on Science and Society. His newest book, Hiding in the Mirror: The Mysterious Allure of Extra Dimensions from Plato to String Theory and Beyond, an exploration of our fascination, in art, literature, and science, with the idea that the three dimensions of space we experience are not all there is, will appear in the October 2005.

Statement:

We are living in dangerous times. Attacks on science are occurring from Washington to high school science classes. At the same time, scientific and technological issues are becoming of ever-greater importance for society. The Forum for Physics and Society serves an important role in helping highlight these important questions for the physics community, promoting debate and discussion within the community, and helping to promote efforts by physicists to reach out and help educate the public, and government on important issues of science and technology and their societal impact. I would be happy to continue this tradition, and to help raise the profile of the Forum if possible, both within the APS and outside of it.

Maury Goodman

Background:

Maury Goodman is a member of the High Energy Physics Division at Argonne National Laboratory. He received his Ph.D. from the University of Illinois in 1979, working on a Fermilab photoproduction experiment under Al Wattenberg. Starting in 1980 he worked with the MIT Lab for Nuclear Science on a neutrino experiment at Fermilab. In 1984 he joined Argonne where he has worked at the Soudan mine, first on a proton decay experiment and then on the MINOS long-baseline neutrino oscillation experiment. He was an early advocate for neutrino experiments which have now burgeoned into a neutrino oscillation industry. He is the author of a popular monthly electronic newsletter on neutrinos. He is an active promoter of science outreach through high schools and in several other contexts. Civically, he is most active on the local level, having served five terms on his city council, and having been actively involved in park, library and school issues. He was elected a delegate to a national party convention in 1996.

Statement:
Physics and Society intermingle on many levels, from local issues to national and global ones. Members of the American Physical Society can offer an important point of view on many such issues, both as scientists and as citizens. International human rights is an example of an issue where we should not underestimate the importance of speaking out when those rights are in danger. Global warming, future energy strategies, nuclear non-proliferation, and the perils of unchallenged pseudo-science are all issues where it is appropriate for scientists to speak out both individually and collectively. The forum on Physics and Society is just that, a forum where these issues can be discussed and debated. If given the opportunity to serve as an officer, I would work to build on the good work that the forum does with its meeting sessions, newsletter and web site. I suspect that a large number of our members would like to be more actively involved in the activities of the forum, and I would try to find ways to encourage and support that.

Candidates for Executive Committee 2006-2009

Stephen Benka
Pushpa Bhat
Peter Zimmerman
Barbara Levi

Stephen Benka

Background:
Stephen Benka received his PhD in physics from the University of North Carolina in Chapel Hill. He was a solar physicist at NASA's Goddard Space Flight Center and at the Naval Research Lab in Washington DC. In 1993, he joined the American Institute of Physics and has been Physics Today's Editor-in-Chief since 1994. He is a Fellow of the American Physical Society.
Statement:
Physics is ever more entwined with society at large. From the big issues such as energy, climate change, and warfare, to the seldom-thought-of little things --- like materials used in clothing and automobiles --- physics surrounds us in this technological 21st century. The paradox is that science in general and physics in particular underpins all of modern global society, yet science in general and physics in particular is catastrophically losing its visibility within our US society. With that loss of visibility comes loss of support and, worse, an ascendancy of pseudo-science and anti-science elements in society. Those elements have always been present but have never been more threatening. In my capacity on the executive committee of APS's Forum on Physics and Society, I will work to energize our physics community to raise the visibility of physics throughout society. We as individuals need to talk with other people --- neighbors, sales clerks, taxi drivers, youngsters, everyone --- without being embarrassed to be physicists. It will be part of my job to provide us all with material for such discourse.

Pushpa Bhat

Background:
Dr. Pushpa Bhat is a scientist at the Fermi National Accelerator Laboratory (Fermilab), and has worked there since 1989. She obtained her Ph.D. in Physics in 1982 from Bangalore University, India. She has carried out research at the Indian Institute of Science, Bhabha Atomic Research Center, the Variable Energy Cyclotron Center in India, Eindhoven University in the Netherlands, Duke University, NC, and Fermilab, IL. Dr. Bhat's research career has spanned applied physics, nuclear physics and experimental particle physics, from keV energies to the energy frontier. She has been an active member of the DZero collider collaboration, making significant contributions to the discovery of the top quark, the measurement of its mass and new particle searches. She is now Head of the Run II Luminosity Upgrades project at Fermilab. She is also an adjunct professor and member of the graduate faculty at Northern Illinois University. Her publications include over 250 papers and many

review articles. She has given several public lectures and invited talks as well as organized international conferences.

Statement:

I have a keen interest in furthering a clear understanding, among the public and politicians alike, that progress in science and societal advancement go hand in hand; that human progress depends heavily on informed and intelligent investments in science; that science is one of the pillars of our civilization. I believe that there has been insufficient discussion of the role of science in society and of the public's concerns – it is impossible to exaggerate its urgency and importance. The Forum on Physics and Society provides the unique opportunity to lead such a multilateral dialogue between the public, the policy makers and scientists in the public arena —an opportunity I would like to be given a chance to capitalize upon. An important part of my strategy involves media communication – the media has the power to bring science and the dialogue to the living rooms of everyday Americans imbuing the socio-economic aspects with unparalleled relevance. I would like to promote the interaction that physicists have with the media, in terms of newspaper articles, documentaries, and panel discussions. The public has a vested interest in knowing about the work that will be shaping its future. I shall work towards making this a reality.

Peter Zimmerman

Background:

Peter D. Zimmerman is Chair of Science & Security in the Department of War Studies at King's College, London and Director of the KCL Centre for Science & Security Studies. At King's his interests include nuclear terrorism, nuclear proliferation, and technical studies of debris in space caused by the use of space weaponry. Concurrently, he serves as a member of the National Academies of Science panel on the Safety and Security of Spent Reactor Fuel, a panel mandated by the U.S. Congress. Before moving to London, he served as the Chief Scientist of the Senate Foreign Relations Committee until 15 January 2003 and Democratic Chief Scientist until 15 March 2004. His responsibilities at the Senate included nuclear testing, nuclear arms control, cooperative threat reduction and bioterrorism. He was the principal architect of S-3121, the "Nuclear and Radiological Terrorism Threat Reduction Act of 2002" cosponsored by Senators Biden, Lugar, Domenici, Clinton, Gregg and Schumer. He also organized the Foreign Relations Committee's hearing on "Dirty Bombs" (radiological dispersion devices) in 2002 and the classified briefings the Committee received on the subject. He has written on Dirty Bombs and nuclear terrorism for the National Defense University. Prior to assuming his duties in the U.S. Senate he was the Science Adviser for Arms Control in the U.S. State Department where he provided advice directly to Assistant Secretary for Arms Control Avis T. Bohlen and to John Holum, Undersecretary for Arms Control and International Security. His responsibilities included technical aspects of the Comprehensive Test Ban Treaty, biological arms control, missile defense, and strategic arms control. Prior to the merger of the Arms Control and Disarmament Agency into the Department of State, Dr. Zimmerman served as the last Chief Scientist of ACDA. He has held positions as a senior associate of the Carnegie Endowment for International Peace and a Senior Fellow of the Center for Strategic and International Studies and as an adjunct member of the research staff of the Institute for Defense Analyses. At IDA he led the technical working group which wrote the sections of the Militarily Critical Technologies List dealing with nuclear weapons and nuclear industry. From April, 1999 until April, 2000 he was Chair of the American Physical Society's Forum on Physics and Society; he had already served two terms as Secretary-Treasury of FPS. In 2001 he was elected to a four year term as a member of the Council of the Society and re-elected in 2004. He was elected a Fellow of the American Physical Society in 1988. Dr. Zimmerman is the recipient of the 2004 Burton/Forum Award of the American Physical Society for his work in arms control and national security, and of the 2005 G. William Morgan Lectureship of the Health Physics Society for his work on "dirty bombs." His first appointment in Washington was as a William C. Foster Fellow at the Arms Control and Disarmament Agency (1984-1986) during which time he served as a technical expert on the START I negotiating team. Dr. Zimmerman holds B.S. (With Distinction, Phi Beta Kappa) and Ph.D. degrees from Stanford University and a Filosofie Licentiat degree from Lunds Universitet in Lund, Sweden, all in

experimental nuclear and elementary particle physics. He was Professor of Physics at Louisiana State University and is the author of more than 100 papers and articles on basic physics, arms control, and national security.

Statement:

To me the Forum on Physics and Society has always been "The Forum," despite the many additional Forums added by APS and my own service with the Forum on Education. Several years ago I was privileged to serve FPS as Secretary Treasurer and in the "Chair line" -- career-changing events for me as it turned out. After some years in which I have primarily confined my FPS contributions to being an observer at ExCom meetings and to organizing sessions, I would like to have a chance to participate actively once again. I will be encouraging the Forum to start studies of issues in physics and society in which any and all FPS members with an interest can participate. The subjects could include work on issues of international and homeland security, communicating the ideas of science and why things like "intelligent design" are not science, or trying to combat what I have called pseudophysics in the past. There is no shortage of problems at the intersection of physics and society where FPS members have a duty to become engaged. Some may not be as glamorous as nuclear missiles and space defense, but they may be more important for our profession and in some ways for our country. I now live and teach in the United Kingdom, a circumstance which gives me a different perspective on both physics and the United States than I have had before. I think that would also be valuable to the FPS ExCom and the Forum itself.

Barbara Levi

Background:

Barbara Goss Levi earned a PhD in particle physics from Stanford University in 1971. For most of the past 30 years, she has written for Physics Today, reporting on new discoveries at the frontiers of physics. After rising to senior editor, she was in charge of Physics Today's news section, "Search and Discovery". She now serves as a contributing editor. Because of Dr. Levi's interest in issues at the interface of physics and society, she became a consultant for the US Congress' Office of Technology Assessment, from the late 1970s to the Office's closure in 1995. From 1981 to 1987, Dr. Levi was a member of the research staff at Princeton University's Center for Energy and Environmental Studies. Her work there on arms control and the effects of nuclear weapons resulted in, among others, two articles in Scientific American. She was the chair of the APS Forum of Physics and Society and co-edited a book on global warming produced under the Forum's auspices. She served on the APS Executive Board and is currently a member of its Panel on Public Affairs. She has served on the Governing Council of the Federation of American Scientists and on the steering committee of the physics section of the American Association for the Advancement of Science. She is a fellow of both the APS and the American Association for the Advancement of Science.

Statement:

The Forum on Physics and Society has long served to facilitate the involvement of physicists in public affairs, especially in issues with a strong science or technology component. The list of such issues is a familiar one: nuclear weapons, nuclear proliferation, energy policy, science education, atmospheric effects of ozone or carbon dioxide. The list only keeps growing. So does the need for greater participation of scientists in the public debate. I am concerned about the public debate of “science and society” issues. The general public seems less and less able to understand—and appreciate—the key science principles affecting the issues. We as scientists haven’t been sufficiently effective in educating the citizenry about such key principles. And the news media reporting on some of these issues too often oversimplify, politicize, or distort the issues. There’s a need for physicists to be more proactive. These problems have always been with us but I think they have become more critical as late. That’s why FPS is more vital than ever. Through the articles in its newsletter and the sessions it organizes at APS meetings, FPS can help its members educate themselves on these issues. Perhaps we need to work harder to get our members to help educate the general public as well. I have been especially concerned about the threat to science education posed by those who advocate teaching “intelligent design” in public science classrooms. I am helping to organize some FPS-sponsored invited-paper sessions on this topic this year. As FPS liaison to POPA until December 2005, I am serving on a subcommittee

concerned with intelligent design. POPA is proposing a number of activities for APS, some in concert with other science societies. FPS can and should play a big role as well.
I hope to help FPS continue to address the many critical science and society issues of the day and to find more ways to mobilize our members to promote greater public understanding of them.

Candidates for forum representative on PoPA: 2006
Paul Craig
Ruth Howes

Paul Craig
Background:
I'm a Professor of Engineering Emeritus from UC Davis. BA Math and Physics, Haverford College 1954. PhD Physics CalTech 1959. My research and teaching interests relate to energy efficiency, global warming, and nuclear waste. At various times I've served in the APS Forum, including Chairman and Forum Delegate to POPA; I've been a staff member at LANL and BNL; and a Guggenheim Fellow. I shifted from Physics to policy in the 1970s while working in DC the Office of the President's Science Advisor. Until last year I was a Member of the Nuclear Waste Technical Review Board (an independent agency advising the Congress and the Secretary of Energy about Yucca Mountain). I was a Member and later Chairman of the Sierra Club's National Global Warming and Energy Committee. I'm currently liaison to that Committee from another Club entity. I'm active in my local community (Martinez, CA) on issues relating to industrial safety and emergency response, and to land preservation.
Statement:
I'd like to encourage APS and Forum policy studies, especially as these relate to global warming and climate change. The physics community has a long history of excellent studies, some of which have had significant impact. We need to maintain that tradition. I'd like to see the Forum work with physics and related departments to encourage students to think in terms of public policy careers. One good way to do that is by providing access to physicists who have successfully moved into such careers, and providing on-campus contact lists for prospective students. The physics community needs to find new ways to show the brightest students that physics is a superb pathway not only to basic and applied science but also to policy-related careers.

Ruth Howes
Background:
Ruth Howes is professor and chair in the Physics Department at Marquette University. She is an experimental nuclear physicist with an interest in the history of women in physics and holds a Ph.D. from Columbia University. She served as a Foster Fellow at the U.S. Arms Control and Disarmament Agency (1983-84), a AAAS Congressional Fellow (1993-94), a program officer at NSF (1994-95), president of the AAPT and the Indiana Academy of Science (2000) and as a member of the National Task Force on Undergraduate Physics (2001-2005). Within APS, she has served as chair of the Committee on Education, the Forum of Education, POPA and the Forum on Physics and Society. She is a fellow of APS, AAAS and the Indiana Academy of Science
Statement:
The American public is optimistic and operates on a very short timeline. Business leaders are driven by quarterly reports, and Congress by a two-year election cycle. Many of the issues facing the country – energy supplies, global warming, nuclear arms control and managing terrorism among others – demand long-term planning for their solutions. The Forum on Physics and Society possesses the technical know-how to devise solutions to these problems, and we must work on strategies for "selling" them to Congress, business leaders and the country. It is also critical that the Forum join the efforts of others to convince the public of the importance of investing in scientific research. Like any risky investment, fundamental research cannot guarantee an immediate payoff nor will all good

research result in economic benefits. However, stocking our national supply closet with good ideas and new techniques is essential to the strength of our economy thirty years in the future. If the imbalance in funding of the physical and life sciences is not corrected, the life sciences will find a dearth of new technologies to drive their future growth.

EDITOR'S COMMENTS

This is the time for the annual election of Forum officers. Your Forum is only as interesting and effective as you make it - by electing appropriate officers and by serving yourself. Please vote! And consider nominating your self in future elections.

I (AMS) owe our readers an apology for an apparent source of confusion in the News section of the July 2005 issue. I can now see that it may appear that "Unknowns at MIT" describes some anonymous author(s). Actually, the piece is an Editorial by the Boston Globe, written by their editors, given the title, by them, of "Unknowns at MIT", and republished in P&S with their permission. I thought that was made explicitly clear at the end of the piece, as we published it - but I now see that the heading could be somewhat misleading.

With this issue, we kick off a series of articles on the subject of science advice in the formulation of federal government policy. Professor Wolfgang Panofsky from SLAC has written our kickoff article, published in this issue, that summarizes the essential issues with which we will be dealing in the series. One of us (JJM) wants to thank Professor Panofsky for proposing this series and for providing a wealth of names of potential authors. In addition to the kickoff article by Panofsky, we are pleased to publish here the first paper of the series, by Professor Edwin Salpeter of Cornell University. He was asked to provide a comparison of the attitudes of various U.S. presidential administrations toward scientific input to policy formulation, and he responded with the informative and very frank paper that you see in this issue.

We would very much welcome manuscripts regarding this topic from interested readers of P&S.

Our government, with or without science, often seems very theatrical and so it is natural to follow our articles about the relation between science and government with one about the relation between science and theater. The theater often raises the question of what is "true". The following article on fallout and cancer indicates the difficulty much of the American public has in separating fact from fiction in their own lives. Apparently, given a contradiction between "scientific fact " and anecdote, much of our public - and their media and politicians - will opt for the latter. Perusing the references in Dr. Miles story, one is saddened by the number of fallacies which appear to have been fostered on the public by university presses; it appears that the refereeing process, of which our scientific societies are so proud, does not always extend to our distinguished academic presses.

AMS and JJM

ARTICLES

Introduction to a Series of Articles in Physics & Society on Science Input to Government

W.K.H. Panofsky

An upcoming series of articles in this journal will be authored by, among others, senior individuals who held science advisory positions at a high level, primarily for the President of the United States. This article is to serve as background to those articles and is meant to illuminate the basic issues which affect the interaction of science and government in general, and science advice to government in particular.

Desire for understanding the working of nature has been part of all recorded civilizations, as have human activities designed to improve well being through technology based on science. To varying degrees, consequently, structures within governments have been moved to utilize science; conversely, governments have enacted measures affecting the well-being of science. But this interdependence should not obscure the basic differences between science and the political process.

Science is the quest for understanding the reality of nature, followed by the dissemination of the resultant knowledge. Science uses rational methods in arriving at its conclusions, preferably, but not always, using mathematics as a language. Science demands consistency among observation, experimentation and interpretation. The pursuit of science continues to uncover new questions. Therefore, gaps and limits in knowledge will continually be made manifest; this in no way is a defect of scientific method, but a consequence of the ever-expanding frontier which science creates. Pursuit of science can be curiosity driven, or it can be motivated by a search for applications. Yet while the dividing line between these motivations is clear, curiosity driven (usually called fundamental) research often results in application, while pursuit of applications can lead to basic insights.

When science and government interact, it is not surprising that the gaps and limits in scientific knowledge become prominent. Scientific issues of most relevance to government are areas where uncertainty is frequently apparent: forecasting future developments or future impacts of science on the human condition, and attempting to judge which areas of science should receive priority in the public interest can rarely be based on solidly established facts.

In contrast to the scientific endeavor, governmental policy is designed to lead to decisions based on a combination of inputs, stemming from experience, political association, and pre-conceived beliefs or even faith. Formulation of policy is often described as “the art of the possible” and there is no firm requirement of internal consistency or logical interconnectedness.

Notwithstanding their fundamental differences in method, science and governmental policy need each other. The pursuit of science is increasingly dependent on public support, and there are few governmental policy decisions today which do not depend to a significant extent on scientific realities. Thus the interaction between government and science can be differentiated between “government in science”, that is, support of science by government, and “science in government”, i.e., the processes through which scientific realities are being factored into governmental decisions.

The management of these interactions follows a large variety of practices worldwide. The United States is largely governed by individuals not expert in science; therefore, scientific input is generated either within the government from its lower levels or from outside the government. On the other extreme, for instance, essentially all the senior members of the governmental bodies of China have an engineering or scientific background; the direct expertise in science and technology of the senior leadership of other countries generally falls in between.

Historically, the realization of the importance of science to the United States government has grown over time. President Jefferson had a deep personal interest in science although he was not a trained scientist. John Quincy Adams made an heroic attempt to incorporate a comprehensive set of scientific institutions into the U.S. governmental structure. President Lincoln promoted the Congressional charter for the establishment of the National Academy of Sciences with the explicit mission to advise the government of the United States. Most of the early attempts to link science and government dealt with the practical missions of government, such as the establishment of weights and measures, or generating the tools for navigation and mapping the lands of the United States. In contrast, the pursuit of fundamental science was left to private institutions. The major universities of the United States progressively considered graduate education and science to be inseparable and established research programs in accordance with that principle. Industry created major research laboratories. In particular, those industries enjoying near-monopolies in their respective field could support research with a very long lead-time to application.

All this changed dramatically as a result of the role of science in the pursuit of the Allies’ victory in World War II. Academic scientists, when liberally supported, proved extremely productive in military activities such as the release of nuclear energy, in radar, rockets, undersea warfare and similar

endeavors. After the war, the universities were induced to spend almost all of their resources on supporting education, particularly in view of the flood of students returning from military service. As a result of these factors, the support of research at the universities, as well as at the laboratories created during the war, largely became the responsibility of the federal government. In turn, the government was fully persuaded that such support served the economy and well being of the United States' citizenry. As a result, government support of science proceeded well after the war, but this was not generally the case in respect to input of science to governmental policy.

The relationship between scientific advice to government policy changed after the Soviets successfully launched Sputnik into orbit, while the first attempt by the United States to do so failed. These events were publicly interpreted, probably over-interpreted, to be the result of a lag of the American scientific endeavor relative to that of the Soviets and resulted in a public outcry. In response, President Eisenhower elevated the science advisory structure in the Office of Defense Mobilization (ODM) to the Presidential level, renaming it the President Science Advisory Committee (PSAC). He also created the post of Special Assistant to the President (James Killian was its first incumbent, colloquially called the "Science Advisor.") Neither PSAC nor the Science Advisor were accountable to the Congress. This changed through the creation of the statutory Office of Science and Technology, now renamed the Office of Science and Technology Policy (OSTP). In order to make the voice of science to the President unique, the Science Advisor chaired both PSAC and the Office of Science and Technology. Initially, the agenda of PSAC and that of the Science Advisor were largely pre-empted by issues of National Security, broadening later to other issues of "Science in Government." This system worked at its best under Presidents Eisenhower and Kennedy, possibly because of the excellent personal "chemistry" between the Science Advisor and the President. Since that time, the relationship between science and government in regards to science advice to the government has significantly deteriorated, while support of science by government has generally proceeded well with some ups and downs. Accordingly, the articles to follow will address primarily science in government, rather than government in science.

It has often been suggested that the government should create a Department of Science, with its Secretary being a cabinet officer. This proposal has been rejected by most scientists and government officials. Science is an inherent component of almost all governmental activities, and thus creation of a Department of Science might be considered to be as inappropriate as creation of a Department of Politics.

To give a background for the articles to follow, let me list here the tensions which beset the relationship of independent science advice to a high level governmental advisee, in particular the President.

[1] Conflict of Interest
A scientific advisor to government is presumed to be an "independent expert," but the problem is that he may be neither sufficiently expert nor sufficiently independent. Decisions taken in response to the advice given may influence the future of the Advisor's field, and sometimes even the career of the Advisor. Thus the advisors frequently have a direct interest in the outcome of the governmental decisions. These tensions can be minimized but never fully eliminated. Good practice strives to balance the backgrounds and interests of the members of advisory bodies, but the search for balance has its limits. It clearly makes no sense to attempt to strive for "balance" between geneticists and religious creationists; the former is a scientific discipline, the latter is not. Moreover, if highly extreme views are included among members of advisory bodies, consensus and agreed reports are difficult to achieve.

[2] Who Owns the Advisor?
In parallel with independent advice sought by the President, the Advisor may also be requested to furnish expert advice to other bodies, such as Congress. While the actual nature of the advice given to

the President rightfully can and frequently should remain privileged, once an advisor testifies in other forums, it can become manifest that the decision taken by the President was taken in conflict with the advice received, leading to embarrassment.

[3] Accountability
Science advice to the President is fundamentally privileged, but broad science policy -- and even some narrower science-policy issues -- are of general public interest, and therefore also of Congressional concern. Thus Congress insisted on an accountable science advisory process, a demand which was met by creation of OSTP. In addition, Congress decided to establish a science advisory body of its own, called the Office of Technology Assessment (OTA) with established safeguards to assure non-partisan advice. OTA was, however, abolished by the Republican majority dissatisfied with this non-partisan arrangement.

[4] Access
If science advice to the highest level is to be effective, the Advisor must have personal access to the target of the advice. The access of the President's Science Advisor has been variable, depending on the President's direct interest. Frequently, the "de facto" access has been largely limited to the Vice President or senior White House staff. Conversely, the Advisor must also have access to input from the scientific community and the relevant public or executive agencies. Thus, such agencies at a lower level of government must be free and encouraged to communicate to the Science Advisor. However, the Science Advisor must not be a line officer through whom decisions made by the Executive which have a bearing on science must first be cleared. The effectiveness of the Science Advisor depends on having access to the advisee in principle. It is the potential of that access which makes the Advisor's communication with lower echelons effective.

[5] Science Advisor v. Spokesman for Science Policy.
The policymaker is free to accept or reject science advice as rendered. For that reason, tensions arise if the Science Advisor is used by the advisee to be an official spokesman to support the policy which is eventually decided upon. Therefore, it is best to avoid having the Science Advisor to be a spokesman in defense of governmental policy, unless the area in question is non-controversial, such as the support of selected scientific endeavors or general proclamations on the importance of science.

[6] Conflict of Advice with Preconceived Policy
Possibly the most serious tension between science advice and governmental functions arises if preconceived policy is in conflict with sound scientific advice. This has been the case in recent times in such sensitive areas as environmental policy, global warming, issues relating to reproductive health, and certain military issues where moves in the ostensible national security interest appear to be in violation of sound scientific criteria. While such conflicts are unavoidable, their very existence points to the value -- in fact, to the necessity -- of independent science advice. Under such circumstances, disregarding such advice or modifying for public consumption the advice rendered will result in grave danger to the nation.

The above listing gives only a very rudimentary description of both the essential character of science advice to the government and the benefits, but also the tensions, which result from such advice. The recital of the details of the advisory process in the articles to follow must be viewed with these generalities in mind.

Wolfgang K.H.Panofsky is an elementary particle and accelerator physicist. He has also served in numerous advisory capacities, principally relating to National Security. He was a member of the President's Science Advisory Committee from 1959-1964, and served on the General Advisory Committee on Arms Control to President Carter. He chaired the Committee on International Security and Arms Control of the National Academy of Sciences for several years and continues as Senior

Advisor. He is a member of JASON, and served on many advisory committees to the Department of Energy and other government agencies.

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SCIENTIFIC INTEGRITY IN GOVERNMENT AND BALLISTIC MISSILE DEFENSE

Edwin E. Salpeter

Governments often receive scientific reports which evaluate some trend, such as global warming, or some proposed military project, such as Nuclear Bunker Busters or Ballistic Missile Defense. If the conclusion and recommendation of the report is opposite to government policy, the government may disregard the recommendation but, hopefully, will still quote the conclusion correctly. Over the last two years or so, however, the Union of Concerned Scientists has documented many cases where the Bush Administration has not only misquoted the conclusions, but also put pressure on the authors to falsify some parts of the report before publication. [See www.ucsusa.org/rsi for articles concerning scientific integrity.] Of course this directly undermines scientific integrity in government operations, but I mainly want to point out here some other, indirect, detrimental consequences connected with a certain dichotomy or tension in many industries: Some people in administration will lie and cheat if it helps the company's profits, whereas most people doing the actual work are anxious to do an honest job (but are also influenced by outside forces). I will describe three episodes over the last 45 years of Ballistic Missile Defense (BMD) preparations, where the deteriorating attitude of the federal government to scientific integrity is one of these forces:

(1): In the 1960's there already was a proposal from industry for a BMD system called Nike-Zeus (replaced later by "Sentinel"), even though radars were very slow in those days. As a member of the Jason group, working for the Advanced Research Project Agency (ARPA) of the Defense Department, I was evaluating various industry claims for this proposal. In 1963 I was sent to Kwajulene Atoll in the Marshall Islands, where the radars looking at incoming simulated ICBMs from California were located. ARPA was interested in the likelihood of eventual success or failure of the Nike-Zeus BMD, rather than in promoting the deployment of the system, and they sent me to Kwajulene for a whole week. I was at first surprised why two or three days would not have been sufficient, but I soon found out why: For the first three days I was given briefings by the industry's administration representatives, who claimed that the radars would acquire the incoming projectiles without any previous information. This claim was an outright lie, as I found out in the remaining four days which I spent with the industry's radar experts as they were trying to lock in on an incoming missile: In fact, they had been given detailed flight information beforehand which they needed for the radar tracking. I worked on Nike-Zeus evaluations for a couple of years and am rather proud of a comprehensive report I wrote on the system (The system was never deployed.). However, I am even more proud of the indirect effect I had on the radar experts on Kwajulene. They were encouraged when they saw from my searching questions that the Defense Department was really interested in the technical facts rather than in boosting the industry administration claims. As mentioned, I personally only spent four days at the radars, but a number of people at Lincoln Laboratory (associated with M.I.T.) did similar evaluations to mine, intensively and over a long period. I found the Lincoln Lab staff most competent and conscientious at evaluations in those days. In addition they, as I, were also middlemen between the federal government and industry: The interest in technical honesty displayed by President Johnson and Secretary McNamarra rubbed off onto us evaluators and then from us onto industry. I will return to Lincoln Lab later.

(2): The situation for the "Directed Energy Weapons" system under President Reagan (the so-called "Star Wars" initiative) was intermediate between the 1960's and the present. The Reagan administration was not particularly interested in the truth, but at least they were not violently opposed. In 1985 a panel to evaluate the directed energy weapons potential was started, not by the Defense Department this time but by the American Physical Society, and I was a member. One feature of the panel was that each of us had security clearance for classified information, so the government could not play the present-day game of releasing data that it likes and classifying data that it doesn't like. Political views varied enormously among the panel members, but it was gratifying that we were able to come out with a single objective report without any dissenting opinions. The conclusions of the report [Rev. Mod. Phys. 59, 51 (1987)] regarding technical feasibility were negative, and this BMD system also was not deployed. The social implications of our panel are described in an interesting report by B. W. Kubbig [PRIF Research Report January 2001, Leimenrode 29, D-60322 Frankfurt, Germany]. After the panel finished its work it offered to give a detailed briefing to Defense Department representatives. They attended the briefing diligently but were mostly antagonistic to the conclusions. During the panel deliberations we listened to a number of people from industry, somewhat as in the 60's, but I detected a bit more ambivalence this time about "the full truth" versus "pleasing both your own bosses and the government"

(3): The present Bush government started on yet another ambitious BMD concept, and the American Physical Society commissioned another Panel to evaluate at least one aspect of the scheme (dealing with the boost phase). The panel, co-chaired by Dan Kleppner and Fred Lamb, came out with a (somewhat negative) report and again offered a detailed briefing to the Defense Department. This time no one from the Department even showed up for the briefing!

The present BMD system is being deployed before it is fully designed, and TRW has been carrying out some of the relevant experiments and tests. Lincoln Lab, which is still supervised (nominally) by MIT, again had to evaluate these tests, somewhat as 42 years ago. But this time there is a difference: A Boston Globe editorial, "Unknowns at MIT", reprinted in the July 2005 issue of this publication, documents claims that some Lincoln Lab reports misrepresented facts and that the government has classified material to make it difficult for MIT to monitor the situation. Of course, any claim that Lincoln Lab deliberately and systematically portrayed the system as more successful than it really is has to be investigated. However, although I have no direct knowledge this time around, I have a different (and more murky) theory: I have a hunch that deliberate dishonesty at Lincoln Lab is less likely than loss of focus and accuracy, the latter loss stimulated by the government's dishonesty. Accurate evaluation requires undivided devotion and is almost impossible when your ultimate paymaster, the federal government, does not want the truth. Work is particularly scary when Karl Rove might even do you (or your wife) damage if you tell the truth nevertheless, as happened to Ambassador Wilson. With such distractions, mistakes which inadvertently tip the scales in favor of the government's position will predominate over preplanned lies. In either case do not expect reliable evaluations!

I have another hunch about industries building the components for the present-day BMD system (Boeing and others). While the system as a whole will almost certainly not work because of its complexity, the most basic components for it are standard. The industries are generally very competent, but now "on the same side" as the government regarding lies, with the following consequence: Tests of the basic components that should be quite routine and successful have resulted in a spectacularly large number of failures. General Obering, director of the Missile Defense Agency, simply blames Boeing, but there is, in my view, a more general malaise: The fog of dishonesty during the deployment of a system that does not work must breed confusion and incompetence in the industry. You yourself start believing some of the lies you tell the public, and soon you can't even tell the difference between centimeters and inches. This leads to technical goofs and failures which produce more lies; this will increase incompetence further, etc., etc.

(4): With an early-stage proposal such as "nuclear bunker busters" the lack of scientific integrity is in the form of ignoring basic facts. Using a low-yield nuclear warhead in an earth-penetrating weapon is supposed to give deeper penetration with "minimal collateral damage". In reality, basic physics shows that a nuclear warhead does not increase the penetration depth appreciably, so the explosion cannot be contained underground and the above-ground radio-active fallout is particularly deadly [see R. W. Nelson, Science and Global Security, 10, 1 (2002)]. Unfortunately, Congress does not seem to be aware of the danger of this proposal and may give it some funds. Congress generally has a low level of information where the physical sciences are involved (but do somewhat better on health-related issues).

We rank and file scientists have to ask ourselves what we can do to counteract the government trampling on scientific integrity. Most obviously we should vigorously support the Union of Concerned Scientists as they emphasize urgent issues and put out information intelligible to the public. In addition to such passive support, each of us must also get involved more directly and speak out. We first have to take the effort to get informed ourselves, technically and politically, and then speak to rotary clubs, etc. It is particularly important to speak to the Senate and Congress, even apart from scientific integrity issues.

Science and the federal legislature should now have a particularly close bond for two reasons: With the executive branch distorting scientific results, the legislature should be first at receiving the correct results. The other reason relates to the loss of democracy and science: After the demise of the Hitler regime, German industry and economics recovered remarkably quickly, but German science has still not fully returned to its former glory. The Bush/Cheney administration is systematically pushing this country towards a totalitarian regime, and this by itself threatens science. The House and the Senate should be sensitive to this threat to freedom and science, but they need input from the public. With diligence and preparation, we rank and file scientists can give not only technical information to the legislature but also coherent input on political and moral issues.

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Physics in Theater

Harry Lustig

I have a little list of "science plays" (1). Actually it is not so little; it consists of 114 titles, the names of their authors, publication and/or performance data, and thumbnail descriptions. Although there have been plays in which scientists and science play a role since antiquity - the first, in 423 BC, having been Aristophanes' Clouds (which ridicules the work of all varieties of "rank pedants, those palefaced vagabonds in the academy ") - the bulk of science plays have appeared in the past twenty years. There is no agreed upon definition of what constitutes a science play. Some would restrict the category to works for the stage in which there actually is a presentation of scientific ideas or where the fact that the protagonist is a scientist is important. Others would admit any play that deals with the consequences of scientific research or technological invention, or even when the hero, or, more frequently, anti-hero, being a scientist is irrelevant. The compilers of the list have tended to adapt the latter view.

I will be less inclusive in this article. Of the plays (and, yes, musicals and operas) on the list some forty can be reliably and narrowly identified as "physics plays". I will briefly describe and critique a small subset of them, making use in several cases of an outstanding essay by M. A. Orthoffer in the journal

"Interdisciplinary Science Reviews" (2). . Then I shall examine the reasons for the current flood, give various opinion of what liberties a playwright may legitimately take and not take with the science, with historical fact, and with the lives and character of real people, and, inevitably, ask about the boom, " but is it good for the scientists?"

An attribute of historical science plays is that they reflect the views of their time about science or scientists. That is by no means always the case for contemporary plays in which scientists appear as characters; they often serve only as props for the examination of mundane psychological problems or as mindless entertainment. Yet there are some that illuminate science as theater has never done before.

After Aristophanes, there was essentially no science on the stage for two millennia. The work of Copernicus, Kepler, Galileo and Francis Bacon was barely acknowledged in the dramas of their times. The few exceptions included plays featuring an alchemist (Ben Jonson) and the Faust figure (Christopher Marlowe.) In them the protagonists , as Orthoffer says (3), "are presented as seekers of higher truths [. . . but] the natural sciences were not yet considered a viable sphere in which they might find them". Even two centuries later, Goethe who himself engaged in scientific work, chose to return to the old Faust legend, rather than focus on contemporary science or scientists. "When Faust has exhausted the possibilities of academic learning, instead of thinking of research and, especially, experimentation, which "are not seen as viable means of attaining more wisdom, or understanding. Instead Faust resorts to "Magic art", and famously overreaches with his ambition" (3).

Thomas Shadwell's 1676 play The Virtuoso was the first drama in which a major character is finally clearly recognizable as a scientist. The protagonist, Sir Nicholas Gimcrack, is devastatingly portrayed as "a scientific dabbler and dilettante" (3), and a figure of ridicule. He claims to be interested in pure research for its own sake - pure disinterested research being a notion that the author presents as risible - but when Gimcrack's discoveries and inventions do have practical applications, Shadwell attacks them as having dangerous and deleterious economic, political, and moral consequences.

Bertolt Brecht's Life of Galileo (1938 - 1956) is the first science drama that deals with real persons and events and remains the prototypical modern science drama. It addresses significant issues: the responsibility of the scientist to society, the importance of the scientific enterprise, and science (and scientists) in relation to the authority of church and state. "Though Brecht's play is set in the seventeenth century, his Galileo is a modern scientist and Brecht frames the conflict in the play in ways that evoke contemporary issues"(3). There are three distinct versions of the play, the changes corresponding to the evolution of Brecht's politics, as well as to the unfolding events in the world. The most important event was the use of the atomic bomb and the roles of scientists in its development, Brecht noting that "with Hiroshima, overnight the biography of the founder of the new system of physics, reads differently". (I find this exercise in time-reversal problematic.). From science and its practices, initially celebrated as a great good, and the failure to stand up for it denounced as cowardice and worse, Brecht came to see a failure in science to consider the interests of humanity as a fatal flaw. In the revised version "Science for science,s sake . . .[becomes] the worst outcome [. . .] Galileo can imagine, bringing with it little more than the potential to be abused by the authorities" (3).

The most important and best known physics play after Galileo and before Copenhagen is arguably Friedrich Dürrenmatt's The Physicists, which was first performed in 1962. It is set in a private sanatorium for the insane and the three inmates are physicists, calling themselves Einstein, Newton and Möbius. (The real Möbius was a mathematician and astronomer.) Möbius sought refuge in the madhouse in order to escape from the profound implications and danger to mankind of the scientific work he was doing. The other two, who are intelligence agents, have gotten themselves locked up with Möbius to get him to reveal his secrets for the benefit of the countries they serve. Each kills his nurse out of fear that the nurses suspect one of the physicists to be really sane. Möbius convinces the others to act responsibly by keeping the secrets he has discovered out of the hands of mankind, at the cost of remaining locked up for the rest of their lives . But only then does he discover that the woman who

runs the sanitarium is really a madwoman who has appropriated his work and has already set in motion the destruction of the world. The author's portrayal of the scientists is a mixed one; they are neither entirely to blame for nor to be absolved of the tragedies that have ensued.

Carl Zuckmayer's 1955 drama Das kalte Licht is more of a historical drama, because it is loosely based on the story of the physicist Klaus Fuchs who, while working at Los Alamos, was a spy for the Soviet Union. It was a timely and successful work - there were more than thirty productions during the 1955-56 season in West Germany alone - but it has not endured. That is a pity because it is one of the few plays that examines the practice of science closely. Even so, "Zuckmayer is more concerned with the political and nationalist pressures exerted on the characters than with the science" (3).

Heinar Kipphardt's In the Matter of J. Robert Oppenheimer, first staged in 1964, is a very different work from the ones that preceded it, and remains one of the most significant plays dealing with science. In contrast to the approach of many of the earlier plays portraying scientists, In the Matter of J. Robert Oppenheimer is a quasi-documentary. Almost all of the text is taken verbatim from the transcript of the 1954 hearing that was convened by the US Atomic Energy Commission to review Oppenheimer's security clearance. Kipphardt does "allow himself certain liberties, including cutting a great deal of material, reducing the number of witnesses and occasionally shifting who said what" (3). But the most notable, in fact the only, significant violation of the play's documentary character are the closing remarks that Kipphardt has Oppenheimer make. The speech is a summing up and considers the role of the scientist in modern society, much like Galileo does in Brecht's play. Clearly Kipphardt did not feel that Oppenheimer said what needed to be said, so he put the appropriate words, his own, into Oppenheimer's mouth instead.

In Tom Stoppard's Hapgood (1988) science and theater are integrated as they never had been before, with science determining both form and content of the drama. It is a spy play in which experiments are constantly set up on the basis of working hypotheses. Mostly accurate, intricate presentations of quantum mechanics are given. But when Hapgood initially did not meet with much success, Stoppard decided to revise it. Although he maintained that it was not the physics that was the problem, but the plot, the narrative, and the timing, the science was heavily cut and presented in a grossly simplified manner for the 1994 New York production. The physics is now mostly window dressing.

Ten years later, in 1998, Michael Frayn's Copenhagen opened in London. It is not only, in my opinion, the finest science play ever written and staged, but it enjoyed an enthusiastic reception by critics and the much of the public. After Copenhagen the steady flow of science plays became a rushing stream. What are the reasons for this eruption? The causes undoubtedly include an even stronger reaction than during the preceding five decades to the cataclysmic invention and use of the atomic bomb, and the fears that it would be used again. This probably also helps account for the fact that the majority of science plays have physicists as protagonists, usually as anti-heroes, or just plain villains. The ever growing dominance of our lives by technology, both for good and for bad, is a very much related reason. Playwrights often have strong, if not always well-informed opinions and (often messianic) political goals, with which to influence and imbue the public. And it should not be glossed over that theater is by and large a commercial venture. The success of Copenhagen certainly aroused hopes that other science plays would find a ready market. Finally, to encourage the writing and production of science plays, the Alfred P. Sloan Foundation, whose mission it is to propagate knowledge and appreciation of technology and science among the general public, has instituted a program of grants to playwrights and to a theater company, the Ensemble Studio Theater, in order to achieve that goal. To-date some thirty science plays and musicals have been written and produced under Sloan sponsorship. Most of them present science and scientists in an unfavorable, and, sometimes, ridiculing light. Clearly the Foundation has imposed, or enforced, no restrictions or guidelines on its authors or producers. This is a good thing for freedom of speech, but it does not encourage a favorable or even a balanced appreciation of science.

Among the science plays, and especially the physics plays, there are some in which the protagonist, or several protagonists, are real characters; some in which the scientists are fictional characters; some in which science is presented well; some in which it is presented poorly; and some in which it doesn't really figure at all and in which science and the fact that the protagonist is a scientist are completely irrelevant. There are plays in which history is rendered reasonably truthfully and some in which it is either cavalierly or mischievously distorted. There are plays with greater and lesser theatrical values. Another cut that can be made is between plays that are serious (or think they are serious) and those that admit and even celebrate that they are not. There are some that are slapstick and some that aspire to offer satire.

An attempt at the latter is Picasso at the Lapin Agile, first staged in 1996. The "nimble rabbit" is a bar in Montmartre. The conceit is that Picasso and Einstein hung out there, presumably in the 1920's, holding forth from time to time on their work, ideas, and achievements, and spending much of the time going after the available women in the establishment. Picasso is portrayed as a suave ladies man and Einstein as a nerdy one. One problem is that the dialogue is not all that sparkling and hardly satirical. Picasso at the Lapin Agile was written by the sitcom writer and actor Steve Allen, who is no Tom Lehrer. But then perhaps the play was meant to be profound after all. Shortly before the end a third important character makes his appearance. He is Elvis Presley and the author makes the convincing if depressing point that Presley was every bit as important to the twentieth century as were Einstein and Picasso.

In contrast, Paul Mullin's Louis Slotin Sonata is an important and serious, if flawed, play. Regrettably, it is little known. The play depicts a real event: on May 21, 1946. Louis Slotin, a Canadian physicist at Los Alamos repeated a "criticality test" that he had done many (perhaps too many) times before. He moved the pieces of a plutonium bomb closer together and farther apart, "flirting" (as Dennis Overbye wrote in a review in the New York Times (4)) with the moment when the assembly would be on the verge of achieving critical mass. The two plutonium hemispheres were encased in thin shells of beryllium to serve as the neutron reflector. Wooden spacers between the two halves of the shell normally kept it from closing all the way and bringing on criticality. On this occasion Slotin had removed the spacers and was using the blade of a screwdriver to keep the halves separated. This time Slotin's screwdriver slipped and the assembly clicked together. Slotin pulled the bomb apart but it was too late. In the millisecond after the blade had slipped and the shell was closed, he received more than 2100 rems of radiation, more than three times the lethal dose. Smaller doses were received by the seven men who were standing behind Slotin and thus were partially shielded by him. They survived and most lived long, healthy lives. Louis Slotin died after nine days of increasing agony at the Los Alamos hospital.

The playwright uses Slotin's death and his journey to the grave to examine and pronounce on troubling questions of personal behavior and national policy. The device for doing that is the pretense that Slotin in the days before his death suffered hallucinations; this allows Mullin to bring on real people and one imaginary character in didactic sequences, somewhat reminiscent of Brecht. J. Robert Oppenheimer is there repeating his line from the Bhagavad-Gita "I am become death, shatterer of worlds". Einstein appears - yes - playing dice, and God himself shows up, dressed in a period pinstripe suit and a fedora, the very image of Harry S. Truman, the American President who made the decision to drop the two atomic bombs on Japan. But, so also does Josef Mengele, the sadistic Nazi death camp doctor, who in one of the dream sequences arrives in Hiroshima to watch "what took us years to do in stinking, filth filled camps" performed in milliseconds. The purpose is of course to compare Mengele's experiments to the Los Alamos scientists' work on the bomb and its use as a weapon of mass destruction.

The trouble, as the theater critic Bruce Weber pointed out (5), is that the argument is rendered thinly and in a show-offy manner. "It feels motivated more by theatricality than drama, especially when Mengele leads the show's weirdest sequence, a parody of a vaudeville chorus line, with scientists singing doggerel about thermodynamics. Like a lot of the elements in the play, the scene is ornamental

and distracting, presented by the playwright not because he should but because he can. In stage terms, that,s playing dice with the universe." For many of the Manhattan project veterans who came to a symposium on the play after a special reading at Los Alamos, Louis Slotin Sonata was anti-science and impugned the honor of the bomb-builders. In an interview with Dennis Overbye, the author, Paul Mullin, said that it would make him sad if the play were interpreted as anti-science. "I'm asking different questions than science would ask, not how it happened but why it happened, what it means that it happened. There are certain questions science can't ask because it can't answer them."

What then makes for a good science play? There is no agreement between literary and drama scholars, writers and producers, historians, and scientists - and sometimes among them - what is acceptable and desirable. To my mind a good science play should be, not necessarily in this order, 1) a gripping drama or an entertaining comedy about an important subject; 2) an accessible, but reasonably accurate presentation of the science in it; and 3) when it is or purports to be historical, be fundamentally truthful. In asserting the last requirement I am at odds with the practitioners of one of C. P. Snow's two cultures, the humanistic one. As Kirsten Shepherd-Barr has written (6) , " the. . consensus among literary scholars[. . . is] that there is no problem appropriating historical for fictional purposes; the author is under no obligation to "get it right" since it's a work of fiction."

There are problems with my - what may strike some readers as an unrealistic and even puritanical - demand for a fundamentally truthful account. After all, not only the goals of drama and history writing, not to mention those of science, but the rules for getting at truth and even the meaning of the word are different. As the historian of science Robert Marc Friedman has said (7),, "history and drama are not necessarily compatible with respect to end and means." Historians, even though they may write with the present and future in mind, still seek understanding of the people and period they write about, using categories, issues, and norms from that particular time and place. Historical plays, whether or not scientists figure in them, probe not the milieu, social relations or political processes that held sway at the time of the protagonist, but those that of the time of the dramatist. "Schiller's Don Carlos belongs to the late 18th century rather than to the 16th; Shakespeare's histories address the political realities of the 16th century and not those of previous eras;[. . .] Brecht's Galileo[. . .] is definitely not about the actual life and times of the play's namesake". Friedman also poses the question "Why use the [actual] names and events of history when the dramatist's purpose is to illuminate a thesis or provoke discussion" (7) ? And I say "why indeed?"

As for means, Luigi Pirandello is said to have claimed, that truth doesn't have to be plausible, but drama and other fiction does. Friedman goes on: "Historians must accept the chaotic and the contingent, the randomness and even the meaninglessness of events and actions. Playwrights normally work with a structured logic grounded in dramatic requirements and conventions" (7). They therefore sometimes reject historical truth for reasons of implausibility. Is it acceptable do so out of ignorance or to impose their social, or political Weltanschauung on their audiences, or to épater le bourgeois?

Conceding then that some facts must be neglected and some truths modified, what are the limits? What do the dramatists have to get right and what is it that may or even must be fudged? A good play must have dramatic tension and interesting characters. To achieve these characteristics, it must sometimes oversimplify, disregard intellectual or historical subtleties, and even invent events that did not actually occur. But what if the scientist - protagonists are made out to be either buffoons or incarnations of evil, so as to entertain or frighten the audience? What if history is rewritten to serve an author's political goals or world view? What if, not only scientific content and results are mischaracterized, but the spirit, goals, and methodology of science are misrepresented? What if the play is a weapon in the deconstructionist campaign to strip science of its claims to reality and truth? Then, I firmly believe that the retort "it's after all, a play" or, worse, "it's only a play" does not provide exoneration..

The closer to the present time the scientists and the history being depicted are, the stricter the standard of truthfulness needs to be. Although there is even now a group of people working to rehabilitate

Richard III from Shakespeare's scathing portrayal, it makes little difference to our understanding of the history of England, much less to the social and political issues of today, whether Richard actually had the Princes in the Tower murdered or not. In historical dramas set in the past, the audience already has a knowledge of the people and the events that are depicted. In contrast, when a scientist who lived recently is portrayed on stage, most members of the audience will have only this one characterization from which to form an opinion. Friedman concludes from this that dramatists should "think twice before transforming people who have lived recently into dramatis personae" (7). My view is that they need to think only once, provided they resolve to portray the person's life, actions, and character with reasonable accuracy.

Friedman ends his symposium remarks: "If we choose theater, we must accept a basic truth: Theater cannot depict comprehensive narrative history [emphasis added] and ought not to try[. . .Still] significant chapters in science history have a right to enter our cultural heritage and not merely remain the property of historians and scientists. A play such as Michael Frayn's Copenhagen[. .] has clearly brought significant chapters in the history of modern physics to the attention of many non-specialists. Is Frayn's accomplishment a unique event in contemporary theater or might we see this play as an indication that[[. . .] a well-crafted, intelligent drama can win an audience?" (7) .

After the New York premiere of Copenhagen in April 2000, the New York Times critic Ben Brantley asked, in his unreservedly enthusiastic review, "who would have ever thought that three dead, long-winded people talking about atomic physics would be such electrifying companions? (8).

As many readers will know, the play reenacts the 1941 visit of Werner Heisenberg to Niels Bohr in Nazi-occupied Denmark. Bohr had been Heisenberg's mentor, friend, and collaborator in creating quantum mechanics, foundations or consequences, complementarity, and the uncertainty principle. From 1939 until Germany's defeat in 1945, Heisenberg was the most important figure in his country's "uranium project", whose goal was both to produce an atomic bomb and to build a nuclear reactor. The third "long-winded" character in the play is Bohr's wife Margrethe. "Reenacts" is not really the right word, for no one now alive knows with any certainty what actually took place during the visit and it is becoming more and more unlikely that anyone ever will. And Frayn does not pretend to solve the mystery. Instead what he does is to use the device of having the three characters meet after their deaths and review the 1941 encounter three times, each time with different memories, opinions, emotions, and answers.

As the historian of science Klaus Hentschel has pointed out (9), "Frayn,s use of "historical polyphony, does not do violence to the rarely attained goal of historical truthfulness." Instead of advocating one amongst a multitude of widely different reconstructions of what "really, happened . .. Frayn's piece enacts three somewhat plausible and partly documented versions one after another". The break is not so much with historical historiography, but with "tenets of classical dramaturgy such as "uniqueness" and "separability". Whereas in a conventional piece "with one coherent plot followed through from beginning to end" the playwright and the actors force their vision of an often uncertain and sometimes false and propagandistic reality on an audience, in Copenhagen it falls "to the audience to judge who was most convincing[. . .] the simple, superimposed coordination between drama and reality is broken" (9).

The controversy about what really happened in Copenhagen and in the German atomic program, - why did the Germans, under Heisenberg's leadership, not achieve an atomic bomb? - and how accurately and responsibly Frayn's play deals with the history of the time, has given rise to numerous books, articles and letters by scientists, historians and journalists, as well as talks and debates at a number of symposia that followed the production of the play in the United States and in other countries.

While most of the physicists, historians, and critics who have seen the play consider Copenhagen a masterpiece theatrically and for its rendering of the science, reaction to what they see as Frayn's

portrayal of Heisenberg's character and his behavior under the Nazi regime has been mixed, with some denouncing the play as a historical fiction. Most of these critics at the same time concede that Copenhagen is a gripping piece of theater. (How could they do otherwise?) They see no contradiction between these two findings, because, they claim or infer, it is perfectly all right that theater, including plays about recent events and real, living or barely deceased people, be wholly fictitious, and that there are no limits to how far a playwright may depart from historical fact. As Bohr's biographer, Abraham Pais, put it in an article(10) in which he labels Copenhagen as fictitious : "As theater calls for the suspension of belief, a playwright is at liberty to modify reality as he sees fit." And as Gerald Holton wrote in a letter to the New York Times, responding to another writer who "seems upset" that Holton derided Copenhagen for what he sees as historical untruths : "[. . .] though it is a gripping drama, it is still a work of fiction. That is why it got a Tony, not a medal of science" . Because of my rejection of the thesis that in a play anything goes and that essential historical truth need not be respected, I find this assertion of an exclusion principle acting between drama and truth wrongheaded . If Copenhagen misrepresented history and its protagonists in any fundamental way, I would give it neither a Tony, nor an award for history or for science writing.

What has grated on critics of Copenhagen and brought out their resentment is, I believe, what they see as a soft treatment of Heisenberg and an implied moral equivalence between the Germans and the Allies. What these critics would have liked Frayn to take note of and condemn is that, although Heisenberg never built a bomb, he did work under and for the Nazi regime, aware of its repressive and aggressive character, of the full extent of the atrocities committed, and yet to be committed by it. What some of them would have wanted Frayn not to mention, is the firebombing of German cities by the Allies and the dropping of the atomic bombs on Japan. In America, contemplation of these actions and an examination of the morality (or the necessity) of these bombings has been all but taboo and is still confined to a small minority.

Of course Frayn takes liberties with details. He puts words into the mouths of his characters many of which they probably never spoke. How else could he show what they thought and what emotions they felt? The mode of expression of the protagonists was not exactly as portrayed: Bohr is too articulate and lucid, Margrethe too contentious and belligerent, and Heisenberg perhaps too brash and boisterous (11). The frequency and the locations of the 1941 encounter are, based on Bohr's later recollection, inaccurately rendered in the play. At least so it was thought until June of 2003, when a letter that Heisenberg wrote to his wife from Copenhagen came to light.

Frayn, in one of his remarkable postscripts to the play, argues that everyone knows how evil the Nazis were, and that there was therefore no need to make a big point of it. But he also quotes the dictum of the nineteenth-century German playwright Friedrich Hebbel: "In a good play everyone is right." Therefore he had to offer the possibility that Heisenberg, like Bohr, was a good man. What, in their vexation, some critics refuse to acknowledge is the Rashomon-like portrayal of events and motivations in Copenhagen. Or at least they contend that Frayn gives too much uncritical exposure to a picture they vehemently object to.

Copenhagen is a deep and subtle play about history and about many of the most important scientists of the twentieth century - Bohr and Heisenberg in the main, but also dozens of other physicists, to whose work and contributions reference is made. Does this amount to name dropping? If engaged in by a lesser and less conscientious writer, perhaps. In Frayn's hands the references are not only accurate and to the point, but they contribute brilliantly to an understanding of how physics progresses through the interactions, scientific and personal, of many contributors. Copenhagen is, after all, not only about science and history but a drama about human interactions .

Its special virtue, however, is that it is genuinely, unapologetically, and accurately also about science itself. Frayn has done prodigious research and has understood, assimilated, and accurately and accessibly presented the (together with relativity) most important findings of modern physics. He

delivers mini-courses in Quantum Mechanics and in Nuclear Physics, which include admirable expositions and explanations of the uncertainly principle and of complementarity, as well as of nuclear fission and its applications

I do need to voice a slight discomfort and reservation about Frayn's drawing of parallels between quantum mechanics and human behavior (12). Frayn, or rather his characters, seem to say that we must also forever be uncertain what is in a person's mind and that we have complementary motives for our actions. If that statement were equivalent to the assertion that the principles of quantum mechanics produce these human limitations, that would be deplorable indeed. A reductionism which were to assert that there is a line from quantum mechanics through biochemistry to psychology is, at least, premature. Frayn denies in his postscript that he asserts such a causal connection in the play, or that he believes in it.

Is the stream of physics plays good for physicists and its practitioners? After all, many of us believe and are acting on the conviction that informal and non-traditional ways of communicating with the public have become essential for arousing interest in, understanding of, and support for our science, not to mention or course, and for us. If most plays were like Copenhagen, my answer to the question would be an unqualified "yes". But a number of physics plays contain bad or no science and many show it and its practitioners in an unfavorable light: as for Shadwell, the goals of science are ludicrous, and often inhumane, and scientists are usually amoral, or downright immoral, if not mad. The question, therefore, requires a nuanced answer. Some cynics, who may be right, hold that any publicity, even bad publicity, is good. Whether they are correct or not, science plays have become a significant medium for exposing the public to physics and physicists. Some have suggested that in order to avoid and counteract indecent exposure, scientists should write science plays themselves and one or two have done so with non-negligible success. One thing is certain: http://web.gc.cuny.edu/sciart/StagingScience/staging_science.htm#list good physics plays are not only a boon for the public, but they (and even bad ones) can show us how humanists think about us and our science and they can make us more aware than we are of the consequences of our work. That is a good thing

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The Great Fallout-Cancer Story of 1978 and its Aftermath

by Daniel W. Miles

The great fallout-cancer story began twenty years after atmospheric weapon testing at the Nevada Test Site was stopped in 1958. In the fall of 1978, Stewart Udall, former secretary of the Interior, along with a team of lawyers came to Fallout City (St. George, Utah) accompanied by a drumbeat of publicity to hold a series of meetings with local cancer victims and/or their relatives. At a press conference held to announce plans for a class action lawsuit against the United States, Udall said he was stunned by the abnormally high number of suspected fallout cancer victims. “The enormity of it is the shocking thing,” Udall said (1). “There are two to three times more of every type of cancer than we had assumed...Even if the cancer statistics are twice as high as the National average that will be enough.” The case of Allen vs United States would soon follow Udall’s visit to Fallout City.

A few months later Utah Senator Orrin Hatch held the Special Town Meeting in St. George, Utah collecting testimonies and anecdotes about children playing in fallout snow, about hair loss, about skin burns, about hemorrhages, about other symptoms of radiation sickness and about cancer victims. Later Senator Hatch was mainly responsible for the passage of the Radiation Exposure Compensation Act (RECA) in 1990 and for securing a $7 million government grant to determine the fallout dose Utahans had accumulated.

The national publications and networks picked up the plaintiffs’ story. Several major fallout-cancer stories appeared in the Washington Post and in the New York Times and there were articles in Time, Newsweek, Family Circle, Life, Parade, People and other magazines. A Salt Lake TV station, KUTV, did two lengthy documentaries on the plight of the downwinders. Television networks covered the story. One of St. George’s leading citizens, Irma Thomas, was flown in for appearances on Good Morning America, the Today Show, and Ted Koppel Live.

Many stories found in the transcript of the Special Town Meeting, in the transcript of the Allen vs United States court case, and in many magazine articles were about neighborhoods or extended families afflicted with abnormally high cancer rates. Irene McEwen of little Panguitch, Utah is quoted in Life: “There isn’t a block where it hasn’t hit...House after house, street after street, over and over again.”(2) Glenda Orton claimed that of the 2,000 living in Parowan, Utah, “I can safely say that 30 to 40 percent of our livestock men and outdoor people have suffered some kind of cancer since the testing.”(3) Later very thorough dose reconstruction studies4-7 would indicate that the residents of Panguitch and Parowan received far more radiation from natural sources during the fallout period than from Nevada Test Site fallout.

Many of the anecdotes, oral histories and testimonials of downwinders found in the transcripts and magazine articles soon became the cornerstones of a spate of books about the clouds of death over southwestern Utah. The titles of these books point to a doomed population---a population in the midst of a cancer epidemic with many deaths yet to come. On the cover of John G. Fuller's 1984 book The Day We Bombed Utah: America's Most Lethal Secret (8) are found the following snippets from the Denver Post, Atlantic Monthly, and the San Francisco Chronicle : "A chilling, compelling story"; "... a horrifying, carefully reported account..."; "The cleanest, leanest book yet about the southern Utah calamity."

Richard L. Miller's Under the Cloud: The Decades of Nuclear Testing (9) published in 1989, Howard Ball's Justice Downwind: America's Atomic Testing Program in the 1950's(10) published in 1986, and Philip L. Fradkin's Fallout: An American Nuclear Tragedy (11) published in 1989 also took up the cause of the putative victims All three books---full of footnotes and annotations---appeared to be solid contributions to the cause of the downwinders but careful reading reveals that their work, in general, relied on anecdotes and a few preliminary investigations.

Philip L. Fradkin in Fallout: An American Nuclear Tragedy, writes about a young lady losing her hair on the day that fallout from shot Harry reached St. George and then sums it all up this way: "Others that day (May 19,1953) in the downwind region had similar complaints. Headaches, fever, thirst, dizziness, loss of appetite, general malaise, nausea, diarrhea, vomit, hair loss, discoloration of the fingernails, hemorrhages, and skin burns (parenthetical date added)."(12)

Carole Gallagher in her 1993 book American Ground Zero writes, "In St. George and Cedar City I was astounded to find cancer in every house, and often not just one cancer."(13) American Ground Zero contains photographs and oral histories which blame all types of health problems on fallout---cancers, especially leukemia, breast cancer and even skin cancer, cataracts, diabetes, miscarriages, arthritis, strokes, birth defects, immune system malfunctions, sterility, hereditary effects, permanent baldness, small breast on women, scoliosis (curvature of the spine), and even heart disease.

The oral histories contain anecdotes about pink clouds from atomic tests drifting over towns and children eating fallout debris thinking it was snow. We find this testimony from a women who was born in St. George in 1952: "After a bomb, there it would be, the fallout, fine like flour, kind of grayish white. We would play like that was our snow."(14) It is noteworthy that nearly 90% of the total fallout that fell on St. George arrived before this lady was even one year old.(15)
In my research I have found 11 anecdotes about fallout snow: Fallout is mostly dirt ladened with radioactive particles. Yet we read: "You know how little kids love snow. They went out and would eat fallout snow."(16) "...[T]he fallout was so thick it was like snow."(16)

Without any documentation Carole writes: "The bombs' ashes ....burned the paint off the hoods of trucks, leaving behind the names scrawled by children who would eat and breathe the bone-seeking radioactive isotopes... Their progeny would be genetically distorted, often growing misshapen bones and sprouting tumors, succumbing to leukemia detected shortly after birth."(17) "After I moved 60 miles north from St. George to Cedar City, I would occasionally go to the dreaded K-Mart for batteries or soap and feel the horror of seeing there four- and five-year old children wearing wigs, deathly pale and obviously in chemotherapy."(18) Carol came to Utah about thirty years after the fallout era so, of course, these alleged sick children were the progeny of fallout victims.
An important point must be inserted here. Starting in 1950, Japan and the United States have spent almost $1 billion studying a select population of over 75,000 Japanese bomb survivors and their progeny which amounted to more than 80,000 in 1991. This study has not found any direct evidence that exposure of parents to radiation has caused any significant effects on still births, congenital abnormalities, infant mortality, childhood mortality, or leukemia.(19)

Carole Gallagher writes: “Cancer was such a rarity that when a cluster of leukemia deaths struck the small towns of southern Utah and Nevada a few years after testing began in 1951, even the doctors had no idea what this illness could be.”(20) Carole claims the local mortician told her that leukemia was unknown in southwestern Utah until the fallout came.(20) Iron and Washington County doctors, however, diagnosed 8 cases of leukemia between March 1948 and September 1952.(21) None of these cases can be blamed on fallout for two reasons. First, virtually no fallout arrived prior to March of 1953. Second, leukemia has a latency period of about three years.

I lived in St. George during most of the fallout period. I was there during the series of tests in the spring of 1953, called the Upshot-Knothole tests, which accounted for a whopping 88% of the total accumulated radiation dose received at St. George with 75% attributed to shot Harry detonated on May 19, 1953.(15)

I don’t remember paint being burned off the hood of trucks, or the family’s new Mercury, or my brother’s little red wagon. I don’t remember any visible fallout “snow” on the ground, on cars, or on trees. Yes, an almost invisible thin film of radioactive dust from shot Harry did settle down on vehicles traveling north of Mesquite, Nevada on the old Highway 91 but not on St. George vehicles. The Washington County News reported: “Radiation monitors held up 100 northbound cars at St. George. Some of the cars required a decontamination washing.”(22)

Nora Lyman was associate editor of the Washington County News located in St. George during the fallout period. Nora, in her weekly Observation column, commented extensively on the testing going on in Nevada. Eighteen other ladies wrote weekly columns for the Washington County News keeping the reader abreast of going-ons, of deaths, of births, and of illnesses in every hamlet and town in Washington County and in Mount Trumball, Arizona and three Nevada towns, Bunkerville, Overton, and Panaca---all downwind communities.

Not a line or a photograph is found in the Washington County News about fallout snow. Certainly “fallout so thick it was like snow” would be news worthy. Where are the photographs of fallout snow? Wouldn’t even a dusting of fallout “snow” be news worthy? The simple May 1953 story about cars coming off the Nevada desert requiring a washdown would mushroom years later into “fallout so thick it was like snow.”

I don’t remember anybody with skin burns or hair loss. The young lady identified by Fradkin as losing her hair the day of shot Harry still had her beautiful brown hair all through the next school year as attested to by five photographs of her in the 1954 Dixie College yearbook.

Gallagher writes in American Ground Zero that local women had severe radiation illness including lost of hair and badly burned skin.(23) Radiation exposure sufficient to cause lost of hair and badly burned skin would require a very heavy dose of radiation---about 100 times that found in dose reconstruction studies of the St. George area.(4-7) Such a radiation dose would have seriously fogged any photograph taken later on film for sell in stores or films in cameras. Everybody taking pictures with these irradiated films would have noticed it. I have checked out all the photographs in the Washington County News post Dirty Harry and family photographs taken that summer without finding a single fogged photograph.

I have read all those weekly columns found in the Washington County News during the weapon testing period and beyond. Often these columns alerted the readers to cold and flu outbreaks in their respective communities and other minor health complaints and even animal health problems. Nothing, absolutely nothing, is found in these weekly columns about people afflicted with hair loss, badly burned skin, discoloration of the fingernails, loss of hair, spontaneous internal and external bleeding from weakened blood vessels producing large purple patches under the skin. Nothing about towns covered with fallout “snow” or vehicles needing a new paint job. No photographs of a city covered

with pink snow. Nothing about people becoming sick and dying right away as reported in a recent article in The Deseret News.(24)

Admitedly the scores of local anecdotes seem to support Udall's claim that fallout ballooned the local cancer rate. For example in a 1995 article featured in the periodical The American Legion Magazine titled "Is St. George Expendable" is found an often rehearsed local anecdote: "In the St. George cemetery, two years leap out from the headstones of children. The first year is 1926, when diphtheria epidemic swept the small town, claiming many young lives. The second year is 1955, the fourth year following the first of the Nevada atomic tests." This anecdote, so typical of many, is nonsense. There is only one headstone in the St. George, Utah cemetery for a child who died in 1955 (a 9 year old girl was killed in a tragic vehicle accident in 1955).

In Justice Downwind, Ball devotes nearly two pages to Preston Jay Truman, founder of Downwinders, a concerned citizens' group dedicated to end all nuclear testing. "His resolve was strengthened further when he attended his high school reunion in Enterprise a few years ago. Part of the reunion was held at the local cemetery. Out of nine young friends he had grown up with in the small rural community of Enterprise, Truman was the only one to reach his twenty-eighth birthday---the rest had died of cancer or leukemia."(25)

I have conducted phone interviews with two of Preston's teachers and classmate Lee Bracken, co-chairman of the 2004 reunion for the Enterprise High School classes of 1968, 1969, and 1970. According to Lee Bracken, now a prominent Enterprise business man, no class reunion has ever been held at the Enterprise cemetery.(26) Lee and his wife have spent considerable time determining for me if any members of the Enterprise High School classes of 1968,1969, 1970, 1971 and 1972 have died of any causes. They found that only one member of the above classes had died by May 16, 2004---the sister of Lee's wife who died in an accident. It is utterly amazing that Harold Ball did not check out Preston's claim. The claim that almost all of the boys in the Enterprise High School class of 1970 had died of cancer by 1980 should have rung alarm bells.

There exists an amazing disconnect between the documented leukemia deaths of exposed young people and anecdotal "evidence". For example a very alarming statement by Issac Nelson of Cedar City, largest city in Iron County, is found in Gallagher's American Ground Zero: "And when the young boys and girls developed leukemia, dropping off like flies, a regular epidemic around here, nobody seemed to know. They were holding three or four funerals a week."(27) We read in a Life article that there were seven cases of leukemia in Cedar Çity's young people within 100 yards of Blaine Johnson's house.(28)
However, all the scientific fallout-leukemia studies from the 1965 Weiss study (published in 1979) (21) to the 1987 Machado et al. Study (29) and the 1990 Stevens et al. Study (30) documented only two case of childhood leukemia mortality in Cedar City for those born in 1958 or earlier during the period from 1951 to 1972.

Ball quotes an unidentified Kane County resident who remembered: "Almost every family had had at least one member die from cancer, leukemia, or some other debilitating disease."(31) However the above epidemiological studies reported no leukemia deaths in Kane County from 1951 to 1972.

Carole Gallagher writes in American Ground Zero, "Friends and neighbors, especially children, were dying of leukemia in Washington and St. George and Cedar City, all over southern Utah."(32) All epidemiological studies of leukemia deaths in St. George document only 1 leukemia deaths in youth born before 1958. Yet Carole tells us that the St. George mortician had to learn new embalming techniques "to prepare such small, wasted, near bloodless bodies for burial."(14)

Periodically the Utah press revisits the cancer-fallout story giving much weight to emotionally loaded anecdotal accounts (24,33)---three pages worth in a recent issue of The Deseret News and nearly seven

pages worth in The Spectrum, a southwestern Utah daily. The stories are unscientific and very non-quantitative. Amateur epidemiology is rampant as the following quotes indicates: “Every time I go out, I see someone else my age that’s dying.” “My mom had a big chart and within a three-block radius it was amazing how many people got cancer.” “My class reunions are held at the cemetery.”(24) This latter quote is found a number of times in the print media---the class in question is the 1970 Dixie High School Class. I have conducted 61 phone interviews with members of the 1970 class including two gals in charge of recent class reunions. No one could recall a single classmate who has died of cancer; no class reunions have ever been held at the cemetery.

Lucinda Dillon, a Deseret News staff writer, writes (24): “But as pink clouds of fallout passed, rural residents sucked in their powdery, radioactive dust. It fell on their skin, it leeched into the ground and into the vegetables they ate. Many got sick and died right away. Others got cancers later.” Many got sick and died right away? A little research reviewing old Washington County News would have revealed a total lack of comment on this “catastrophe” in the Washington County News during the entire testing period and beyond.

No Utah politician has ever questioned the alleged horror from radioactive fallout that the lawyers, the media, and the environmental activist have beat into the consciousness of downwinders with very little supporting scientific data. A few years ago the Deseret News quoted a portion of letter written by former Utah Governor Mike Leavitt (and later the head honcho at EPA) to the Minnesota Public Utility Commission: “Utahans experienced an epidemic of cancer and other radiation-related illnesses as a result of radioactive fallout from the ..nuclear weapons testing in the Fifties and Sixties.”(24)

Utah Congressman Jim Matheson alleged that the horrendous legacy of fallout is still going in a recent opt-ed piece in The Deseret News titled "Don’t Let East Add to Utah’s Legacy of Nuclear Misery". Matheson writes: “Thousands of citizens throughout the West continue to get sick and die from radiation-exposure-caused illnesses.”(34) Matheson states that the small southern Utah town of Parowan in Iron County saw 85-90 cancer deaths a year. That would be some epidemic in a town of less than 2,000 people---over 25 times the yearly national cancer death rate during the same period. That number should stand out in Iron County’s cancer mortality statistics like Saddam Hussein singing with the Mormon Tabernacle Choir. I spent three hours in the beautiful Parowan cemetery recording death dates found on headstones. In no year between 1951 and 2004 were there more than fifteen people buried in that cemetery.

Recent reviews (35,36) of the completed dose-reconstruction studies and radioepidemiological studies of fallout effects on downwind areas indicate that downwinders were generally exposed to radiation doses orders of magnitude less than those received by the Japanese atomic bomb survivors who have experienced only a 5 percent excess cancer rate. I use the word “only” in reference to Udall’s claim that fallout caused a 200 to 300 percent increase in the cancer rates in southwestern Utah.

These studies have been summarized succinctly by Dr. Lynn R. Anspaugh: “First, the major studies have been very expensive, in the tens of millions of dollars. Second, even for the NTS, where the releases were large and the resulting collective doses were appreciable, it has been very difficult to find a statistically significant biologic effect.”(35) According to Charles E. Land of the National Cancer Institute “the overall value of the studies is limited by the fact that radiation doses were so low as to almost preclude the possibility of learning anything new about risk.”(36)

In southwestern Utah thousands of people came to falsely believe twenty five years after shot Harry that they were in the midst of a cancer epidemic. However, instead of a hyped abnormally high cancer rate (even 200 to 300 percent above normal according to Stewart Udall) the actual cancer rate, according to a National Cancer Institute study, was over 30 percent below nationwide rates during the 1955 to 1980 period.(29)

In summary, this article proves once again that scientific evidence trumps anecdotal evidence of harm arising from low-level exposure to a potentially hazardous substance. Unfortunately the general public, the media, and our politicians tend to accept anecdotal information (especially as it pertains to something as emotional as cancer, birth defects, or other incidents of bad health) as undeniable proof.

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The Genius as National Icon
Albert Einstein, Zionism and Social Responsibility

Adapted from a paper presented at an FPS session commemorating the Einstein Year at the APS March Meeting
Ze'ev Rosenkranz

"The pursuit of knowledge for its own sake, an almost fanatical love of justice and the desire for personal independence – these are the features of the Jewish tradition which make me thank my lucky stars that I belong to it."
From "Jewish ideals", Mein Weltbild (1934)

This somewhat ethnocentric statement illustrates Einstein's belief that it was the Jewish component in his multinational and muticultural identity as a Jew, Swabian, German, Berliner (and, for a certain period, Swiss) that led him to support various social ideals which could be characterized as progressive in today's terminology.

In this article, I hope to demonstrate how his commitment to these ideals strongly influenced Einstein's association with the Zionist movement and his actions on its behalf.

This article will focus on Albert Einstein's involvement with the Zionist movement in the period between the two world wars.

I will discuss the transformation in Einstein's views on Zionism in the aftermath of the First World War; his subsequent mobilization for the Zionist movement; the interrelationship between Einstein's new-found fame and his involvement with Zionism; and his actions on behalf of the movement. I will also elaborate on his positions on the Arab-Jewish conflict in Mandatory Palestine; and conclude with the various symbolic roles he fulfilled for the Zionist movement.

Albert Einstein was born into an acculturated middle-class, not religiously observant, Jewish family from Southern Germany. Nevertheless, his family seems to have inculcated in him a strong sense of Jewish identity. As a child, he received both Jewish religious instruction at home and Catholic

religious instruction at school.1 Einstein's social milieu – his extended family and friends - were predominantly Jewish in his early years and beyond. At the age of eleven, he went through a short religious phase during which he composed songs in praise of God.2 However, his family was acculturated to such an extent that there are no indications that he celebrated his Bar-Mitzvah.

Tendencies towards outright assimilationism (as opposed to his parents' acculturation) seem to have become more pronounced in Einstein's late adolescence following his move away from his family to Switzerland in 1895 at the age of 16. During his Swiss years, his social milieu was both Jewish and Gentile. The most significant step away from his Jewish background during this period was his marriage to his fellow classmate at the Zurich Polytechnic, the Serbian physicist Mileva Mariÿ in 1903. In addition, from the age of 17 onwards, he repeatedly claimed that he was "konfessionslos" ("without religious affiliation").3

The issue of his religious affiliation took a mildly absurd turn in 1911 when he was appointed to a position at the German University of Prague and was asked to declare his religious affiliation. He initially declared that he was "without religious affiliation". Only when the Austro-Hungarian authorities in Vienna made it clear to Einstein that, as a professor of the Habsburg Empire, he had to declare his allegiance to a recognized denomination, did he resignedly declare himself as belonging to the Jewish faith.4 The next year, Einstein described in the typically cavalier tone of his early years how meaningless this step had been for him: "To return to the fold of Abraham – that was nothing. A signed piece of paper."5

Although Einstein met with members of Zionist circles in Prague during his appointment there in 1911-12, he does not seem to have been influenced by them ideologically or impressed by them, for that matter. Quite the opposite, in fact. Four years later, Einstein made some very disparaging remarks about the Prague Zionists in reference to Hugo Bergmann, one of their most influential leaders: "By the way, I think I met the man in Prague. He may have belonged to one of those local small circles which were infested by philosophy and Zionism, who were loosely grouped around the philosophers at the University, a seemingly medieval small band of unworldly people…".6

On the other hand, at least one Einstein biographer, Philipp Frank, who was Einstein's successor in Prague, has argued that in spite of this indifference (or even antipathy) to Zionism during his period in Prague, Einstein's interest in Jewish affairs (which had been dormant since his early adolescence) was starting to be rekindled. Frank mentions that Emil Nohel, Einstein's teaching assistant in Prague, stimulated Einstein's "interest in the relation between the Jews and the world around them".7 In light of the complex situation in which the Jews of Prague found themselves between the fervent adherents of German and Czech nationalism, this certainly seems likely.

Two years after Einstein's disparaging comments about the Zionist circles in Prague, we find the first documented official contact between Einstein and the German Zionist movement in the immediate aftermath of the First World War in December 1918. He was asked by the German Zionist Federation to participate in a provisional committee towards creating a Jewish Congress in Germany. Amazingly, in light of his previously quoted comments, Einstein agreed to participate in at least one meeting of this committee – it was his first public action related to the Zionist movement.8 But what brought about this radical transformation in Einstein's views?

Let us take a look at what was going on in Einstein's life during this period: first of all, similar to other German-Jewish intellectuals of his generation, Einstein was deeply disturbed by the plight of Eastern European Jewish refugees (the so-called Ostjuden) in Germany who had migrated there as a consequence of the hostilities and hardships during the War and its aftermath. Similar to some other Jewish intellectuals of his generation, he saw the Ostjuden as the more authentic representatives of the Jewish people, far more authentic than their assimilated and culturally barren Western European co-religionists.9 Einstein was also deeply troubled by a renewed wave of anti-Semitism in Germany

which arose in reaction to the increased numbers of Ostjuden in Germany. He was especially concerned about the plight of young Jewish academics and students from Eastern Europe, who were being subjected to entrance restrictions at universities in Central and Eastern Europe.10 In addition, as a consequence of his having been one of very few German academics to oppose the War, he also felt a considerable degree of alienation from German society during the War. This was also a period of extreme political instability in Germany - Einstein lived through the upheaval of revolution and counter-revolution in Berlin.

There were also turbulent personal events in Einstein's life around this time which may have influenced his turn towards Jewish nationalism: during the War, he suffered from malnutrition and several severe illnesses.11 His divorce from his first wife Mileva Mariÿ finally came through in Zurich in February 1919 after five years of separation;12 Einstein only saw his sons infrequently as they were living with Mileva in Zurich and the difference in exchange rates between Germany and Switzerland made visiting Switzerland prohibitively expensive for him;13 he married his cousin Elsa in Berlin four months after the divorce.14 Furthermore, he was deeply affected by his mother's terminal illness throughout 1919 – she would eventually die in early 1920.15 So it seems fair to speculate that Einstein was feeling quite vulnerable at this period in his life and may well have been looking for a new cause to support. Thus he may have been "ripe" for "conversion" to Zionism.

This vulnerability may have been sensed by Kurt Blumenfeld, who was head of the propaganda department of the German Zionist Federation and who, in his later writings, claimed to have had a major influence on Einstein in his move towards Zionism.16 Blumenfeld was the major proponent of the "second generation" of German Zionists. This generation, most of whom were born in the 1880's, came from assimilated Jewish families and experienced the sharp increase in anti-Semitism during their high school and university years in the 1890's. They rejected both the assimilationist approach of German-Jewish liberals and the philanthropic approach of the "first generation" of German Zionists, who saw Zionism primarily as an option for their less fortunate co-religionists from the East rather than for themselves. Members of the second generation were more overtly ideological than the previous generation of German Zionists and not willing to collaborate with the assimlationalists. They defined themselves as "post-assimilated" German Jews and adopted a program whereby every Zionist should incorporate immigration to Palestine into their "life plan".17

In his memoirs, Blumenfeld described the mobilization of Einstein for the Zionist movement as follows: in light of the Balfour Declaration of November 1917 and the opportunity for new developments in Palestine in the aftermath of the First World War, he and fellow Zionist leader Felix Rosenblüth drew up list of German Jewish intellectuals they wanted to interest in Zionism. In February 1919, Blumenfeld invited Einstein to one of his lectures and immediately afterwards he noticed a "transformation" in Einstein on Zionist issues. After the lecture, Einstein remarked: „I am against nationalism, but in favor of Zionism". According to Blumenfeld, he justified his backing of the Zionist cause by comparing the Jews' lack of a homeland and the need for Jewish nationalism to a man without a right arm who had to compensate for the lack of his limb. Blumenfeld stated that this is how Einstein reconciled the seeming contradiction between his general disdain for nationalism and his support for Zionism.18

The first contemporary documentation for this major change in Einstein's views can be found as early as the next month in March 1919 in a letter to Einstein's colleague and close friend Paul Ehrenfest: in the aftermath of war, revolution and counter-revolution in Germany and Berlin, Einstein stated that "the issue from which I derive most joy is the realization of the Jewish state. It seems to me that our tribal comrades are more likeable (and at least less brutal) than these awful Europeans."19

In the meantime, the Zionist Organization (which was the main administrative body of world Zionism and had its headquarters in London at the time) was proceeding with its plans for the establishment of a Jewish university in Jerusalem. The decision to establish the Hebrew University as a "University of

the Jewish people" had been taken at the Eleventh Zionist Congress held in Vienna in 1913.20 In October 1919, Einstein wrote to his fellow physicist Paul Epstein that "the Zionist cause is very near to my heart" and that he had had recent meetings with Zionist leaders. He went on to write: "… You can certainly count on my support [in the matter of the University] … the development of the Jewish colony is gratifying and … I am glad there will be a spot of earth on which our tribal comrades will not be foreigners."21

Ten days later, the Zionist Bureau in Berlin informed the Zionist Organization in London that Einstein's main interest in Zionism focused on plans for the establishment of the Hebrew University.22 That same month, Einstein was invited by the Zionist Organization to attend a conference of Jewish scholars in Basle on plans for the Hebrew University. Einstein accepted the invitation and even recommended other European Jewish scholars who could attend.23

In November 1919, Einstein became a household name after sensationalist headlines in the Anglo-American press proclaimed the verification of his general theory of relativity by British astronomer Arthur Eddington and his colleagues.24 This did not pass unnoticed by the Zionists in London and he was described by them as "the hero of the day". They pleaded with their colleagues in Berlin to send them a photo of Einstein as soon as possible as "all the newspapers" were "besieging" them for his picture. Indeed, it was (the previously much maligned) Hugo Bergmann (who had since moved from Prague to London) who sent Einstein copies of The Times articles on the verification of his theory.25 So, intriguingly, the Zionists had "discovered" Einstein prior to his acquisition of world-wide fame and they were even the ones who informed him of his newly-acquired celebrity status. On 14 December 1919, Einstein also became a household name in Germany when his image appeared on the front cover of the Berliner Illustrirte Zeitung.

After his initial acceptance to attend the planned scholars' conference, Einstein deliberated for quite some time whether he should, indeed, attend. In a letter to his close friend Michele Besso, he explained his motivation for accepting the invitation: "The reason I am going to attend is not that I think that I am especially well qualified, but because my name, in high favor since the English solar eclipse expeditions, can be of benefit to the cause by encouraging lukewarm kinsmen." But in the same letter, he also expressed his doubts about the value of attending such a conference by adding a note written as an afterthought: "I have promised [to attend], but I doubt that I will keep the promise. Such an event entails too much hogwash and useless exhaustion."26

Subsequently, the planned scholars' conference in Basle was cancelled by the Zionist Organization for various political and organizational reasons.27
Various factors led to Einstein's support of the Hebrew University project: first and foremost, he saw it as a refuge for young Eastern European Jewish academics and students who were unable to study in the East or in Germany;28 secondly, he was aware that his newly-acquired fame could be utilized for the cause;29 and thirdly, as Einstein viewed intellectual aspiration as an important Jewish ideal, the academic nature of the University project added to its appeal for him.30

Following his initial mobilization on behalf of the Zionist movement, the next major step in Einstein's support for the Zionist cause was his joint trip - together with the head of the Zionist Organization, Chaim Weizmann - to the U.S. in April 1921. The main declared purpose of the trip was to raise funds for the planned medical faculty at the Hebrew University. However, Einstein also gave a series of lectures at Princeton, visited other major universities, and addressed the National Academy of Sciences in Washington.31 After it was explained to President Warren Harding that Einstein was a Swiss citizen and not a German one, Harding agreed to meet with him at a reception on the White House Lawn.

Einstein received a tumultuous welcome from the (mostly Eastern European) Jewish immigrants in the U.S., especially in New York. In an article written upon his return to Berlin, Einstein stated that although he had "seen many Jews ... in Berlin [and] Germany", it was in the U.S. that he had first

“discovered the Jewish people”.32 On some occasions during the trip – to the embarrassment of the Zionist functionaries - Einstein was greeted more enthusiastically by the Jewish crowds than the leader of world Zionism, Chaim Weizmann. Thus, with this trip, Einstein had become an emblematic figure within the world Zionist movement.

In February 1923, on their return trip from the Far East, Einstein and his wife Elsa visited the British Mandate of Palestine. During their 12-day visit, they toured all over the country and Einstein was given the royal treatment and hailed as a Zionist hero.33 In Jerusalem, Einstein and Elsa were personal guests of the British High Commissioner, Herbert Samuel, at Government House, his official residence.

Einstein’s impressions of his tour of the Old City of Jerusalem recorded in his Palestine travel diary are particularly intriguing and evocative: “Path into the city bathed in sunshine. Hard, barren hilly landscape with white stone houses, mostly dome-topped, and blue sky, breathtakingly beautiful, as is the city squeezed into the walls. .... Through the bazaar and other narrow alleys to the large mosque on a splendidly wide, raised square where Solomon’s temple stood. ... On the other side of the square a basilica-like mosque of mediocre taste. Then down to the temple wall (Wailing Wall) where dull-minded fellow Jews prayed out loud, their faces turned to the wall, bending their bodies backwards and forwards in a rocking movement. Pitiful sight of people with a past but no present. Then zig-zag through the (very dirty) city, swarming with all kinds of holy men and members of various races, noisy and strangely oriental.”34

Einstein gave two talks in Jerusalem, including what is considered the inaugural scientific lecture of the Hebrew University at its future site on Mt. Scopus – this was considered the high point of his visit. He was made an honorary citizen by the municipality of Tel Aviv and held lectures there and in Haifa. He toured the Dead Sea, Tiberias and Nazareth as well as various agricultural settlements including a kibbutz and brand new industrial plants.35

According to the Hebrew press of the time, Einstein’s visit was perceived as a sign that the days of “national redemption were closer at hand”.36 Einstein’s lectures in Palestine were overrun by enthusiastic crowds and the ushers had great difficulty controlling them – an early outbreak of Einstein mania. Some of the Zionist leaders accompanying Einstein during his tour did not hesitate to utilize the visit for their propagandistic purposes. In one speech, it was claimed that Einstein was “learning Hebrew and seriously considering settling in Palestine”.37 This does not seem to have exactly been the case. In his personal travel diary, written during his visit, Einstein wrote about the requests for him to settle in Palestine: “The heart says yes, yet reason says no.”38

Apart from being the official guest of the British High Commissioner and the local Zionist organizations, Einstein also met with two representatives of the Arab community in Palestine, the mayor of Jerusalem, Ragheb Nashashibi, and the Arab-German poet, Aziz Domet.39

Einstein saw Palestine first and foremost as a refuge for Eastern European Jews. He did not expect the majority of Western Jewry to settle there, including himself (although he was offered an academic position at the Hebrew University several times). He envisioned Palestine becoming a spiritual center for world Jewry, especially as a means to strengthen their cultural identity and social cohesion and to enhance the self-esteem of Western Jewry.40 In his references to a national entity in Palestine prior to the Holocaust, he usually referred to a Jewish homeland, but not necessarily to a state.

In 1925, Einstein was chosen to be a member of the Hebrew University’s first Board of Governors and chairman of its first Academic Council. In the late Twenties and early Thirties, major differences of opinion emerged between Einstein, Chaim Weizmann, and the University’s chancellor, Judah Leib Magnes regarding the way in which the University was being administered.41 Einstein was opposed to what he saw as the excessive influence of American philanthropists in the handling of academic affairs

– he advocated a German model for the University whereby the academics would have the decisive say. The biological terminology Einstein used to describe his displeasure with developments at the Hebrew University and with some of his Jewish colleagues there may come as a shock to those who only know of Einstein as a lofty humanitarian. In a letter to Weizmann of May 1933, Einstein wrote that proposed constitutional changes at the University would be useless "as long as outright vermin ("ausgesprochene Schädlinge") continue to play a dominant role in the [University's] Palestinian Executive and in the faculty".42 He went on to say that the University was "a bug-infested house" ("ein verwanztes Haus") which required "radical sanitation".43 Major reforms were instituted at the Hebrew University in 1935 to satisfy Einstein's demands for change and he returned to actively supporting the University which he had ceased to do without public fanfare in 1928. The greater influence of academics on determining the course of the University was reflected by the appointment of a Rector as academic head and the installation of an academic senate.44

With the increase of violence in Palestine from the late Twenties onwards, Einstein advocated peaceful co-existence between its Arab and Jewish inhabitants – indeed he wrote to Weizmann in November 1929 (three months after an outbreak of violence in August of that year) that, to his mind, the Zionist movement had "no moral justification or practical possibility of establishing a homeland there without such cooperation with the Arabs".45 Two months later, Einstein exchanged some significant correspondence with Azmi El-Nashashibi, the editor of Falastin, an English-speaking Arab newspaper published in Jerusalem, on concrete ways to promote peaceful coexistence between Jews and Arabs in Palestine.46

What influenced Einstein's views on Zionism on a political, cultural and ideological level?

To some extent, Einstein's views were closer to the first generation of German Zionists (who believed in Zionism as philanthropy) than to the second generation (who viewed Zionism as a tool for personal fulfilment),47 as he saw Palestine first and foremost as a solution for others rather than for his own "redemption".

Within the various streams of Zionism, Einstein seems to have been influenced most by cultural Zionism - whose major proponent was the Russian Hebrew ideologue Achad Ha'am. This influence was probably not direct – we don't know whether Einstein read the anthology of Achad Ha'am's works which was in his private library. The influence was probably indirect via Kurt Blumenfeld and possibly via the German Zionists' journal Die Jüdische Rundschau. This influence is clear in Einstein's defining Judaism as a culture rather than as an institutionalized religion. He also subscribed to cultural Zionism's view of the Jews as a Schicksalsgemeinschaft - a community with a common destiny and a common history.48

Under the influence of his Zionist contacts in Berlin, Einstein strongly rejected assimilationist attempts to combat anti-Semitism. Instead of the Jews' enlightening the Gentiles by combating anti-Semitism, in Einstein's opinion, "anti-Semitism and the subservient mentality of us Jews need to be combated by our own enlightenment ... anti-Semitism will always exist and maybe we are indebted to it for our continued existence as a race."49

On ideological and social issues, Einstein leaned more towards left-wing Labor Zionism – he was very impressed by the kibbutzim during his trip to Palestine50 - rather than towards right-wing, hawkish Revisionist Zionism. This was due to two main factors: firstly, Einstein viewed the pursuit of social justice as an important Jewish ideal,51 and secondly, he subscribed to the left-wing Zionist tenet that the Jews' return to the land and tilling the soil would contribute to the "reproductivization" of the Jewish people: "By repatriating Jews to Palestine and giving them a healthy and normal economic existence, Zionism is a productive activity that enriches human society".52

What can we say about the role Einstein fulfilled within the Zionist movement?

Zionism's mobilization of Einstein for their cause was a huge public relations coup. Intriguingly, Einstein was inducted or "converted" to Zionism by the German Zionists in 1919, but contacts between him and world Zionist leaders were established soon afterwards. During his trips to the U.S. in 1921 and to Palestine in 1923, Einstein was given a hero's welcome by the Jewish masses. By this time, he had firmly become an iconic figure within the world Zionist movement. For the German Zionist Federation, landing the support of such a renowned genius gave them much needed prestige both vis-à-vis their assimilatory co-religionists and the general German public.

How typical was Einstein of the German Zionists? Age-wise, Einstein was more or less a contemporary of the second generation of German Zionists. However, he was not a typical member of that generation. Like them, he did come from an acculturated German-Jewish middle-class family and received an academic education. However, in strong contrast to them, he studied in Switzerland and not in Germany, he did not join a Zionist student association during his student years (he actually did not join any form of student association) and was not exposed to the virulent academic anti-Semitism which was rampant in Germany during those years.53

In general, Einstein was much less of a "joiner" than the average Zionist supporter or leader - this was a pattern of behavior that Einstein would repeat vis-à-vis other political causes he supported such as pacifism and socialism.54 He did support various Zionist goals and specific Zionist projects (most notably the Hebrew University), but he did not identify himself completely as being a Zionist - after it was published, it turned out that he had not himself written the article "How I Became a Zionist", published in the German Zionists' official newspaper after his return from his first trip to the U.S..55 He does not seem to have been viewed as fully belonging to the Zionist movement by its leaders either (in 1921, Kurt Blumenfeld wrote to Chaim Weizmann: "er ist kein Zionist in unserem Sinne").56 They treated him with kid-gloves as a non-Zionist and a "prize hen" who supported some of their goals. Thus, intriguingly, he fulfilled a propaganda and symbolic role for Zionism without totally belonging to the movement. Einstein often referred to himself as a "Jewish saint". By the same token, he could also have described himself as a "Zionist saint" – a saintly, untouchable Zionist icon.

After his emigration to the U.S in 1933, Einstein's symbolic role for the Zionist movement began to decline for a number of reasons: his decision to move to the U.S. rather than to fulfill the Zionist "life plan" of moving to Palestine; the gradual reduction in his public appearances after his second wife's death in 1936; and various internal developments within the Zionist movement, to mention just a few. An exception to this trend was the offer of the Israeli Presidency to Einstein in 1952. However, this seems to have been merely a symbolic gesture. Israeli Prime Minster David Ben-Gurion, on whose behalf the invitation was extended, is supposed to have asked an aide: "Tell me what to do if he accepts!"57 Since his death in 1955, Einstein's iconic role for Zionism has largely been forgotten – even in the two major centers of contemporary Jewry, Israel and the U.S., as well as in Germany, his country of origin.

In this article, I hope to have shown how Einstein's belief in the importance of social responsibility deeply influenced his support and actions on behalf of the Zionist movement: his concern for the plight of young Jewish academics and students from Eastern Europe, who were being discriminated against in Central and Eastern Europe, led him to his support for the establishment of the Hebrew University in Jerusalem as a refuge for those academics. And his interest in this specific Zionist project led him to his more general interest in Zionist goals.

He also saw the Hebrew University and its sister institution, the Technion in Haifa - the Zionist Organization's (and later Israel's) major Institute of Technology - as catalysts for the development of agriculture, public health and technology in Mandatory Palestine and in Israel. Similar to other enlightened Europeans of his generation, he firmly believed in the benevolent effect for the Arab population of the colonizing efforts of the Zionist movement. In this, Einstein was certainly not as

“politically correct” as some would perhaps want him to be. But then again, as a historian, I do not believe in judging Einstein anachronistically. To my mind, it is important to point out that, born in 1879, Albert Einstein was, after all, a man of the nineteenth century.

As for Zionism’s social role in Western Europe and the U.S., Einstein firmly believed that the enhancement of Western Jewry’s self-esteem through Jewish nationalism would be beneficial for the wider societies at large in which they dwelled.

Footnotes

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7 Philipp Frank. Einstein: His Life and Times. New York: Da Capo Press, Inc., 1947, p. 82

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LETTERS

Intelligent Designer Inconsistency with Science's Foundations

In all of the discussion of evolution vs intelligent design and related topics, there is a fundamental element that seems to me conspicuous mostly by its absence. Foundational to science is the assumption that the universe is rational and accessible to the human mind. This has a corollary, that there can be no influences upon the physical universe arising from outside that universe, no sources of causation other than those we can in principle contemplate in our theories. If this were not so, the logical connection between theory and experiment would be broken, the experimental result might just be the work of a supernatural agent and so could never be trusted to test the invalidity of a theory. The very center of science and its method would be missing. The Intelligent Designer must be denied by science to avoid inconsistency with science's own foundations. This foundational assumption cannot be derived from something more fundamental; it must be the assumed starting point. Like all the rest of science, it cannot be proven. We can only gain accumulating confidence in its validity as successful scientific predictions of new observations accumulate. The record in the physical sciences is clear, and as understanding of the chemical and physical underpinnings of biology and of life deepens, it becomes clearer there also. The understanding of science in the popular mind seems already to be woefully inadequate. To further confound it by teaching intelligent design in biology classes could be disastrous indeed.

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Letter to Emily

I would like to offer some small solace to Emily Glad and others who struggle with the Role of Faith in modern scientific thought. To me the problem has in fact been solved--not by proving there is no God or declaring that science is invalid--but by having science prove that there is a God. Although not often appreciated by many people, this is what Kurt Gödel did in his famous proof.

If you will indulge me a bit of imprecision, Gödel proved that either all rules in the Universe can be broken or that there are un-provable truths. The first option is equivalent to omnipotence The second, and probably more relevant, option means that there are truths that can *only* be accessed by faith or something omniscient.

So, there must be something with at least one of two properties associated with God: omniscience or omnipotence. Anthropomorphizing a bit, this means Gödel has proven that there is a God. Less dramatically, the theorem realistically tells us that there is a role for faith that can never be challenged by science.

We do not, however, know which truths are in fact un-provable. It has been and will likely always be that science can prove or disprove things that were considered by some as articles of faith. When such an article is disproven it creates the kind of tension. Either one must give up that tenet or one must believe in the omnipotent God, who mostly lets the Universe look like it follows rules but occasionally tweaks things.

If one chooses to believe in the omnipotent God, there is no contradiction, but rationality is then useless since anything is possible. Gödel tells us we cannot rule this out, but as an article of faith I do not believe it.

Gödel protects those of us who believe in both faith and science--but at cost. On the science side, we must accept that there a role for faith. On the other side we have to accept that just because we (or our religion) claims something is an article of faith, it may be proven wrong (or right) by science and must be given up.

I expect that the literalists Emily Glad talks about will not find this argument very satisfying, but I find it satisfying to know that not only can science and faith coexist, but that science has proven that they must.

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Response to "The Role of Faith" by Emily Glad

As a practicing scientist for more than 30 years, I feel compelled to respond to some of the misconceptions raised in the article by Ms. Glad in "Physics and Society" of July 2005. Although the article by Emily Glad is heartfelt, I find it to be incorrect in many of its observations. She begins well by separating science, which deals with what is observable, from religion, which is based on belief. Science is the father of Engineering which has led to all the technological marvels of the modern age like antibiotics, cell phones, open heart surgery and many others. Belief and faith cannot obtain these achievements because there is no understanding of the laws of nature that can be derived from faith, no matter how strongly held. As Ms. Glad points out, faith and science are incommensurate. Unfortunately she falls into the method of argumentation whereby a question is posed in a way that makes the desired answer the only one possible. This technique, called "framing", has been described quite well in the recent book by George Lakoff entitled, ″Don't Think of an Elephant: Know Your Values, Frame the Debate *(2004)."*[1]

For example in her paragraph describing the limits of science she concludes, " If I were only to believe what men tell me, I would never fail to be disappointed". This statement implies that there are good scientists who believe whatever any scientist tells them. However, the truth is that scientific progress is based on continual testing of hypotheses and theories against experimental evidence. It has little in common with religious belief, which is based on faith and the unknowable. In science, we try to keep assumptions to a minimum and derive the laws of nature by logical thinking and experimentation. In matters of relious belief, there can be appeal neither to reason nor observation. Ms. Glad goes on to say "But if I put my faith in God, acknowledging that His ways and thoughts are higher than my own, how can I ever be troubled by the ever-changing knowledge

of man?" Again, she has framed the argument in such a way that implies that scientists are disturbed by the fact that their understanding of nature is imperfect. This is patently untrue. Most scientist are plying their craft for just that reason-that is where the Nobel prizes are!

Footnotes:
1. George Lakoff, *Don't Think of an Elephant: Know Your Values, Frame the Debate,* Chelsea Green Publishing Company (2004), ISBN: 1931498717

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Physicist's Addition to the Bible

I just finished reading your lead editorial in Physics &Society, July 25, which I just received today. Your answer to Emily should have been the explanation I recently gave to my minister. The book of Revelations was not the end of the many revelations God has made to man. Furthermore, somewhere in the Bible there is explained that, "When I was a child, I spoke as a child, etc." Thus when the ancient writers and copiers of the Torah wrote in Hebrew the earliest versions of Genesis, they, too, wrote as they understood, some 5,000 years ago, and not as we would today. Even the translators working for King James about1660, when they translated and compared their translations with several sources, as is described in the preface of the King James version of the Bible, translated and compared as they understood, and not as we do today.

A proper addition we would make to the Bible today would be Chapter Zero of Genesis: In the beginning God created the Laws of Logic, Mathematics and Physics. Then He said, "Let there be Light," and there appeared one enormous photon containing all the energy and mass-energy of the Universe. It immediately began to expand and divide into the plasma of the Big Bang. History of the Universe began there.

All religious people, not just those who believe in the Torah and the other books of the Bible, should rejoice that Drs. George Gamow, Alpher, Bethe, Herman, Penzias, Dicke et al have, along with the many astronomical measurements made by the wonderful telescopes, spanning many octaves of the electromagnetic spectrum, shown by actual measurement that the Universe has not been forever, but did, indeed, have a specific, finite beginning we now call the Big Bang. The Universe did, physicists and chemists have shown by actual observation, have a finite beginning, hence a Creator! Furthermore, these physicists and chemists have shown how each and all of the chemical elements and their subatomic constituents were derived from this initial plasma, even including their latter day manufacture within the stars and their violent evolution. Simon Singh, "Big Bang", is reviewed by William Tucker on pp8&9 in Update, New York Academy of Sciences Magazine, April/May, 2005. The review is a good basic explanation any undergraduate should understand. This should cover a sufficient explanation except for the most extreme believers that insist that God himself dictated the Bible to the first writer, and will not admit that the many copiers and translators could in any way misunderstood, mistranslated, or modified the wording. I might add that I, myself, was most impressed along the lines I explained above, when I was a physics undergraduate ten years before Gamow's writings, when I obtained a Hebrew copy of the Old Testament.

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Re: Commentary by A.M. Saperstein in Jan. 2005, P&S

You are right. But it is the fault of the scientific community. We are failing, often completely. Yet no one is doing anything. But much can be done. It is absurd that the controversy over evolution has been allowed to continue. That emphasizes how badly we have failed. And it is so unnecessary. The same is true in many other ways. What is the point of writing articles about how bad it all is. Let us do something.

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UCS and Nuclear Power

Professor Richard Wilson, in his July Letter to the Editor, gives an incorrect description of the position of the Union of Concerned Scientists regarding nuclear power. UCS has never, to quote Wilson "[taken] a very public position against nuclear power" in the unqualified sense that Wilson suggests. UCS has never opposed nuclear power in principle. UCS has, for over 30 years, criticized lack of adequate attention to the safety of nuclear power plants by the Atomic Energy Commission, the nuclear power industry and the Nuclear Regulatory Commission. While this was a controversial position when first taken by Henry Kendall and Daniel Ford in the early 1970s, it has long since been widely recognized that this criticism has been technically sound, and that it must be properly addressed if nuclear power is to provide a major contribution to meeting our energy needs, and to addressing the greenhouse gas problem.

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NEWS

Politics and Science

The June 18, 2005 edition of the San Francisco Chronicle published an article by Julie Cart of the Los Angeles Times. Her article relates to the issue of the corruption and decline of scientific advice inputs to policy formulation in the Bush Administration. Entitled "Federal cattle grazing analysis called whitewash", the article quotes scientists who were involved in an environmental impact analysis of rule changes regarding cattle grazing on public lands. According to the article, a biologist and hydrologist, both of whom retired this year from the US Bureau of Land Management, "said their conclusions that the proposed rules might harm water quality and wildlife, including endangered species, were excised and replaced with language justifying less stringent regulations, which are favored by cattle ranchers." The following specific conclusion was eliminated from the final draft of the environmental analysis, "The Proposed Action will have a slow, long-term adverse impact on wildlife and biological diversity in general." Erick Campbell, a former BLM state biologist in Nevada with 30 years of experience, said, "This is a whitewash…they took all of our science and reversed it 180 degrees….They rewrote everything…It's a crime." Bill Brookes, a former BLM hydrologist, said in the original draft that the proposed rule change was "an abrogation of [BLM's] responsibility under the Clean Water Act." In an interview on Thursday, June 16, Brookes said, "Everything that I wrote was totally rewritten and watered down." A BLM official acknowledged that changes had been made in the report, but that these changes were "part of a standard editing and review process. (JJM)

Holt, Scientific Societies Oppose Teaching Intelligent Design as Science

"When the tenets of critical thinking and scientific investigation are weakened in our classrooms, we are weakening our nation." - Rep. Rush Holt

Rep. Rush Holt (D-NJ), a physicist, spoke out this month against teaching intelligent design as science in the nation's classrooms. "A scientifically literate nation would not permit intelligent design to be presented and treated as a scientific theory," Holt wrote in an article appearing on the Internet. "Public school science classes are not the place to teach concepts that cannot be backed up by evidence and tested experimentally," he added.

Holt's article followed comments by President George Bush on August 1, in answer to a reporter's question about whether both evolution and intelligent design should be taught in public schools. "I think that part of education is to expose people to different schools of thought," Bush said. Recalling his response as Texas governor to the question of teaching creationism, he said he "felt like both sides ought to be properly taught...so people can understand what the debate is about." John Marburger, Director of the White House Office of Science and Technology Policy, who has repeatedly stated that intelligent design is not a scientific concept, said in an interview with the New York Times that Bush meant intelligent design could be addressed as part of the "social context" of science.

Two Member Societies of the American Institute of Physics, the American Physical Society (APS) and the American Geophysical Union(AGU), issued responses to Bush's remarks. APS President Marvin Cohen stated that "only scientifically validated theories, such as evolution, should be taught in the nation's science classes" (seehttp://www.aps.org/media/pressreleases/080405.cfm for the complete APS response). AGU Executive Director Fred Spilhaus declared that "ideas that are based on faith, including 'intelligent design, 'operate in a different sphere and should not be confused with science" (see http://www.agu.org/sci_soc/prrl/prrl0528.html for the complete AGU response).

Holt's article, entitled "Intelligent Design: It's Not Even Wrong, "originally appeared in the September 8 "Talking Points Memo "Internet blog, and can be found at: athttp://www.tpmcafe.com/story/2005/9/8/183216/1039/. Selected portions of the article follow:

"As a research scientist and a member of the House Education Committee, I was appalled when President Bush signaled his support for the teaching of 'intelligent design' alongside evolution in public K-12 science classes. Though I respect and consistently protect the rights of persons of faith and the curricula of religious schools, public school science classes are not the placet o teach concepts that cannot be backed up by evidence and tested experimentally.

"Science, by definition, is a method of learning about the physical universe by asking questions in a way that they can be answered empirically and verifiably. If a question cannot be framed so that the answer is testable by looking at physical evidence and by allowing other people to repeat and replicate one's test, then it is not science. The term science also refers to the organized body of knowledge that results from scientific study. Intelligent design offers no way to investigate design scientifically. Intelligent design explains complicated phenomena of the natural world by involving a designer. This way of thinking says things behave the way they do because God makes them behave that way. This treads not into science but into the realm of faith. A prominent physicist, W.Pauli, used to say about such a theory 'It is not even wrong'. There is no testable hypothesis or prediction for intelligent design.

"It is irresponsible for President Bush to cast intelligent design -a repackaged version of creationism - as the 'other side' of the evolution 'debate.' Creationists and others who denigrate the concept of evolution call it a theory, with a dismissive tone. They say that, as a theory, it is up for debate. Sure, evolution is a theory, just as gravitation is a theory. The mechanisms of evolution are indeed up for debate, just as the details of gravitation and its mathematical relationship with other forces of nature are up for debate. Some people once believed that we are held on the ground by invisible angels above us beating their wings and pushing us against the earth. If angels always adjusted their beating wings to exert force that diminished as the square of the distance between attracting bodies, it would be just like our idea of gravitation. The existence of those angels, undetected by any measurements, would not be the subject of science. Such an idea of gravity is 'not even wrong'. It is beyond the realm of science. So, too, is intelligent design.

"Colloquially, a theory is an idea. Scientifically, a theory is an accepted synthesis of a large body of knowledge, consisting of well-tested hypotheses, laws, and scientific facts, which concurrently describe and connect natural phenomena. There are actually very few theories in science, including atomic theory, the theory of gravity, the theory of evolution, and the theory of the standard model of particle physics. Without the ability to test the hypotheses of intelligent design, it cannot be considered a theory in the scientific sense.

"So who cares? What difference does it make if schools spend time on unscientific ideas? This raises the role of science education in the United States. A scientifically literate nation would not permit intelligent design to be presented and treated as a scientific theory. Science education is necessary for all students, especially for those who are not going to become professional scientists. We must not lose the important American characteristic- hard, practical thinking.

"Traditionally, Americans are a faithful people. Most say they are guided by their faith in their God. Also, Americans are an intellectually lively people. Our forebears did not lapse into lazy thinking. Sometimes it has been called Yankee ingenuity or good old American know-how. Whatever you call it, it has been a source of our prosperity and quality of life. Throughout our history, every farmer, every business owner, every manufacturer, continuously has been thinking how things work and how to make them better. Americans have thought like scientists. Not just those in lab coats, but many Americans, even most Americans. We must not allow this American intellectual habit to be replaced with wishful thinking or lazy thinking. Intelligent design is lazy thinking."

"Our weakened state of science and mathematics education reverberates throughout national and even global issues, and this should be the focus of our school systems rather than a 'debate' that only diverts attention away from the challenges at hand. The United States must prepare for the changing global economy through fundamental scientific research fueling technological innovation. When the tenets of critical thinking and scientific investigation are weakened in our classrooms, we are weakening our nation. That is why I think the President's off-hand comment about intelligent design as the other side of the debate over evolution is such a great disservice to Americans."

FYI
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REVIEWS

The Future of Life
By Edward O. Wilson, Knopf, 2002, xxiv+229 pp, $22, ISBN 0-679-45078-5.

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Wilson begins this book with a letter written apostrophically to Henry David Thoreau about the changes in nature resulting from human behavior during the intervening 150 years. "Now more than six billion people fill the world," he writes. "The great majority are very poor . .. all are struggling to raise the quality of their lives any way they can. . . . We have been too self-absorbed to foresee the long-term consequences of our actions," he continues, "and we will suffer a terrible loss unless we shake off our delusions and move quickly to a solution." (pp. xii, xxiv)

Using the concept of ecological footprint developed by William Rees (as reported in *Teachers Clearinghouse,* Spring 2004), Wilson observes that to provide the American quality of life for all of Earth's six billion inhabitants would require four more Earths. He sees the immediate future of coping with increased population in the context of finite environmental resources as a bottleneck in the short term, and seeks an answer in the long term to what he calls the question for the 21st century: "How best can we shift to a culture of permanence, both for ourselves and for the biosphere that sustains us?" (p. 22)

Biodiversity is Wilson's chief concern. His list of factors endangering species forms the acronym HIPPO: Habitat destruction, Invasive species, Pollution, Population (human), and Overharvesting. All five result from human behavior. Under a "business as usual" scenario Wilson sees the flora of Earth dominated in 2100 by seven alien species that have been particularly destructive of native environments, and agricultural crops, many of them bioengineered. In this scenario "the cosmopolitan flow of alien organisms" (p. 77) will have created a homogenous ecosystem for a given latitude and altitude throughout the world. Technology will have brought water to grow food even in the vastest desert, but "An aging and wiser human population understands very well -- too late now -- that Earth is a much poorer place than it was back in 2000, and will stay that way forever." (p. 77)

Although Wilson sees moral reasons to preserve the species of the world, he also points up economic reasons to preserve them as well. In 1997 an "international team of economists and environmental scientists" valued "ecosystems services," including "the regulation of the atmosphere and climate; the purification and retention of fresh water; the formation and enrichment of the soil; nutrient cycling; the detoxification and recirculation of waste; the pollination of crops; and the production of lumber, fodder, and biomass fuel" as $33 trillion per year, nearly twice the "gross world product" of $18 trillion.

Although 90% of agriculture is based on "slightly more than a hundred plant species out of a quarter-million known to exist," and "twenty species carry most of the load, of which only thre --wheat, maize, and rice--stand between humanity and starvation" (p. 114), Wilson sees the world's other species as potential edibles, medicines, and genetic donors to bioengineered crops. Thus, present species must be evaluated for their future value even if they have none at present.

Thus, while Wilson recognizes ethical differences between those who put the environment over people and those who put people over the environment, he also recognizes that "the ethical solution is . . . to move toward the common ground where economic progress and conservation are treated as one and the same goal." (p. 155) To this end he advocates a 12-point program embodying both economic progress and conservation, two points of which should be noted here. Admitting to being an "extremist" on conservation, he would increase the present 10% of Earth allotted to nature to 50% ("half the world for humanity, half for the rest of life. . . ." (p. 163)); and he would "support population planning."

But at a time when improving the standard of living for all humankind would require four more Earths, population planning would be essential to increase the percentage of Earth allocated to nature Wilson waxes more optimistic in claiming that "Earth is still productive enough and human ingenuity creative enough not only to feed the world now but also to raise the standard of living of the population projected to at least the middle of the twenty-first century." (p. 164) Wilson is buoyed by the success that non-governmental organizations (NGOs) have experienced in recent years in protecting large tracts of undeveloped land, and he attributes this to "some of the better attributes of business corporations" (p. 181). But he adds that more is needed: "The tropical wilderness areas and the hottest of the hotspots . . . which together contain perhaps 70 percent of Earth's plant and animal species, can be saved by a single investment of roughly $30 billion," which he points out is one thousandth of the annual combined gross national products of the world -- "or, viewed another way, one-thousandth of the value of services provided free each year by the world's natural ecosystems" (p. 183).

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J. Robert Oppenheimer: And the American Century
By David Cassidy, Pi Press, 2004, $28, 480 pages, ISBN 0131479962

David C. Cassidy's biography of J. Robert Oppenheimer is a concise, well-written book about the life of the famous 20th century scientist. The broad lines of Oppenheimer's public persona are well known: as the foremost American theoretical physicist in the 1930's, the aesthete scientist with communist sympathies was called by his government to lead the successful effort to build the world's first atomic bomb only to be humiliated in 1954 when his security clearance was stripped shortly before it would have expired. Two portraits of Oppenheimer have typically appeared in the public's imagination: he has tended to be cast either as Faustus who sells his soul to the devil (read Pentagon) for fame and power only to eventually pay a terrible price, or as Prometheus, a Titan who unleashes the energy of the atomic nucleus in service to his country only to suffer at the hands of powers intent on promoting their agenda now threatened by an authoritative figure.

Oppenheimer has often been described by his acquaintances as a man who did not know who he was, an extremely complex individual with no deep sense of self. According to Cassidy, an intuition about Oppenheimer's fundamental insecurity partly explains why General Leslie Groves chose him to lead the Manhattan project: He could be manipulated. Furthermore, the choice of Oppenheimer, despite his communist sympathies, would foster a sense of indebtedness that would give Oppenheimer the impression that

he needed Groves as a shield against future accusations. Groves eventually withdrew his protection when he testified against Oppenheimer at his security hearing.

Long before we read about the hearings, Cassidy tells the tale of the wealthy Upper West Side Jewish family where Oppenheimer was born. His father, Julius, emigrated from Germany to work in the garment industry where he prospered and became part of the Society for Ethical Culture. The Society had sprung in 1876 from the largest and wealthiest Jewish congregation of the United States, the Reform Judaism Temple EmmanuEl. Composed at the time mainly of wealthy members of German heritage, the Society's goal was to improve the real world through morally motivated action. In order to fulfill this end, the Society's tool of choice was transcendent reason applied to the urban social problems caused by industrialization and immigration. At the turn of the 20th century a new wave of more religious Jews from Slavic countries entered the United States causing some consternation amongst many older, established, Jewish families originally from Germany who strove to assimilate within New York high society. The Ethical Culture Society's assistance to the new more Orthodox Jewish immigrants stemmed to some extent from a desire to facilitate their integration into American culture. The Oppenheimer's membership in the Ethical Culture Society and young Robert's schooling for ten of his twelve years at its Ethical Culture School inculcated young Oppenheimer with the view that economic inequality is a major underlying cause of urban and societal ills and was probably the root of his lifelong liberalism. The book implicitly suggests that the Society's emphasis on the secular and its rejection of the divine (Judaism) as a basis for morality may have contributed to Oppenheimer apparent trouble with developing a core sense of identity.

This helps explain how Oppenheimer could transform himself from leftist outsider to the ultimate government insider with the highest security clearance. The book does go into some detail about Oppenheimer fragile psyche as a young man including an episode where he attempted to strangle fellow Ethical Culture School alum, Francis Fergusson, during a conversation on personal and professional matters as well as his habit to become suddenly "ill" whenever faced with an unpleasant prospect. How these mental woes affected Oppenheimer's career as a physicist is only a guess. But an assessment of Oppenheimer as a scientist invariably leaves the impression that he could have contributed far more if he had been more focused, and David Cassidy makes this point on more than one occasion.

The book also discusses the scientific climate that saw Oppenheimer's coming of age as a physicist. The scientific content of the biography is adequate and its description of scientific ideas is passable. Cassidy draws parallels between the research careers of Oppenheimer and Werner Heisenberg, the leader of the German Bomb project. In particular, he compares the subject matters of the papers written by the two physicists in an effort to reveal their basic style of research. Within this context, Cassidy gives an account of how Oppenheimer and his collaborators provided the correct explanation of cosmic ray showers by staying close to experimental results while their German counterparts looked for fundamental theories that kicked in at energies of a few hundred MeVs. Although Heisenberg's physical insights have had a far more profound impact on our understanding of nature, Oppenheimer's more data-driven approach to physics probably contributed to the success of the Manhattan project in contrast to the German effort.

The book concludes with the security hearings and their aftermath. From the records, it is clear that the purpose of the hearing was not so much about whether or not Oppenheimer was a security risk, since his one-year contract as an adviser to the Atomic Energy Commission (which required the security clearance) expired one day after the final report from the commission. As an alternative to holding public hearings, the AEC could have simply not renewed the contract if they held misgivings about Oppenheimer. Instead, the public hearings were more likely designed to pull down an influential man who had opposed the construction of the H-bomb in such a fashion as to send a powerful message to the scientific community: As non-elected consultants, their role was not to set policy which should be left to elected officials. Their role was confined to providing technical advice on what can and cannot be done and no more.

Oppenheimer is a book about the foremost representative of American science in the 20th century and is a worthwhile read for anyone with an interest in the coming of age of American physics and how the weaknesses and strengths of one of its leaders shaped the relationship between science and the government for decades to come.

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